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Report No.: 1505RSU00401  
Report Version: V01  
Issue Date: 05-18-2015

## MEASUREMENT REPORT

### FCC PART 15.247 / RSS-210 Zigbee 802.15.4

**FCC ID:** 2ABX8SH-0000000007

**IC:** 12219A-000000000007

**APPLICANT:** Zhejiang shenghui lighting Co., Ltd. Shanghai Branch

**Application Type:** Certification

**Product:** sengled element

**Model No.:** Z01-CIA19NAE26

**Trademark:** sengled

**FCC Classification:** Digital Transmission System (DTS)

**FCC Rule Part(s):** Part 15.247

**IC Rule(s):** RSS-210 Issue 8

**Test Procedure(s):** ANSI C63.10-2013, KDB 558074 D01v03r02

**Test Date:** May. 11 ~ 17, 2015

Reviewed By : Robin Wu  
\_\_\_\_\_  
( Robin Wu )

Approved By : Marlinchen  
\_\_\_\_\_  
( Marlin Chen )



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 558074 D01v03r02. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

## Revision History

Report No.	Version	Description	Issue Date
1505RSU00401	Rev. 01	Initial report	05-18-2015

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## §2.1033 General Information

<b>Applicant:</b>	Zhejiang shenghui lighting Co., Ltd. Shanghai Branch
<b>Applicant Address:</b>	Rm. 801, 1st Xinye Building, 388 Tianlin Rd., Caohejing Development Zone, Shanghai, 200233, China
<b>Manufacturer:</b>	ZHEJIANG SHENGHUI LIGHTING Co., Ltd
<b>Manufacturer Address:</b>	South Jiachuang Rd., Xiuzhou Industrial Park Jiaxing, Zhejiang 314015 P.R. China
<b>Test Site:</b>	MRT Technology (Suzhou) Co., Ltd
<b>Test Site Address:</b>	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
<b>MRT Registration No.:</b>	809388
<b>IC Registration No.:</b>	11384A
<b>FCC Rule Part(s):</b>	Part 15.247
<b>IC Rule:</b>	RSS-210 Issue 8
<b>Model No.:</b>	Z01-CIA19NAE26
<b>FCC ID:</b>	2ABX8SH-0000000007
<b>IC:</b>	12219A-000000000007
<b>Test Device Serial No.:</b>	N/A <input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
<b>FCC Classification:</b>	Digital Transmission System (DTS)

### Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.
- MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.
- MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.



## 1. INTRODUCTION

### 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

### 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



## 2. PRODUCT INFORMATION

### 2.1. Equipment Description

Product Name	sengled element
Model No.	Z01-CIA19NAE26
Power Type	AC 120V/60Hz
Frequency Range	2405 ~ 2475 MHz
Maximum Output Power	6.83dBm
Type of Modulation	O-QPSK
Antenna Type	Internal
Antenna Gain	2dBi

### 2.2. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02
- ANSI C63.10-2013
- RSS-210 Issue 8

Note:

1. All the test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table as an alternative in ANSI C63.10-2013 through inquiry tracking number 198796.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B recorded in a separate report.

### 2.3. Operation Frequency / Channel List

Channel	Frequency	Channel	Frequency	Channel	Frequency
11	2405 MHz	12	2410 MHz	13	2415 MHz
14	2420 MHz	15	2425 MHz	16	2430 MHz
17	2435 MHz	18	2440 MHz	19	2445 MHz
20	2450 MHz	21	2455 MHz	22	2460 MHz
23	2465 MHz	24	2470 MHz	25	2475 MHz

### 2.4. Test Mode

Test Mode	Mode 1: Transmit by 802.15.4
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### 2.5. Test Software

The test utility software used during testing was “sscom32.exe”.

Final Power Parameter Value of the test software.

Test Mode	Test Frequency (MHz)	Power Parameter Value
802.15.4	2405	8.0
	2440	8.0
	2475	8.0

## 2.6. Device Capabilities

This device contains the following capabilities:

2.4GHz Zigbee (DTS)

**Note:** 2.4GHz Zigbee (DTS) operation is possible in 5MHz channel bandwidth. The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of KDB 558074 D01v03r01. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.15.4	99.9%

## 2.7. Test Configuration

The **sengled element FCC ID: 2ABX8SH-000000007** was tested per the guidance of KDB 558074 D01v03r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

## 2.8. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.9. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the trade name and FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

### 3. DESCRIPTION OF TEST

#### 3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v03r02 were used in the measurement of the **sengled element FCC ID: 2ABX8SH-0000000007**.

**Deviation from measurement procedure.....None**

#### 3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.8.

### 3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-25GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

## 4. ANTENNA REQUIREMENTS

### Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

- The antenna of the sengled element is **permanently attached**.
- There are no provisions for connection to an external antenna.

### **Conclusion:**

The **sengled element FCC ID: 2ABX8SH-000000007** unit complies with the requirement of §15.203.

## 5. TEST EQUIPMENT CALIBRATION DATE

### Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2015/11/07
Temperature/ Meter Humidity	Anymetre	TH101B	MRTSUE06045	1 year	2015/11/14

### Radiated Emission

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	E4447A	MRTSUE06028	1 year	2015/10/09
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2015/11/07
Preamplifier	MRT	AP18G40	MRTSUE06020	1 year	2015/10/06
Preamplifier	MRT	AP01G18	MRTSUE06019	1 year	2015/12/13
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2015/11/08
TRILOG Antenna	Schwarzbeck	VULB9162	MRTSUE06022	1 year	2015/11/08
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2015/11/08
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2016/01/05
Temperature/Humidity Meter	Anymetre	TH101B	MRTSUE06048	1 year	2015/11/14

### Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2016/04/23
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2015/10/15
Temperature/Humidity Meter	Anymetre	TH101B	MRTSUE06046	1 year	2015/11/14

## 6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k = 2$ .

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_{c(y)}$ ): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_{c(y)}$ ): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB

## 7. TEST RESULT

### 7.1. Summary

**Company Name:** Zhejiang shenghui lighting Co., Ltd. Shanghai Branch  
**FCC ID:** 2ABX8SH-000000007  
**IC:** 12219A-000000007  
**FCC Classification:** Digital Transmission System (DTS)  
**Data Rate(s) Tested:** 250kbps

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-210 [A8.2]	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 7.2
15.247(b)(3)	RSS-210 [A8.4]	Output Power	$\leq 1\text{Watt}$ & EIRP $\leq 4\text{Watt}$		Pass	Section 7.3
15.247(e)	RSS-210 [A8.2]	Power Spectral Density	$\leq 8\text{dBm} / 3\text{kHz Band}$		Pass	Section 7.4
15.247(d)	RSS-210 [A8.5]	Band Edge / Out-of-Band Emissions	$\geq 20\text{dBc(Peak)}$		Pass	Section 7.5
15.205 15.209	RSS-210 [A8.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6&7.7
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	N/A	Section 7.8

#### Notes:

- 1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

## 7.2. 6dB Bandwidth Measurement

### 7.2.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

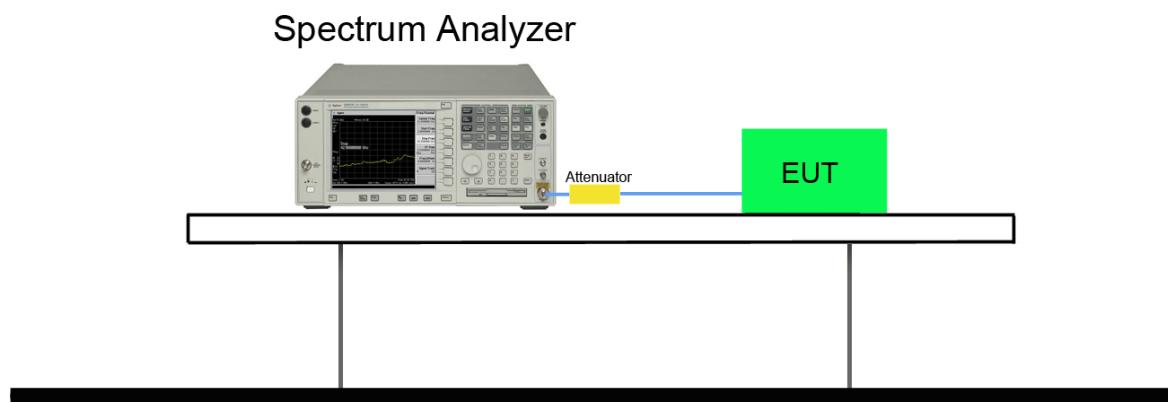
### 7.2.2. Test Procedure used

KDB 558074 D01v03r02 – Section 8.2 Option 2

### 7.2.3. Test Setting

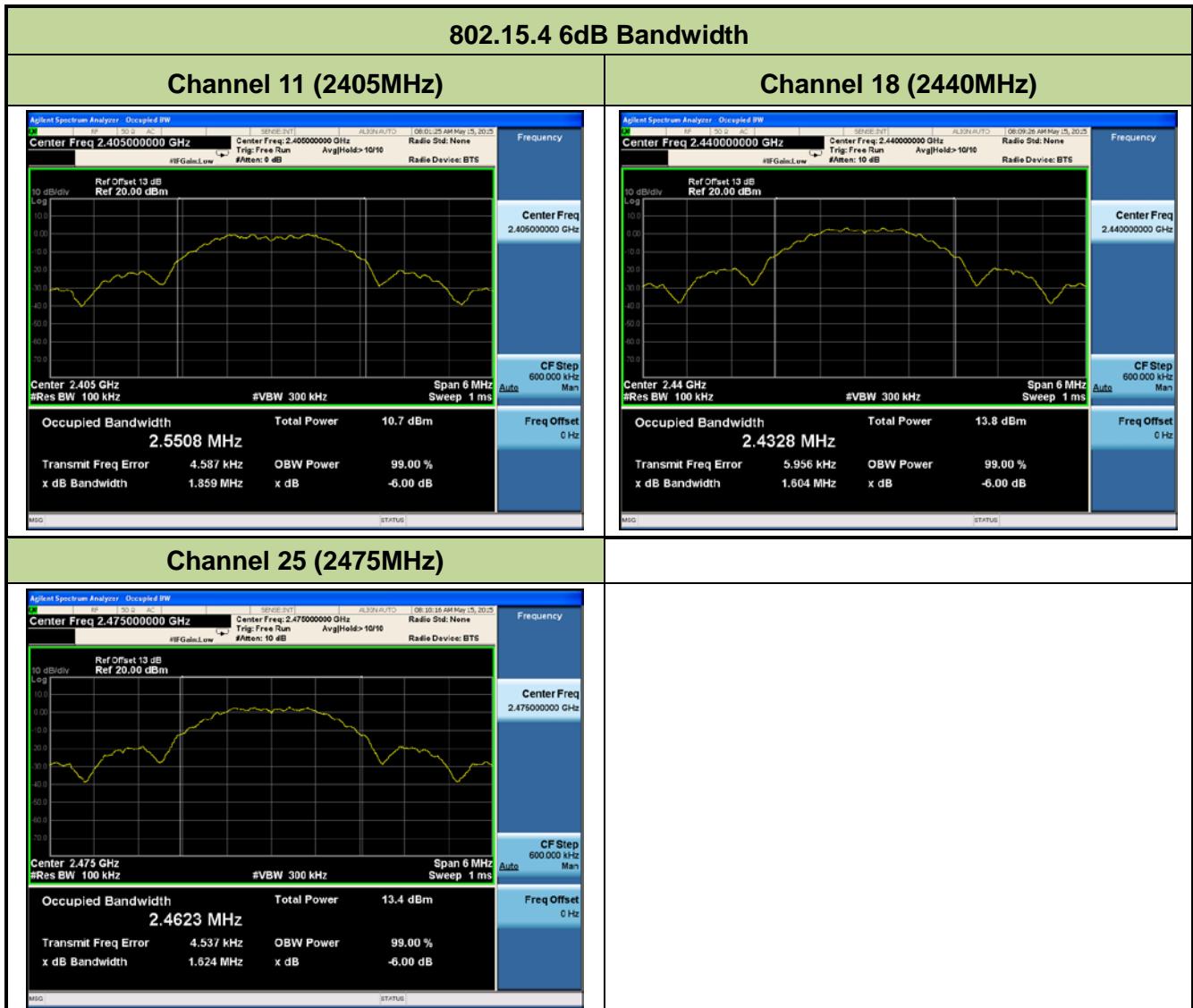
1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to  $X = 6$ . The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW  $\geq 3 \times$  RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

### 7.2.4. Test Setup



### 7.2.5. Test Result

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.86	≥0.5	Pass
802.15.4	O-QPSK	18	2440	1.60	≥0.5	Pass
802.15.4	O-QPSK	25	2475	1.62	≥0.5	Pass



## 7.3. Output Power Measurement

### 7.3.1. Test Limit

The maximum output power shall be less 1 Watt (30dBm).

### 7.3.2. Test Procedure Used

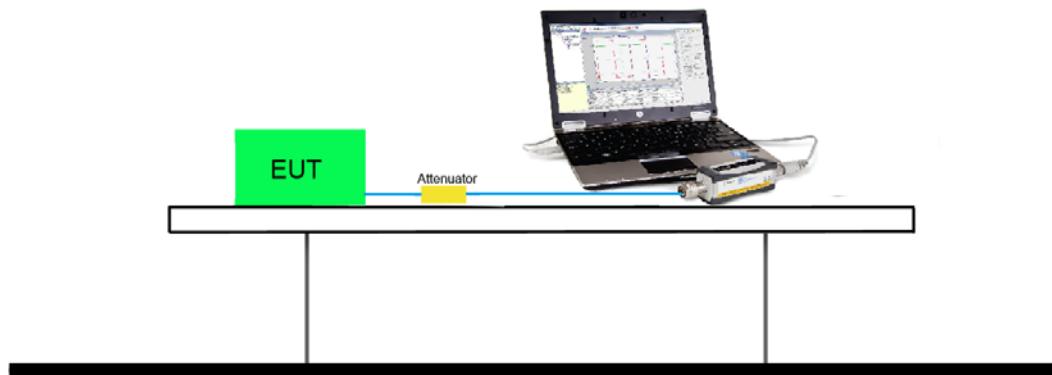
KDB 558074 D01v03r02 - Section 9.1.2 PKPM1 Peak Power Method (for signals with  $BW \leq 50\text{MHz}$ )

### 7.3.3. Test Setting

#### **Method PKPM1 (Peak Power Measurement of Signals with DTS BW $\leq 50\text{MHz}$ )**

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a  $VBW = 50\text{MHz}$  so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

### 7.3.4. Test Setup



### 7.3.5. Test Result of Peak Output Power

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	6.79	≤ 30	8.79	≤ 36	Pass
802.15.4	O-QPSK	18	2440	6.72	≤ 30	8.72	≤ 36	Pass
802.15.4	O-QPSK	25	2475	6.83	≤ 30	8.83	≤ 36	Pass

## 7.4. Power Spectral Density Measurement

### 7.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

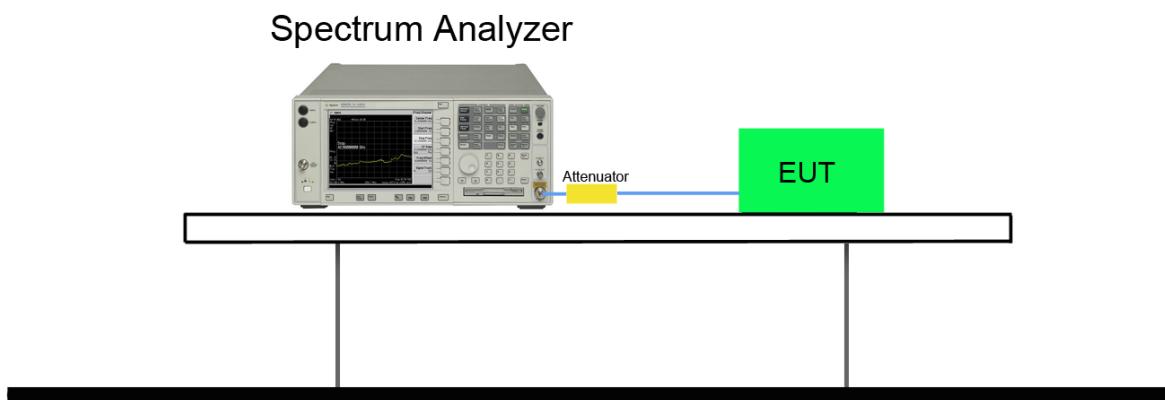
### 7.4.2. Test Procedure Used

KDB 558074 D01v03r02 - Section 10.2 Method PKPSD

### 7.4.3. Test Setting

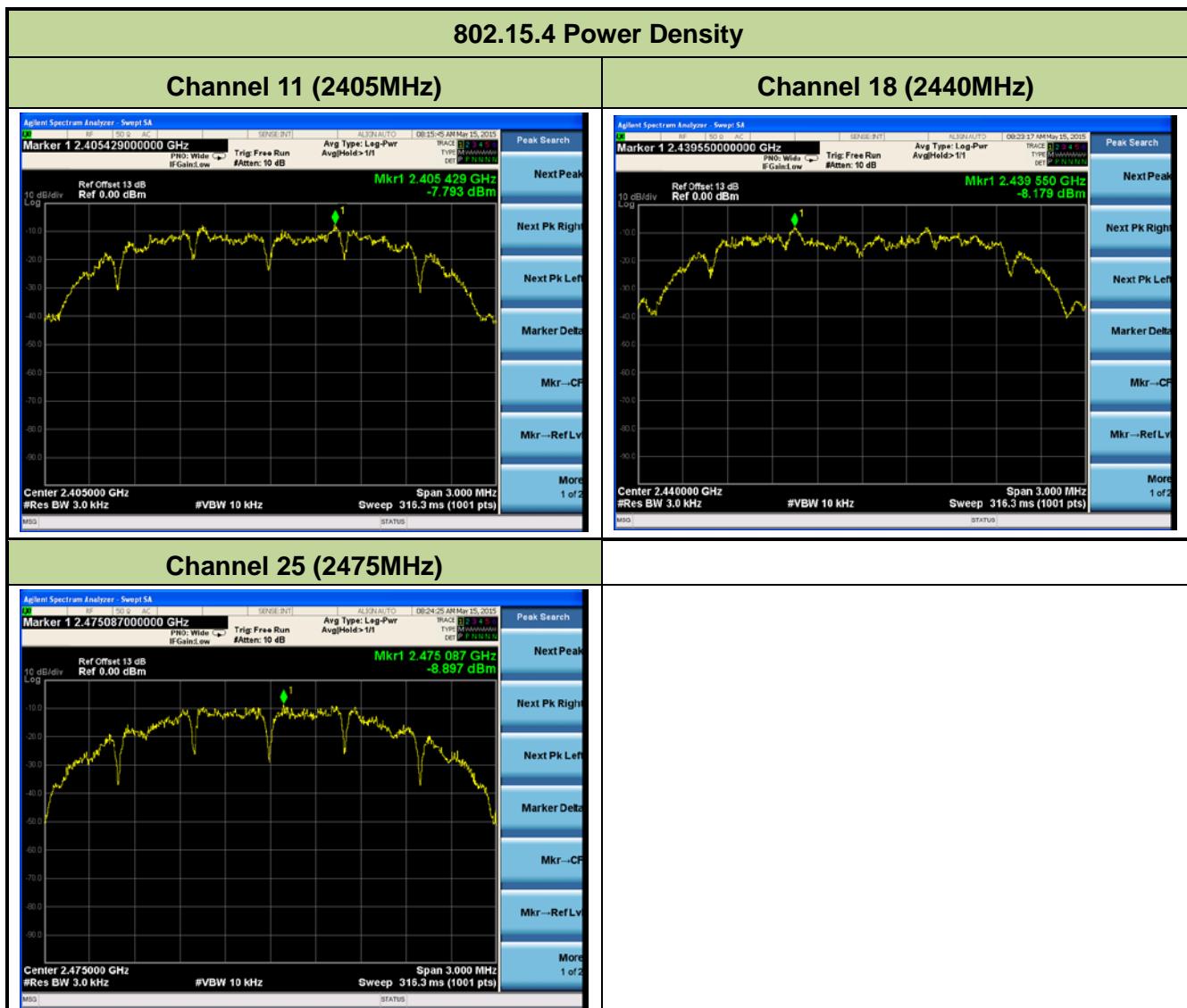
1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 10kHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

### 7.4.4. Test Setup



#### 7.4.5. Test Result

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Measured PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	-7.79	≤ 8	Pass
802.15.4	O-QPSK	18	2440	-8.18	≤ 8	Pass
802.15.4	O-QPSK	25	2475	-8.90	≤ 8	Pass



## 7.5. Conducted Band Edge and Out-of-Band Emissions

### 7.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

### 7.5.2. Test Procedure Used

KDB 558074 D01v03r02 - Section 11.2 & Section 11.3

### 7.5.3. Test Setting

#### 1. Reference level measurement

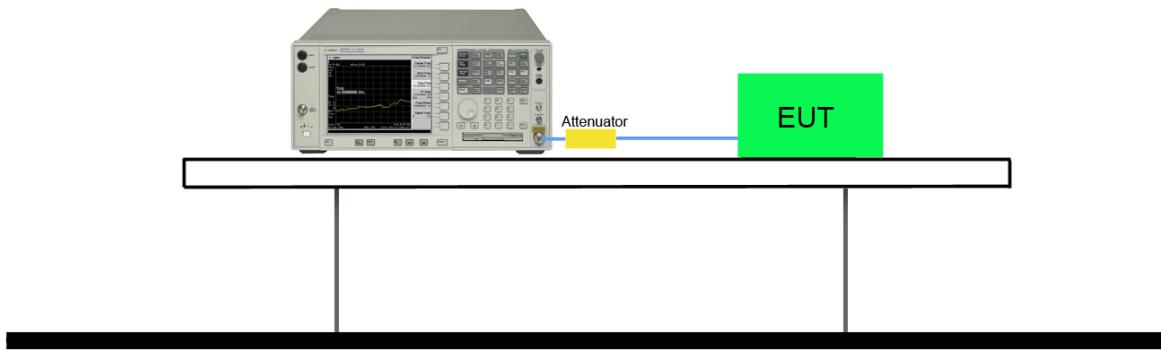
- (a) Set instrument center frequency to DTS channel center frequency
- (b) Set the span to  $\geq$  1.5 times the DTS bandwidth
- (c) Set the RBW = 100 kHz
- (d) Set the VBW  $\geq$  3 x RBW
- (e) Detector = peak
- (f) Sweep time = auto couple
- (g) Trace mode = max hold
- (h) Allow trace to fully stabilize

#### 2. Emission level measurement

- (a) Set the center frequency and span to encompass frequency range to be measured
- (b) RBW = 100kHz
- (c) VBW = 300kHz
- (d) Detector = Peak
- (e) Trace mode = max hold
- (f) Sweep time = auto couple
- (g) The trace was allowed to stabilize

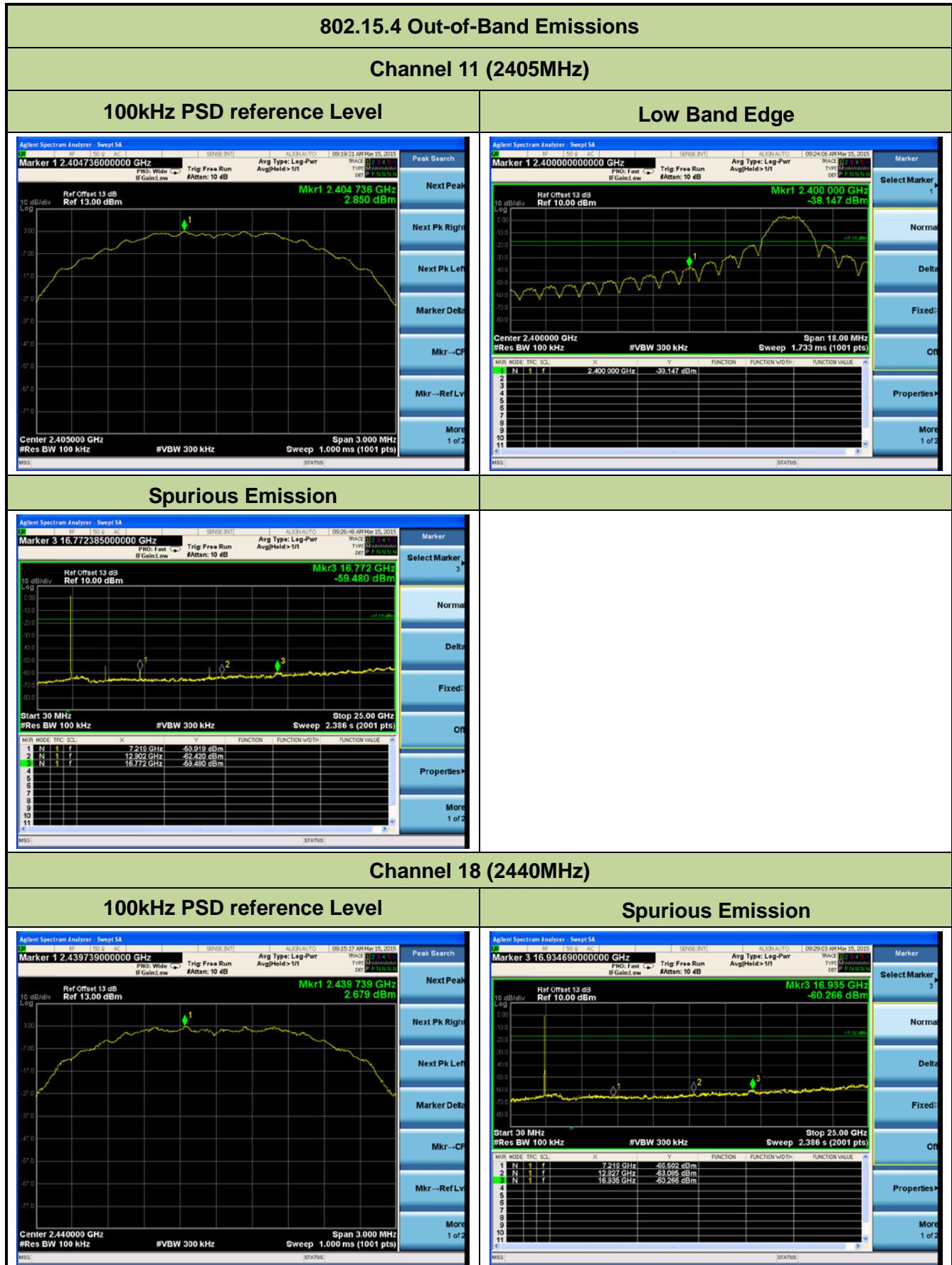
#### 7.5.4. Test Setup

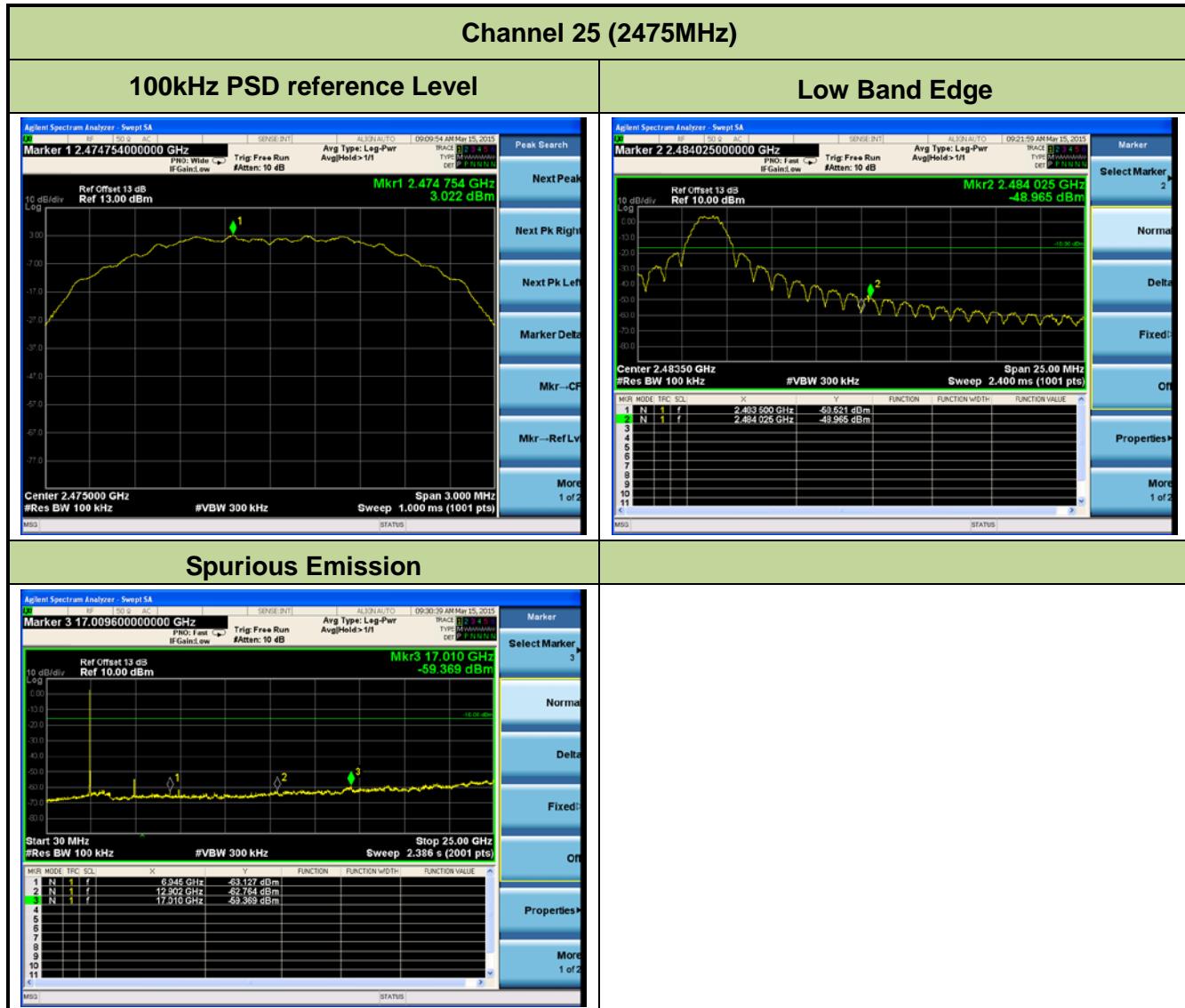
Spectrum Analyzer



### 7.5.5. Test Result

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Limit	Result
802.15.4	O-QPSK	11	2405	20dBc	Pass
802.15.4	O-QPSK	18	2440	20dBc	Pass
802.15.4	O-QPSK	25	2475	20dBc	Pass





## 7.6. Radiated Spurious Emission Measurement

### 7.6.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [V/m]	Measured Distance [Meters]
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

### 7.6.2. Test Procedure Used

KDB 558074 D01v03r02 – Section 12.2.3 (quasi-peak measurements)

KDB 558074 D01v03r02 – Section 12.2.4 (peak power measurements)

KDB 558074 D01v03r02 – Section 12.2.5 (average power measurements)

### 7.6.3. Test Setting

#### Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01v03r02

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple

6. Trace mode = max hold
7. Trace was allowed to stabilize

**Table 1—RBW as a function of frequency**

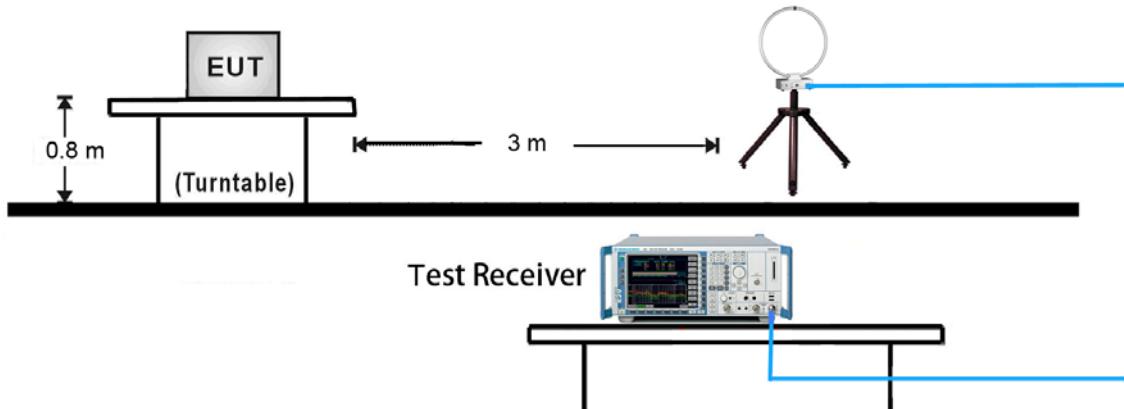
Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

**Average Field Strength Measurements per Section 12.2.5.3 of KDB 558074 D01v03r02**

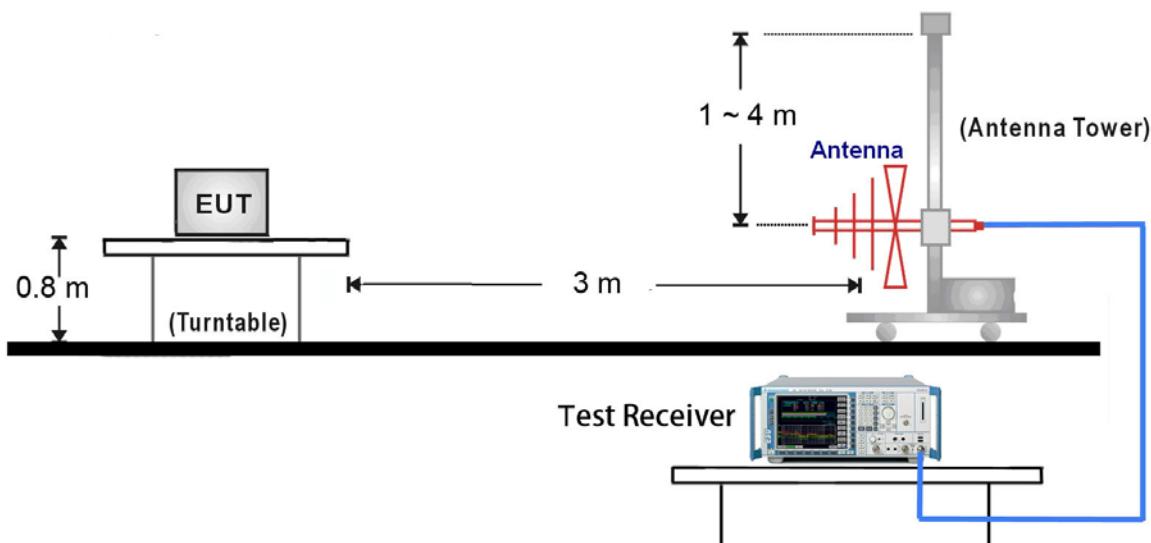
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW  $\geq 1/T$
4. De As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

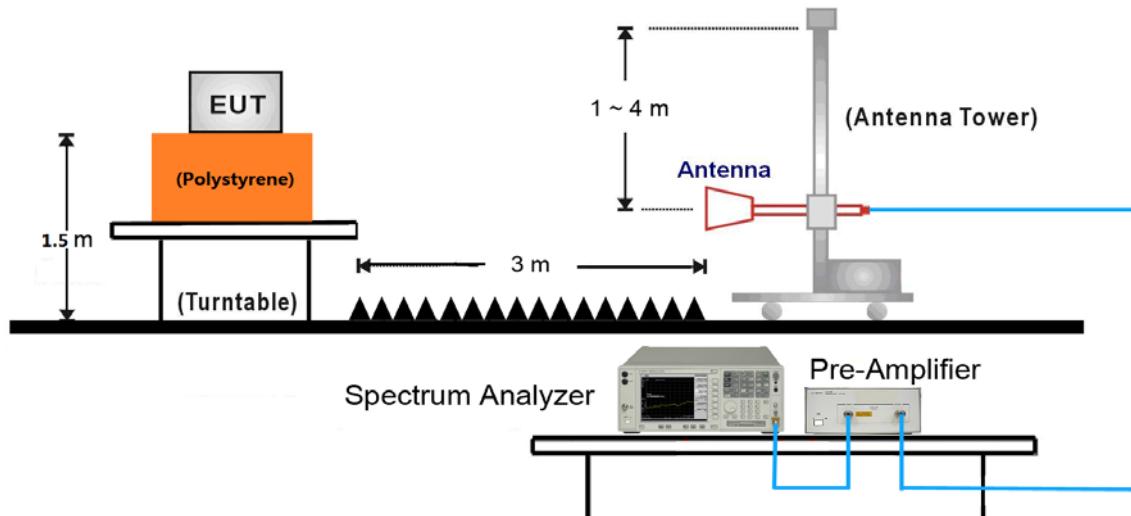
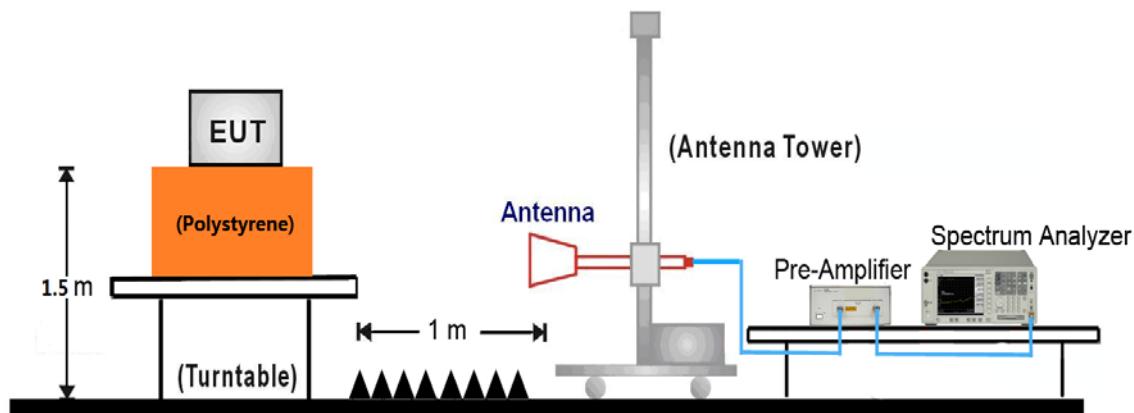
#### 7.6.4. Test Setup

##### 9kHz ~ 30MHz Test Setup:



##### 30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:18GHz ~25GHz Test Setup:

### 7.6.5. Test Result

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	11	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dB $\mu$ V)	Factor (dB)	Measure Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Polarization
*	7103.0	35.9	7.5	43.4	74.0	-30.6	Peak	Horizontal
*	8658.5	36.7	8.8	45.5	74.0	-28.5	Peak	Horizontal
	9134.5	36.1	9.7	45.8	74.0	-28.2	Peak	Horizontal
	10928.0	36.8	13.0	49.8	74.0	-24.2	Peak	Horizontal
*	7927.5	36.4	8.5	44.9	74.0	-29.1	Peak	Vertical
*	8582.0	37.7	8.6	46.3	74.0	-27.7	Peak	Vertical
	9321.5	35.8	10.4	46.2	74.0	-27.8	Peak	Vertical
	11489.0	36.6	12.8	49.4	74.0	-24.6	Peak	Vertical

Note 1: “\*” is not in restricted band, its limit is 20dBc of the fundamental emission level (91.6dB $\mu$ V/m) or 15.209 which is higher.

Note 2: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre\_Amplifier Gain (dB)

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	18	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dB $\mu$ V)	Factor (dB)	Measure Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Polarization
*	7111.5	36.1	7.5	43.6	74.0	-30.4	Peak	Horizontal
*	8709.5	36.5	9.0	45.5	74.0	-28.5	Peak	Horizontal
	9474.5	36.3	10.6	46.9	74.0	-27.1	Peak	Horizontal
	11523.0	37.2	12.7	49.9	74.0	-24.1	Peak	Horizontal
*	7103.0	35.9	7.5	43.4	74.0	-30.6	Peak	Vertical
*	8820.0	35.9	9.0	44.9	74.0	-29.1	Peak	Vertical
	9466.0	35.6	10.5	46.1	74.0	-27.9	Peak	Vertical
	11225.5	36.0	12.4	48.4	74.0	-25.6	Peak	Vertical

Note 1: “\*” is not in restricted band, its limit is 20dBc of the fundamental emission level (92.8dB $\mu$ V/m) or 15.209 which is higher.

Note 2: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre\_Amplifier Gain (dB)

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	25	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dB $\mu$ V)	Factor (dB)	Measure Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Polarization
*	7825.5	37.1	8.4	45.5	74.3	-28.8	Peak	Horizontal
*	8599.0	37.2	8.7	45.9	74.3	-28.4	Peak	Horizontal
	9364.0	36.0	10.5	46.5	74.0	-27.5	Peak	Horizontal
	11327.5	36.4	12.5	48.9	74.0	-25.1	Peak	Horizontal
*	7162.5	37.0	7.7	44.7	74.3	-29.6	Peak	Horizontal
*	8684.0	36.9	9.0	45.9	74.3	-28.4	Peak	Vertical
	9449.0	35.8	10.5	46.3	74.0	-27.7	Peak	Vertical
	10902.5	36.4	13.0	49.4	74.0	-24.6	Peak	Vertical

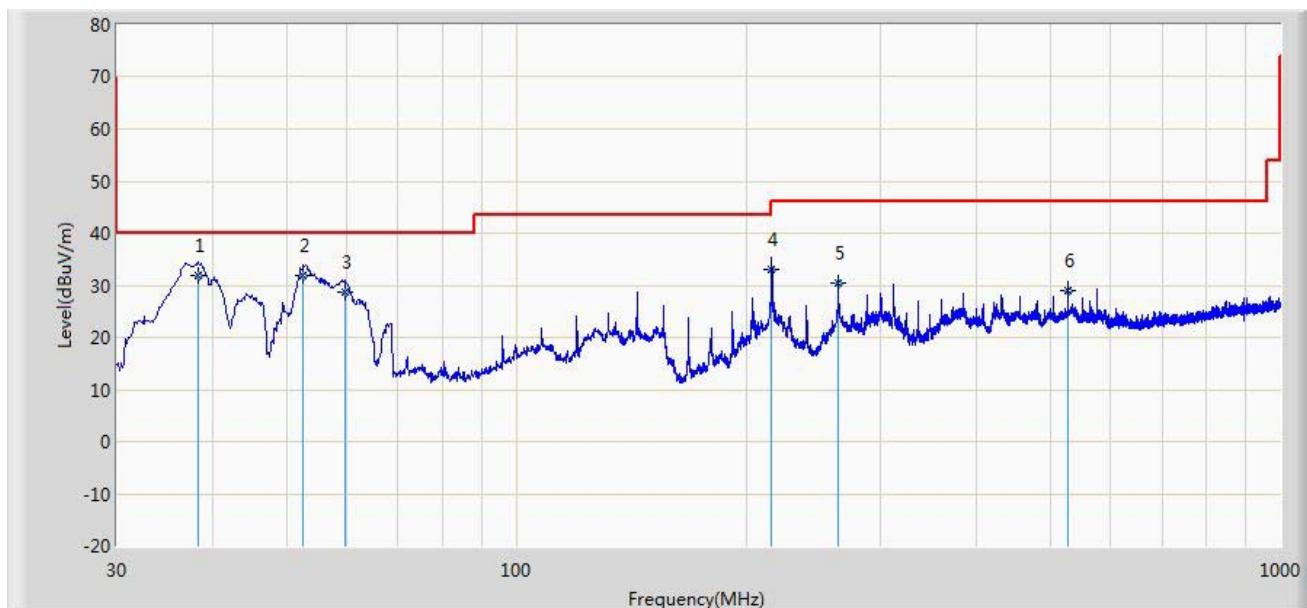
Note 1: “\*” is not in restricted band, its limit is 20dBc of the fundamental emission level (94.3dB $\mu$ V/m) or 15.209 which is higher.

Note 2: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre\_Amplifier Gain (dB)

**The worst case of Radiated Emission below 1GHz:**

Site: AC1	Time: 2015/05/13 - 15:38
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
<b>Worse Case Mode:</b> Transmit at channel 2440MHz	

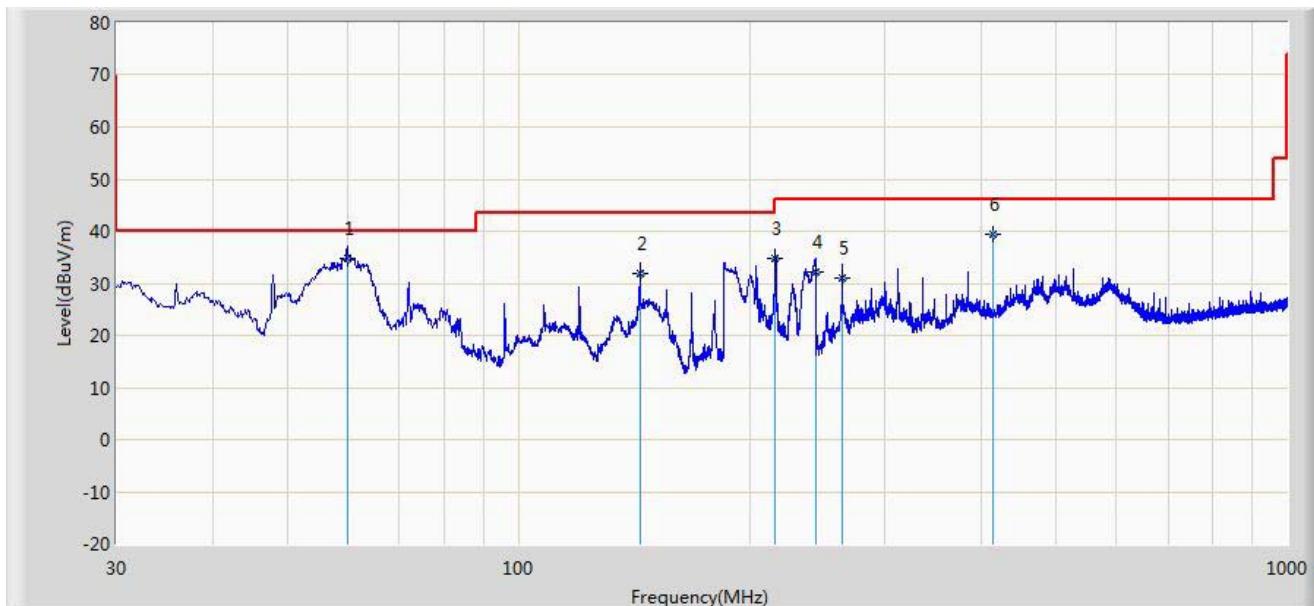


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			38.366	31.882	18.350	-8.118	40.000	13.532	QP
2	*		52.674	31.962	17.100	-8.038	40.000	14.862	QP
3			59.585	28.672	14.750	-11.328	40.000	13.922	QP
4			215.997	33.050	20.540	-10.450	43.500	12.511	QP
5			264.021	30.449	16.544	-15.551	46.000	13.904	QP
6			527.975	28.896	10.254	-17.104	46.000	18.642	QP

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/05/13 - 15:44
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
<b>Worse Case Mode:</b> Transmit at channel 2440MHz	

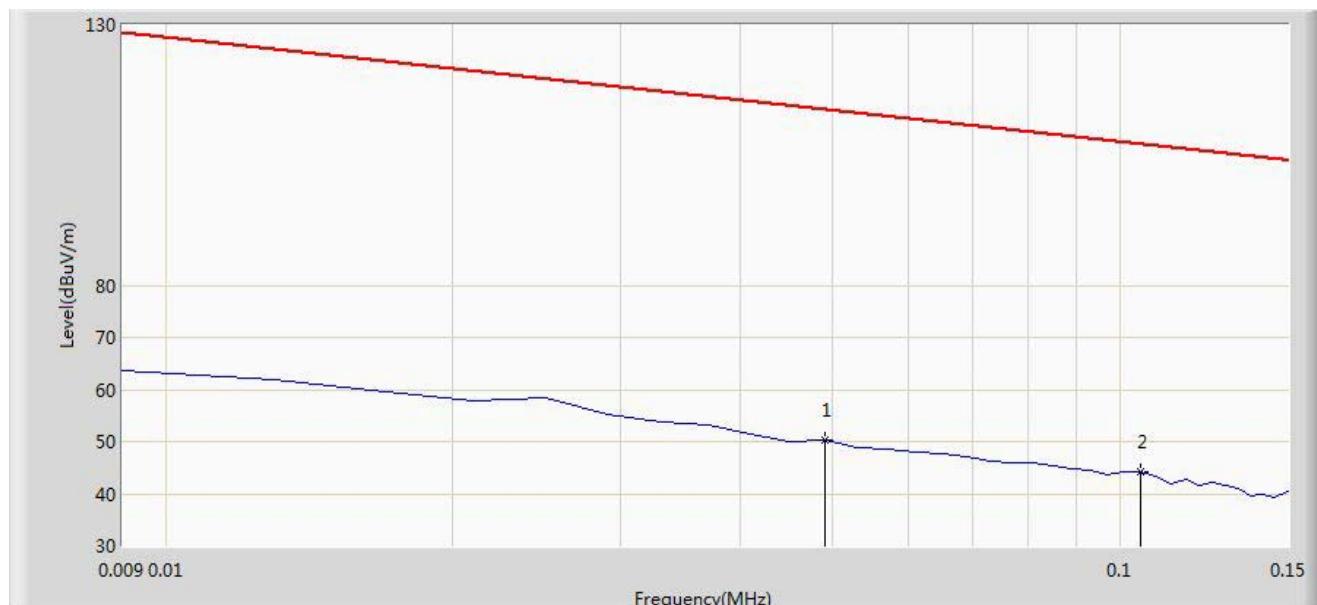


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	59.949	34.888	21.025	-5.112	40.000	13.862	QP
2			143.975	31.856	22.440	-11.644	43.500	9.416	QP
3			215.997	34.867	22.357	-8.633	43.500	12.511	QP
4			243.279	32.222	18.765	-13.778	46.000	13.458	QP
5			264.013	31.058	17.154	-14.942	46.000	13.904	QP
6			413.978	39.404	22.541	-6.596	46.000	16.864	QP

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/05/13 - 18:12
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: FMZB1519_0.009-30MHz	Polarity: Face on
EUT: sengled element	Power: AC 120V/60Hz
<b>Note: There is the ambient noise within frequency range 9kHz~30MHz.</b>	

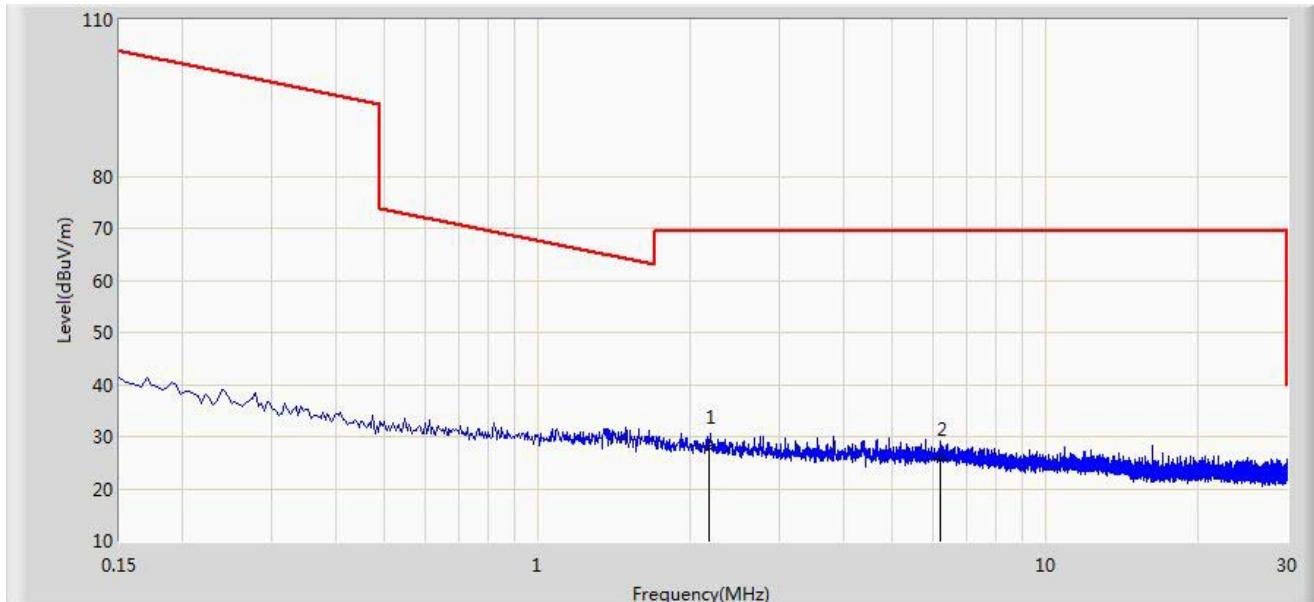


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			0.049	50.367	29.861	-63.422	113.789	20.505	QP
2		*	0.105	44.143	23.996	-63.029	107.173	20.147	QP

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor. (dB).

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/05/13 - 18:16
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: FMZB1519_0.009-30MHz	Polarity: Face on
EUT: sengled element	Power: AC 120V/60Hz
<b>Note: There is the ambient noise within frequency range 9kHz~30MHz.</b>	



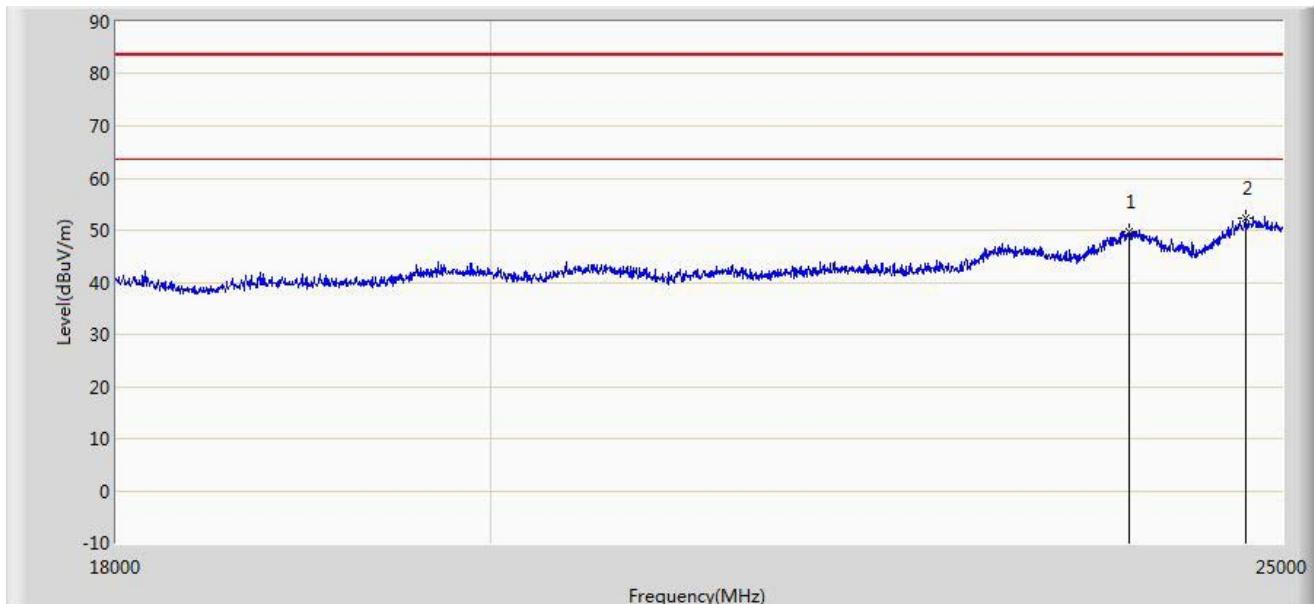
No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2.175	27.894	7.735	-41.606	69.500	20.159	PK
2			6.216	25.672	5.318	-43.828	69.500	20.354	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB).

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Limit@3m =  $20 \cdot \log(30\mu\text{V}/\text{m}) + 20 \cdot \log(30\text{m}/3\text{m}) = 49.5\text{dB}\mu\text{V}/\text{m}$  (Average detector), and  $69.5\text{dB}\mu\text{V}/\text{m}$  (Peak detector).

Site: AC1	Time: 2015/05/13 - 21:20
Limit: FCC_Part15.209_RE(1m)	Engineer: Roy Cheng
Probe: BBHA9170_18-40GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
<b>Note: There is the ambient noise within frequency range 18GHz~25GHz.</b>	



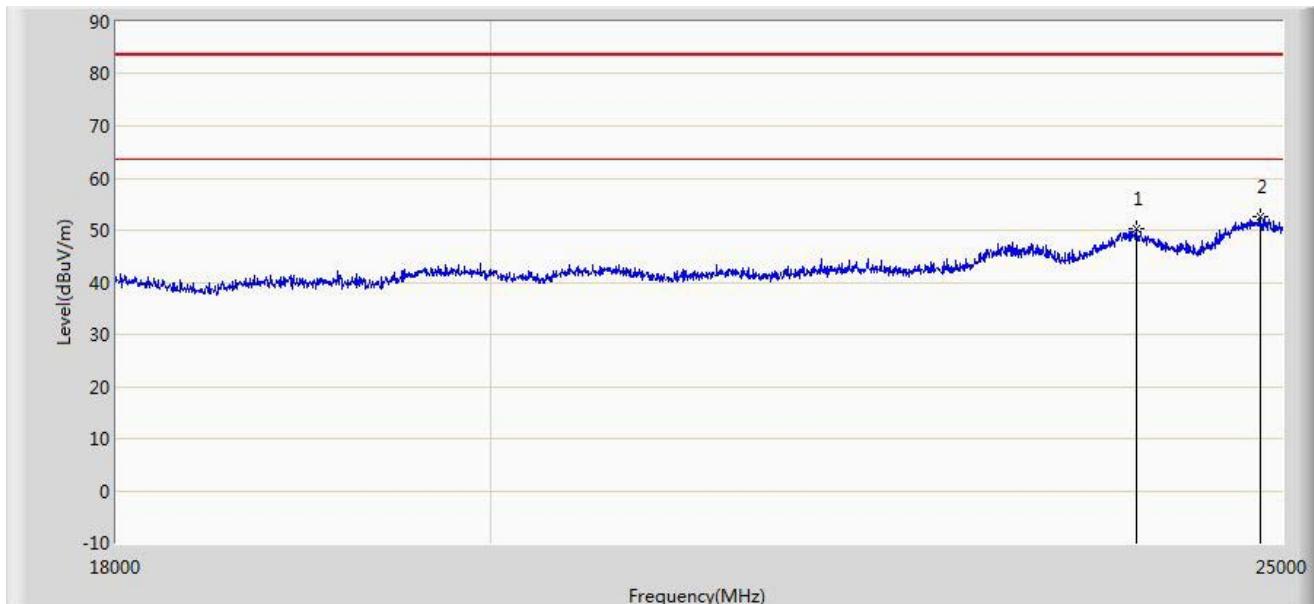
No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			23943.000	49.776	35.866	-33.724	83.500	13.910	PK
2		*	24741.000	52.375	37.681	-31.125	83.500	14.694	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre\_Amplifier Gain (dB)

Limit@1m =  $20 \cdot \log(500 \mu\text{V}/\text{m}) + 20 \cdot \log(3\text{m}/1\text{m}) = 63.5 \text{ dB}\mu\text{V}/\text{m}$  (Average detector), and  $83.5 \text{ dB}\mu\text{V}/\text{m}$  (Peak detector).

Site: AC1	Time: 2015/05/13 - 21:32
Limit: FCC_Part15.209_RE(1m)	Engineer: Roy Cheng
Probe: BBHA9170_18-40GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
<b>Note: There is the ambient noise within frequency range 18GHz~25GHz.</b>	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			23999.000	50.379	36.435	-33.121	83.500	13.944	PK
2		*	24846.000	52.503	37.735	-30.997	83.500	14.768	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

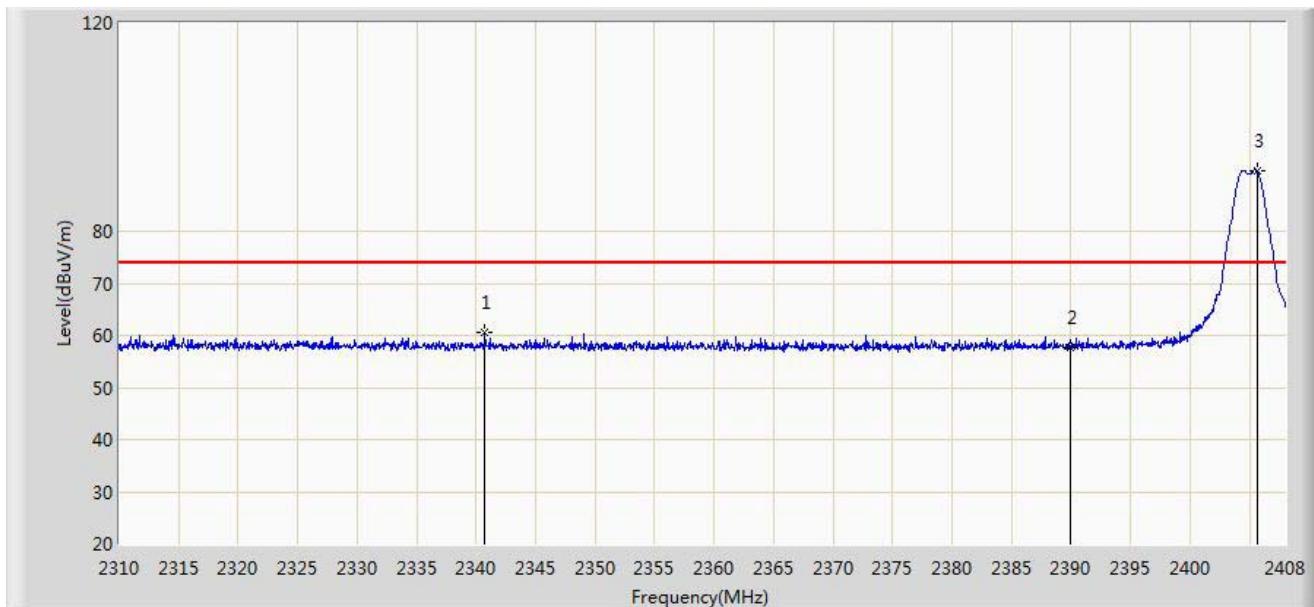
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre\_Amplifier Gain (dB)

Limit@1m =  $20 \cdot \log(500 \mu\text{V}/\text{m}) + 20 \cdot \log(3\text{m}/1\text{m}) = 63.5 \text{ dB}\mu\text{V}/\text{m}$  (Average detector), and  $83.5 \text{ dB}\mu\text{V}/\text{m}$  (Peak detector).

## 7.7. Radiated Restricted Band Edge Measurement

### 7.7.1. Test Result

Site: AC1	Time: 2015/05/12 - 19:31
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2405MHz	

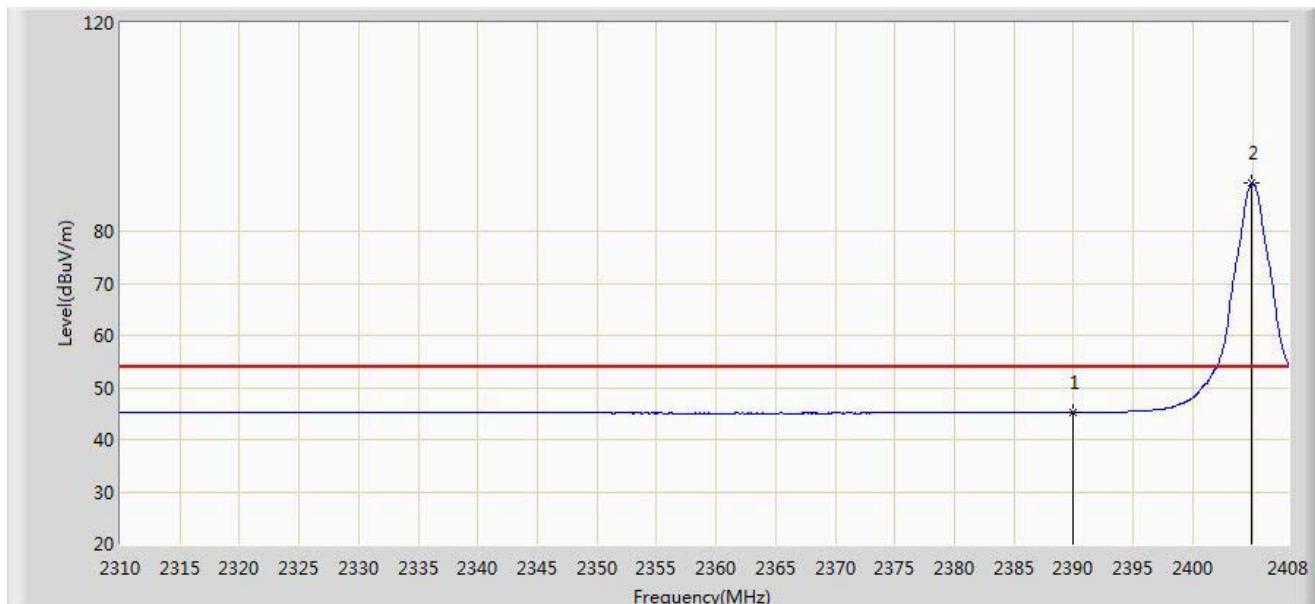


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2340.723	60.567	29.240	-13.433	74.000	31.327	PK
2			2390.000	57.603	26.400	-16.397	74.000	31.203	PK
3	*	*	2405.648	91.601	60.422	N/A	N/A	31.179	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 19:36
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2405MHz	

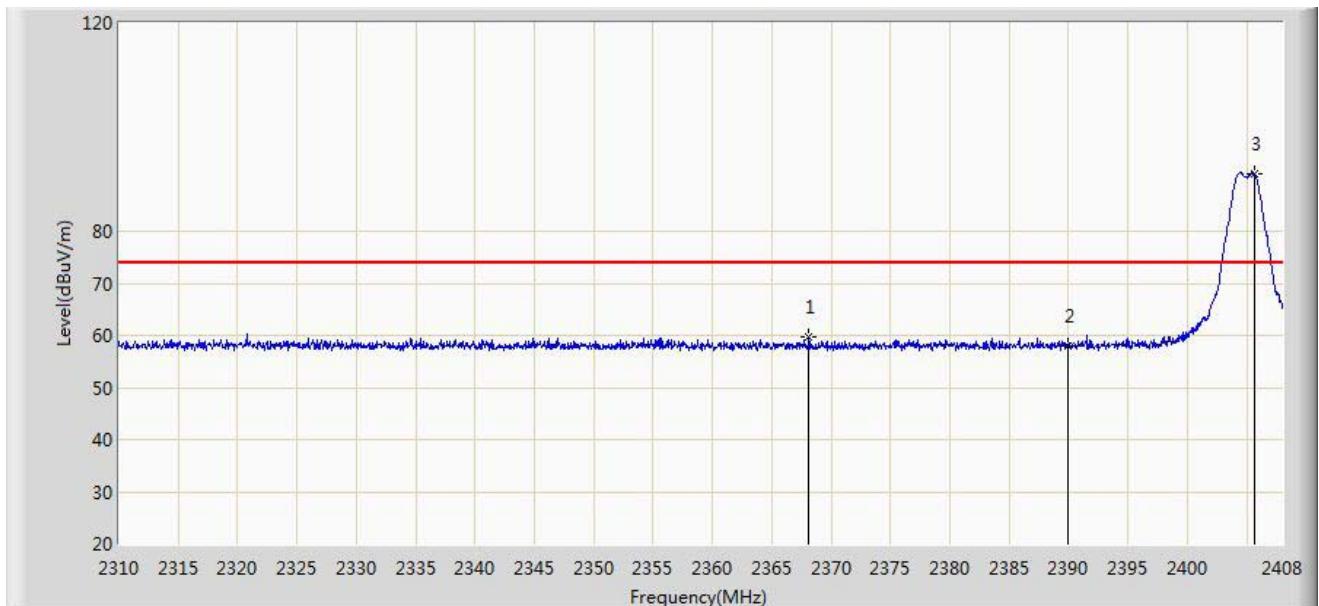


No	Flag	Mark	Frequency (MHz)	Measure Level (dB $\mu$ V/m)	Reading Level (dB $\mu$ V)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	45.201	13.998	-8.799	54.000	31.203	AV
2		*	2404.962	89.159	57.979	N/A	N/A	31.180	AV

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 19:37
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2405MHz	

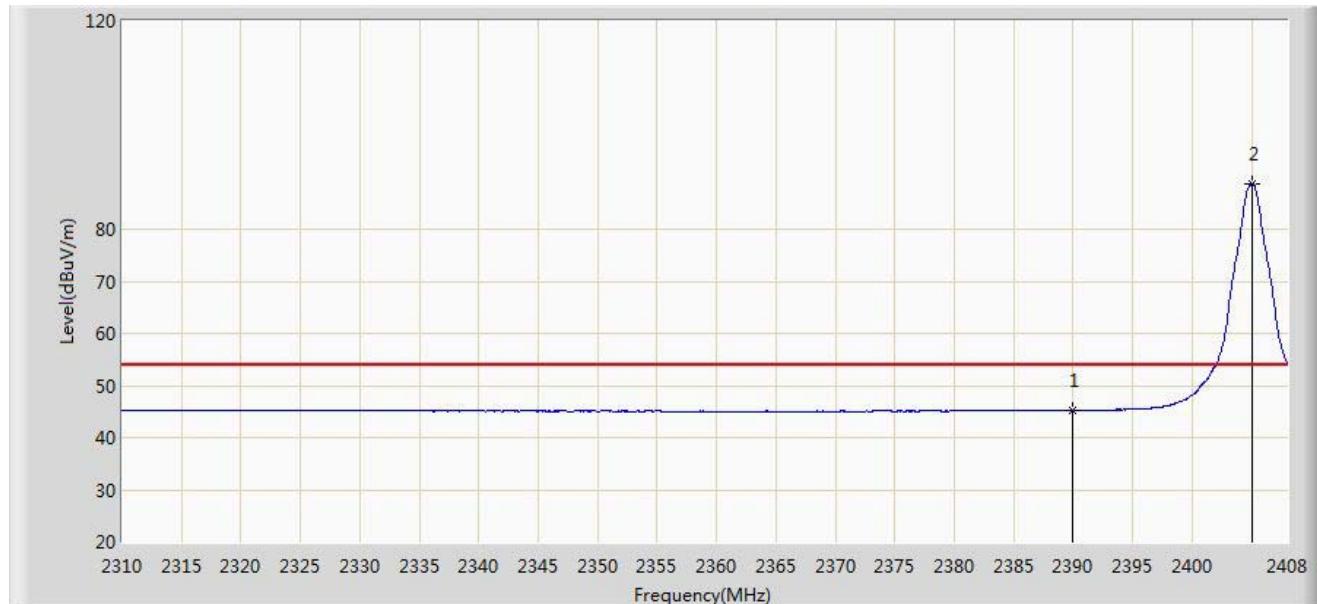


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2368.114	59.584	28.341	-14.416	74.000	31.244	PK
2			2390.000	58.073	26.870	-15.927	74.000	31.203	PK
3	*		2405.648	91.001	59.822	N/A	N/A	31.179	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 19:38
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2405MHz	

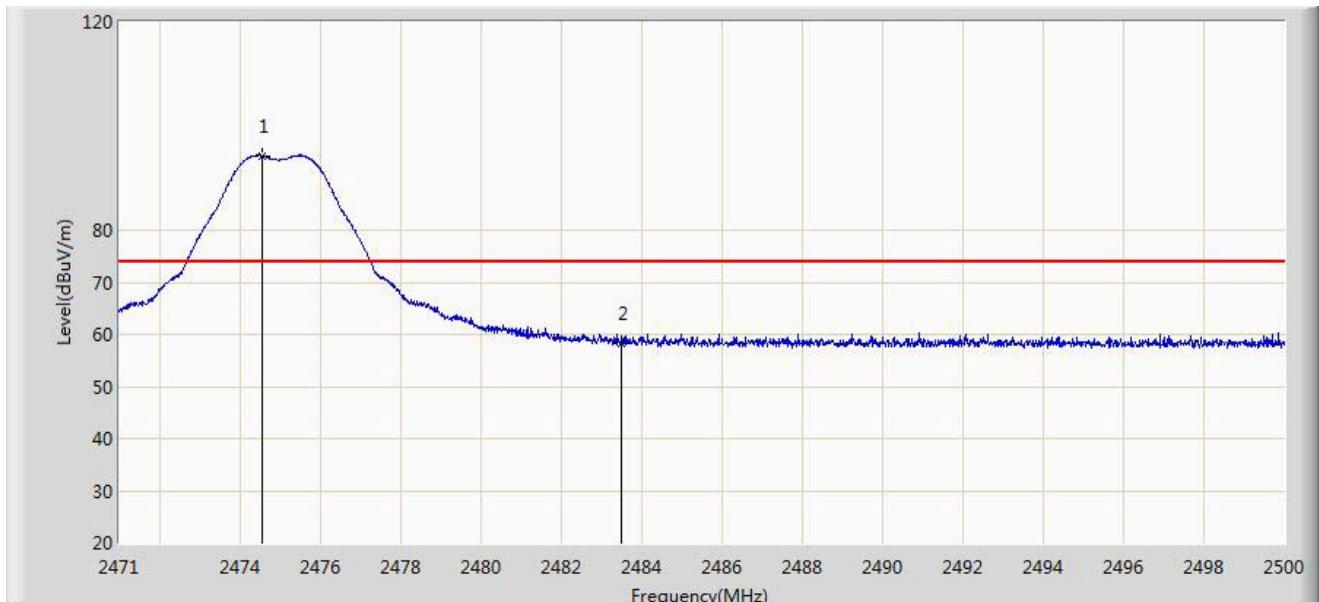


No	Flag	Mark	Frequency (MHz)	Measure Level (dB $\mu$ V/m)	Reading Level (dB $\mu$ V)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	45.162	13.959	-8.838	54.000	31.203	AV
2		*	2405.011	88.814	57.634	N/A	N/A	31.180	AV

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 20:17
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2475MHz	

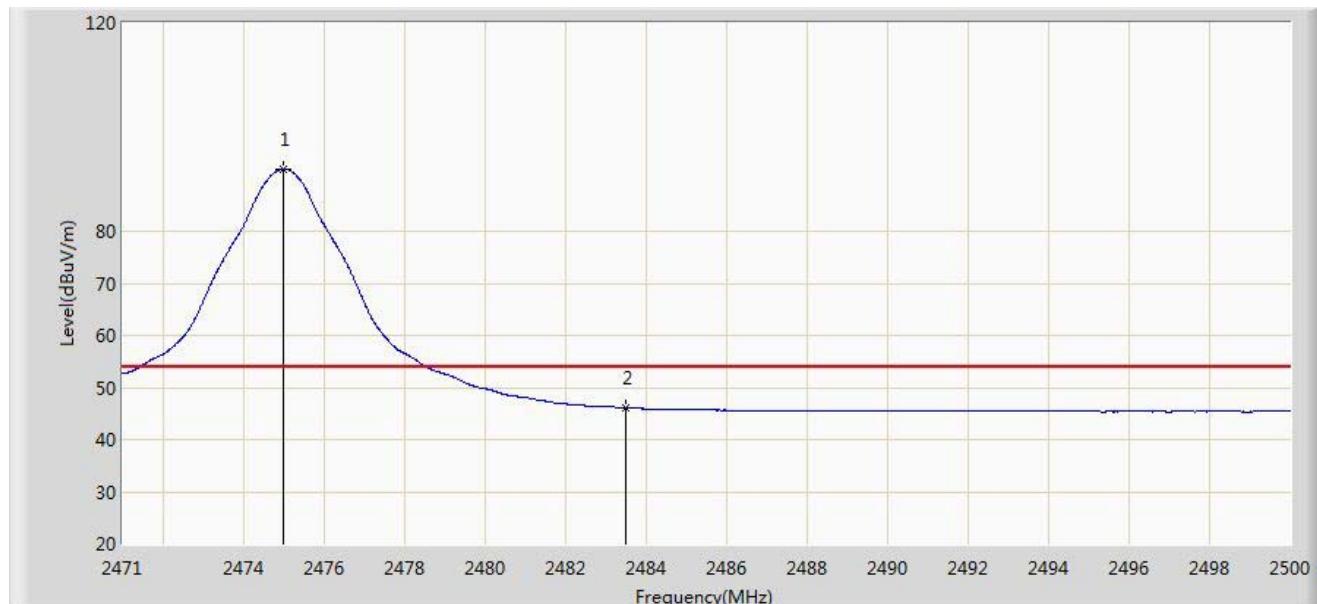


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2474.552	94.324	63.155	N/A	N/A	31.169	PK
2			2483.500	58.120	26.927	-15.880	74.000	31.194	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 20:18
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2475MHz	

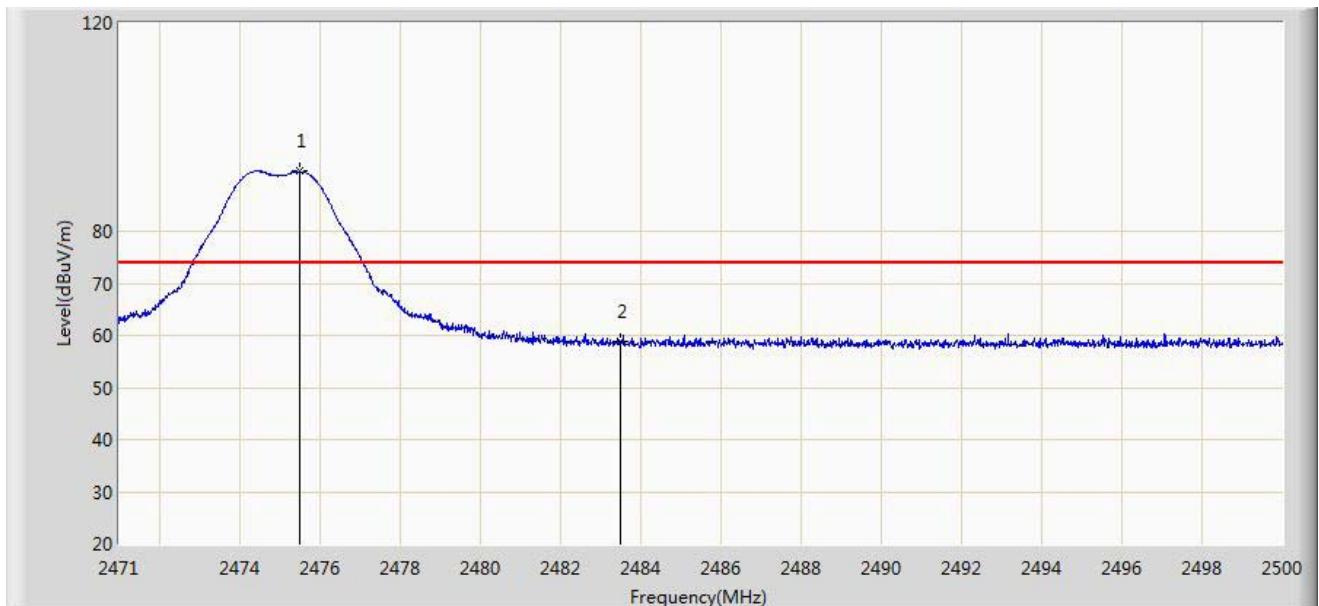


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.002	91.866	60.696	N/A	N/A	31.170	AV
2			2483.500	46.079	14.886	-7.921	54.000	31.194	AV

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 20:19
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2475MHz	

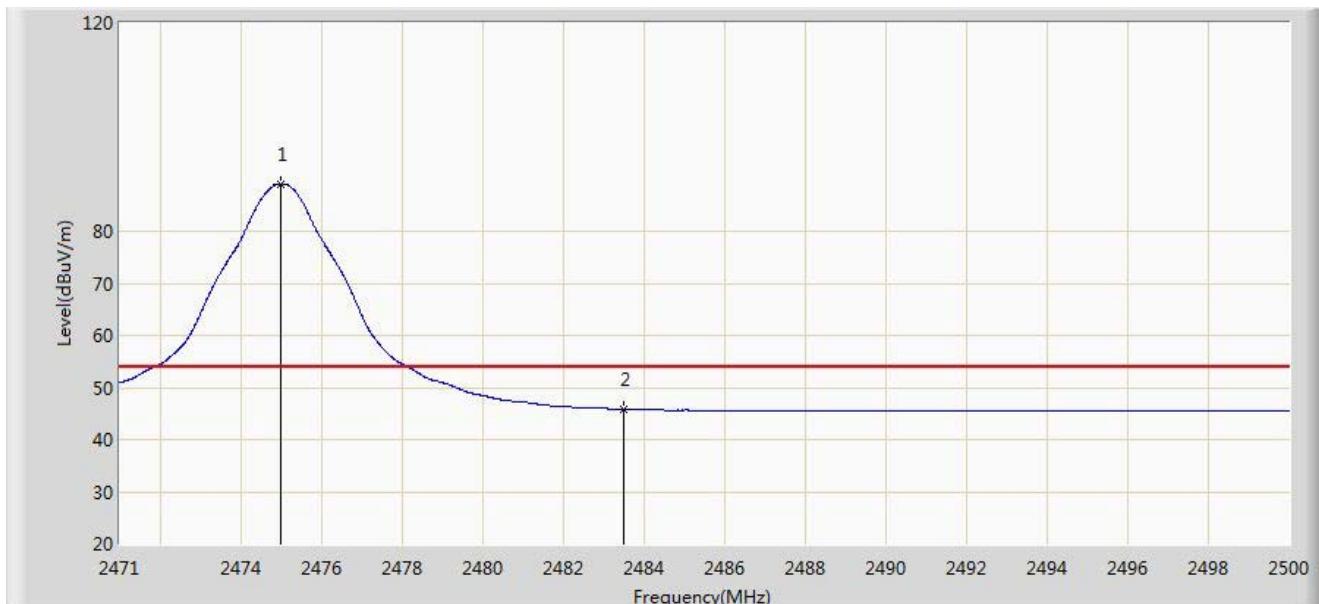


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.495	91.453	60.281	N/A	N/A	31.171	PK
2			2483.500	58.707	27.514	-15.293	74.000	31.194	PK

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2015/05/12 - 20:21
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: sengled element	Power: AC 120V/60Hz
Note: Test Mode: Transmit at channel 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dB $\mu$ V/m)	Reading Level (dB $\mu$ V)	Over Limit (dB)	Limit (dB $\mu$ V/m)	Factor (dB)	Type
1		*	2475.002	89.076	57.906	N/A	N/A	31.170	AV
2			2483.500	45.829	14.636	-8.171	54.000	31.194	AV

Note: Measure Level (dB $\mu$ V/m) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

## 7.8. AC Conducted Emissions Measurement

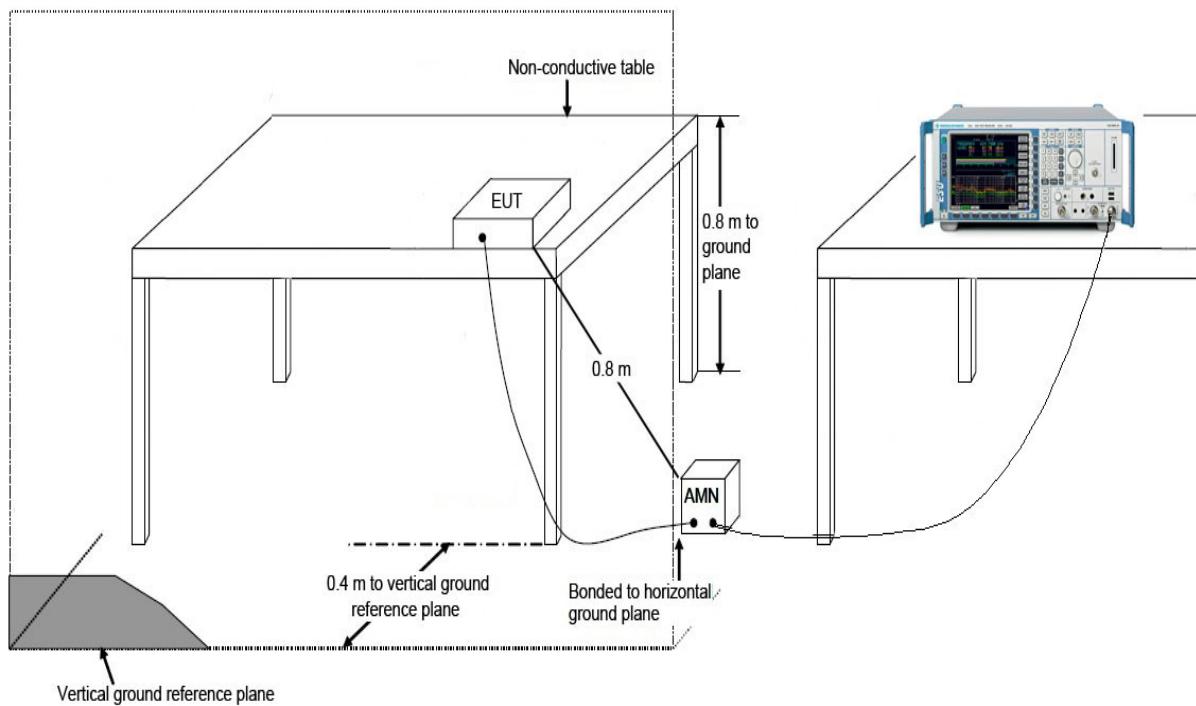
### 7.8.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 – 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

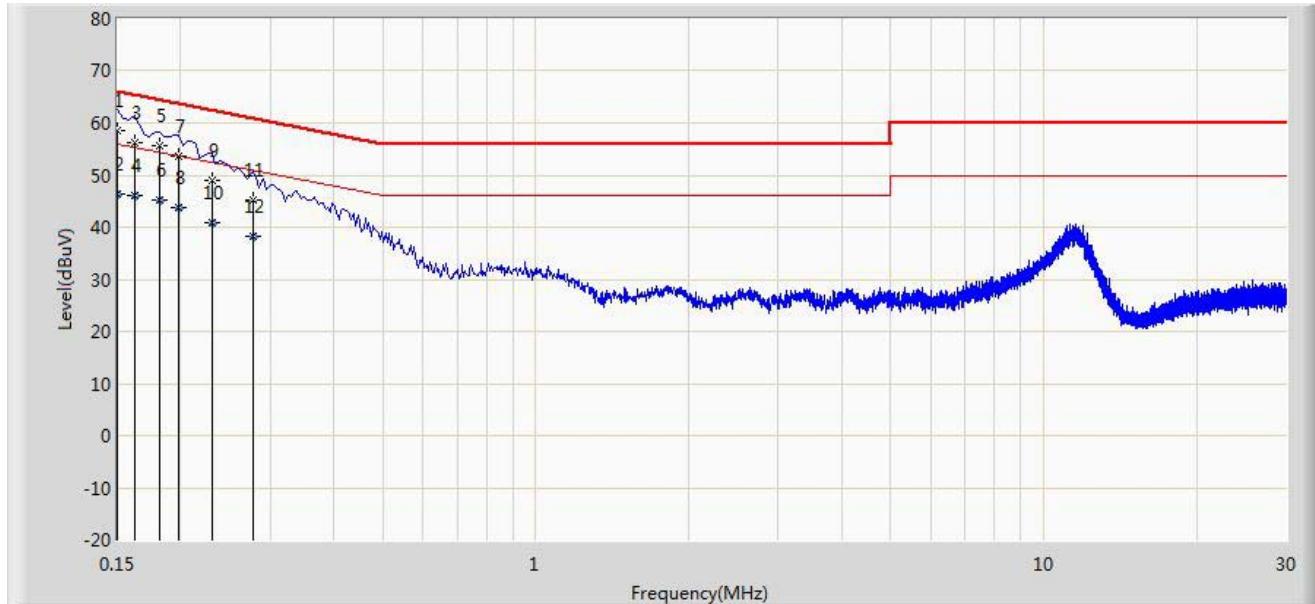
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

### 7.8.2. Test Setup



### 7.8.3. Test Result

Site: SR2	Time: 2015/05/13 - 20:24
Limit: FCC_Part15.207_CE_AC Power	Engineer: Roy Cheng
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: sengled element	Power: AC 120V/60Hz
Note: Mode1	

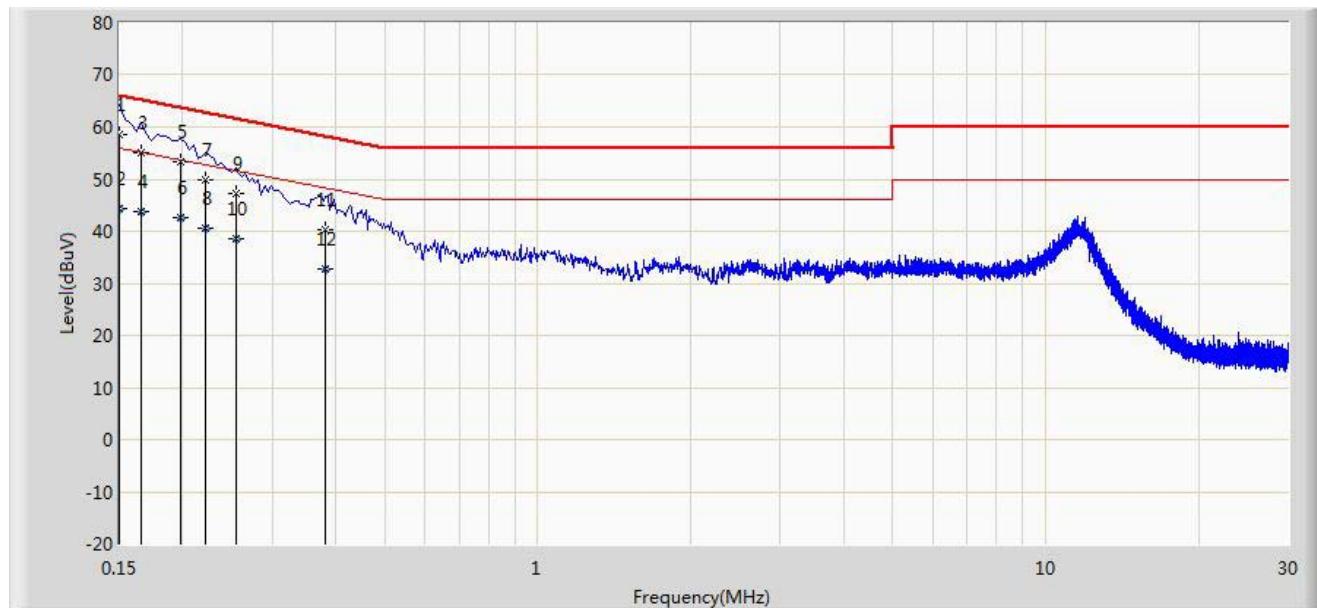


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1	*		0.150	58.578	47.410	-7.422	66.000	11.168	QP
2			0.150	46.454	35.286	-9.546	56.000	11.168	AV
3			0.162	56.315	46.218	-9.046	65.361	10.097	QP
4			0.162	46.133	36.036	-9.227	55.361	10.097	AV
5			0.182	55.775	45.727	-8.619	64.394	10.048	QP
6			0.182	45.348	35.300	-9.045	54.394	10.048	AV
7			0.198	53.504	43.499	-10.190	63.694	10.005	QP
8			0.198	43.732	33.727	-9.962	53.694	10.005	AV
9			0.230	48.948	39.001	-13.501	62.450	9.947	QP
10			0.230	40.886	30.938	-11.564	52.450	9.947	AV
11			0.278	45.277	35.291	-15.598	60.875	9.986	QP
12			0.278	38.129	28.142	-12.747	50.875	9.986	AV

Note: Measure Level (dB $\mu$ V) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

Site: SR2	Time: 2015/05/13 - 20:30
Limit: FCC_Part15.207_CE_AC Power	Engineer: Roy Cheng
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: sengled element	Power: AC 120V/60Hz
Note: Mode1	



No	Flag	Mark	Frequency (MHz)	Measure Level (dB $\mu$ V)	Reading Level (dB $\mu$ V)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		*	0.150	58.577	47.435	-7.423	66.000	11.142	QP
2			0.150	44.246	33.104	-11.754	56.000	11.142	AV
3			0.166	55.083	45.011	-10.076	65.158	10.071	QP
4			0.166	43.631	33.560	-11.527	55.158	10.071	AV
5			0.198	53.288	43.273	-10.407	63.694	10.015	QP
6			0.198	42.468	32.453	-11.226	53.694	10.015	AV
7			0.222	49.986	40.006	-12.758	62.744	9.980	QP
8			0.222	40.604	30.624	-12.140	52.744	9.980	AV
9			0.254	47.343	37.339	-14.282	61.625	10.004	QP
10			0.254	38.568	28.564	-13.058	51.625	10.004	AV
11			0.382	40.431	30.332	-17.805	58.236	10.099	QP
12			0.382	32.670	22.571	-15.566	48.236	10.099	AV

Note: Measure Level (dB $\mu$ V) = Reading Level (dB $\mu$ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

## 8. CONCLUSION

The data collected relate only the item(s) tested and show that the **single element FCC ID:**

**2ABX8SH-000000007** is in compliance with Part 15C of the FCC Rules.

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The End

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