



MEASUREMENT REPORT

FCC PART 15.247 / RSS-247 ZigBee 802.15.4

FCC ID: 2ACS5-SR24P

IC: 11554B-SR24P

APPLICANT: Yuneec Technology Co., Limited

Application Type: Certification

Product: Radio Controller Receiver

Model No.: SR24+

Brand Name: YUNEEC

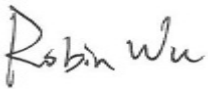
FCC Classification: Digital Transmission System (DTS)

FCC Rule Part(s): Part 15.247

IC Rule(s): RSS-247 Issue 1, RSS-GEN Issue 4

Test Procedure(s): ANSI C63.10-2013, KDB 558074 D01v03r05

Test Date: July 03 ~ Aug 06, 2016

Reviewed By : 
Manager

(Robin Wu)

Approved By : 
CEO

(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 D01v03r05. 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	Note
1607RSU00301	Rev. 01	Initial report	07-21-2016	Invalid
1607RSU00301	Rev. 02	Add the measurement uncertainty	07-31-2016	Invalid
1607RSU00301	Rev. 03	Add the passive device equipment and extra PSD testing	08-03-2016	Invalid
1607RSU00301	Rev. 04	Add the extra occupied bandwidth	08-06-2016	Valid

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§2.1033 General Information

Applicant:	Yuneec Technology Co., Limited
Applicant Address:	2/F Man Shung Industrial Building, 7 Lai Yip Street, Kwun Tong, Hong Kong
Manufacturer:	Yuneec International (China) Co., Ltd.
Manufacturer Address:	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT Registration No.:	809388
IC Registration No.:	11384A
FCC Rule Part(s):	Part 15.247
IC Rule:	RSS-247 Issue 1, RSS-GEN Issue 4
FCC ID:	2ACS5-SR24P
IC:	11554B-SR24P
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	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	Radio Controller Receiver
Model No.	SR24+
Brand Name	YUNEEC
ZigBee Specification	802.15.4

2.2. Product Specification Subjective to this Report

Frequency Range	802.15.4: 2405 ~ 2475 MHz
Maximum Peak Output Power	19.56dBm
Type of Modulation	O-QPSK

Note: For other features of this EUT, test report will be issued separately.

2.3. Operation Frequency / Channel List

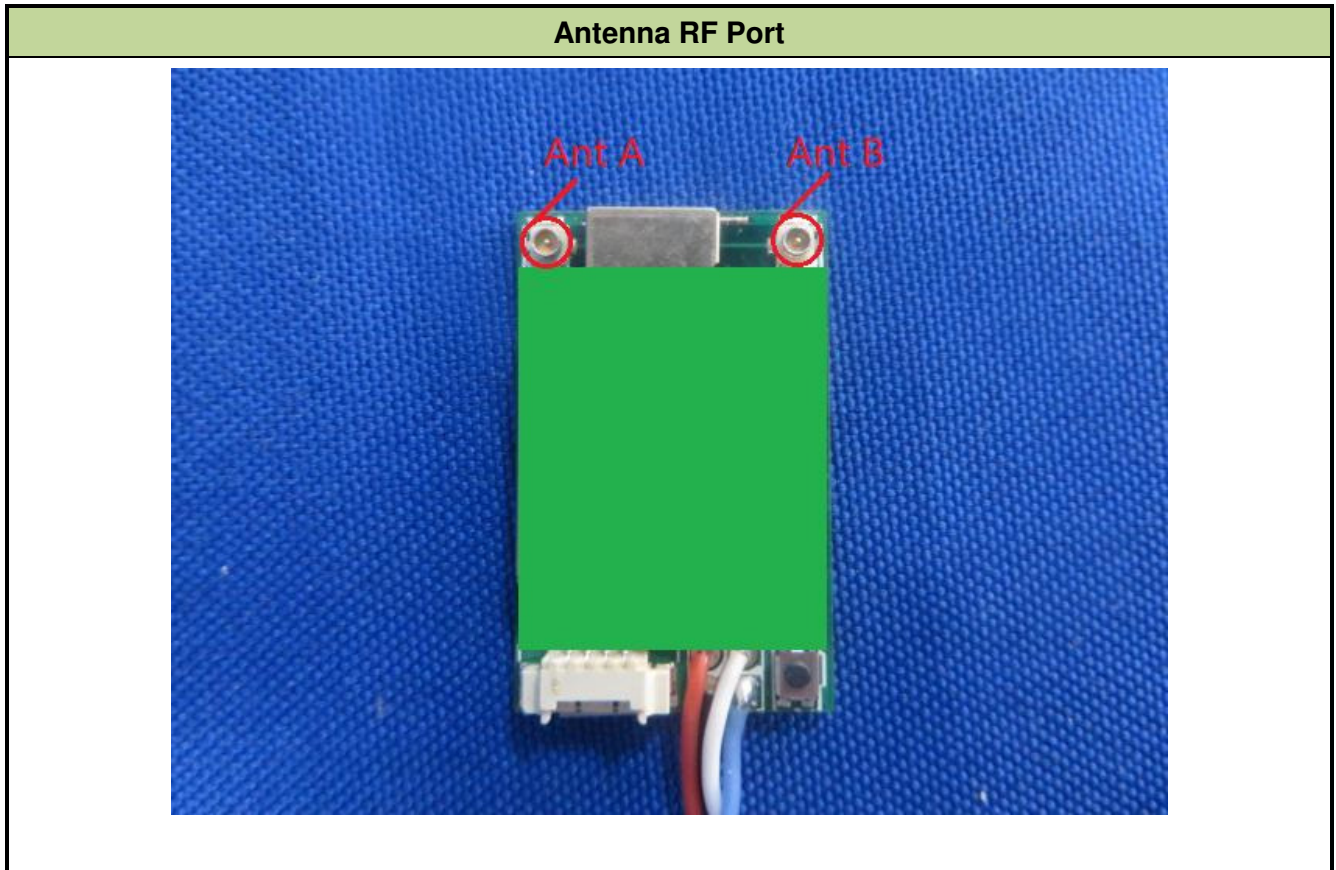
Channel	Frequency	Channel	Frequency	Channel	Frequency
11	2405 MHz	12	2410 MHz	13	2415 MHz
14	2420 MHz	15	2425 MHz	16	2430 MHz
17	2435 MHz	18	2440 MHz	19	2445 MHz
20	2450 MHz	21	2455 MHz	22	2460 MHz
23	2465 MHz	24	2470 MHz	25	2475 MHz

2.4. Description of Available Antennas

Antenna No.	Antenna Type	Manufacturer	Frequency Band (GHz)	Max Peak Gain (dBi)
1# 	Dipole Antenna	Yuneec Technology Co., Limited	2.4	1.5
2# 	Dipole Antenna		2.4	1.5
3# 	Dipole Antenna		2.4	1.5

Note: We choose the dipole Antenna 1# to do all radiated emission testing.

2.5. Description of Antenna RF Port



Note: It has two diversity antennas (TX and RX) which are used to avoid dropouts due to multipath fading. Only one antenna is selected for use at any time through the on-board RF switch.

2.6. Test Mode

Test Mode	Mode 1: Transmit by 802.15.4
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2.7. Test Software

The test utility software used during testing was engineering directive ordered by applicant.

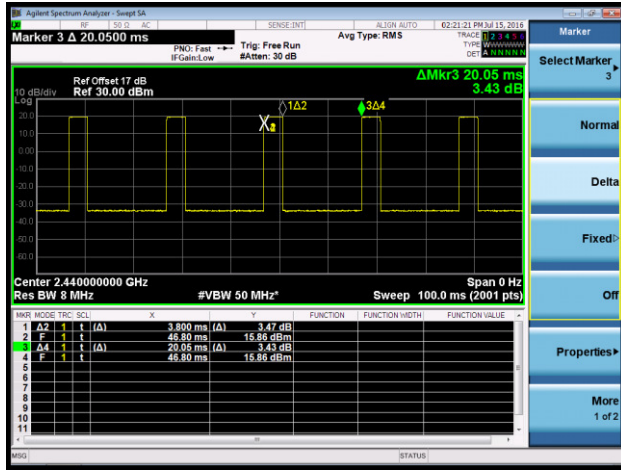
2.8. Device Capabilities

This device contains the following capabilities:

2.4GHz ZigBee (DTS)

Note: 2.4GHz ZigBee (DTS) operation is possible in 3MHz 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. 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	18.95%



2.9. Test Configuration

The **Radio Controller Receiver FCC ID: 2ACS5-SR24P Mode Number: SR24+** was tested per the guidance of KDB 558074 D01v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.10. EMI Suppression Device(s)/Modifications

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

2.11. 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 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 D01v03r05 were used in the measurement of the **Radio Controller Receiver FCC ID: 2ACS5-SR24P**.

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 **Radio Controller Receiver** uses a reversed connector.
- There are no provisions for connection to an external antenna.

Conclusion:

The **Radio Controller Receiver FCC ID: 2ACS5-SR24P Mode Number: SR24+** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2016/11/03
Temperature/Humidity Meter	Yuhuaze	N/A	MRTSUE06182	1 year	2016/12/20
Shielding Anechoic Chamber	MIX-BEP	Chamber-SR2	MRTSUE06215	1 year	2017/05/10

Radiated Emission - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	Agilent	N9038A	MRTSUE06125	1 year	2016/08/03
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2017/03/28
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2016/12/14
TRILOG Antenna	Schwarzbeck	VULB9168	MRTSUE06172	1 year	2016/12/11
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2016/11/07
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2017/01/04
RF Cable	HUBER+SUHNER	Cable 01	MRTSUE06055-1	1 year	2017/03/29
RF Cable	HUBER+SUHNER	Cable 02	MRTSUE06055-2	1 year	2017/03/29
Digital Thermometer & Hygrometer	Yuhuaze	HTC-2	MRTSUE06183	1 year	2016/12/20
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2017/05/10

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2017/05/08
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2017/05/08
RF Cable	HUBER+SUHNER	Cable 03	MRTSUE06055-3	1 year	2017/03/29
Attenuator	Woken	WATT-218FS-15	MRTSUE06220	1 year	2017/03/29
DC Block	Woken	00900A1A2A101A	MRTSUE06221	1 year	2017/03/29
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06180	1 year	2016/12/20

Software	Version	Function
e3	V8.3.5	EMI Test Software

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 - SR2
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB
Spurious Emissions, Conducted - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 0.78dB
Output Power - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 1.13dB
Power Spectrum Density - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 1.15dB
Occupied Bandwidth - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 0.28%

7. TEST RESULT

7.1. Summary

Company Name: Yuneec Technology Co., Limited
FCC ID: 2ACS5-SR24P
IC: 11554B-SR24P
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-247 [5.2]	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Output Power	$\leq 1\text{Watt} \ \& \ \text{EIRP} \leq 4\text{Watt}$		Pass	Section 7.3
15.247(e)	RSS-247 [5.2]	Power Spectral Density	$\leq 8\text{dBm} / 3\text{kHz Band}$		Pass	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	$\geq 20\text{dBc(Peak)}$		Pass	Section 7.5
15.205 15.209	RSS-247 [5.5]	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 [8.8]	AC Conducted Emissions 150kHz - 30MHz	$< \text{FCC 15.207 limits}$	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.
- 4) For the test item 6dB Bandwidth & Power Spectral Density & Band Edge / Out-of-Band Emissions & Radiated Spurious Emission & Radiated Restricted Band Edge, we selected the worst-case antenna port A to perform testing.

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

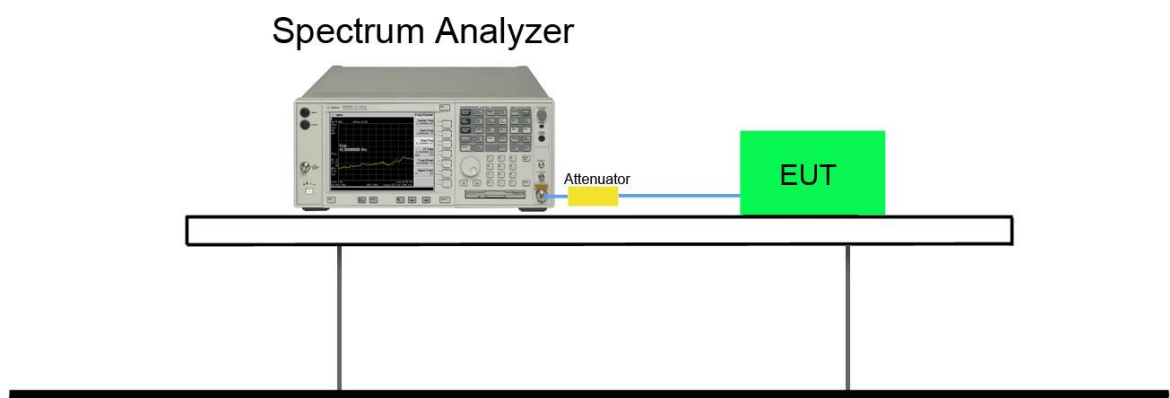
KDB 558074 D01v03r05 – Section 8.2 Option 2

RSS-Gen Issue 4 Section 6.6

7.2.3. Test Setting

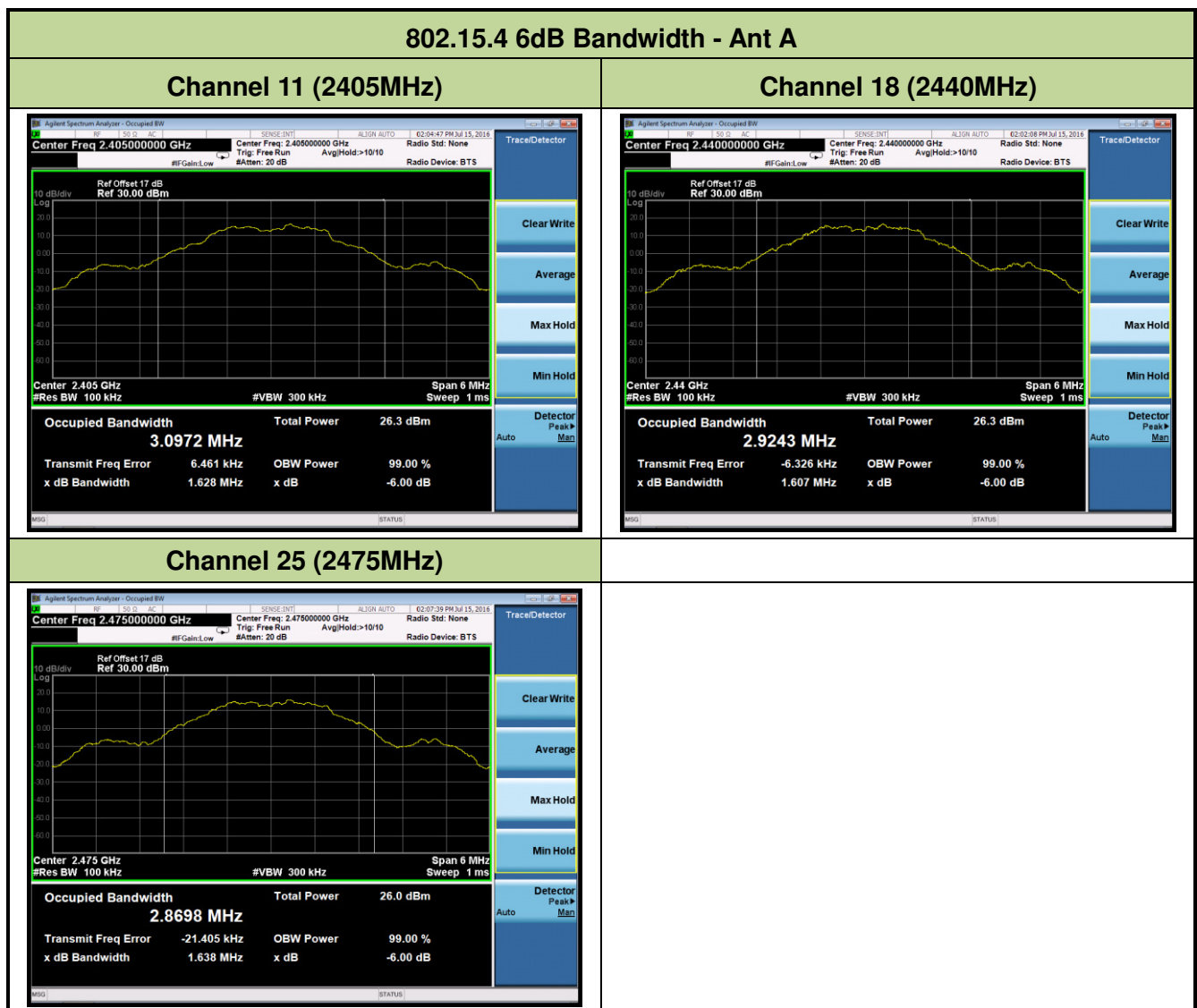
1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 6$. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set $RBW = 100 \text{ kHz}$ / $RBW = 1\% \text{ to } 5\% \text{ of the } 6\text{dB bandwidth}$
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



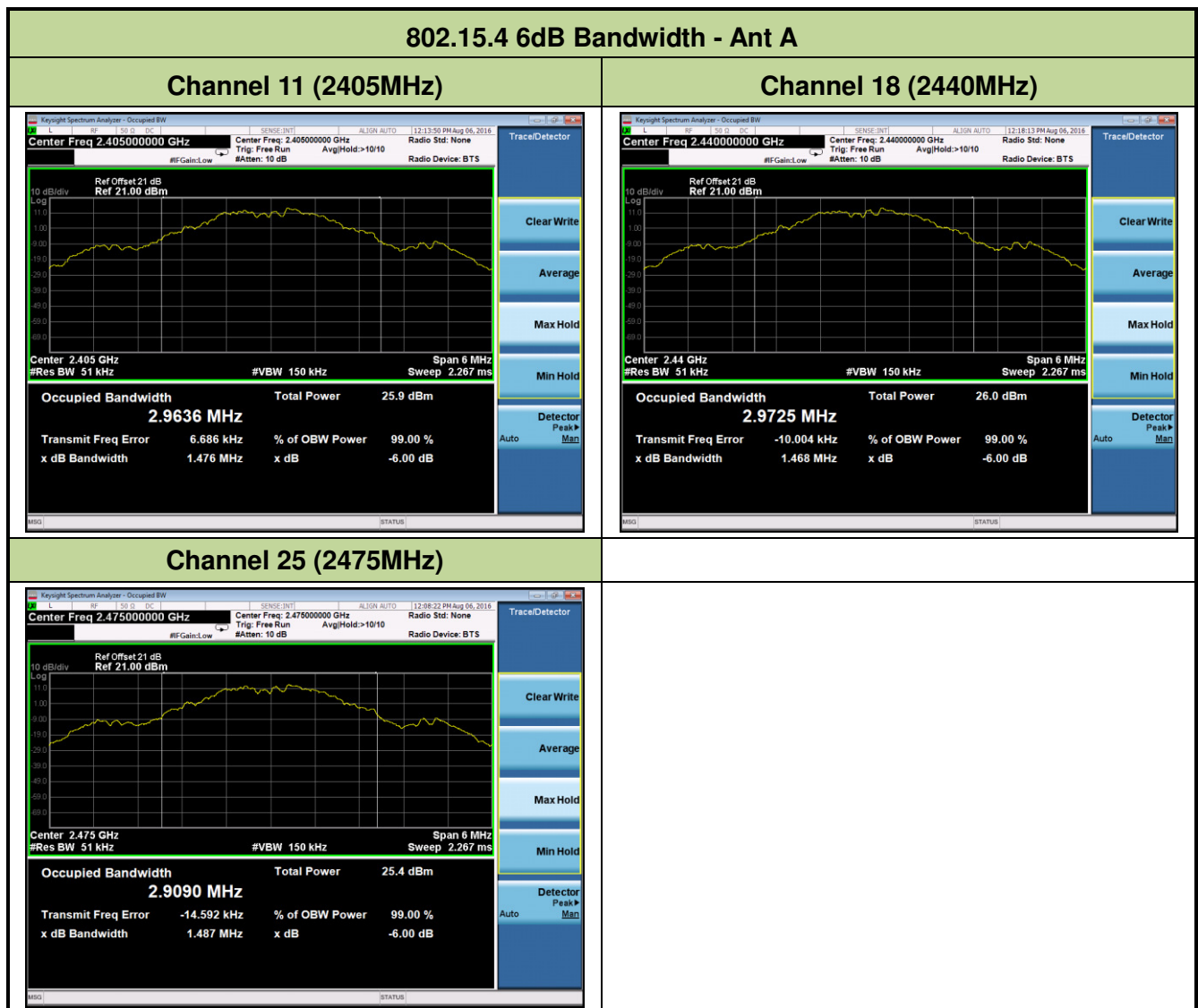
7.2.5. Test Result

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.63	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.61	≥ 0.5	Pass
802.15.4	O-QPSK	25	2475	1.64	≥ 0.5	Pass



Refer to RSS-Gen

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.48	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.47	≥ 0.5	Pass
802.15.4	O-QPSK	25	2475	1.49	≥ 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

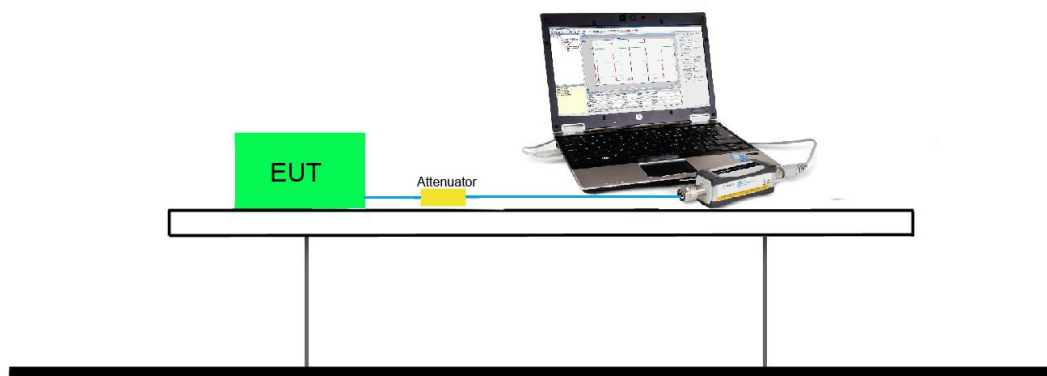
KDB 558074 D01v03r05 - Section 9.1.2 PKPM1 Peak Power Method (for signals with $BW \leq 50\text{MHz}$)

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 = 50MHz 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 Output Power

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
				Ant A	Ant B		Ant A	Ant B		
802.15.4	O-QPSK	11	2405	19.29	19.27	≤ 30	20.79	20.77	≤ 36	Pass
802.15.4	O-QPSK	18	2440	19.56	19.55	≤ 30	21.06	21.05	≤ 36	Pass
802.15.4	O-QPSK	25	2475	19.02	19.01	≤ 30	20.52	20.51	≤ 36	Pass

Note: E.I.R.P (dBm) = Peak Output Power (dBm) + Antenna Gain (dBi).

Test Result of Average Output Power for Report Only

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Average Output Power (dBm)		Limit (dBm)	E.I.R.P (dBm)		Limit (dBm)	Result
				Ant A	Ant B		Ant A	Ant B		
802.15.4	O-QPSK	11	2405	18.98	18.97	≤ 30	20.48	20.47	≤ 36	Pass
802.15.4	O-QPSK	18	2440	19.31	19.32	≤ 30	20.81	20.82	≤ 36	Pass
802.15.4	O-QPSK	25	2475	18.74	18.73	≤ 30	20.24	20.23	≤ 36	Pass

Note: E.I.R.P (dBm) = Average Output Power (dBm) + Antenna Gain (dBi).

7.4. Power Spectral Density Measurement

7.4.1. Test Limit

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

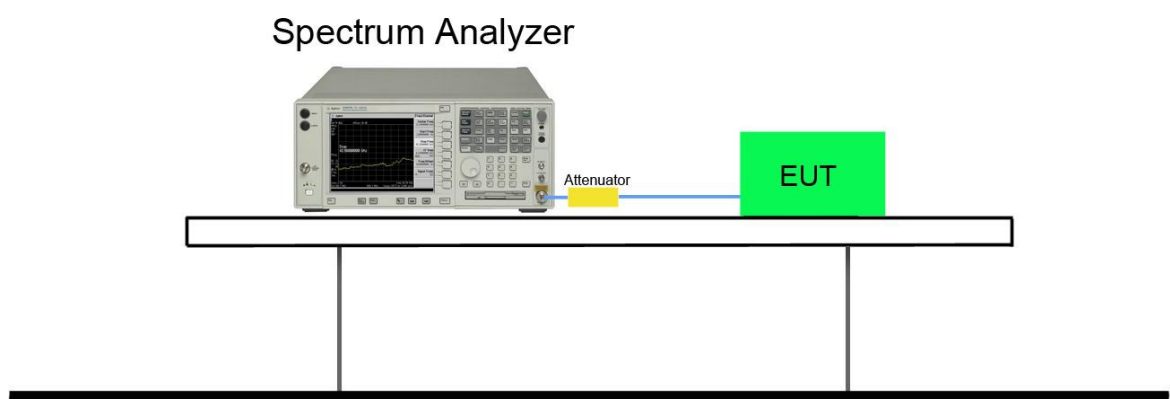
7.4.2. Test Procedure Used

KDB 558074 D01v03r05 - 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

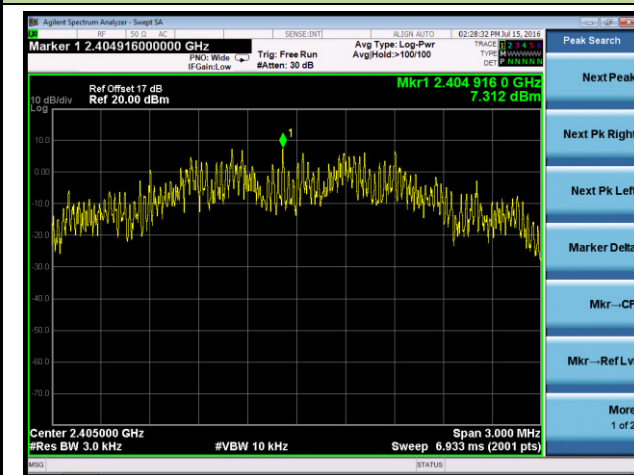


7.4.5. Test Result

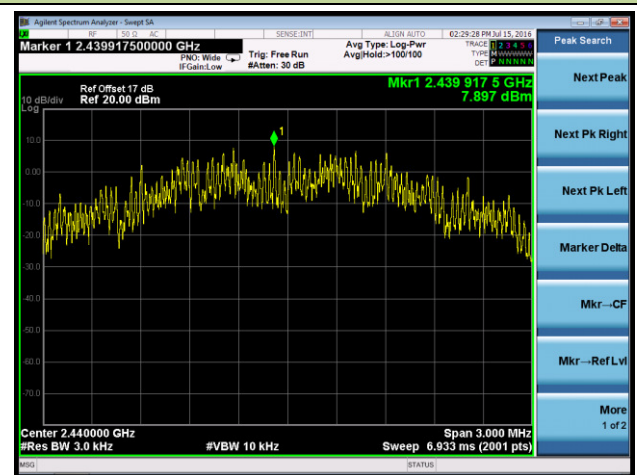
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Measured PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	7.31	≤ 8	Pass
802.15.4	O-QPSK	18	2445	7.90	≤ 8	Pass
802.15.4	O-QPSK	25	2480	7.87	≤ 8	Pass

802.15.4 Power Density - Ant A

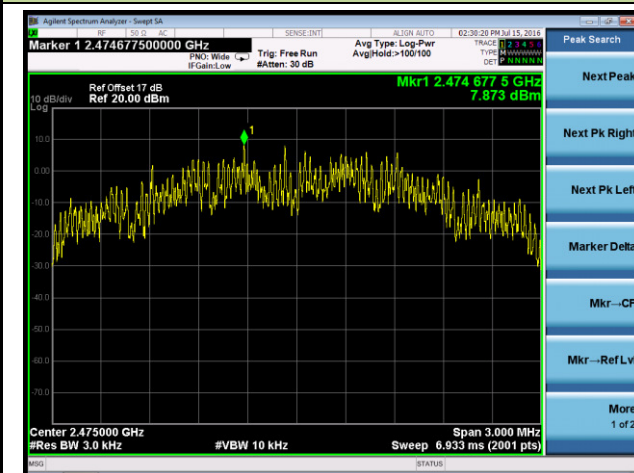
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 25 (2475MHz)



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 D01v03r05 - Section 11.2 & Section 11.3

7.5.3. Test Settling

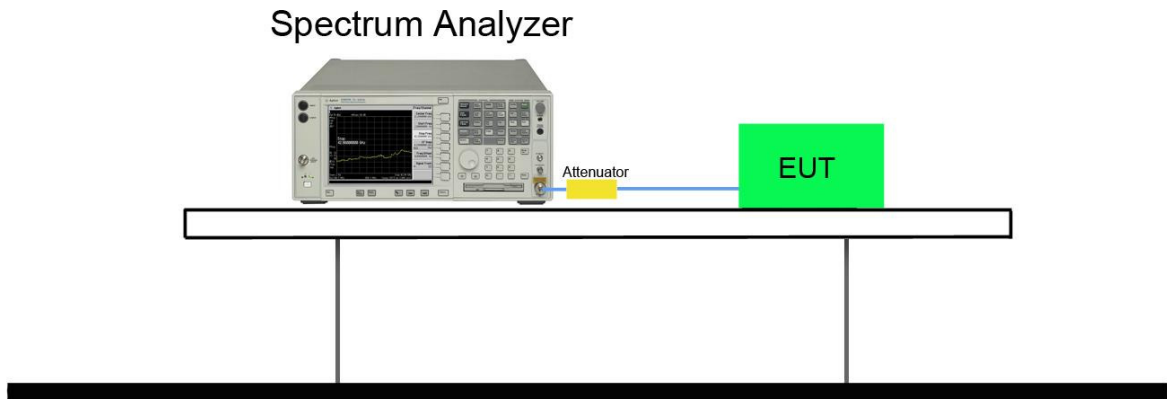
1. Reference level measurement

- (a) Set instrument center frequency to DTS channel center frequency
- (b) Set the span to ≥ 1.5 times the DTS bandwidth
- (c) Set the RBW = 100 kHz
- (d) Set the VBW $\geq 3 \times$ 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



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

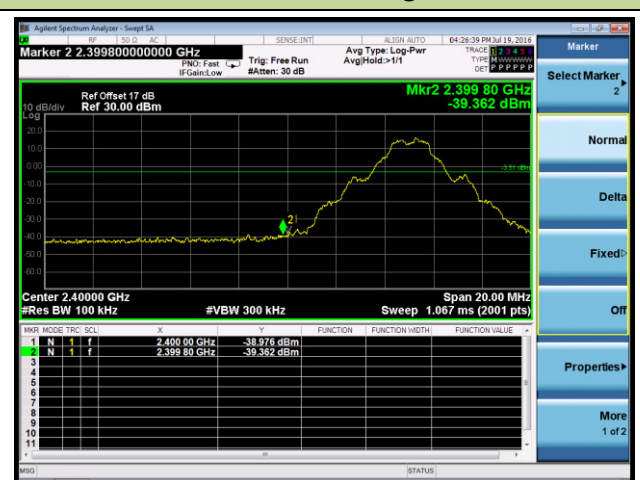
802.15.4 Out-of-Band Emissions - Ant A

Channel 11 (2405MHz)

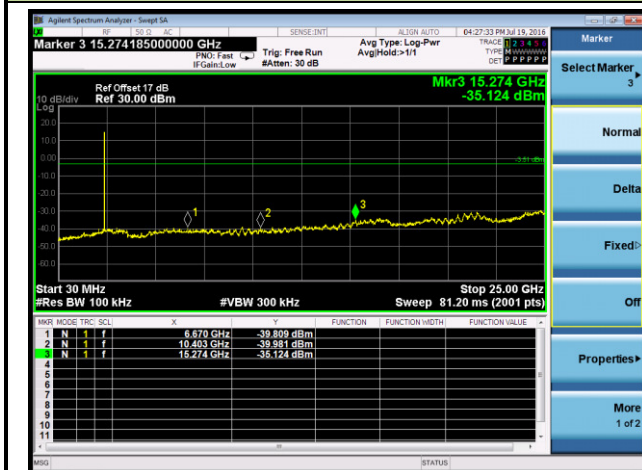
100kHz PSD reference Level



Low Band Edge



Spurious Emission

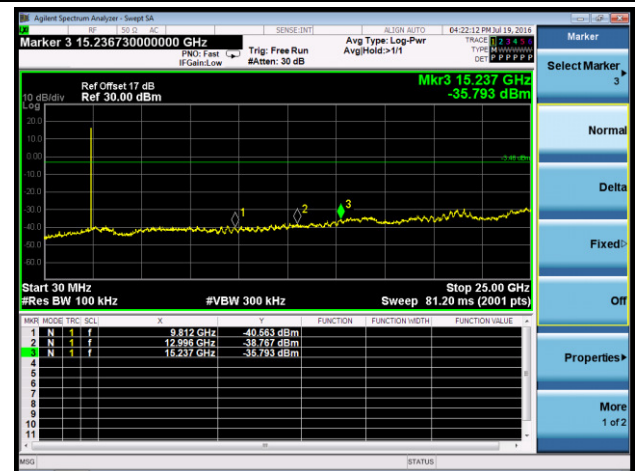


Channel 18 (2440MHz)

100kHz PSD reference Level



Spurious Emission

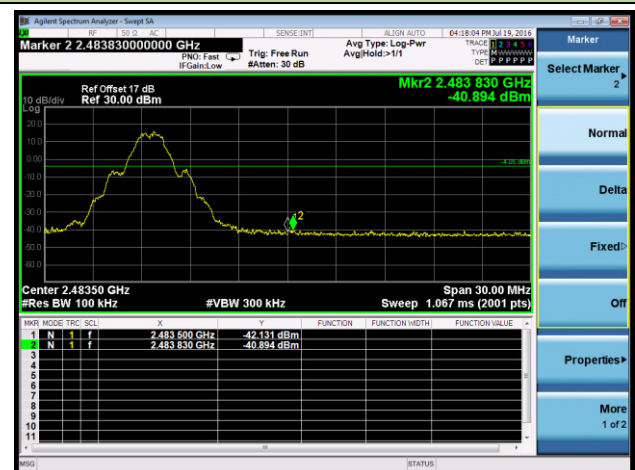


Channel 25 (2475MHz)

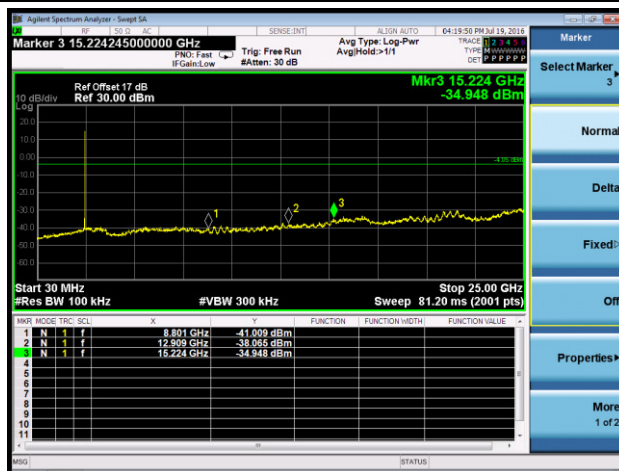
100kHz PSD reference Level



High Band Edge



Spurious Emission



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 [uV/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 D01v03r05 – Section 12.2.3 (quasi-peak measurements)

KDB 558074 D01v03r05 – Section 12.2.4 (peak power measurements)

KDB 558074 D01v03r05 – Section 12.2.5 (average power measurements)

7.6.3. Test Setting

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01v03r05

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

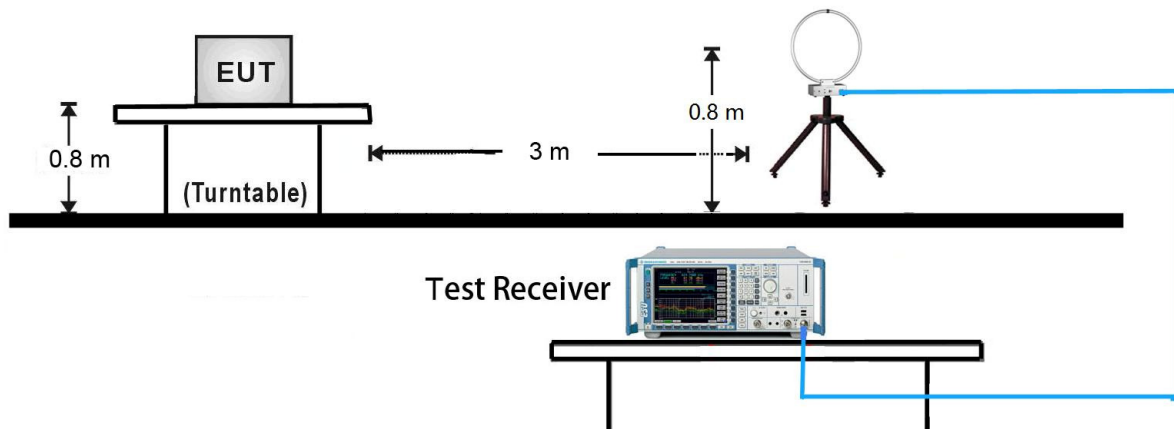
Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

Average Field Strength Measurements per Section 12.2.5.3 of KDB 558074 D01v03r05

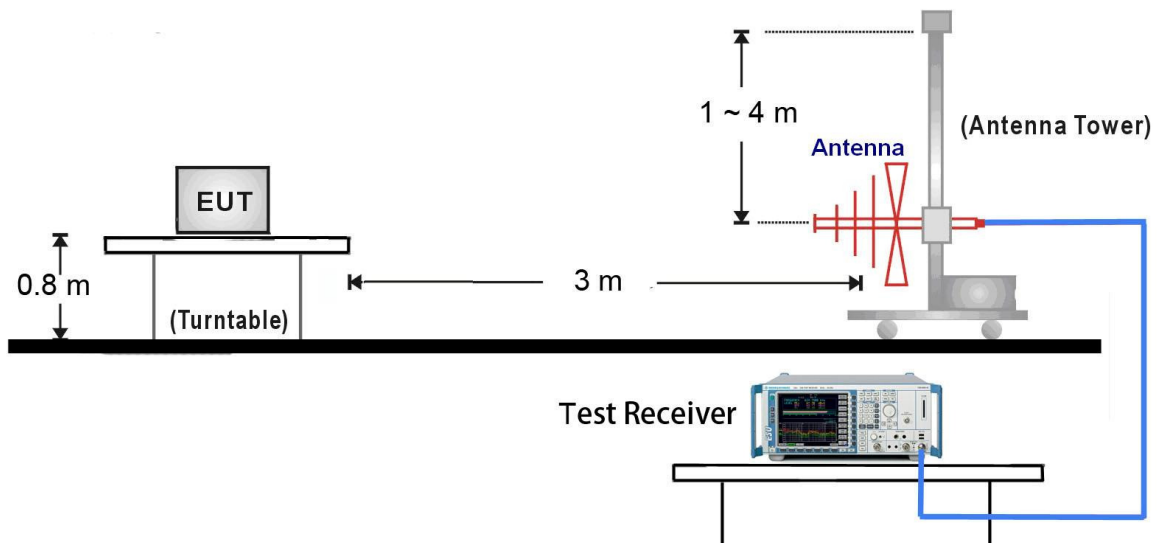
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW $\geq 1/T$
4. De As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). 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

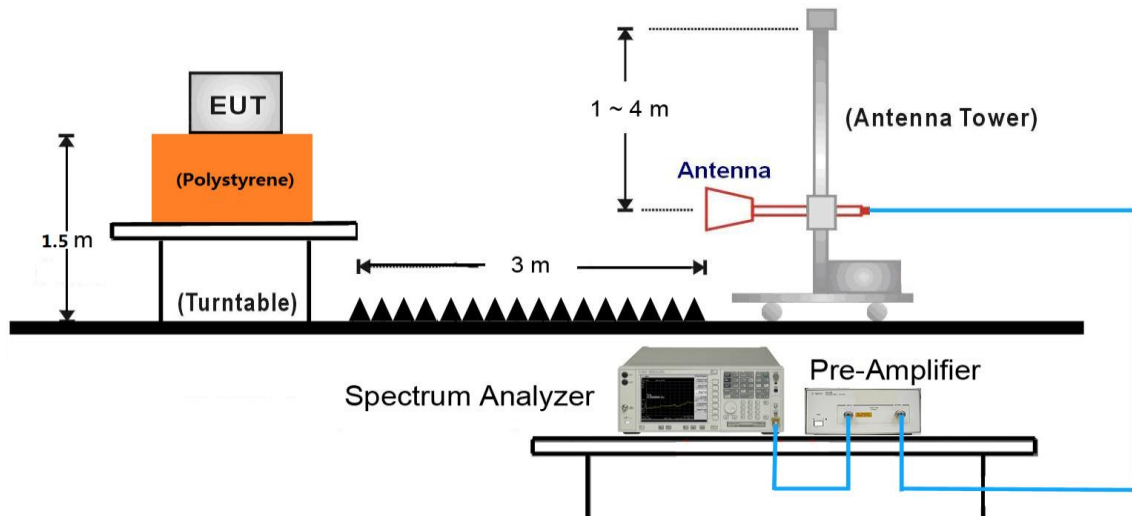
9kHz ~ 30MHz Test Setup:



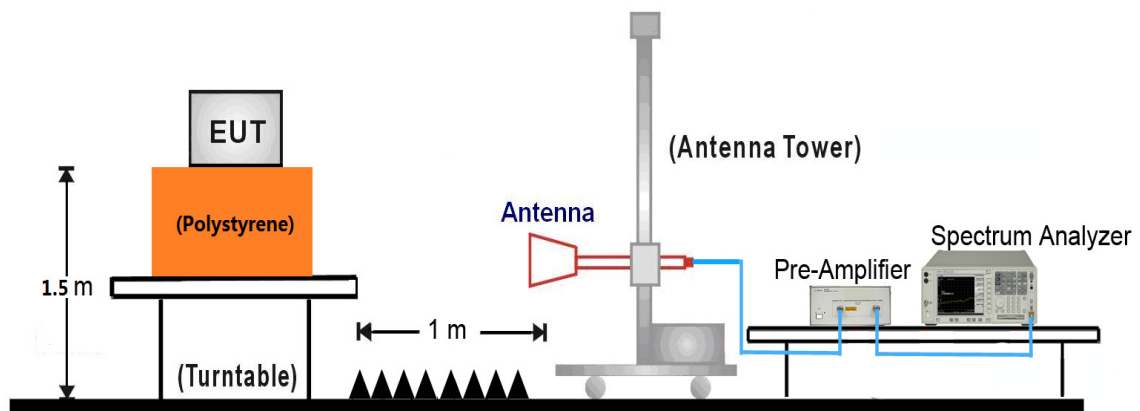
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.6.5. Test Result

Test Mode:	802.15.4 - Ant A	Test Site:	AC1
Test Channel:	11	Test Engineer:	Vince Yu
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 (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	3431.0	37.7	-1.5	36.2	94.1	-57.9	Peak	Horizontal
	4808.0	41.9	2.7	44.6	74.0	-29.4	Peak	Horizontal
*	7213.5	42.3	7.8	50.1	94.1	-44.0	Peak	Horizontal
*	9619.0	35.8	10.9	46.7	94.1	-47.4	Peak	Horizontal
*	3473.5	38.4	-1.3	37.1	94.1	-57.0	Peak	Vertical
	4808.0	43.7	2.7	46.4	74.0	-27.6	Peak	Vertical
*	7213.5	38.5	7.8	46.3	94.1	-47.8	Peak	Vertical
	12024.5	37.5	12.0	49.5	74.0	-24.5	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (114.1dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	802.15.4 - Ant A	Test Site:	AC1
Test Channel:	18	Test Engineer:	Vince Yu
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 (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	3397.0	37.2	-1.7	35.5	94.3	-58.8	Peak	Horizontal
	4884.5	44.5	2.7	47.2	74.0	-26.8	Peak	Horizontal
*	6482.5	35.4	5.9	41.3	94.3	-53.0	Peak	Horizontal
	12194.5	37.9	11.7	49.6	74.0	-24.4	Peak	Horizontal
*	3422.5	37.7	-1.6	36.1	94.3	-58.2	Peak	Vertical
	4884.5	44.5	2.7	47.2	74.0	-26.8	Peak	Vertical
*	6550.5	35.9	5.9	41.8	94.3	-52.5	Peak	Vertical
	12203.0	37.5	11.7	49.2	74.0	-24.8	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (114.3dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	802.15.4 - Ant A	Test Site:	AC1
Test Channel:	25	Test Engineer:	Vince Yu
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 (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	3431.0	38.8	-1.5	37.3	94.4	-57.1	Peak	Horizontal
	4952.5	42.6	2.9	45.5	74.0	-28.5	Peak	Horizontal
*	6576.0	36.2	6.0	42.2	94.4	-52.2	Peak	Horizontal
	7426.0	38.6	8.0	46.6	74.0	-27.4	Peak	Horizontal
*	3388.5	39.0	-1.7	37.3	94.4	-57.1	Peak	Vertical
	4952.5	40.8	2.9	43.7	74.0	-30.3	Peak	Vertical
*	9899.5	39.2	11.6	50.8	94.4	-43.6	Peak	Vertical
	12373.0	37.5	11.5	49.0	74.0	-25.0	Peak	Vertical

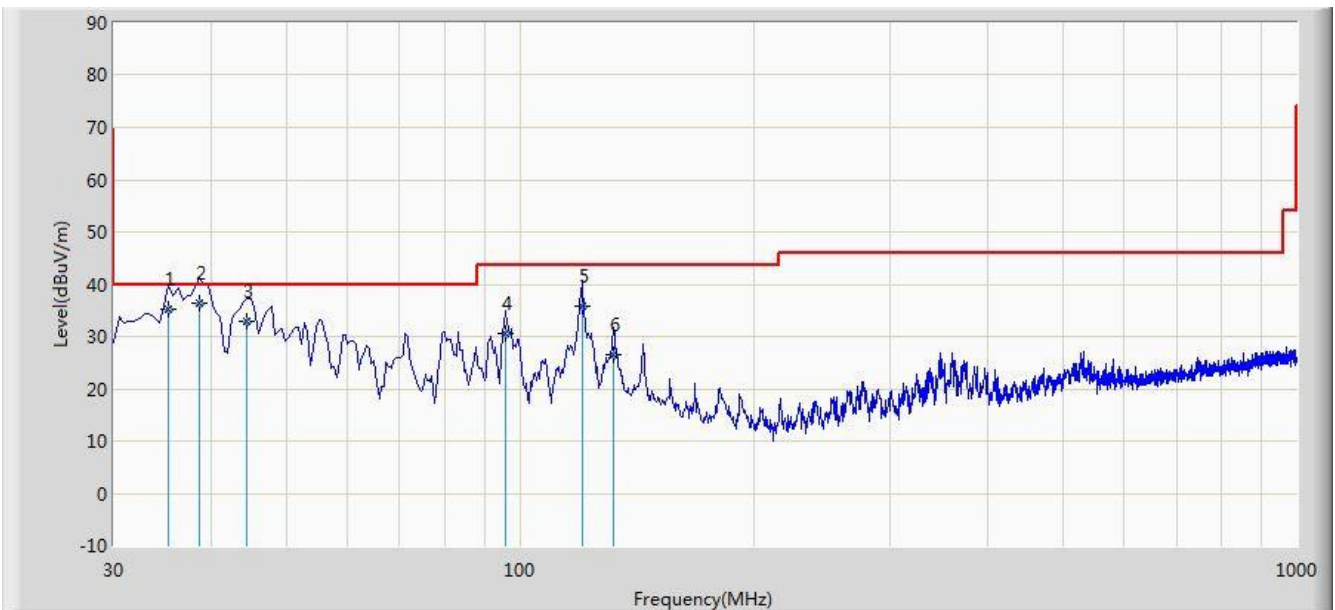
Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (114.4dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + 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: 2016/07/19 - 19:16
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: VULB 9168 _20-2000MHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Worse Case Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	

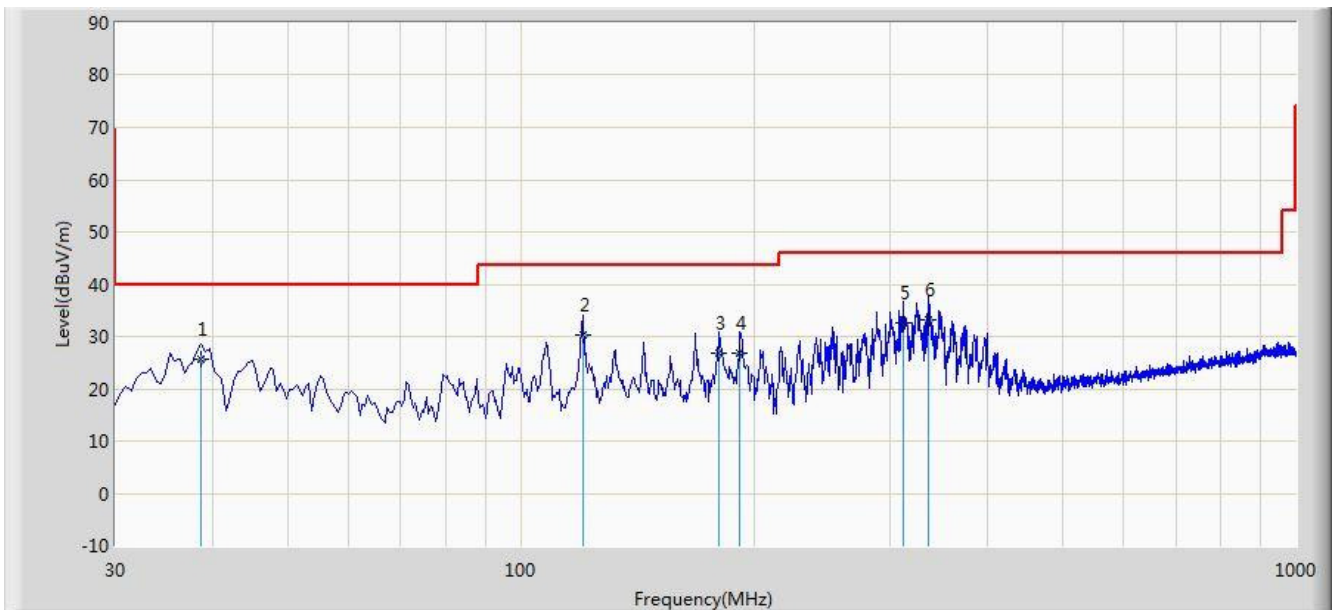


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			35.335	35.244	21.354	-4.756	40.000	13.890	QP
2		*	38.730	36.321	21.951	-3.679	40.000	14.370	QP
3			44.550	32.905	18.687	-7.095	40.000	14.218	QP
4			95.960	30.653	20.005	-12.847	43.500	10.648	QP
5			120.210	35.787	22.657	-7.713	43.500	13.130	QP
6			131.850	26.558	12.687	-16.942	43.500	13.871	QP

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/19 - 19:23
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: VULB 9168 _20-2000MHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Worse Case Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	

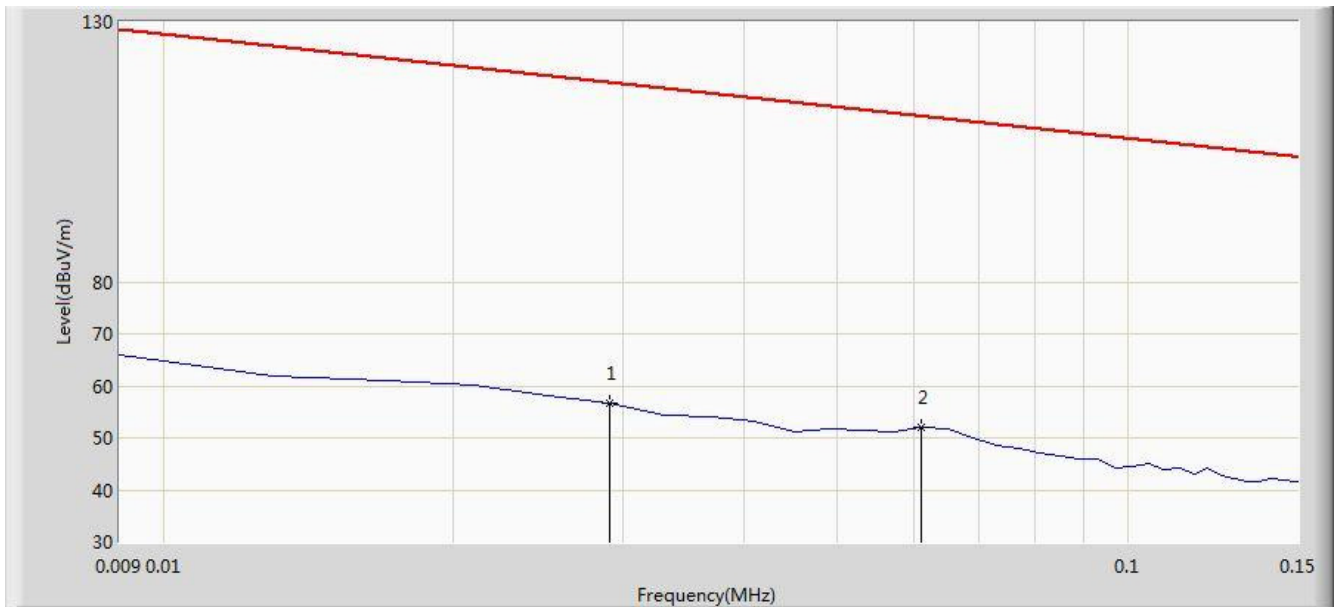


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			38.730	25.724	11.354	-14.276	40.000	14.370	QP
2			120.210	30.344	17.214	-13.156	43.500	13.130	QP
3			180.350	26.868	14.112	-16.632	43.500	12.756	QP
4			191.990	26.859	15.347	-16.641	43.500	11.512	QP
5			312.270	32.652	18.005	-13.348	46.000	14.647	QP
6		*	336.035	33.293	18.115	-12.707	46.000	15.178	QP

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 10:42
Limit: RSS-Gen Issue 4_RE(3m)	Engineer: Vince Yu
Probe: FMZB1519_0.009-30MHz	Polarity: Face on
EUT: Radio Controller Receiver	Power: By Battery
Note: There is the ambient noise within frequency range 9kHz~30MHz.	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			0.029	56.610	35.660	-61.746	118.356	21.049	AV
2		*	0.061	51.899	31.588	-59.999	111.898	20.311	AV

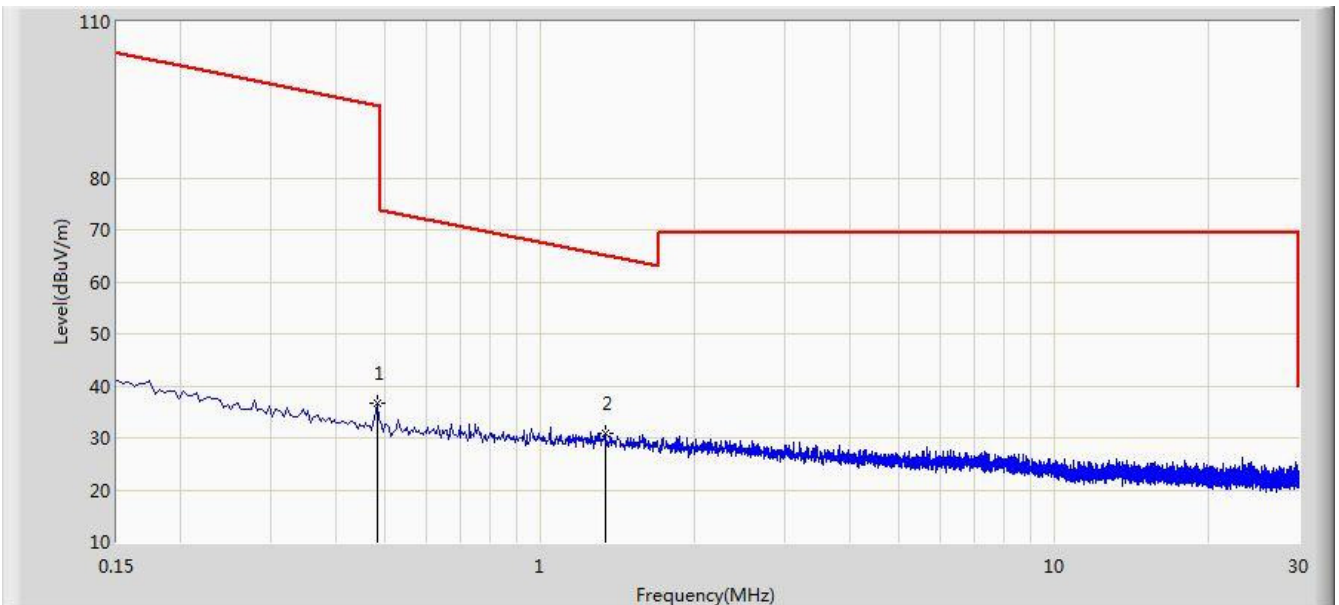
Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Limit@3m = $20 \cdot \log((2400/29) \mu V/m) + 40 \cdot \log(300m/3m) = 118.356 \text{ dB}\mu V/m$ (Average detector)

Limit@3m = $20 \cdot \log((2400/61) \mu V/m) + 40 \cdot \log(300m/3m) = 111.898 \text{ dB}\mu V/m$ (Average detector)

Site: AC1	Time: 2016/07/16 - 10:45
Limit: RSS-Gen Issue 4_RE(3m)	Engineer: Vince Yu
Probe: FMZB1519_0.009-30MHz	Polarity: Face on
EUT: Radio Controller Receiver	Power: By Battery
Note: There is the ambient noise within frequency range 9kHz~30MHz.	



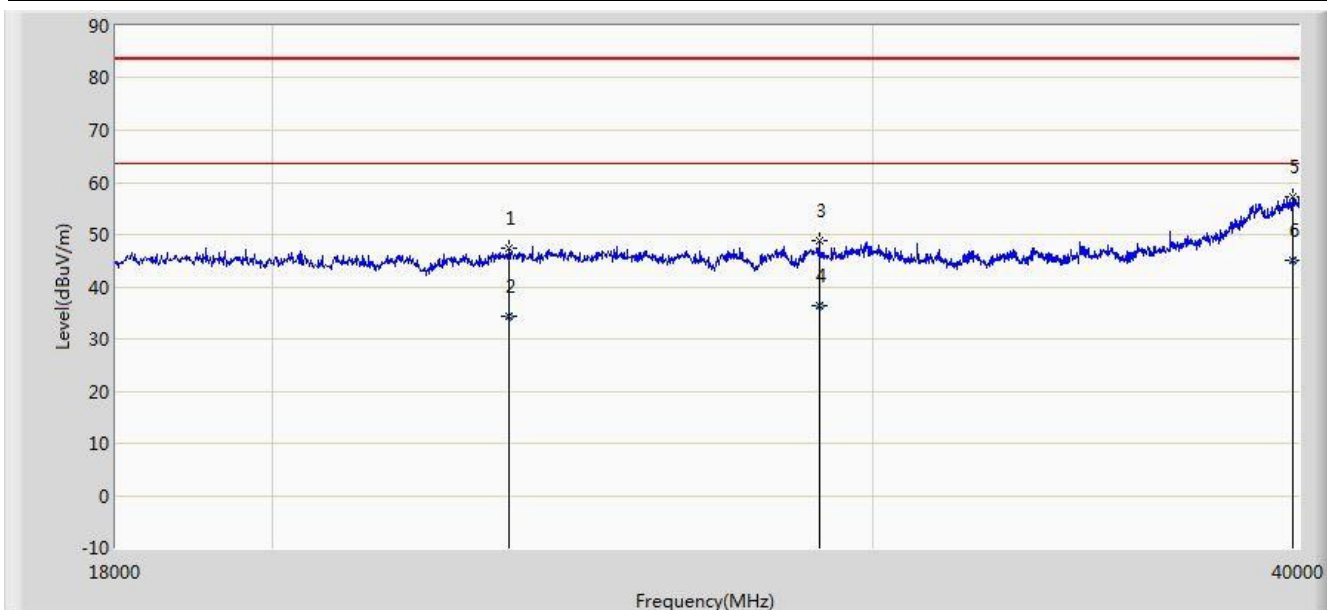
No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			0.482	36.584	16.183	-57.359	93.943	20.401	AV
2		*	1.338	31.001	10.512	-34.098	65.099	20.489	QP

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Limit@3m = $20 \cdot \log((2400/482) \mu\text{V/m}) + 40 \cdot \log(300\text{m}/3\text{m}) = 93.943 \text{ dBuV/m}$ (Average detector)

Site: AC1	Time: 2016/07/16 - 11:15
Limit: RSS-Gen Issue 4_RE(1m)	Engineer: Vince Yu
Probe: BBHA9170_18-40GHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Note: There is the ambient noise within frequency range 18GHz~40GHz.	



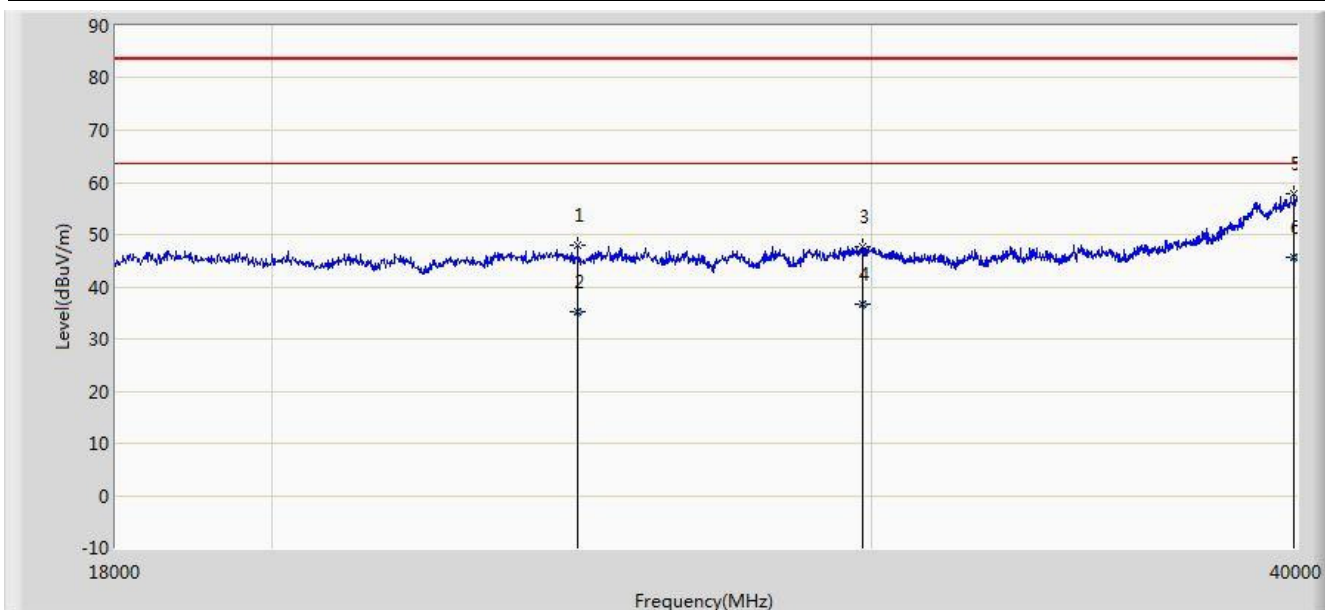
No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			23478.000	47.365	37.708	-36.135	83.500	9.658	PK
2			23478.200	34.298	24.640	-29.202	63.500	9.658	AV
3			28934.000	48.749	35.930	-34.751	83.500	12.819	PK
4			28934.100	36.459	23.640	-27.041	63.500	12.818	AV
5			39857.000	57.224	38.474	-26.276	83.500	18.751	PK
6		*	39857.000	45.090	26.340	-18.410	63.500	18.751	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Limit@1m = 20*Log(500uV/m) + 20*Log(3m/1m) = 63.5dBμV/m (Average detector), and 83.5dBμV/m (Peak detector).

Site: AC1	Time: 2016/07/16 - 11::18
Limit: RSS-Gen Issue 4_RE(1m)	Engineer: Vince Yu
Probe: BBHA9170_18-40GHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Note: There is the ambient noise within frequency range 18GHz~40GHz.	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			24600.000	47.827	36.853	-35.673	83.500	10.974	PK
2			24600.200	35.124	24.150	-28.376	63.500	10.974	AV
3			29825.000	47.825	34.761	-35.675	83.500	13.064	PK
4			29825.200	36.594	23.530	-26.906	63.500	13.064	AV
5			39923.000	57.939	39.179	-25.561	83.500	18.760	PK
6		*	39923.040	45.610	26.850	-17.890	63.500	18.760	AV

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

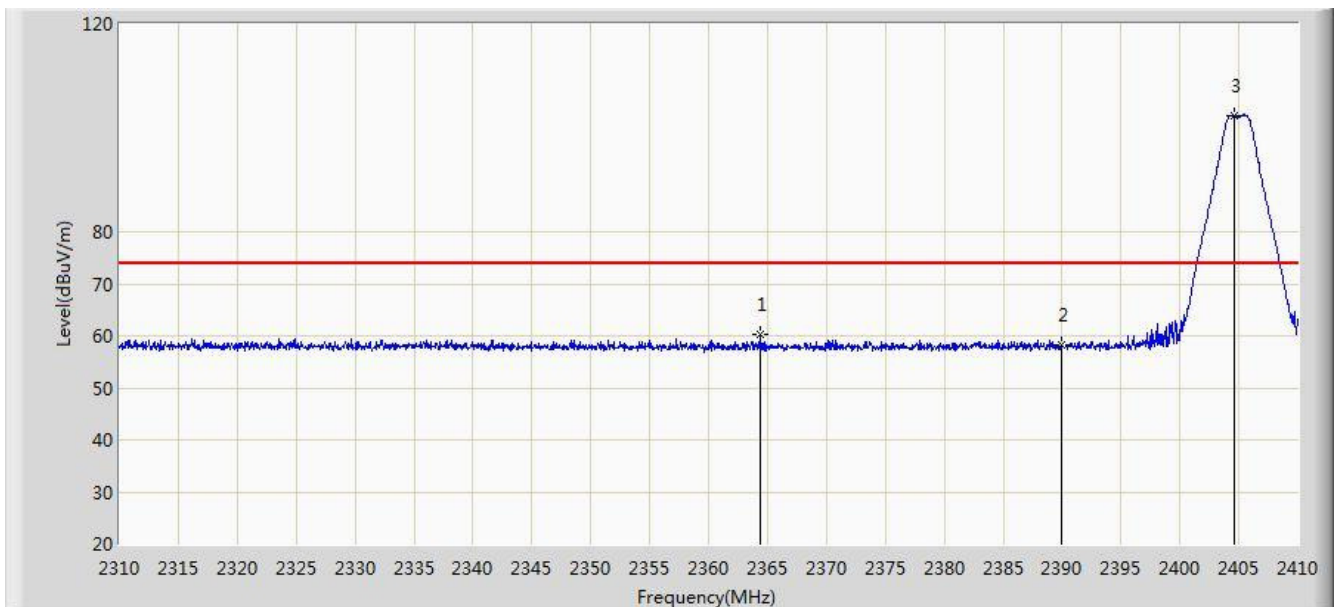
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Limit@1m = 20*Log(500uV/m) + 20*Log(3m/1m) = 63.5dBuV/m (Average detector), and 83.5dBuV/m (Peak detector).

7.7. Radiated Restricted Band Edge Measurement

7.7.1. Test Result

Site: AC1	Time: 2016/07/16 - 15:47
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4 Ant A	

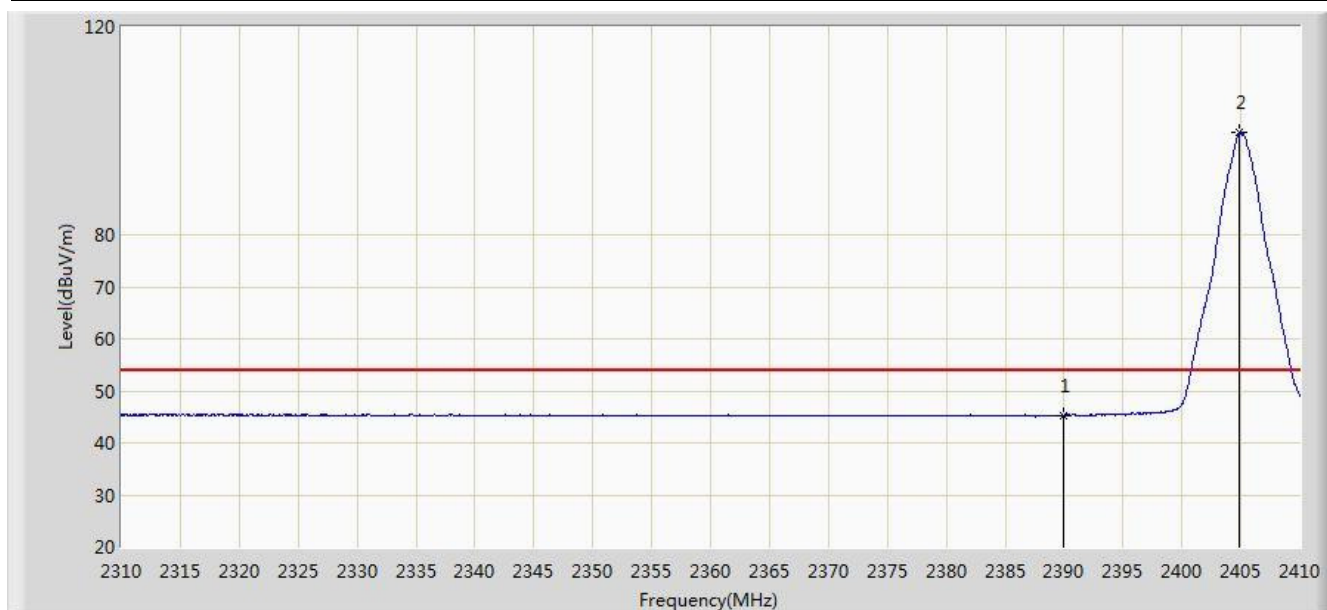


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2364.400	60.195	28.945	-13.805	74.000	31.250	PK
2			2390.000	58.252	27.049	-15.748	74.000	31.203	PK
3		*	2404.550	102.456	71.276	N/A	N/A	31.180	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 15:51
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4 Ant A	

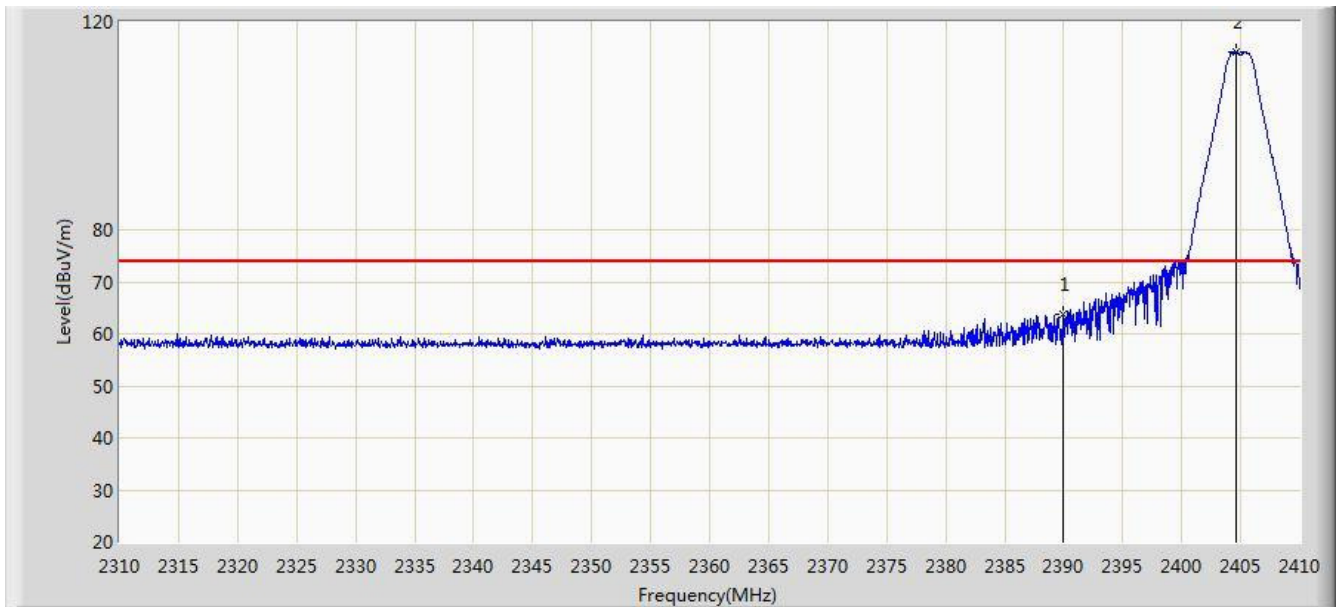


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	45.235	14.032	-8.765	54.000	31.203	AV
2		*	2404.900	99.803	68.623	N/A	N/A	31.180	AV

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:00
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4 Ant A	

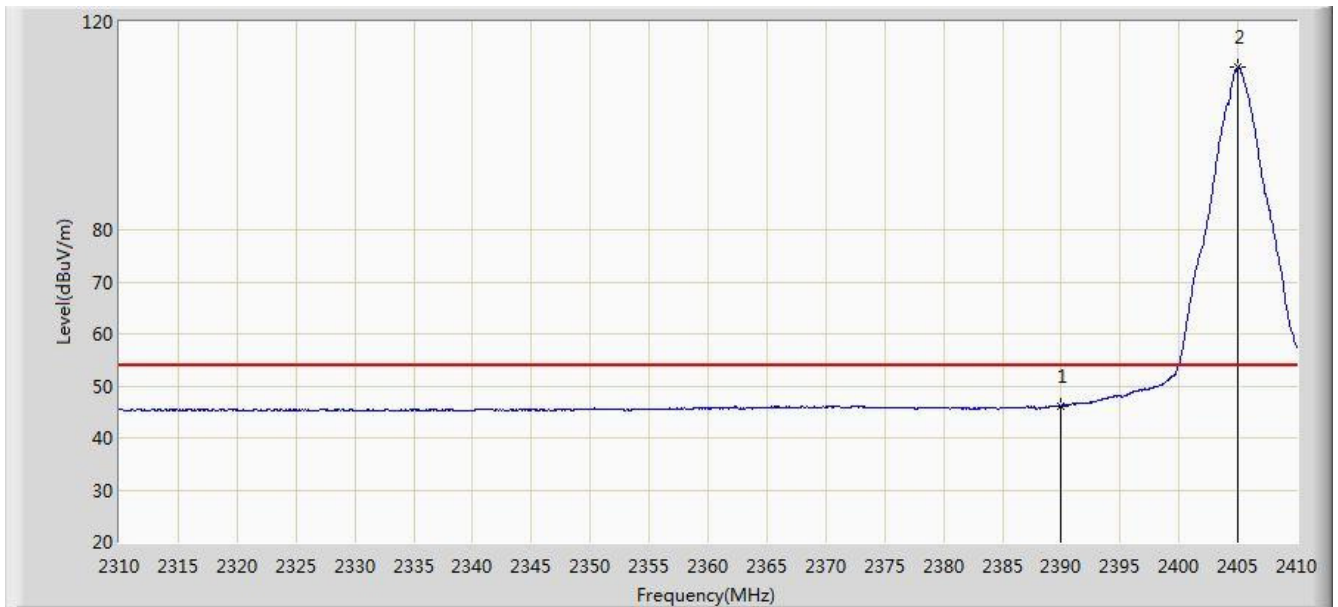


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	63.649	32.446	-10.351	74.000	31.203	PK
2		*	2404.600	114.130	82.950	N/A	N/A	31.180	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:02
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4 Ant A	

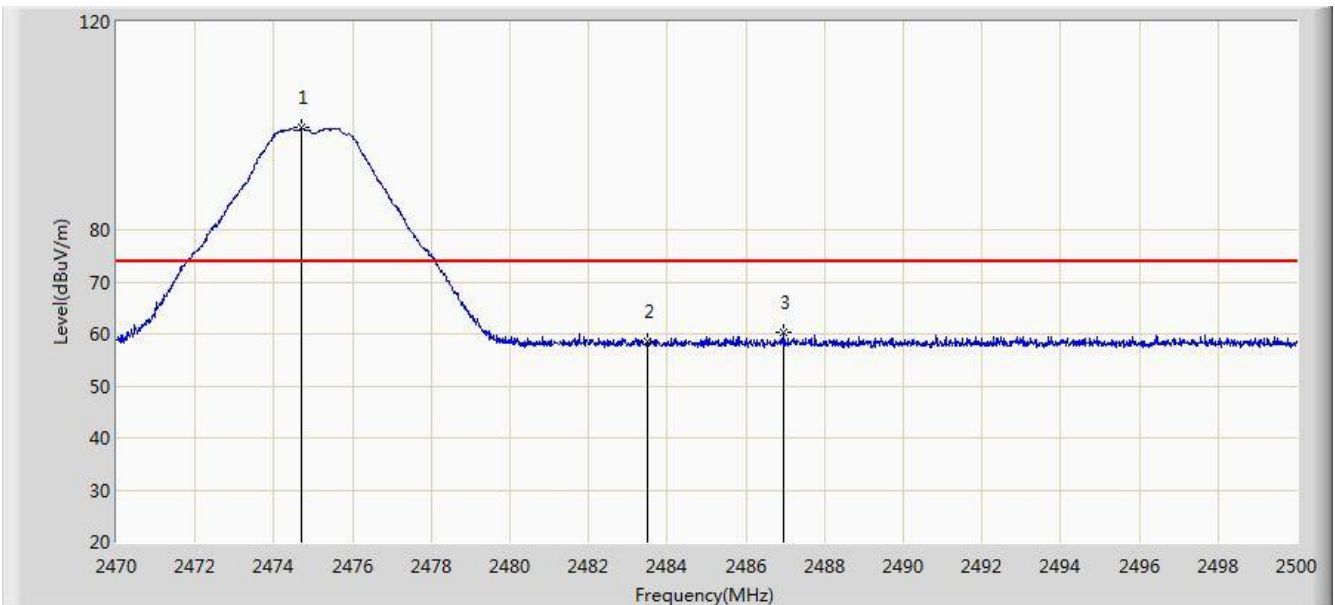


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	45.985	14.782	-8.015	54.000	31.203	AV
2		*	2405.000	111.182	80.002	N/A	N/A	31.180	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:03
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	

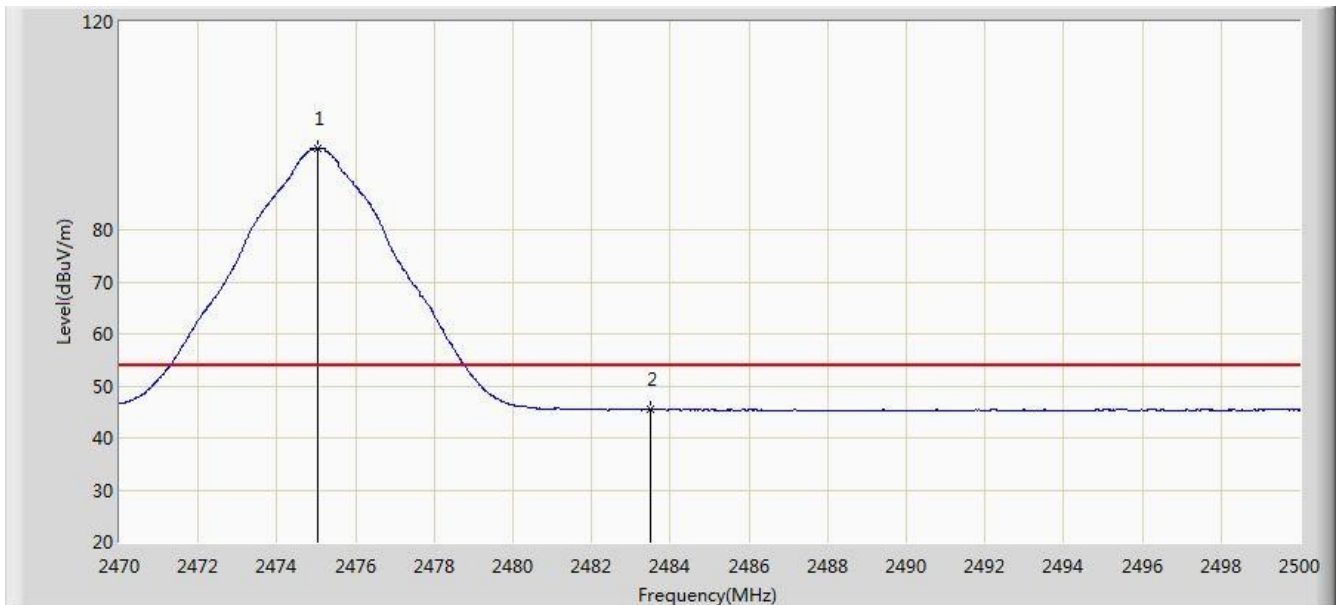


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2474.710	99.593	68.424	N/A	N/A	31.170	PK
2			2483.500	58.606	27.413	-15.394	74.000	31.194	PK
3			2486.965	60.190	28.988	-13.810	74.000	31.203	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:11
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	

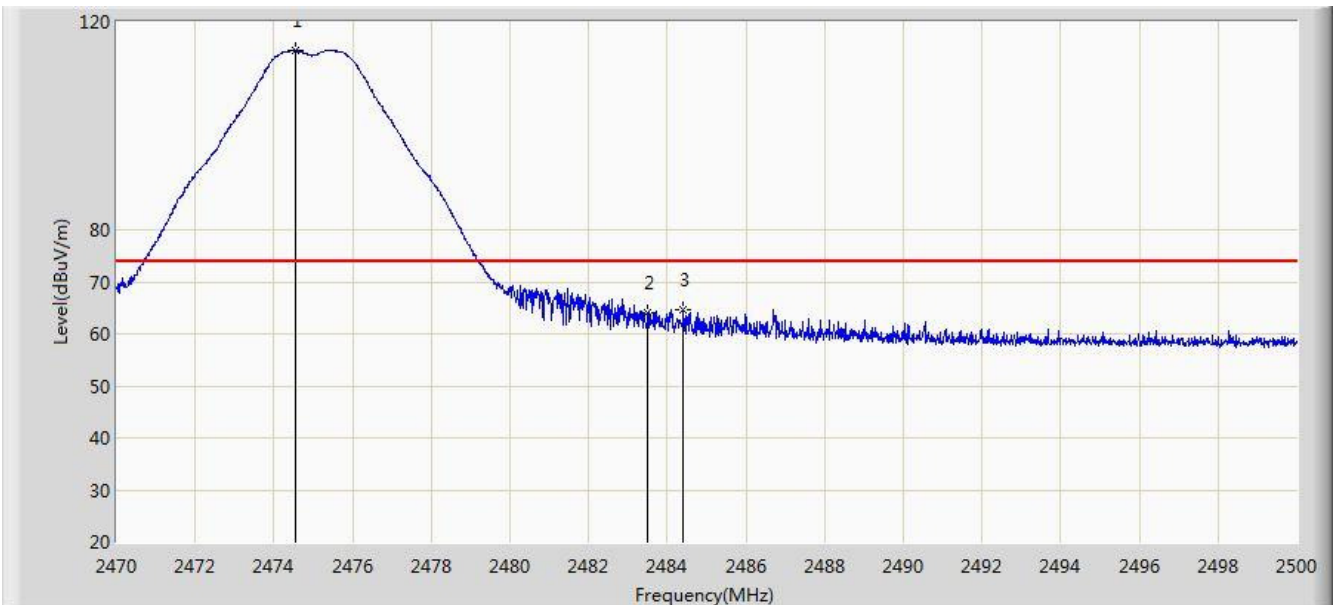


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.025	95.701	64.531	N/A	N/A	31.170	AV
2			2483.500	45.503	14.310	-8.497	54.000	31.194	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:13
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	

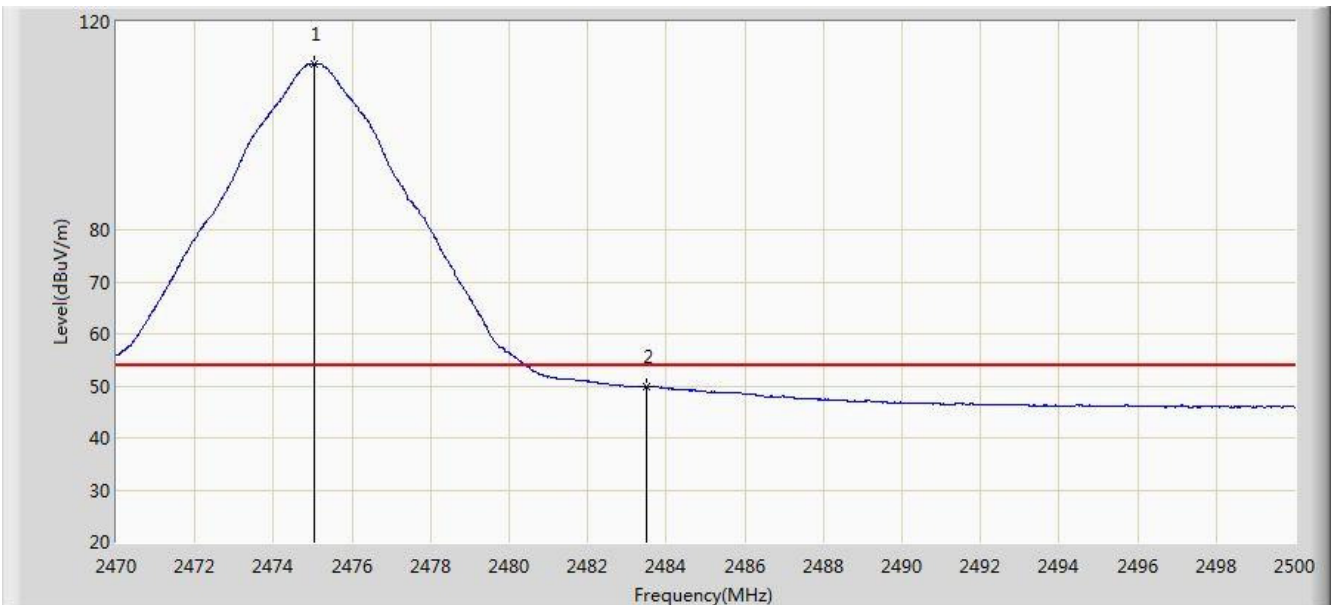


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2474.545	114.412	83.243	N/A	N/A	31.169	PK
2			2483.500	64.100	32.907	-9.900	74.000	31.194	PK
3			2484.415	64.758	33.562	-9.242	74.000	31.195	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

Site: AC1	Time: 2016/07/16 - 16:16
Limit: FCC_Part15.209_RE(3m)	Engineer: Vince Yu
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Radio Controller Receiver	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4 Ant A	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.025	111.993	80.823	N/A	N/A	31.170	AV
2			2483.500	49.834	18.641	-4.166	54.000	31.194	AV

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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

7.1. AC Conducted Emissions Measurement

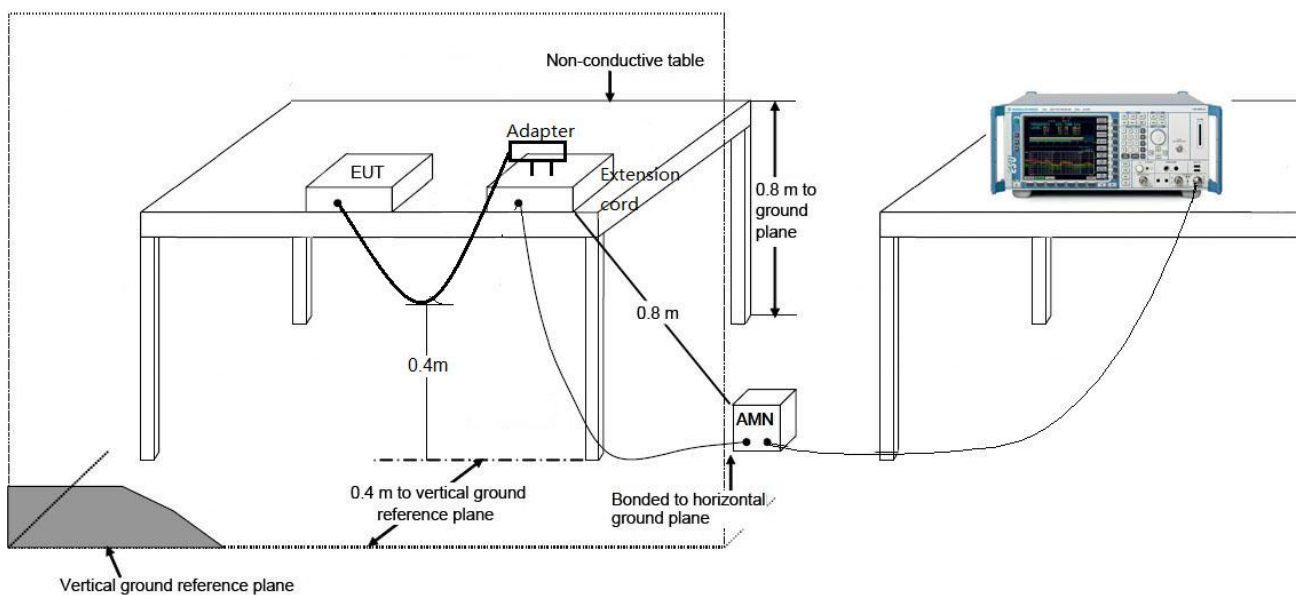
7.1.1. Test Limit

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.

7.1.2. Test Setup



7.1.3. Test Result

This EUT is powered by battery, so this test item is not applicable.

8. CONCLUSION

The data collected relate only the item(s) tested and show that the **Radio Controller Receiver FCC ID: 2ACS5-SR24P Mode Number: SR24+** is in compliance with Part 15C of the FCC Rules.

The End