

**TEST REPORT**  
On behalf of

Philips Lighting (China) Investment Co., Ltd

Product Name: Wireless control board

Model No.: 324131296121

FCC ID: 2AGBW324131296121X

Prepared For: Philips Lighting (China) Investment Co., Ltd  
Building 9, Lane 888, Tianlin Road, Minhang district,  
Shanghai

Prepared By: Audix Technology (Shanghai) Co., Ltd.  
3F and 4F, 34Bldg, 680 Guiping Rd., Caohejing Hi-Tech  
Park, Shanghai 200233, China

Tel: +86-21-64955500  
Fax: +86-21-64955491



File No. : C1D1806055  
Report No. : ACI-F18206  
Date of Test : 2018.06.05 – 12  
Date of Report : 2018.07.20

The statement is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

## TABLE OF CONTENTS

	Page
<b>1 SUMMARY OF STANDARDS AND RESULTS.....</b>	<b>5</b>
1.1 Description of Standards and Results.....	5
<b>2 GENERAL INFORMATION.....</b>	<b>6</b>
2.1 Description of Equipment Under Test.....	6
2.2 Description of Test Facility.....	6
2.3 Measurement Uncertainty.....	7
<b>3 CONDUCTED EMISSION.....</b>	<b>8</b>
3.1 Test Equipment.....	8
3.2 Block Diagram of Test Setup.....	8
3.3 Conducted Emission Limits (§15.207).....	8
3.4 Operating Condition of EUT.....	9
3.5 Test Procedures.....	9
3.6 Test Results.....	9
<b>4 RADIATED EMISSION TEST.....</b>	<b>12</b>
4.1 Test Equipment.....	12
4.2 Block Diagram of Test Setup.....	12
4.3 Radiated Emission Limit (§15.209).....	13
4.4 Test Configuration.....	13
4.5 Operating Condition of EUT.....	14
4.6 Test Procedures.....	14
4.7 Test Results.....	14
<b>5 6 dB BANDWIDTH MEASUREMENT.....</b>	<b>22</b>
5.1 Test Equipment.....	22
5.2 Block Diagram of Test Setup.....	22
5.3 Specification Limits (§15.247(a)(2)).....	22
5.4 Operating Condition of EUT.....	22
5.5 Test Procedure.....	22
5.6 Test Results.....	23
<b>6 MAXIMUM PEAK OUTPUT POWER MEASUREMENT.....</b>	<b>26</b>
6.1 Test Equipment.....	26
6.2 Block Diagram of Test Setup.....	26
6.3 Specification Limits (§15.247(b)(3)).....	26
6.4 Operating Condition of EUT.....	26
6.5 Test Procedure.....	26
6.6 Test Results.....	27
<b>7 EMISSION LIMITATIONS MEASUREMENT.....</b>	<b>30</b>
7.1 Test Equipment.....	30
7.2 Block Diagram of Test Setup.....	30
7.3 Specification Limits (§15.247(d)).....	30
7.4 Operating Condition of EUT.....	30
7.5 Test Procedure.....	30
7.6 Test Results.....	31
<b>8 BAND EDGES MEASUREMENT.....</b>	<b>38</b>
8.1 Test Equipment.....	38

8.2 Block Diagram of Test Setup ..... 38

8.3 Specification Limits (§15.247(d)) ..... 38

8.4 Operating Condition of EUT ..... 38

8.5 Test Procedure ..... 38

8.6 Test Results ..... 39

**9 POWER SPECTRAL DENSITY MEASUREMENT ..... 41**

9.1 Test Equipment..... 41

9.2 Block Diagram of Test Setup ..... 41

9.3 Specification Limits (§15.247(e)) ..... 41

9.4 Operating Condition of EUT ..... 41

9.5 Test Procedure ..... 41

9.6 Test Results ..... 41

**10 DEVIATION TO TEST SPECIFICATIONS ..... 44**

# TEST REPORT

Applicant : Philips Lighting (China) Investment Co., Ltd  
 EUT Description : Wireless control board  
 (A) Model No. : Refer to Sec.2.1  
 (B) Power Supply : DC 5V  
 (C) Test Voltage : DC 5V

### Test Procedure Used:

*FCC RULES AND REGULATIONS PART 15 SUBPART C  
 AND ANSI C63.10-2013*

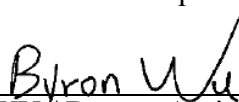
The device described above is tested by Audix Technology (Shanghai) Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits.

The test results are contained in this test report and Audix Technology (Shanghai) Co., Ltd. is assumed full responsibility for the accuracy and completeness of these measurements. This report also shows that the EUT to be technically compliance with the FCC limits.

This report applies to above tested Sample only. This report shall not be reproduced in part without written approval of Audix Technology (Shanghai) Co., Ltd.

Date of Test : 2018.06.05 - 12 Date of Report : 2018.07.20

Producer :   
 JAREY LU / Supervisor

Reviewer :   
 BYRON WU / Deputy Assistant Manager

**AUDIX**® For and on behalf of  
 Audix Technology (Shanghai) Co., Ltd.

Signatory :   
 Authorized Signature(s) BYRON KWO/Assistant General Manager

# 1 SUMMARY OF STANDARDS AND RESULTS

## 1.1 Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Description / Test Item	Test Standard	Results	Meets Limit
<b>EMISSION</b>			
Conducted Emission	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.207
Radiated Emission	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.209(a) 15.205(a)(c)
6 dB Bandwidth Measurement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.247(a)(2)
Maximum Peak Output Power Measurement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.247(b)(3)
Emission Limitations Measurement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.247(d)
Band Edge Measurement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.247(d)
Power Spectral Density Measurement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.247(e)
N/A is an abbreviation for Not Applicable.			

## 2 GENERAL INFORMATION

### 2.1 Description of Equipment Under Test

Description : Wireless control board

Type of EUT :  Production  Pre-product  Pro-type

Model Number : 324131296121

Test Model : 324131296121

Radio Tech : Zigbee

Channel Freq. : 2405MHz, 2425MHz, 2450MHz, 2475MHz, 2480MHz

Tested Freq. : 2405MHz, 2450MHz, 2480MHz

Modulation : O-QPSK

Antenna Gain : -4 dBi

Test Mode : The EUT was set at continuous TX with duty cycle 100% during all the test in the report

Applicant : Philips Lighting (China) Investment Co., Ltd  
No.218 Qianwangang Road, Economy & Technology  
Development Zone, Qingdao, China

Manufacturer : same as Applicant

Factory : Aztech Communication Device (DG) Ltd.

### 2.2 Description of Test Facility

Name of Firm : Audix Technology (Shanghai) Co., Ltd.

Site Location : 3F and 4F, 34Bldg, 680 Guiping Rd.,  
Caohejing Hi-Tech Park,  
Shanghai 200233, China.

Accredited by NVLAP, Lab Code : 200371-0

FCC Designation Number : CN5027

Test Firm Registration Number : 954668

## 2.3 Measurement Uncertainty

Conducted Disturbance Expanded Uncertainty (0.15-30MHz):

$$U = 3.4\text{dB}$$

Radiated Emission Expanded Uncertainty (30-1000MHz):

$$U = 3.99\text{dB}$$

Radiated Emission Expanded Uncertainty (1000M-26.5GHz):

$$U = 4.98\text{dB}$$

6 dB Bandwidth Expanded Uncertainty

$$: U = 6 \times 10^{-8} \text{MHz}$$

Maximum Peak Output Power Expanded Uncertainty

$$: U = 0.84 \text{dB}$$

Power Spectral Density Expanded Uncertainty

$$: U = 0.38 \text{dB}$$

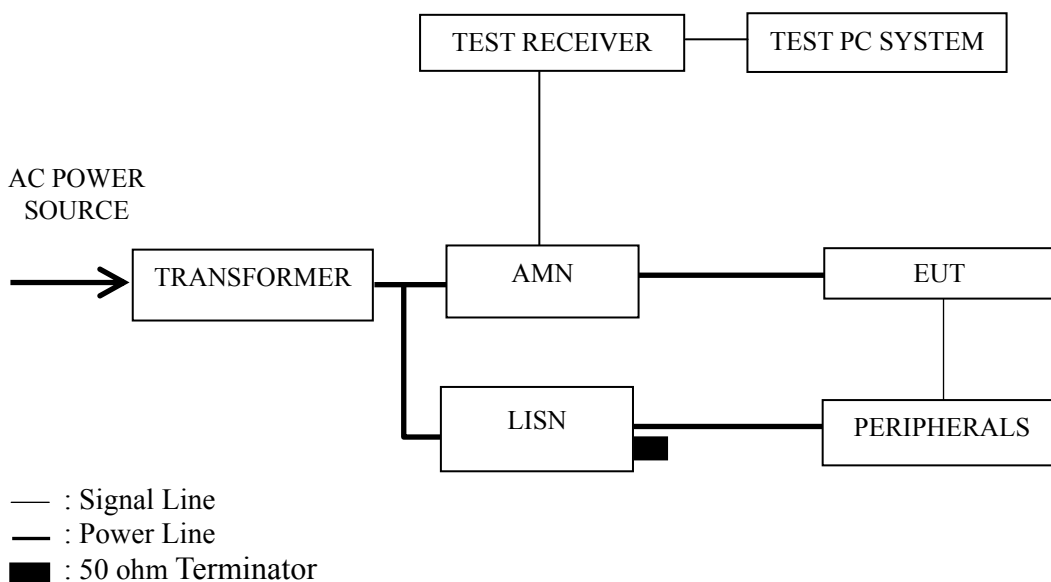
### 3 CONDUCTED EMISSION

#### 3.1 Test Equipment

The following test equipment are used during the conducted emission test in a shielded room.

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Test Receiver	R&S	ESCI	101302	Apr 27, 2018	Apr 26, 2019
2.	Artificial Mains Network (AMN)	R&S	ENV4200	100125	Jun 24, 2017	Jun 23, 2018
3.	Software	Audix	E3	6.2009-1-15	--	--

#### 3.2 Block Diagram of Test Setup



#### 3.3 Conducted Emission Limits (§15.207)

Frequency (MHz)	Field strength limits (μV/m)	
	(μV/m)	dB(μV/m)
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

NOTE 1 - \*Decreases with the logarithm of the frequency.  
 NOTE 2 - Emission Level dB (μV/m) = 20 log Emission Level (μV/m)  
 NOTE 3 - The tighter limit applies at the band edges.



### 3.4 Operating Condition of EUT

- 3.4.1 Setup the EUT as shown in Sec. 3.2.
- 3.4.2 Turn on the power of all equipment.
- 3.4.3 Turn the EUT on the test mode, and then test.

### 3.5 Test Procedures

The EUT was placed upon a non-metallic table, which is 0.8 m above the horizontal conducting ground plane and 0.4 m from a vertical reference plane. The EUT was connected to the power mains through an Artificial Mains Network (AMN) to provide a 50  $\Omega$  coupling impedance for the measuring equipment. Both sides of AC line (Line & Neutral) were checked to find out the maximum conducted emission according to FCC Part 15 Subpart C and ANSI C63.10: 2013 requirements during conducted disturbance test.

The I.F. bandwidth of Test Receiver ESCI was set at 9 kHz.

The frequency range from 150 kHz to 30 MHz was checked.

Test with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band. (According to KDB 174176 D01 Line Conducted FAQ)

### 3.6 Test Results

<PASS>

The frequency and amplitude of the highest radiated emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

Worst case emission:

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	Zigbee	11	2405 MHz	P10
2.	Receiving	Zigbee	--	--	P11

NOTE 1 – Level = Read Level + AMN Factor + Cable Loss

NOTE 2 – “QP” means “Quasi-Peak” values

NOTE 3 – The emission levels which not reported are too low against the official limit.

**Worst case emission**

EUT : Wireless control board Temperature : 22°C

Model No. : 324131296121 Humidity : 51%RH

Test Mode : Transmitting Date of Test : 2018.06.12

**Zigbee:**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	AMN Factor (dB/m)	Cable Loss (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Line	0.24945	21.52	10.4	0.05	31.97	61.78	29.81	QP
	0.24945	13.15	10.4	0.05	23.6	51.78	28.18	Average
	0.47612	30.53	10.33	0.05	40.91	56.41	15.5	QP
	0.47612	23.94	10.33	0.05	34.32	46.41	12.09	Average
	0.90874	18.85	10.32	0.07	29.24	56	26.76	QP
	0.90874	9.26	10.32	0.07	19.65	46	26.35	Average
	1.449	18.24	10.33	0.08	28.65	56	27.35	QP
	1.449	10.26	10.33	0.08	20.67	46	25.33	Average
	2.133	17.93	10.33	0.09	28.35	56	27.65	QP
	2.133	9.16	10.33	0.09	19.58	46	26.42	Average
	5.653	14.05	10.34	0.14	24.53	60	35.47	QP
	5.653	4.31	10.34	0.14	14.79	50	35.21	Average
Neutral	0.26442	21.89	10.39	0.05	32.33	61.29	28.96	QP
	0.26442	11.53	10.39	0.05	21.97	51.29	29.32	Average
	0.47612	23.43	10.33	0.05	33.81	56.41	22.6	QP
	0.47612	17.16	10.33	0.05	27.54	46.41	18.87	Average
	0.95313	15.52	10.32	0.07	25.91	56	30.09	QP
	0.95313	5.13	10.32	0.07	15.52	46	30.48	Average
	2.178	11.23	10.33	0.09	21.65	56	34.35	QP
	2.178	2.16	10.33	0.09	12.58	46	33.42	Average
	3.399	9.55	10.34	0.11	20	56	36	QP
	3.399	1.15	10.34	0.11	11.6	46	34.4	Average
	14.213	9.3	10.28	0.23	19.81	60	40.19	QP
	14.213	0.15	10.28	0.23	10.66	50	39.34	Average

EUT : Wireless control board Temperature : 22°C

Model No. : 324131296121 Humidity : 51%RH

Test Mode : Receiving Date of Test : 2018.06.12

**ZigBee:**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	AMN Factor (dB/m)	Cable Loss (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Line	0.22676	20.85	10.42	0.05	31.32	62.57	31.25	QP
	0.22676	12.86	10.42	0.05	23.33	52.57	29.24	Average
	0.47612	30.36	10.33	0.05	40.74	56.41	15.67	QP
	0.47612	23.73	10.33	0.05	34.11	46.41	12.3	Average
	0.95313	18.56	10.32	0.07	28.95	56	27.05	QP
	0.95313	9.36	10.32	0.07	19.75	46	26.25	Average
	1.487	17.89	10.33	0.08	28.3	56	27.7	QP
	1.487	10.83	10.33	0.08	21.24	46	24.76	Average
	2.055	17.52	10.33	0.09	27.94	56	28.06	QP
	2.055	9.35	10.33	0.09	19.77	46	26.23	Average
	5.249	14.21	10.34	0.13	24.68	60	35.32	QP
	5.249	4.29	10.34	0.13	14.76	50	35.24	Average
Neutral	0.27297	20.56	10.39	0.05	31	61.03	30.03	QP
	0.27297	12.51	10.39	0.05	22.95	51.03	28.08	Average
	0.47612	23.03	10.33	0.05	33.41	56.41	23	QP
	0.47612	16.63	10.33	0.05	27.01	46.41	19.4	Average
	0.97354	14.81	10.32	0.07	25.2	56	30.8	QP
	0.97354	5.18	10.32	0.07	15.57	46	30.43	Average
	1.535	11.58	10.33	0.08	21.99	56	34.01	QP
	1.535	2.54	10.33	0.08	12.95	46	33.05	Average
	2.794	10.15	10.33	0.1	20.58	56	35.42	QP
	2.794	2.17	10.33	0.1	12.6	46	33.4	Average
	6.056	8.61	10.34	0.15	19.1	60	40.9	QP
	6.056	0.67	10.34	0.15	11.16	50	38.84	Average

TEST ENGINEER: Jarey

## 4 RADIATED EMISSION TEST

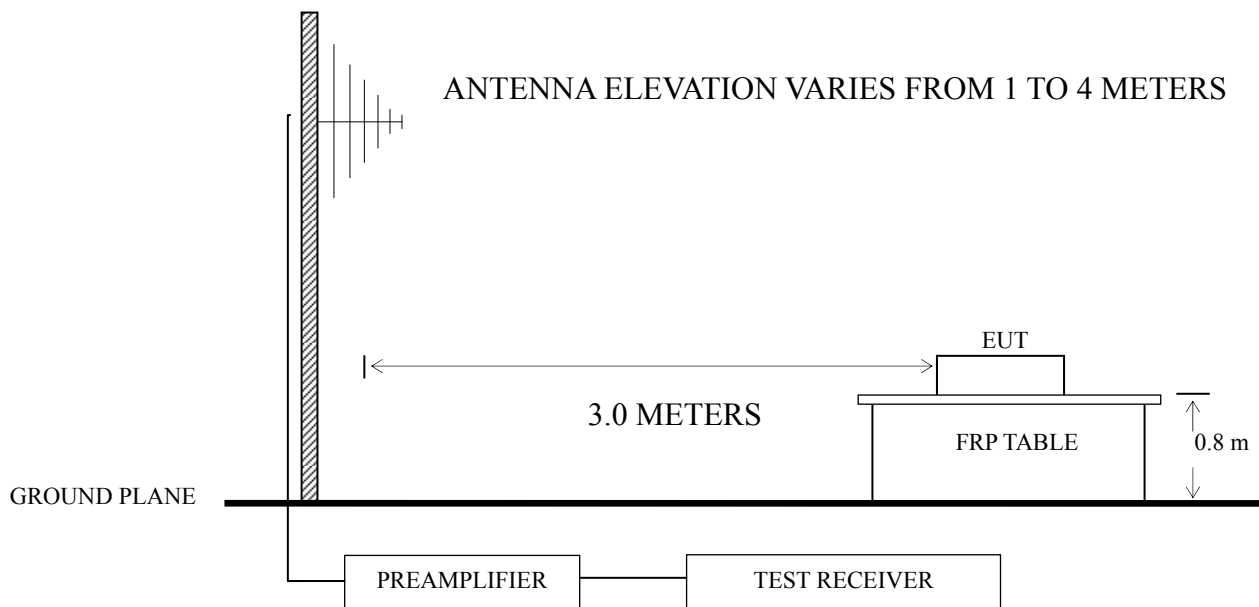
### 4.1 Test Equipment

The following test equipment are used during the radiated emission test in a semi-anechoic chamber:

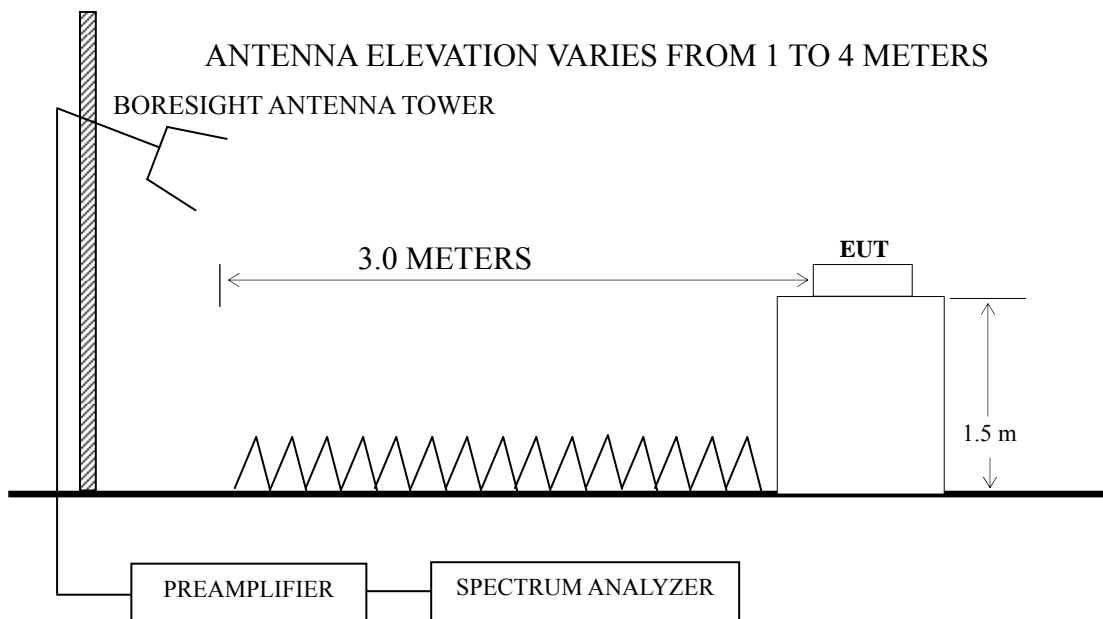
Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Preamplifier	Agilent	8447D	2944A06664	Apr 27, 2018	Apr 26, 2019
2.	Preamplifier	HP	8449B	3008A00864	Mar 8, 2018	Mar 7, 2019
3.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018
4.	Test Receiver	R&S	ESCI	101303	Apr 26, 2018	Apr 25, 2019
5.	Bi-log Antenna	Schwarz beck	VULB 9168	708	Jul 20, 2017	Jul 19, 2018
6.	Horn Antenna	EMCO	3115	9607-4878	Jun 02, 2018	Jun 01, 2019
7.	Horn Antenna	EMCO	3116	00062643	Sep 08, 2017	Sep 08, 2019
8.	Software	Audix	E3	SET00200 9912M295-2	--	--

### 4.2 Block Diagram of Test Setup

#### 4.2.1 Below 1GHz



### 4.2.2 Above 1GHz



### 4.3 Radiated Emission Limit (§15.209)

Frequency (MHz)	Distance (m)	Field strength limits (μV/m)	
		(μV/m)	dB(μV/m)
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
Above 960	3	500	54.0

NOTE 1 - Emission Level dB (μV/m) = 20 log Emission Level (μV/m)

NOTE 2 - The tighter limit applies at the band edges.

NOTE 3 - Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

NOTE 4 - The limits shown are based on Quasi-peak value detector below or equal to 1GHz and Average value detector above 1GHz.

NOTE 5 - Above 1 GHz, the limit on peak emission is 20 dB above the maximum permitted average emission limit applicable to the EUT

### 4.4 Test Configuration

The EUT (listed in Sec.2.1) and the simulators (listed in Sec.2.2) were installed as shown on Sec.4.2 to meet FCC requirements and operating in a manner that tends to maximize its emission level in a normal application.

## 4.5 Operating Condition of EUT

4.5.1 Setup the EUT as shown in Sec. 4.2.

4.5.2 Turn on the power of all equipment.

4.5.3 Turn the EUT on the test mode, and then test.

## 4.6 Test Procedures

Radiated emission test applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp is necessary for this measurement. For measurement above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

The EUT was placed on a turntable. Below 1 GHz, the table height is 80 cm above the reference ground plane. Above 1 GHz, the table height is 1.5 m. The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna, which was mounted on an antenna tower. The antenna moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (Calibrated Bilog Antenna) or Horn antenna was used as receiving antenna. Both horizontal and vertical polarizations of the antenna were set on measurement. In order to find the maximum emission, all of the interference cables were manipulated according to ANSI C63.10: 2013 requirements during radiated emission test.

The bandwidth of Test Receiver R&S ESCI was set at 120 kHz from 30MHz to 1000MHz.

The bandwidth of the VBW was set at 1MHz and RBW was set at 1MHz for peak emission measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emission above 1GHz for Spectrum Agilent N9010A.

The frequency range from 30 MHz to 25 GHz (Up to 10<sup>th</sup> harmonics from fundamental frequency) was checked.

## 4.7 Test Results

**<PASS>**

The frequency and amplitude of the highest radiated emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

## Frequency range: below 1G (Worst case emission)

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	Zigbee	11	2405 MHz	P16
2.	Receiving	Zigbee	--	-	P17

## Frequency range: above 1G

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	Zigbee	11	2405MHz	P18
2.			20	2450 MHz	P19
3.			26	2480 MHz	P19
4.	Receiving	Zigbee	--	--	P20

## Restricted bands:

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	Zigbee	Cabinet Emission		P21

NOTE 1 – Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor

NOTE 2 – “QP” means “Quasi-Peak” values

NOTE 3 – 0° was the table front facing the antenna. Degree is calculated from 0° clockwise facing the antenna.

NOTE 4 – The emission levels which not reported are too low against the official limit.

NOTE 5 – The emission levels recorded below is data of EUT configured in Lying direction, for Lying direction was the maximum emission direction during the test. The data of Side & Standing direction are too low against the official limit to be reported.

NOTE 6 – All reading are Quasi-Peak values below or equal to 1GHz, Peak and Average values above 1GHz.

For above 1GHz test, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

NOTE 7 – The frequency range 2310-2390MHz & 2483.5-2500MHz were tested for Restricted bands.

**Worst case emission < 1GHz**

EUT : Wireless control board Temperature : 22°C  
 Model No. : 324131296121 Humidity : 51%RH  
 Test Mode : Transmitting Date of Test : 2018.06.08

**Zigbee:**

Polarization	Frequency (MHz)	Meter Reading dB ( $\mu$ V)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB ( $\mu$ V/m)	Limits dB ( $\mu$ V/m)	Margin (dB)	Remark
Horizontal	37.812	26.92	19.36	0.63	27.92	18.99	40	21.01	QP
	58.203	26.9	19.22	0.77	27.86	19.03	40	20.97	QP
	179.386	28.91	17.85	1.41	27.02	21.15	43.5	22.35	QP
	404.667	27.35	21.81	2.07	27.33	23.9	46	22.1	QP
	638.369	27.84	26.49	2.59	28.16	28.76	46	17.24	QP
	965.542	27.29	29.77	3.14	27.01	33.19	54	20.81	QP
Vertical	32.406	34.55	19.05	0.57	27.93	26.24	40	13.76	QP
	51.301	29.31	19.29	0.73	27.89	21.44	40	18.56	QP
	179.386	35.53	17.85	1.41	27.02	27.77	43.5	15.73	QP
	472.176	27.32	23.56	2.23	27.82	25.29	46	20.71	QP
	661.151	26.98	26.8	2.62	28.14	28.26	46	17.74	QP
	942.131	26.37	29.28	3.12	27.12	31.65	46	14.35	QP



EUT : Wireless control board Temperature : 22°C

Model No. : 324131296121 Humidity : 51%RH

Test Mode : Receiving Date of Test : 2018.06.08

**Zigbee:**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	45.058	27.75	19.8	0.69	27.91	20.33	40	19.67	QP
	58.203	26.94	19.22	0.77	27.86	19.07	40	20.93	QP
	182.559	30.19	17.45	1.43	27	22.07	43.5	21.43	QP
	444.851	28.03	23.04	2.17	27.63	25.61	46	20.39	QP
	661.151	26.64	26.8	2.62	28.14	27.92	46	18.08	QP
	986.072	26.49	29.77	3.19	26.94	32.51	54	21.49	QP
Vertical	32.864	33.2	19.1	0.58	27.93	24.95	40	15.05	QP
	54.643	29.44	19.25	0.75	27.88	21.56	40	18.44	QP
	182.559	35.76	17.45	1.43	27	27.64	43.5	15.86	QP
	459.114	27.25	23.45	2.2	27.73	25.17	46	20.83	QP
	813.112	26.58	28.37	2.89	27.67	30.17	46	15.83	QP
	972.337	26.28	29.83	3.16	27.01	32.26	54	21.74	QP

TEST ENGINEER: Jarey

**Radiated Emission > 1GHz**EUT : Wireless control board Temperature : 22°CModel No. : 324131296121 Humidity : 51%RHTest Mode : Transmitting Date of Test : 2018.06.08**Zigbee CH11 (2405 MHz):**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	1262.292	48.45	24.72	3.69	36.03	40.83	74	33.17	Peak
	1889.051	51.09	27.42	4.52	35.39	47.64	74	26.36	Peak
	2935.411	49.77	30.31	5.67	35.2	50.55	74	23.45	Peak
	3752.111	50.08	32.21	6.52	34.43	54.38	74	19.62	Peak
	3752.111	36.61	32.21	6.52	34.43	40.91	54	13.09	Average
	4424.514	47.92	33.66	7.19	34.06	54.71	74	19.29	Peak
	4424.514	33.39	33.66	7.19	34.06	40.18	54	13.82	Average
	5545.141	47.04	34.84	8.16	34.07	55.97	74	18.03	Peak
Vertical	5545.141	32.51	34.84	8.16	34.07	41.44	54	12.56	Average
	1526.313	49.22	26.01	4.07	35.73	43.57	74	30.43	Peak
	1889.051	48.92	27.42	4.52	35.39	45.47	74	28.53	Peak
	3461.456	48.95	31.63	6.21	34.7	52.09	74	21.91	Peak
	4215.562	47.88	33.19	6.99	34.13	53.93	74	20.07	Peak
	4215.562	34.29	33.19	6.99	34.13	40.34	54	13.66	Average
	4971.019	46.58	34.18	7.72	33.91	54.57	74	19.43	Peak
	4971.019	32.16	34.18	7.72	33.91	40.15	54	13.85	Average
	5466.224	47.21	34.76	8.11	34.04	56.04	74	17.96	Peak
	5466.224	32.62	34.76	8.11	34.04	41.45	54	12.55	Average

**Zigbee CH20 (2450 MHz):**

Polarization	Frequency (MHz)	Meter Reading dB ( $\mu$ V)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB ( $\mu$ V/m)	Limits dB ( $\mu$ V/m)	Margin (dB)	Remark
Horizontal	1512.7	48.16	25.96	4.04	35.75	42.41	74	31.59	Peak
	1937.036	48.89	27.59	4.55	35.35	45.68	74	28.32	Peak
	2872.97	49.75	30.1	5.63	35.21	50.27	74	23.73	Peak
	3772.333	49.25	32.25	6.52	34.4	53.62	74	20.38	Peak
	4813.252	47.02	34.06	7.59	33.95	54.72	74	19.28	Peak
	4813.252	32.30	34.06	7.59	33.95	40.00	54	14.00	Average
	5595.042	47.32	34.88	8.16	34.08	56.28	74	17.72	Peak
	5595.042	32.53	34.88	8.16	34.08	41.49	54	12.51	Average
Vertical	1449.03	49.87	25.66	3.95	35.81	43.67	74	30.33	Peak
	2000.528	48.35	27.8	4.64	35.3	45.49	74	28.51	Peak
	2951.232	50.07	30.34	5.67	35.2	50.88	74	23.12	Peak
	3738.689	49.51	32.19	6.52	34.44	53.78	74	20.22	Peak
	4821.884	47.6	34.06	7.59	33.95	55.3	74	18.7	Peak
	4821.884	33.26	34.06	7.59	33.95	40.96	54	13.04	Average
	5545.141	47.33	34.84	8.16	34.07	56.26	74	17.74	Peak
	5545.141	32.13	34.84	8.16	34.07	41.06	54	12.94	Average

**Zigbee CH26 (2480 MHz):**

Polarization	Frequency (MHz)	Meter Reading dB ( $\mu$ V)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB ( $\mu$ V/m)	Limits dB ( $\mu$ V/m)	Margin (dB)	Remark
Horizontal	1413.134	49.29	25.5	3.92	35.85	42.86	74	31.14	Peak
	1986.241	49.19	27.74	4.61	35.32	46.22	74	27.78	Peak
	2888.455	50.04	30.15	5.63	35.21	50.61	74	23.39	Peak
	3799.467	49.08	32.32	6.57	34.38	53.59	74	20.41	Peak
	4488.392	47.89	33.77	7.26	34.05	54.87	74	19.13	Peak
	4488.392	33.49	33.77	7.26	34.05	40.47	54	13.53	Average
	5466.224	47.17	34.76	8.11	34.04	56	74	18	Peak
	5466.224	32.43	34.76	8.11	34.04	41.25	54	12.75	Average
Vertical	1576.342	48.47	26.22	4.13	35.68	43.14	74	30.86	Peak
	2025.777	49.55	27.85	4.64	35.3	46.74	74	27.26	Peak
	2972.46	49.96	30.42	5.71	35.2	50.89	74	23.11	Peak
	3772.333	49.52	32.25	6.52	34.4	53.89	74	20.11	Peak
	4839.195	46.96	34.08	7.59	33.94	54.69	74	19.31	Peak
	4839.195	33.79	34.08	7.59	33.94	41.52	54	12.48	Average
	5615.128	47.57	34.89	8.22	34.09	56.59	74	17.41	Peak
	5615.128	33.15	34.89	8.22	34.09	42.17	54	11.83	Average

TEST ENGINEER: Jarey

EUT : Wireless control board Temperature : 22°C

Model No. : 324131296121 Humidity : 51%RH

Test Mode : Receiving Date of Test : 2018.06.08

**Zigbee:**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	1336.782	48.84	25.1	3.81	35.94	41.81	74	32.19	Peak
	1613.49	48.54	26.39	4.19	35.64	43.48	74	30.52	Peak
	2872.97	49.99	30.1	5.63	35.21	50.51	74	23.49	Peak
	3765.58	49.07	32.25	6.52	34.4	53.44	74	20.56	Peak
	4424.514	48.45	33.66	7.19	34.06	55.24	74	18.76	Peak
	4424.514	34.14	33.66	7.19	34.06	40.93	54	13.07	Average
	5515.415	46.67	34.81	8.11	34.06	55.53	74	18.47	Peak
	5515.415	33.37	34.81	8.11	34.06	42.23	54	11.77	Average
Vertical	1162.424	49.35	24.14	3.51	36.16	40.84	74	33.16	Peak
	1613.49	48.46	26.39	4.19	35.64	43.4	74	30.6	Peak
	2888.455	48.97	30.15	5.63	35.21	49.54	74	24.46	Peak
	3752.111	48.25	32.21	6.52	34.43	52.55	74	21.45	Peak
	4448.361	47.12	33.69	7.26	34.06	54.01	74	19.99	Peak
	4448.361	33.81	33.69	7.26	34.06	40.70	54	13.30	Average
	5595.042	46.39	34.88	8.16	34.08	55.35	74	18.65	Peak
	5595.042	32.64	34.88	8.16	34.08	41.60	54	12.40	Average

TEST ENGINEER: Jarey

**Emissions in restricted frequency bands:**

EUT : Wireless control board Temperature : 22°C

Model No. : 324131296121 Humidity : 51%RH

Test Mode : Transmitting Date of Test : 2018.06.08

**Zigbee:**

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2320.999	48.72	28.46	5.04	35.26	46.96	74	27.04	Peak
	2320.999	34.25	28.46	5.04	35.26	32.49	54	21.51	Average
	2356.49	48.34	28.54	5.08	35.26	46.7	74	27.3	Peak
	2356.49	33.73	28.54	5.08	35.26	32.09	54	21.91	Average
	2489.184	48.47	28.79	5.23	35.25	47.24	74	26.76	Peak
	2489.184	34.17	28.79	5.23	35.25	32.94	54	21.06	Average
	2495.418	48.36	28.79	5.23	35.25	47.13	74	26.87	Peak
2495.418	34.44	28.79	5.23	35.25	33.21	54	20.79	Average	
Vertical	2342.581	48.88	28.51	5.04	35.26	47.17	74	26.83	Peak
	2342.581	34.18	28.51	5.04	35.26	32.47	54	21.53	Average
	2366.927	48.85	28.55	5.08	35.26	47.22	74	26.78	Peak
	2366.927	33.65	28.55	5.08	35.26	32.02	54	21.98	Average
	2486.487	48.55	28.77	5.23	35.25	47.3	74	26.7	Peak
	2486.487	34.43	28.77	5.23	35.25	33.18	54	20.82	Average
	2498.541	48.51	28.8	5.23	35.25	47.29	74	26.71	Peak
2498.541	33.61	28.8	5.23	35.25	32.39	54	21.61	Average	

TEST ENGINEER: Jarey

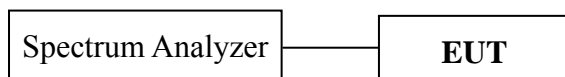
## 5 6 dB BANDWIDTH MEASUREMENT

### 5.1 Test Equipment

The following test equipment was used during the Emission Bandwidth measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

### 5.2 Block Diagram of Test Setup



### 5.3 Specification Limits (§15.247(a)(2))

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

### 5.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 5.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measure by spectrum analyzer with settings: RBW = 100kHz, VBW ≥ 3 × RBW.

The 6 dB bandwidth is defined as the total spectrum the power of which is lower than peak power minus 6 dB .

The test procedure is defined in ANSI C63.10-2013 (the 11.8.2 Measurement Procedure “Option 2” was used).

## 5.6 Test Results

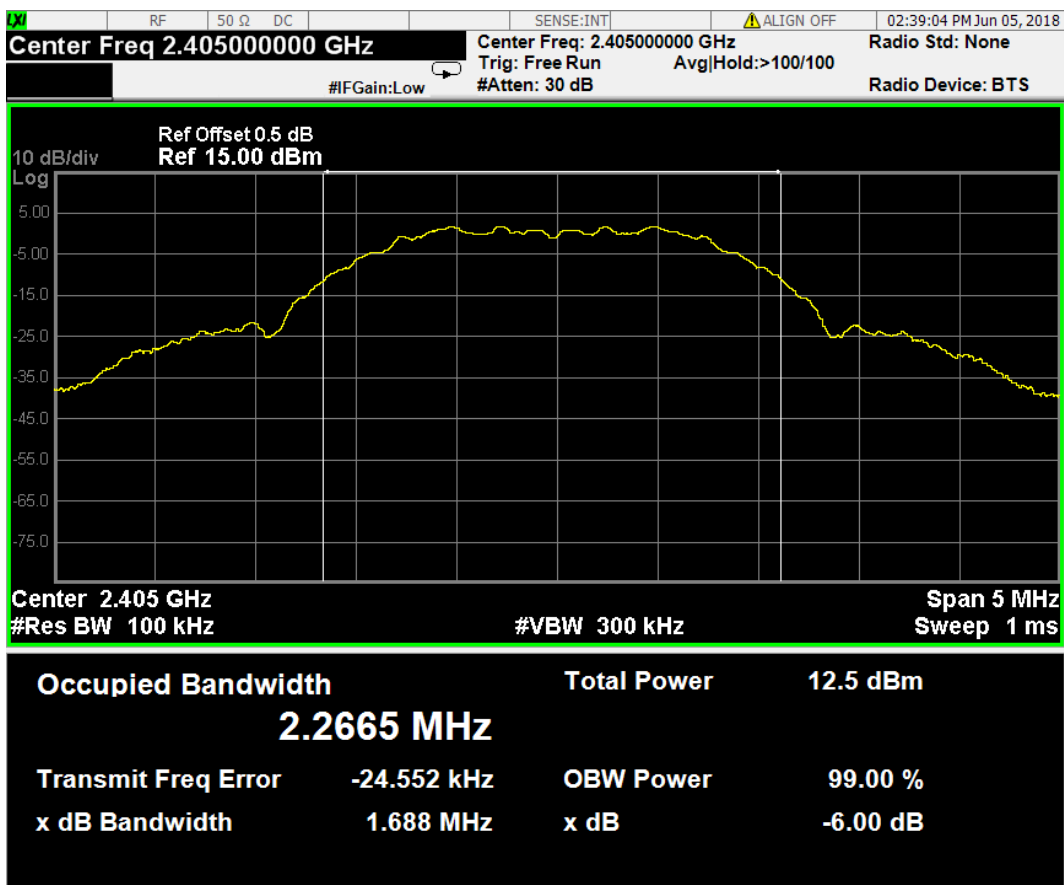
### **PASSED.**

All the test results are attached in next pages.

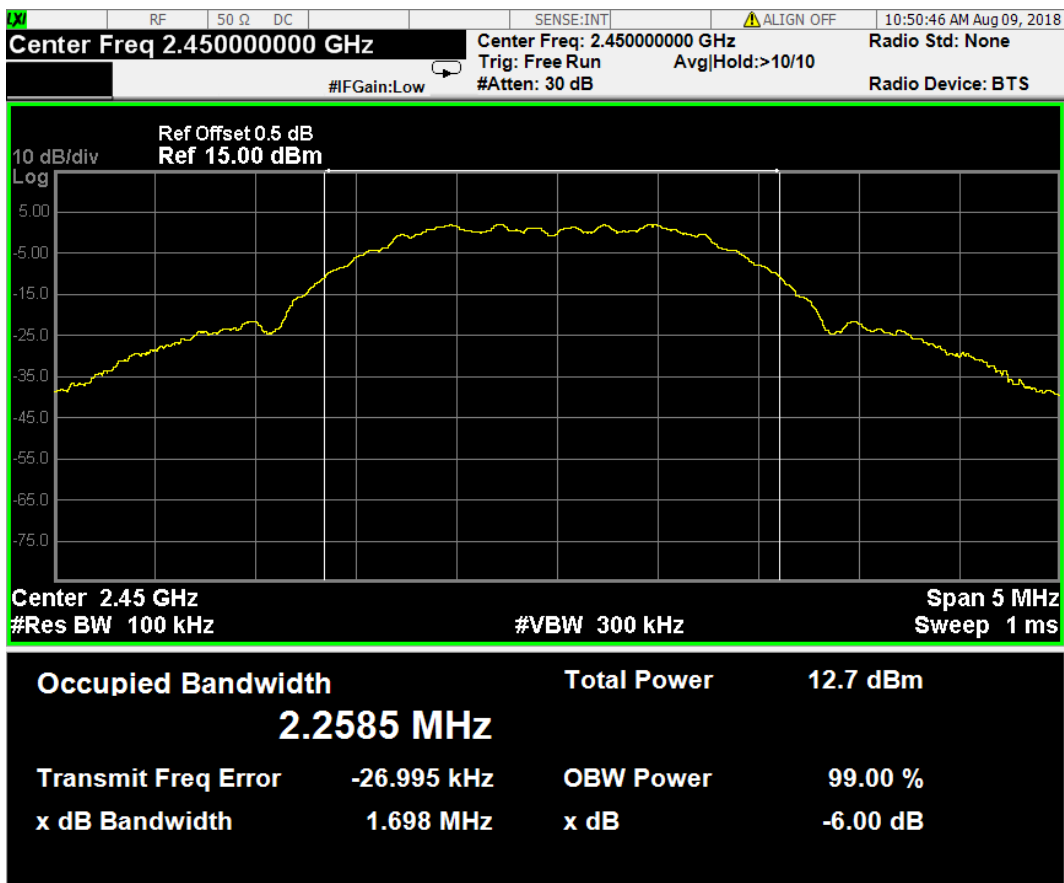
(Test Date: 2018.06.05 Temperature: 23°C Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit
Zigbee	11	2405	<b>1.688</b>	500 kHz
	20	2450	<b>1.698</b>	500 kHz
	26	2480	<b>1.685</b>	500 kHz

**Zigbee: CH11 (2405 MHz)**

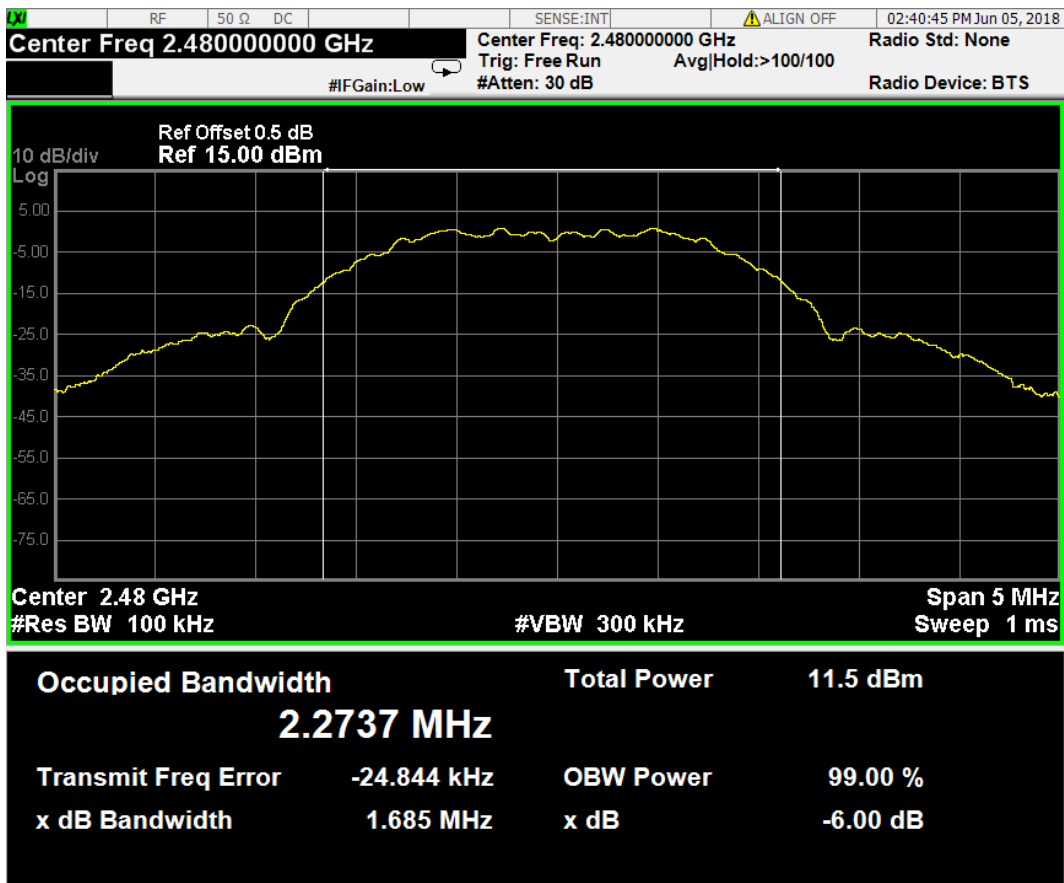


**Zigbee: CH20 (2450 MHz)**





### Zigbee: CH26 (2480 MHz)



## 6 MAXIMUM PEAK OUTPUT POWER MEASUREMENT

### 6.1 Test Equipment

The following test equipment was used during the maximum peak output power measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

### 6.2 Block Diagram of Test Setup

The Same as Section. 4.2.

### 6.3 Specification Limits ((§15.247(b)(3))

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5 MHz is: 1 Watt. (30 dBm)

### 6.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 6.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

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

The test procedure is defined in ANSI C63.10-2013 ( 11.9.1.1 Measurement Procedure “ RBW  $\geq$  DTS bandwidth” was used).

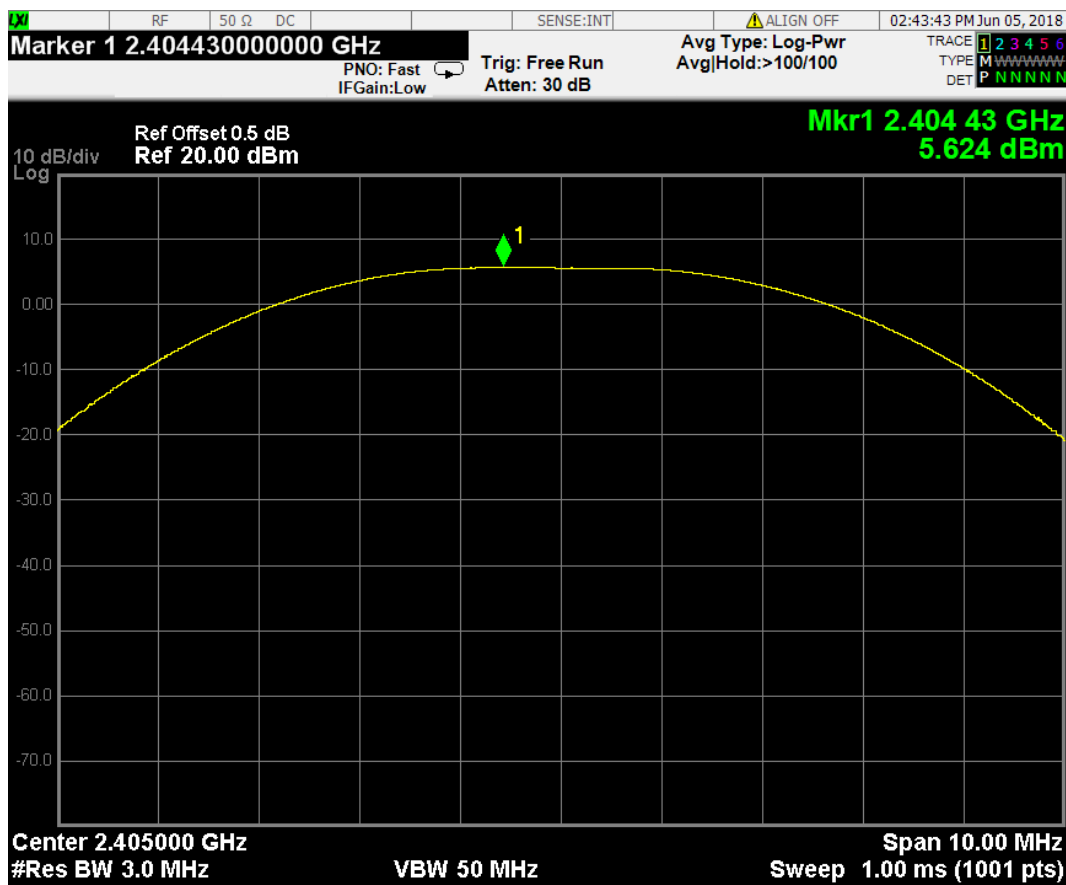
## 6.6 Test Results

**PASSED.** All the test results are listed below.

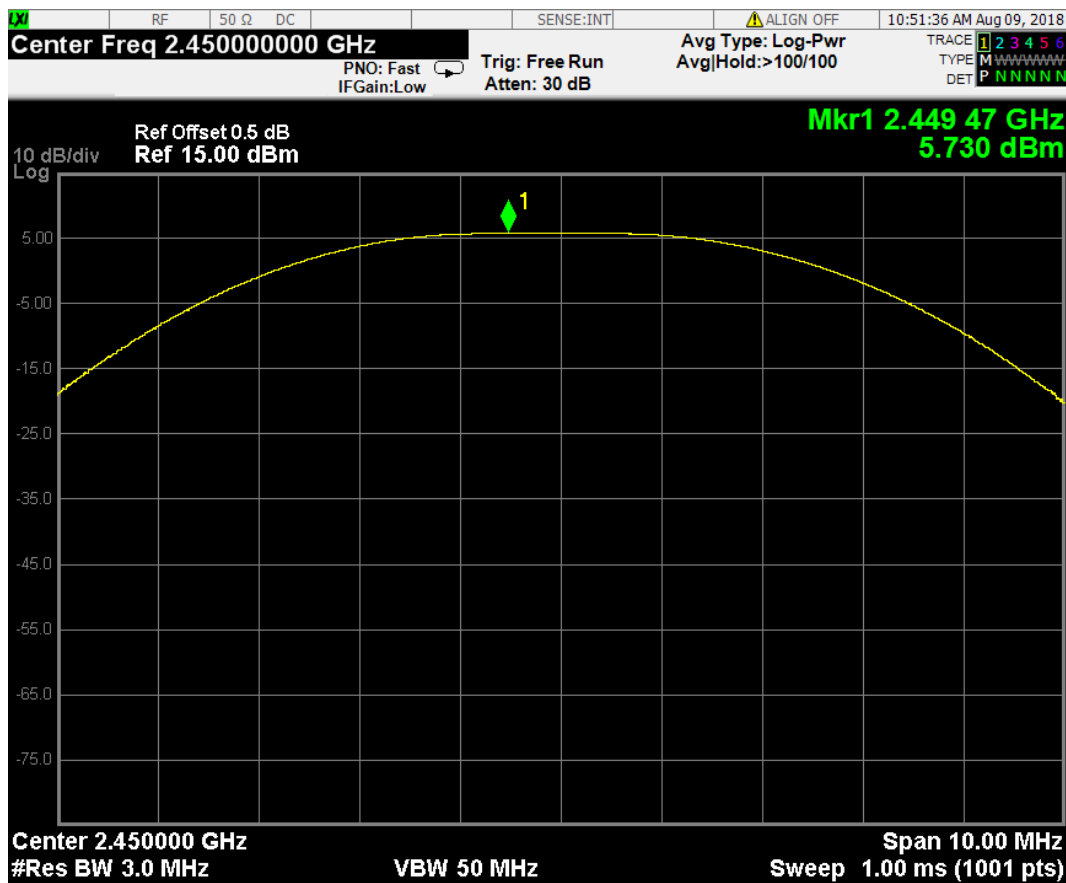
(Test Date: 2018.06.05 Temperature: 23°C Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit
Zigbee	11	2405	<b>5.624</b>	30 dBm
	20	2450	<b>5.730</b>	30 dBm
	26	2480	<b>4.594</b>	30 dBm

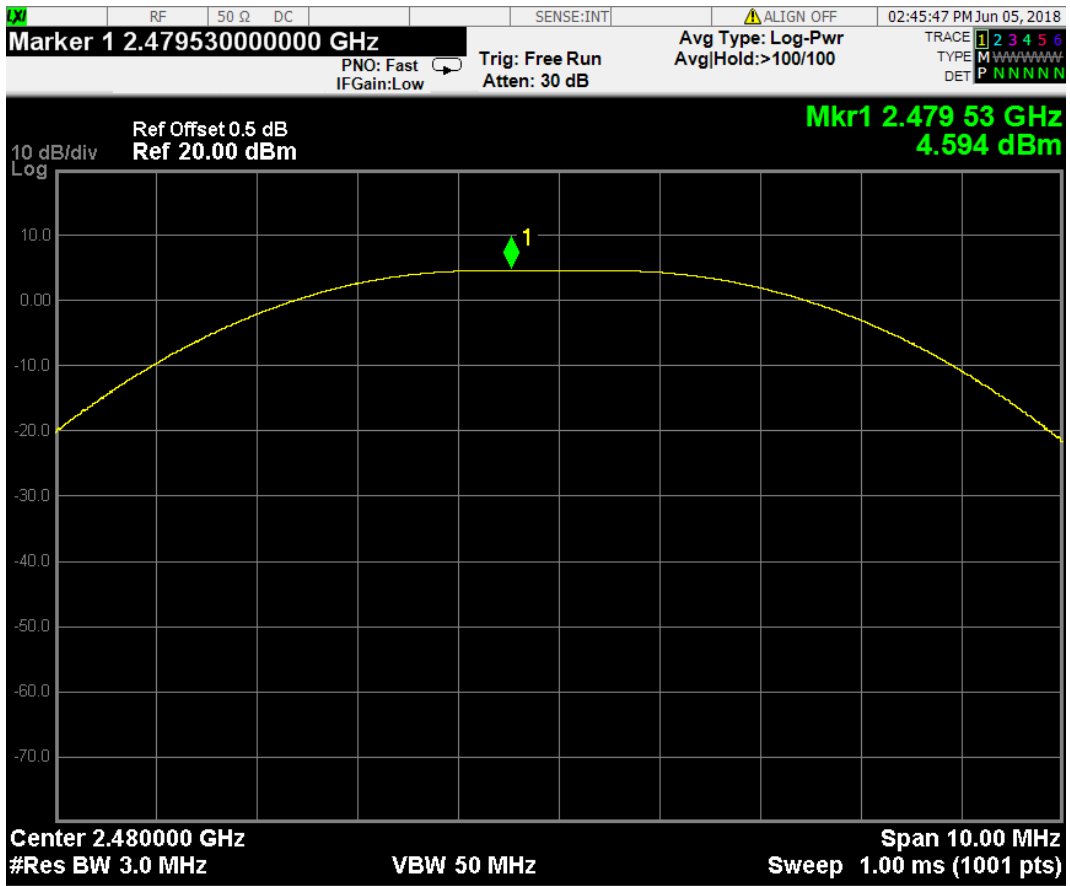
### Zigbee: CH11 (2405 MHz)



### Zigbee: CH20 (2450 MHz)



### Zigbee: CH26 (2480 MHz)



## 7 EMISSION LIMITATIONS MEASUREMENT

### 7.1 Test Equipment

The following test equipment was used during the emission limitations test :

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

### 7.2 Block Diagram of Test Setup

The Same as Section. 4.2.

### 7.3 Specification Limits (§15.247(d))

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (See Section 15.205(c)).(※This test result attaching to Section. 4.7)

### 7.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 7.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. Set RBW = 100 kHz, VBW  $\geq$  300 kHz, scan up through 10<sup>th</sup> harmonic.

When maximum conducted (average) output power was used to determine compliance as described in 11.9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz.

The test procedure is defined in ANSI C63.10-2013 (11.11.2 Reference level measurement and 11.11.3 Emission level measurement was used).

## 7.6 Test Results

### **PASSED.**

The test data was attached in the next pages.

(Test Date: 2018.06.05 Temperature: 23°C Humidity: 51 %)

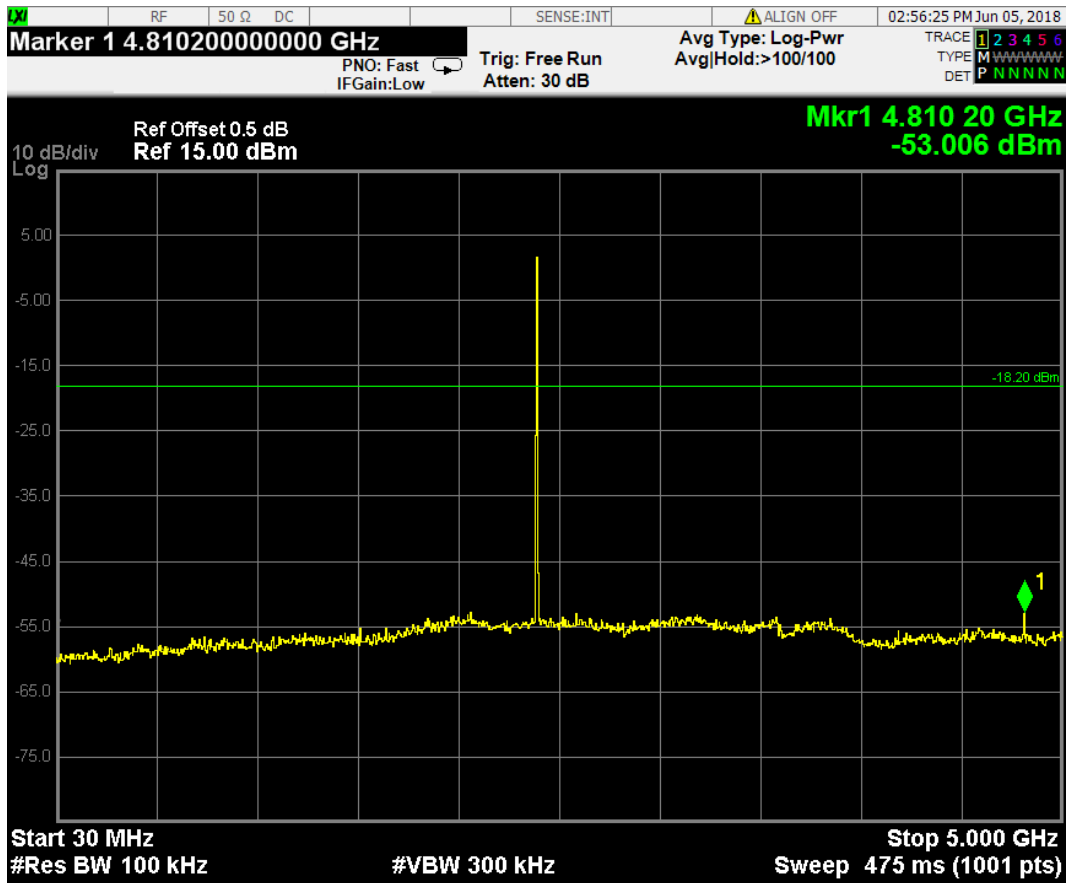
Modulation	Channel	Frequency (MHz)	Data Page
Zigbee	11	2405	P32-33
	20	2450	P34-35
	26	2480	P36-37

### Zigbee: CH11 (2405 MHz)

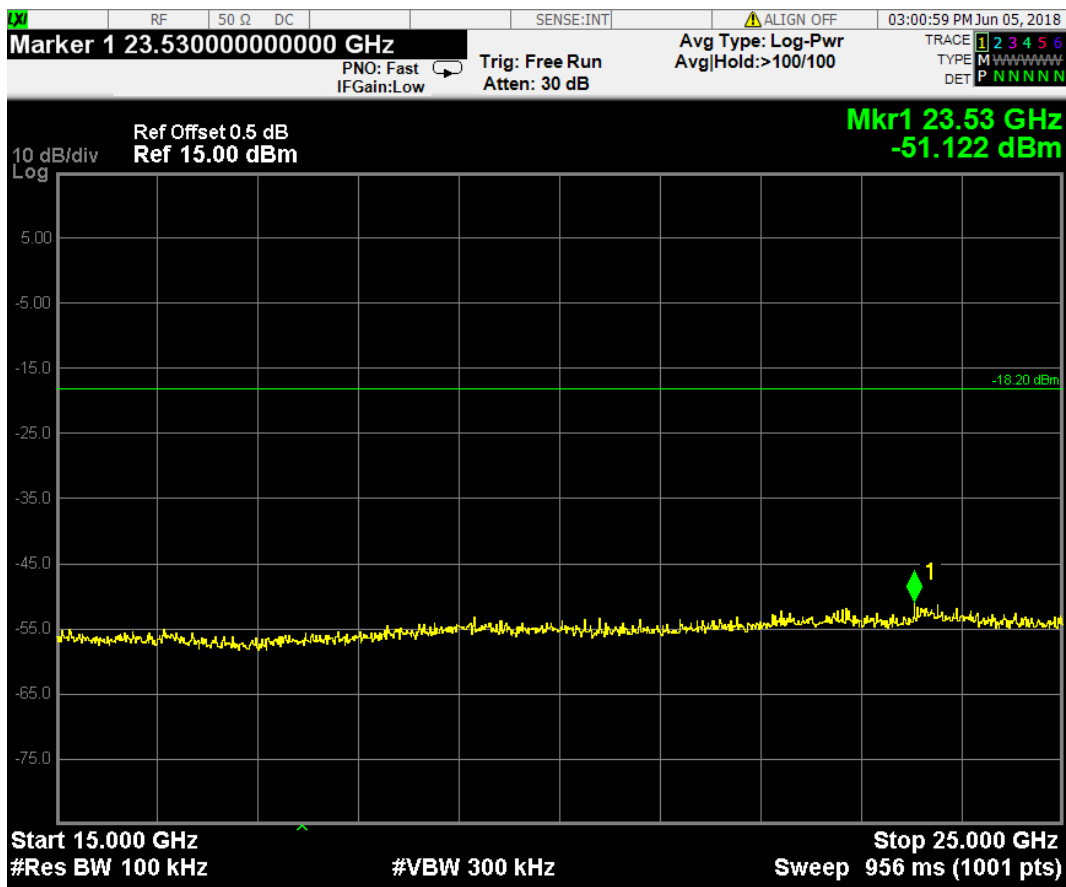
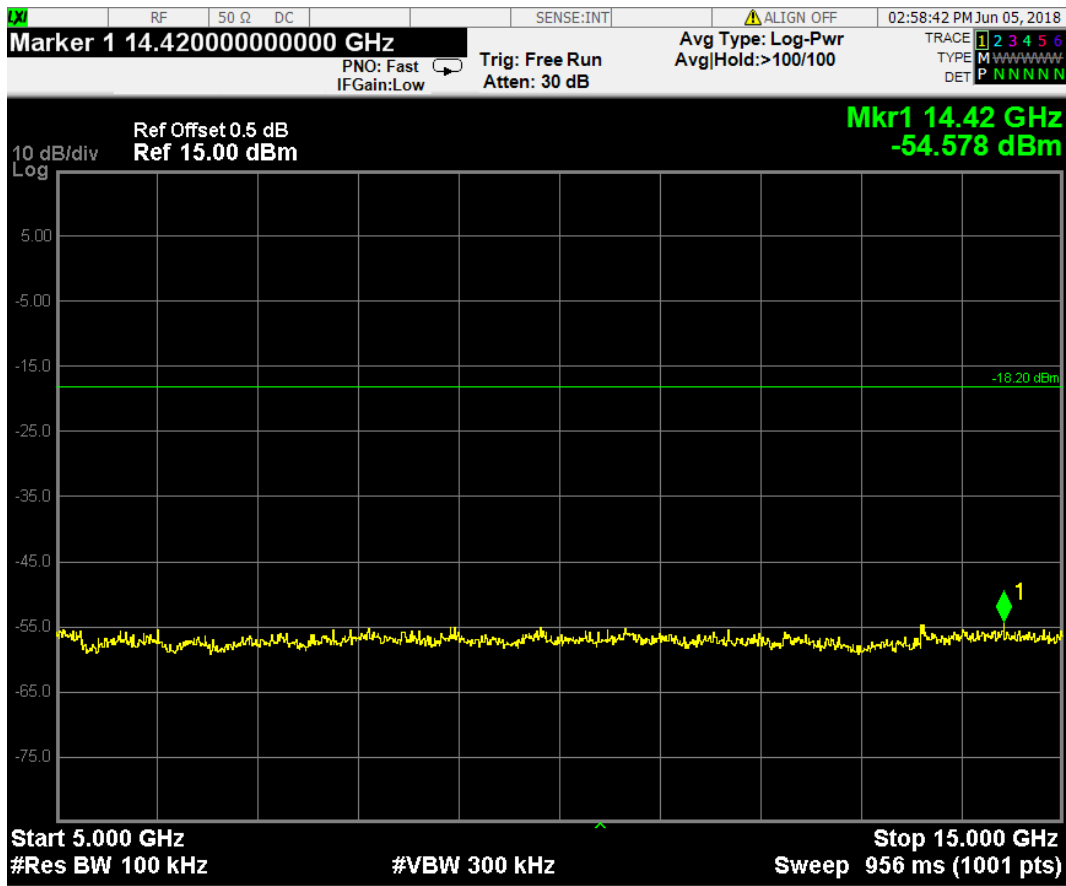
#### Reference level



#### Emission level





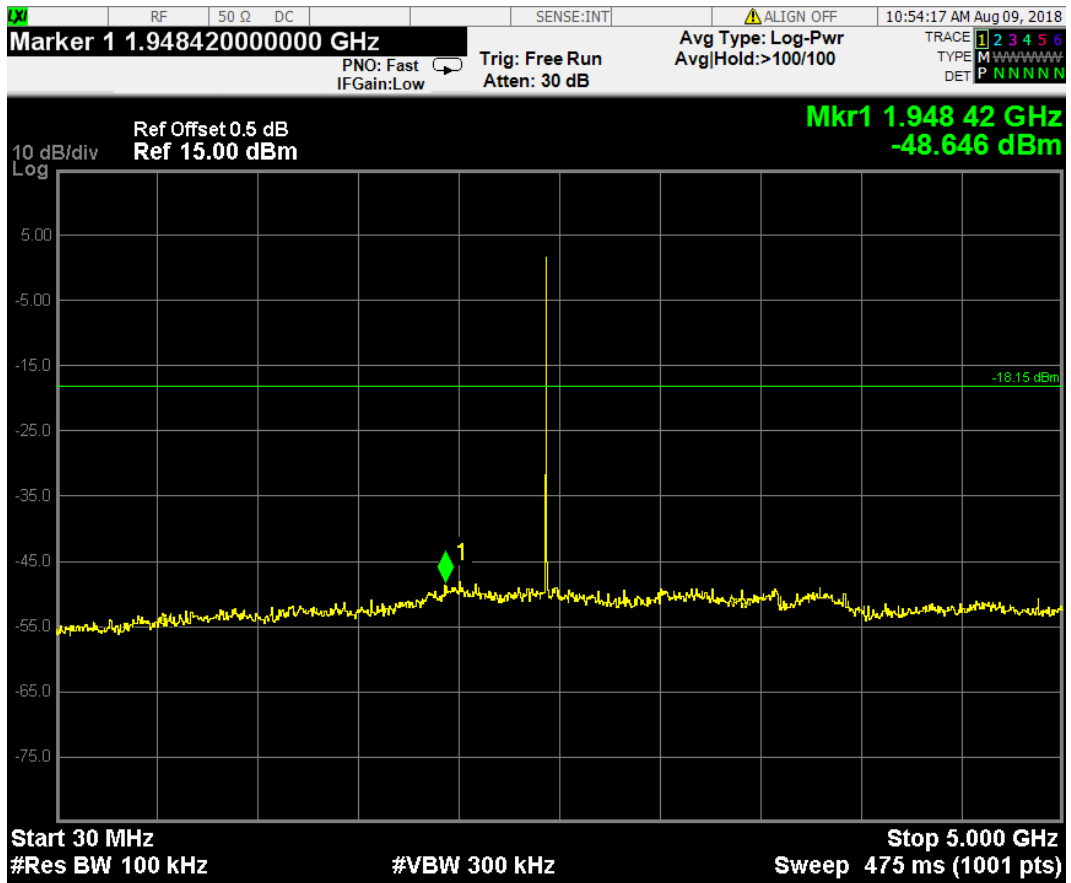


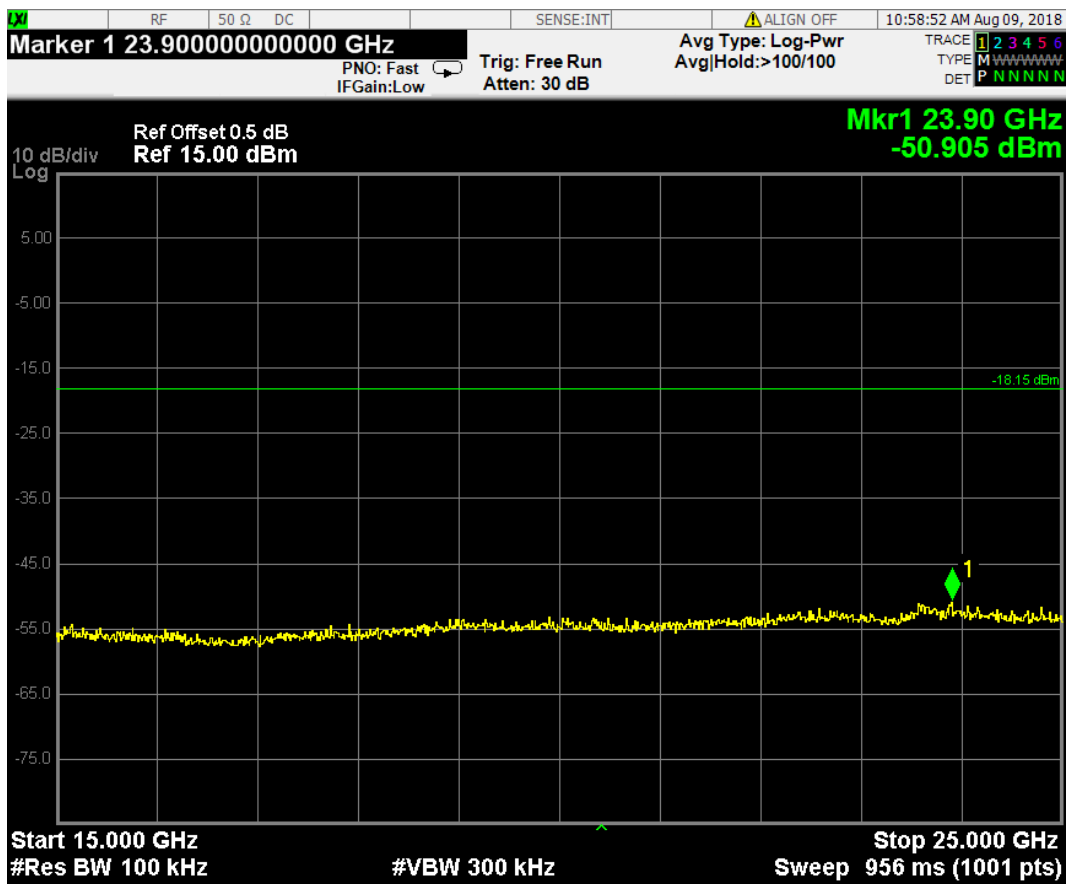
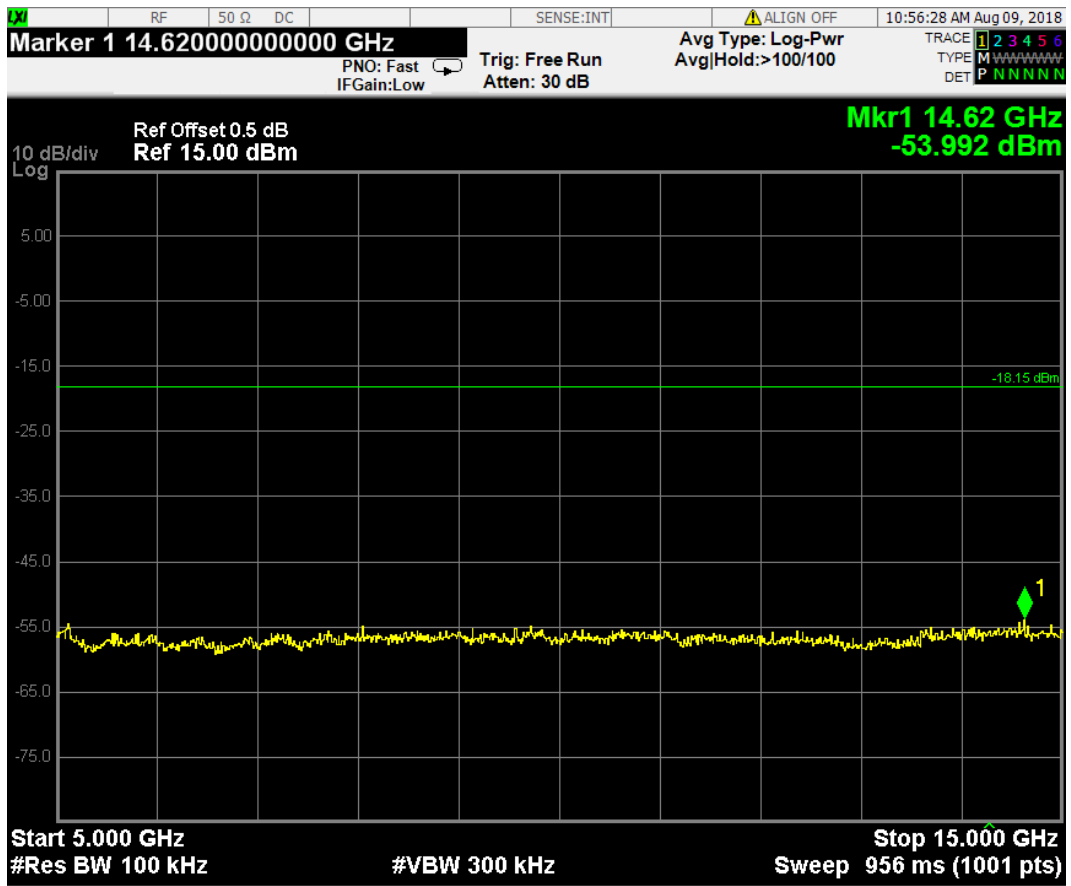
### Zigbee: CH20 (2450 MHz)

#### Reference level



#### Emission level



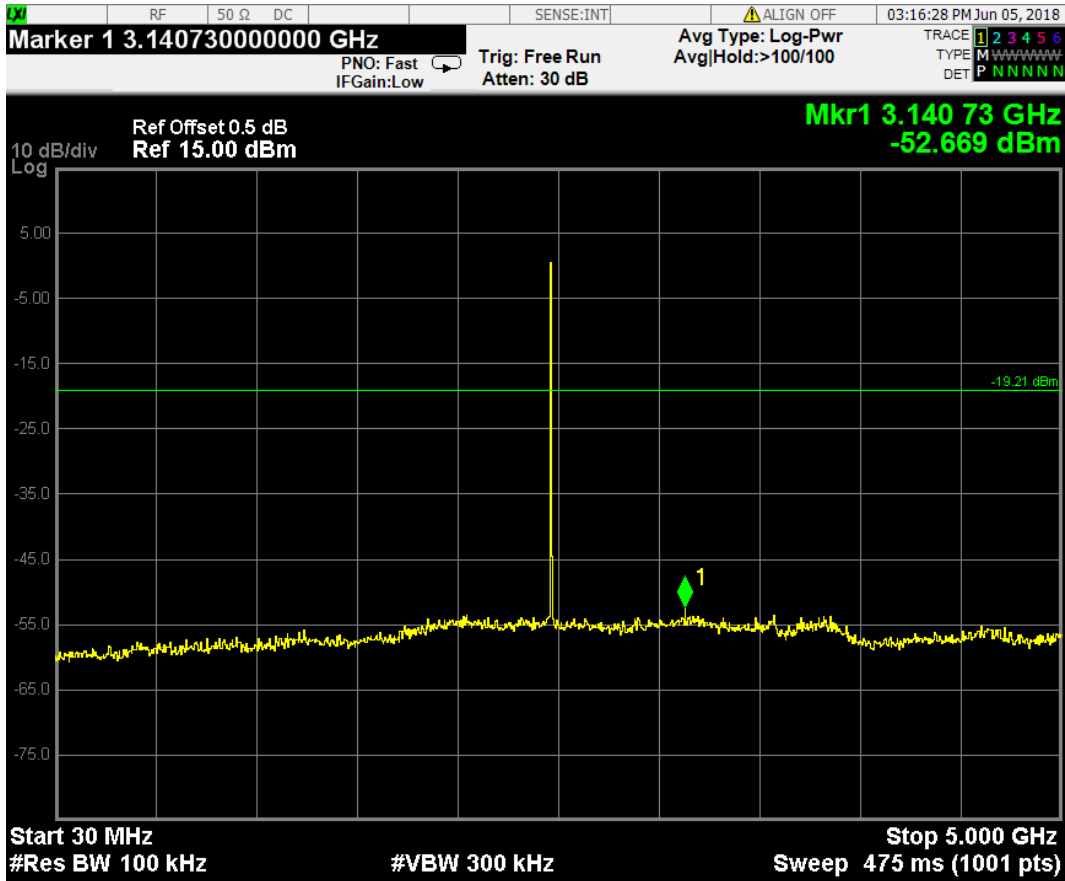


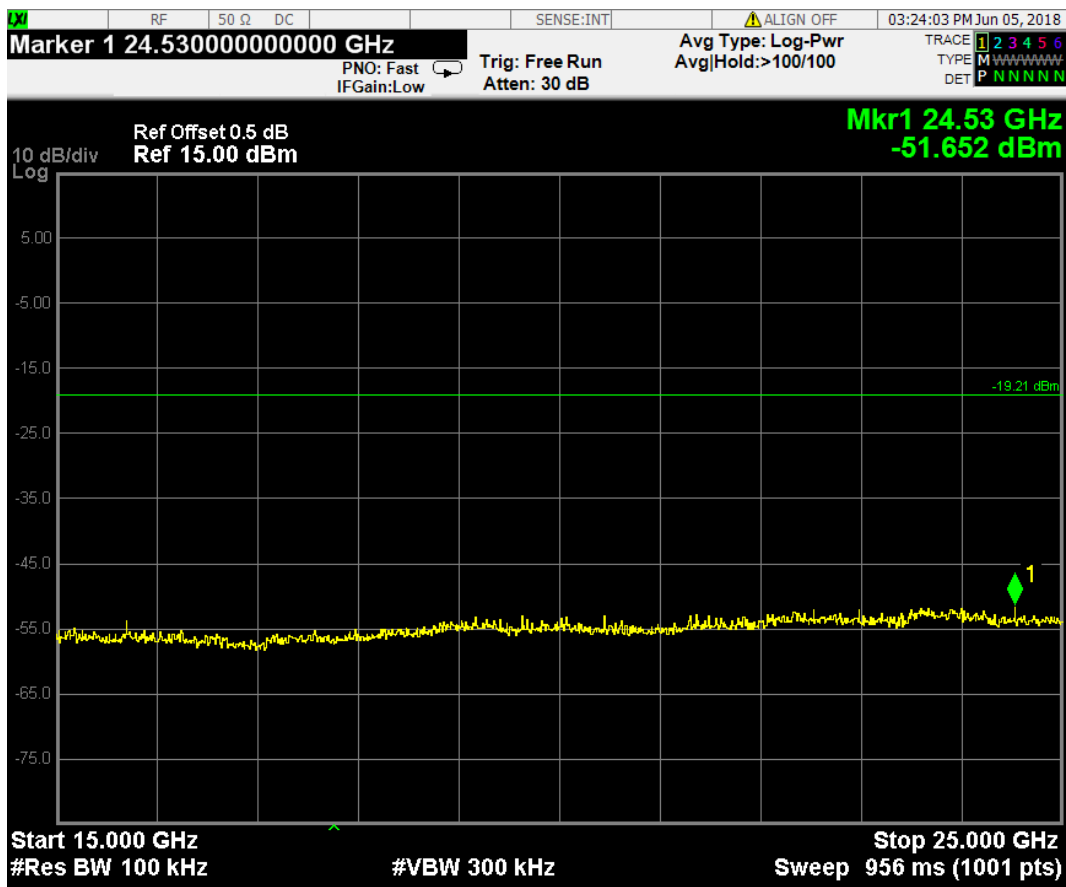
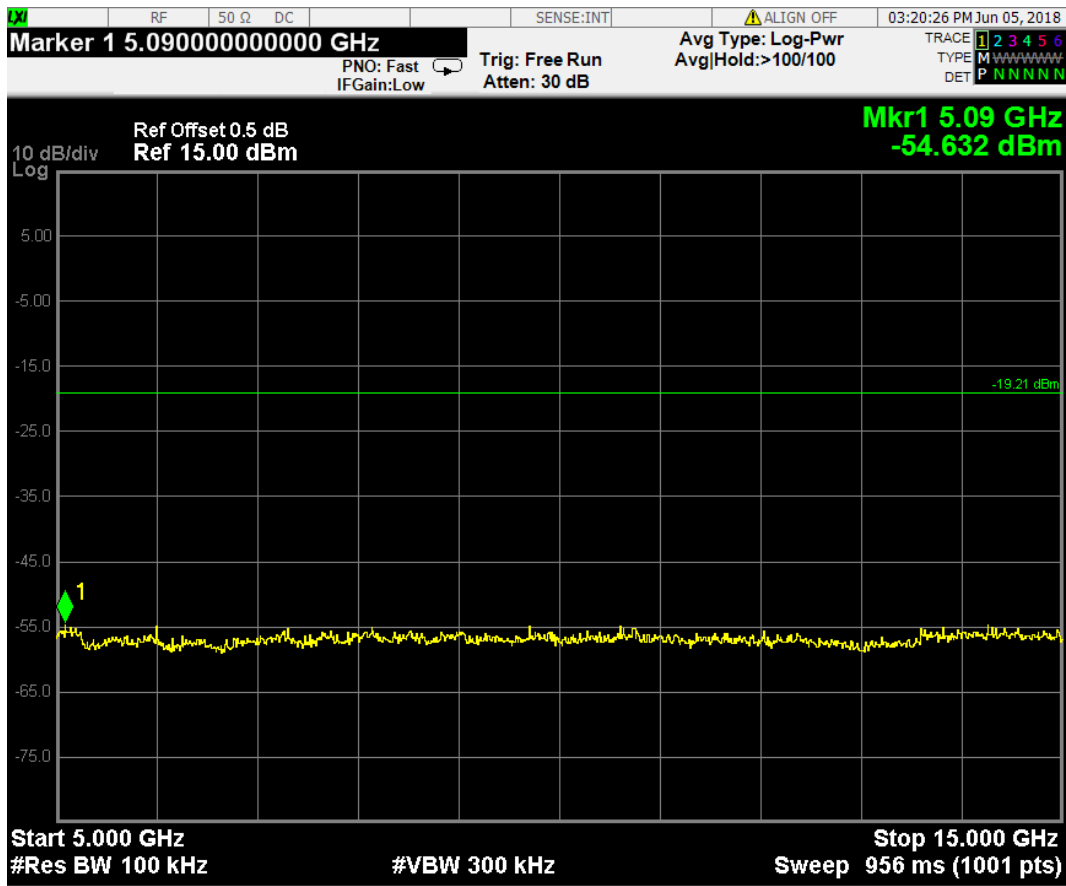
### Zigbee: CH26 (2480 MHz)

#### Reference level



#### Emission level





## 8 BAND EDGES MEASUREMENT

### 8.1 Test Equipment

The following test equipment was used during the band edges measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

### 8.2 Block Diagram of Test Setup

The Same as section.4.2.

### 8.3 Specification Limits (§15.247(d))

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

### 8.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 8.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. Set RBW of Test Receiver to 100kHz and VBW to 300kHz with suitable frequency span including 100kHz bandwidth from band edge.

The test procedure is defined in ANSI C63.10-2013 (11.11.3 Emission level measurement was used).

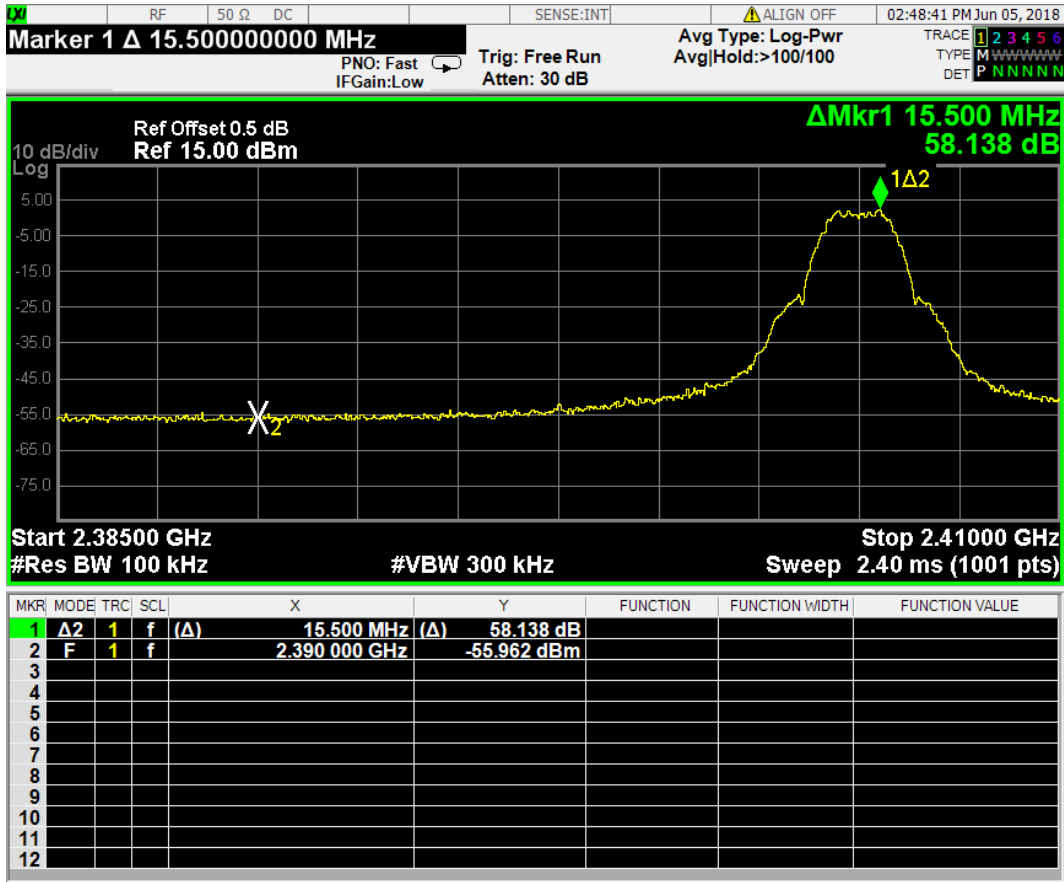
## 8.6 Test Results

**PASSED.** All the test results are attached in next pages.

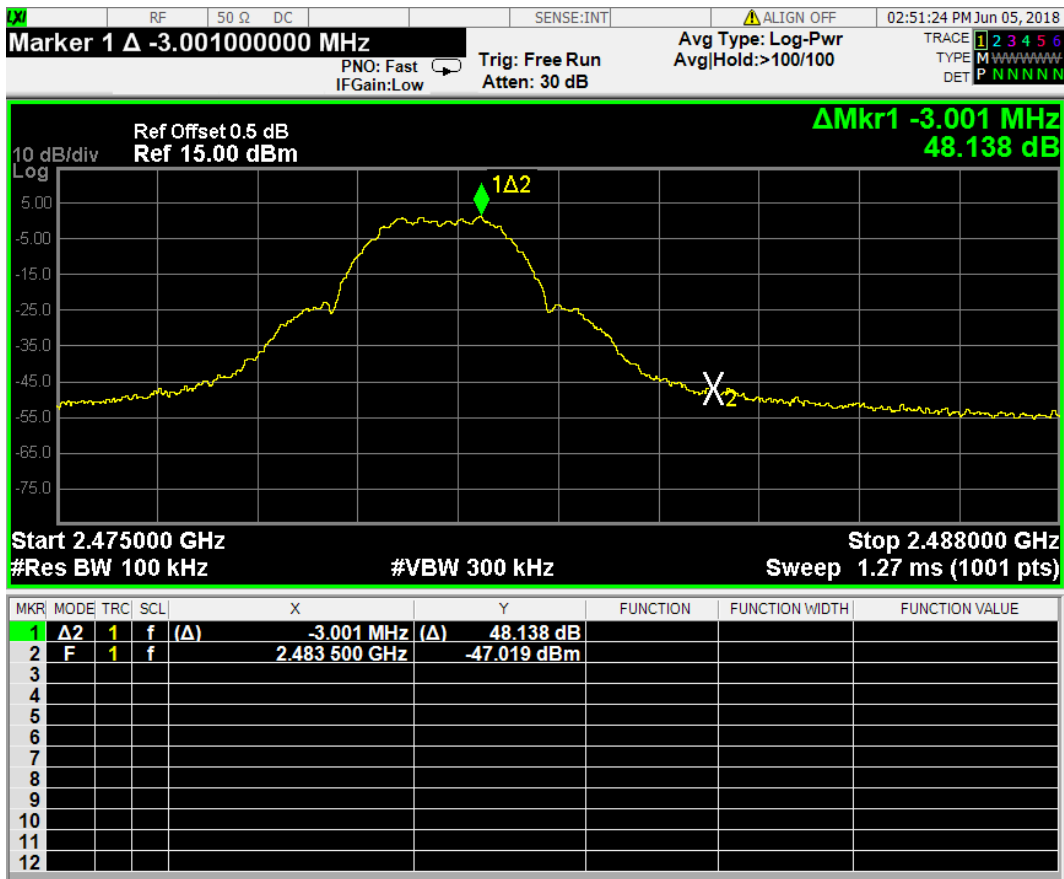
(Test Date: 2018.06.05 Temperature: 23°C Humidity: 51 %)

Modulation	Location	Channel	Frequency (MHz)	Delta Marker (dB)	Result
Zigbee	Below Band Edge	11	2405	<b>58.138</b>	More than <b>20 dB</b> below the highest level of the desired power
	Upper Band Edge	26	2480	<b>48.138</b>	

Zigbee: CH11 2405MHz (Below Edge 2390 MHz)



Zigbee: CH26 2480MHz (Upper Edge 2483.5 MHz)





## 9 POWER SPECTRAL DENSITY MEASUREMENT

### 9.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

### 9.2 Block Diagram of Test Setup

The Same as section 4.2.

### 9.3 Specification Limits (§15.247(e))

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

### 9.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 9.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The Test Receiver was set as  $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$ ,  $\text{VBW} \geq 3 \times \text{RBW}$ ,  $\text{span} = 1.5$  times the DTS channel bandwidth.

The test procedure is defined in ANSI C63.10-2013 ( 11.10.2 Measurement Procedure “Method PKPSD (peak PSD)” was used).

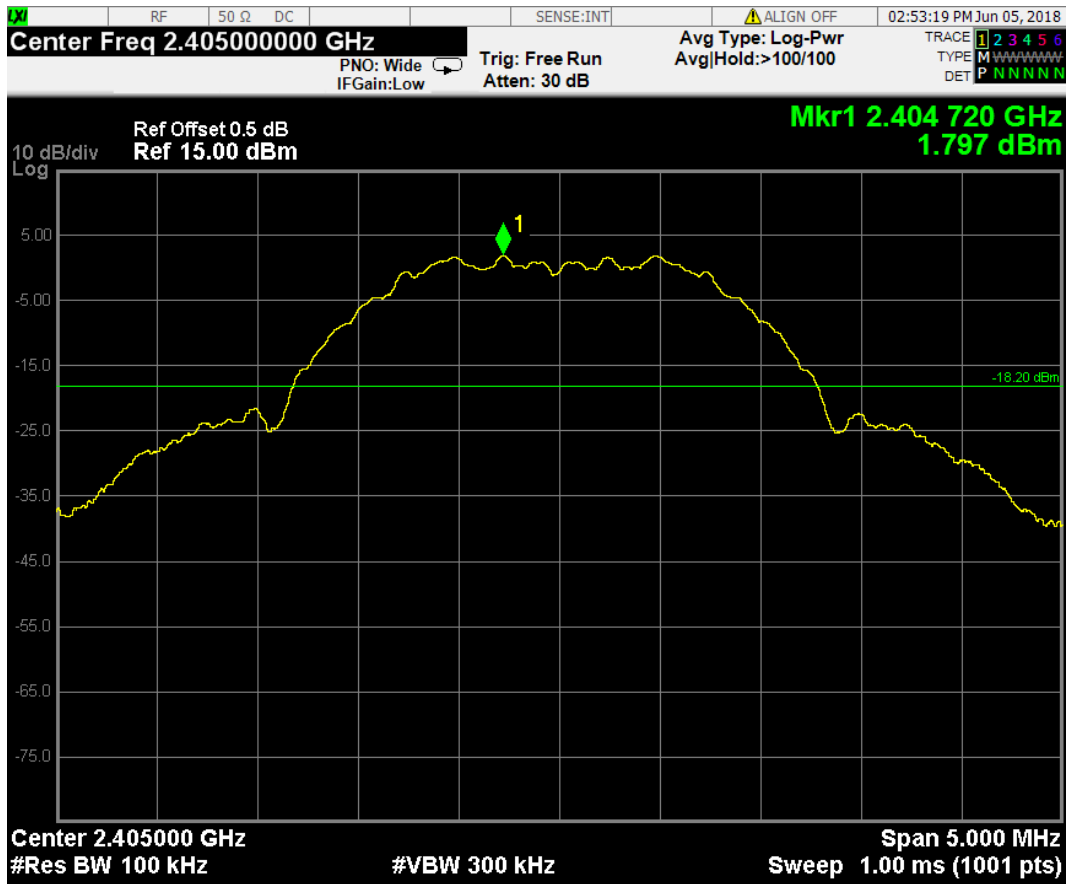
### 9.6 Test Results

**PASSED.** All the test results are attached in next pages.

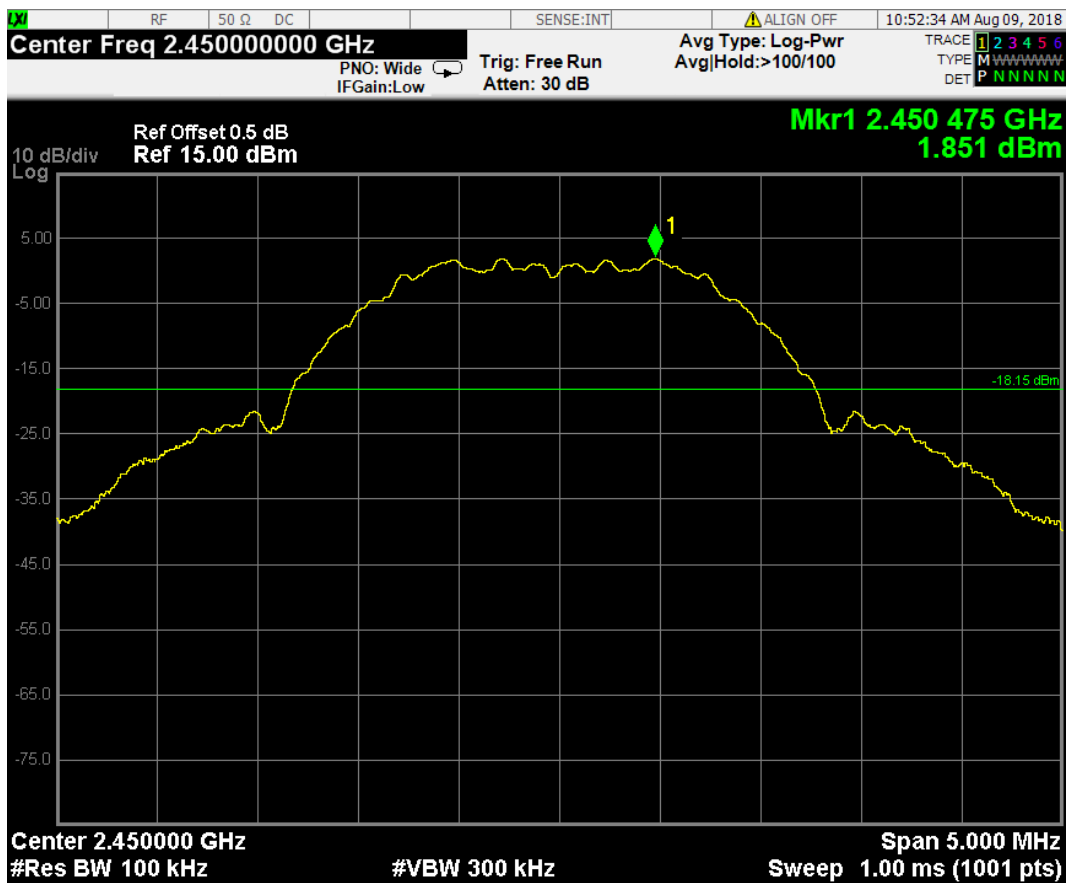
(Test Date: 2018.06.05 Temperature: 23°C Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit
Zigbee	11	2405	<b>1.797</b>	8 dBm
	20	2450	<b>1.851</b>	8 dBm
	26	2480	<b>0.786</b>	8 dBm

### Zigbee: CH11 (2405 MHz)



### Zigbee: CH20 (2450 MHz)



### Zigbee: CH26 (2480 MHz)



## 10 DEVIATION TO TEST SPECIFICATIONS

None.