



## FCC Test Report

**Report No.:** LDF-ESH-P23091838B-2

**FCC ID:** DWNSON2830ZB243

**Product:** SONESSE2 28 Zigbee HP

**Test Model:** 5175514

**Received Date:** Oct.16, 2023

**Test Date:** Oct.16, 2023 to Dec.21, 2023

**Issued Date:** Jan.24, 2024

**Applicant:** Somfy US, Inc.

**Address:** 121 Herrod Blvd, Dayton, NJ 08810

**Manufacturer:** Somfy US, Inc.

**Address:** 121 Herrod Blvd, Dayton, NJ 08810

**Issued By:** BUREAU VERITAS ADT (Shanghai) Corporation

**Lab Address:** No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)



This report is governed by, and incorporates by reference, the Conditions of Testing as posted at the date of issuance of this report at <http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions/> and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurement uncertainty is only provided upon request for accredited tests. Statements of conformity are based on simple acceptance criteria without taking measurement uncertainty into account, unless otherwise requested in writing. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.

### Table of Contents



Release Control Record.....	4
1 Certificate of Conformity .....	5
2 Summary of Test Results .....	6
2.1 Test Instruments .....	7
2.2 Measurement Uncertainty .....	8
2.3 Modification Record .....	8
3 General Information.....	9
3.1 General Description of EUT.....	9
3.2 Description of Test Modes .....	10
3.2.1 Test Mode Applicability: .....	11
3.2.2 Test Condition: .....	12
3.3 Description of Support Units.....	13
3.4 General Description of Applied Standards .....	13
4 Test Procedure and Results.....	14
4.1 AC Power Conducted Emission.....	14
4.1.1 Limits .....	14
4.1.2 Test Procedures .....	14
4.1.3 Deviation from Test Standard.....	14
4.1.4 Test Setup.....	15
4.1.5 EUT Operating Conditions.....	15
4.1.6 Test Results .....	16
4.2 Minimum 6dB Bandwidth.....	18
4.2.1 Limit.....	18
4.2.2 Test Setup.....	18
4.2.3 Test Procedures .....	18
4.2.4 Deviation of Test Standard.....	18
4.2.5 Test Results .....	19
4.3 Conducted Output Power .....	21
4.3.1 Limit.....	21
4.3.2 Test Setup.....	21
4.3.3 Test Procedures .....	21
4.3.4 Deviation of Test Standard.....	21
4.3.5 Test Results .....	22
4.4 Power Spectral Density.....	24



4.4.1	Limit.....	24
4.4.2	Test Setup.....	24
4.4.3	Test Procedures.....	24
4.4.4	Deviation of Test Standard.....	24
4.4.5	Test Results.....	25
4.5	Conducted Band Edges Measurement.....	27
4.5.1	Limit.....	27
4.5.2	Test Setup.....	27
4.5.3	Test Procedures.....	27
4.5.4	Deviation of Test Standard.....	27
4.5.5	Test Results.....	28
4.6	Conducted Spurious Emissions.....	29
4.6.1	Limit.....	29
4.6.2	Test Setup.....	29
4.6.3	Test Procedures.....	29
4.6.4	Deviation of Test Standard.....	29
4.6.5	Test Results.....	30
4.7	Emissions in restricted frequency bands.....	34
4.7.1	Test Limit.....	34
4.7.2	Test Procedure Reference.....	35
4.7.3	Test Procedures.....	35
4.7.4	Test Setup.....	36
4.7.5	Test Results.....	37
4.8	Radiated Emission Measurement.....	40
4.8.1	Limits.....	40
4.8.2	Test Procedures.....	40
4.8.3	Deviation from Test Standard.....	41
4.8.4	Test Setup.....	42
4.8.5	EUT Operating Conditions.....	43
4.8.6	Test Results.....	43
5	Pictures of Test Arrangements.....	48



### Release Control Record

Issue No.	Description	Date Issued
LDF-ESH-P23091838B-2	Original release	Jan.24, 2024

## 1 Certificate of Conformity

**Product:** SONESSE2 28 Zigbee HP

**Brand:** **somfy.**

**Test Model:** #5175514

**Applicant:** Somfy US, Inc

**Test Date:** Oct.16, 2023 to Dec.21, 2023

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
ANSI C63.10:2020

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**Prepared by :**



**Date:**

Jan.24, 2024

Yan ZHOU

Project Engineer

**Approved by :**



**Date:**

Jan.24, 2024

RF Supervisor



## 2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.203	Antenna Requirement	PASS	No antenna connector is used.
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	Minimum 6dB Bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.247(d)	Conducted Band Edges Measurement	PASS	Meet the requirement of limit.
15.247(d)	Conducted Spurious Emissions	PASS	Meet the requirement of limit.
15.247(d)	Emissions in restricted frequency bands	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions Measurement	PASS	Meet the requirement of limit.

### 2.1 Test Facility

**Laboratory Name:** Bureau Veritas ADT (ShangHai) Corporation

**Laboratory Address:** No.829, Xin Zhuan Road, Song Jiang District, Shanghai, China

**Test Location:** No.829, Xin Zhuan Road, Song Jiang District, Shanghai, China

**A2LA Lab Code:** 2343.01

**FCC-Recognized Accredited Testing Lab:** CN1213

**ISED Recognized Lab:** 6392A

**FCC Accredited Test Site Number:** 176467



## 2.2 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid Antenna(30MHz-1GHz)	Schwarzbeck	VULB9168	E1A1012	8/17/2023	8/16/2025
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	7/25/2022	7/24/2024
Horn Antenna(18GHz-40GHz)	Com-Power	AH-840	E1A1040	7/25/2022	7/24/2024
Pre-Amplifier(0.1MHz~1300MHz)	Agilent	8447D	E1A2001	3/3/2023	3/2/2024
Pre-Amplifier(18GHz-40GHz)	EMC Instruments Corporation	EMC184045SE	E1A2008	8/11/2023	8/10/2024
EMI Test Receiver	R&S	ESR7	E1R1005	3/3/2023	3/2/2024
EMI Test Spectrum	Keysight	N9030B	E1S1003	8/29/2023	8/28/2024
Signal Analyzer	Keysight	N9020A	E1S1004	3/2/2023	3/1/2024
LISN(single phase)	Rohde&Schwarz	ENV216	E1L1011	9/1/2023	8/31/2024
RF Control Unit	Toscend	JS0806-2	E1C5003	N/A	N/A
Test Software	Toscend	JS32-CE	5.0.0.1	N/A	N/A
Test Software	Toscend	JS32-RE	5.0.0	N/A	N/A
Test Software	Toscend	JS1120-3	V3.2.22	N/A	N/A

### 2.3 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

Measurement	Frequency	Expanded Uncertainty ( $k=2$ ) ( $\pm$ )
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

### 2.4 Modification Record

There were no modifications required for compliance.



### 3 General Information

#### 3.1 General Description of EUT

Product	SONESSE2 28 Zigbee HP
Brand	<b>somfy</b>
Test Model	#5175514
Power Rating	12V---; 1,0A; Rated torque: 1,1Nm; Operating time: 4minutes for Sonesse 28 WF Zigbee, 6minutes for the others;
Modulation Type	O-QPSK
Modulation Technology	6LoWPAN
Operating Frequency	2405MHz to 2480MHz
Number of Channel	16
Antenna Type	External Antenna
Antenna Connector	--
Antenna Gain	1dBi

Note: For more details, please refer to the User's manual of the EUT.

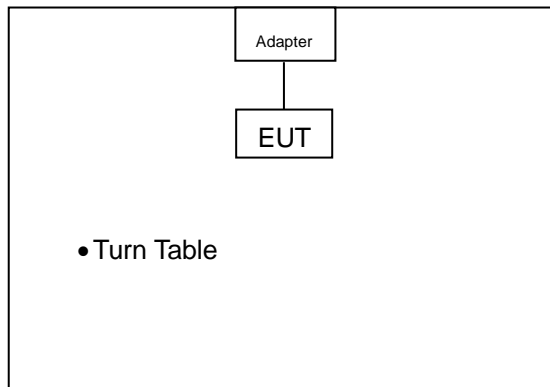
### 3.2 Description of Test Modes

16 channels are provided for Zigbee.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

### 3.3 DESCRIPTION OF SYSTEM UNDER TEST

#### RADIATED TEST CONFIGURATION



### 3.3.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE ≥ 1G	RE < 1G	PLC	APCM	
-	√	√	√	√	-

Where **RE ≥ 1G**: Radiated Emission above 1GHz      **RE < 1G**: Radiated Emission below 1GHz  
**PLC**: Power Line Conducted Emission      **APCM**: Antenna Port Conducted Measurement

#### Radiated Emission Test (Above 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	Zigbee	11 to 26	11,18, 26	DSSS	OQPSK	250kbps

#### Radiated Emission Test (Below 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	Zigbee	11 to 26	11	DSSS	OQPSK	250kbps

#### Power Line Conducted Emission Test:

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	Zigbee	11 to 26	11	DSSS	OQPSK	250kbps

### Antenna Port Conducted Measurement

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	Zigbee	11 to 26	11,18, 26	DSSS	OQPSK	250kbps

### 3.3.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE ≥ 1G	23deg. C, 58%RH	DC 12V
RE < 1G	23deg. C, 58%RH	DC 12V
PLC	23deg. C, 58%RH	DC 12V
APCM	25deg. C, 60%RH	DC 12V

### **3.4 Description of Support Units**

The EUT has been tested as an independent unit together with other necessary accessories or support units.

### **3.5 General Description of Applied Standards**

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

**FCC Part 15, Subpart C (15.247)**

**KDB 558074 D01 DTS Meas Guidance v05r02**

**ANSI C63.10: 2020**

All relaxed test items have been performed and recorded as per the above standard.

## 4 Test Procedure and Results

### 4.1 AC Power Conducted Emission

#### 4.1.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

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

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

#### 4.1.2 Test Procedures

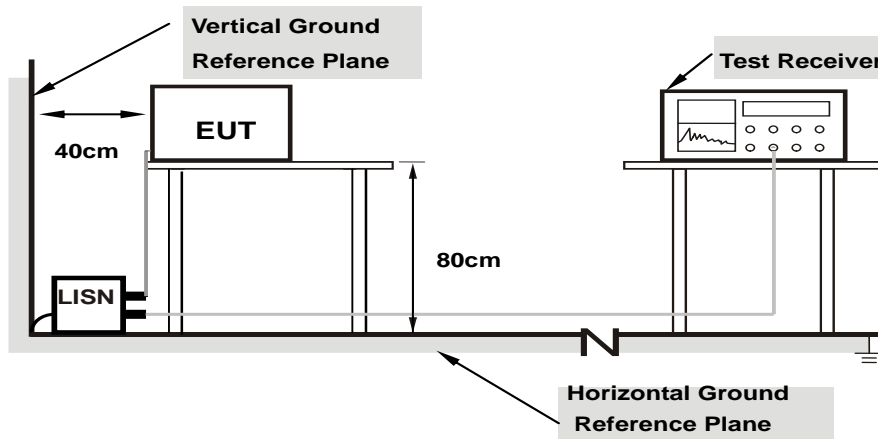
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**NOTE:** The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

#### 4.1.3 Deviation from Test Standard

No deviation.

#### 4.1.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

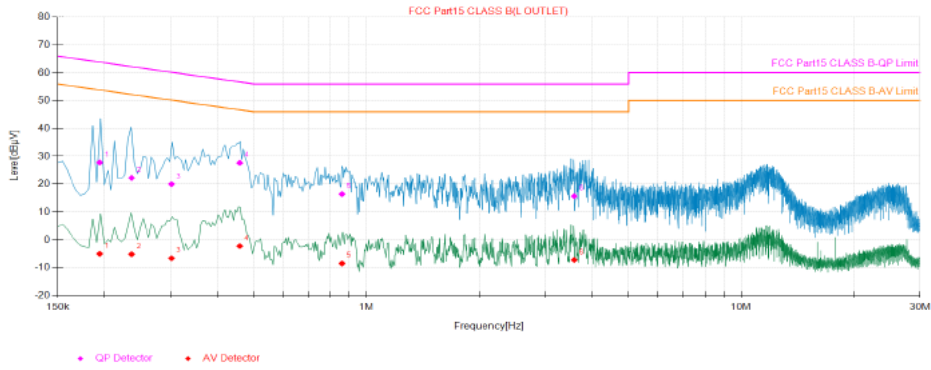
#### 4.1.5 EUT Operating Conditions

Same as 4.1.6.

## 4.1.6 Test Results

### Working While Worst case

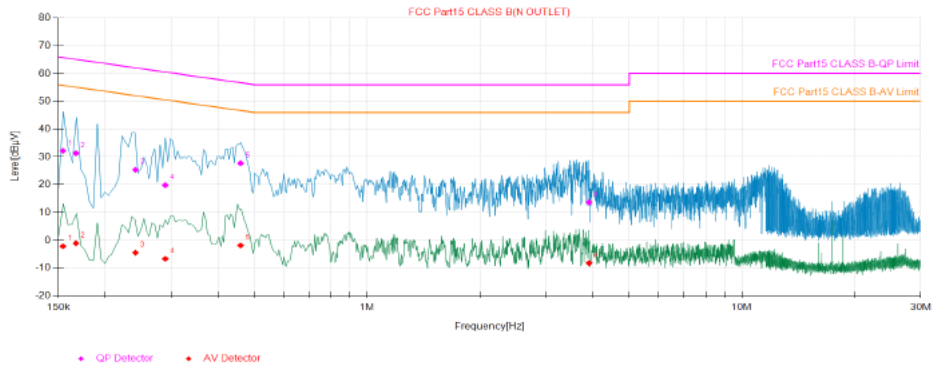
Test Graph



Final Data List												
N O.	Freq. [MHz]	Factor [dB]	QP Reading [dB µV]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading [dB µV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Type	Verdict
1	0.19	9.72	18.04	27.76	63.86	36.10	-14.75	-5.03	53.86	58.89	L	PASS
2	0.24	9.63	12.60	22.23	62.23	40.00	-14.82	-5.19	52.23	57.42	L	PASS
3	0.30	9.46	10.54	20.00	60.19	40.19	-16.08	-6.62	50.19	56.81	L	PASS
4	0.46	9.52	18.11	27.63	56.70	29.07	-11.78	-2.26	46.70	48.96	L	PASS
5	0.86	9.38	7.04	16.42	56.00	39.58	-17.90	-8.52	46.00	54.52	L	PASS
6	3.59	9.71	5.94	15.65	56.00	40.35	-17.01	-7.30	46.00	53.30	L	PASS



### Test Graph



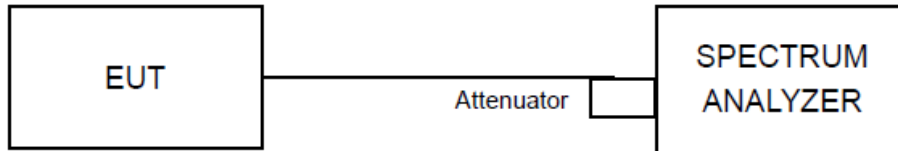
Final Data List												
N O.	Freq. [MHz]	Factor [dB]	QP Reading [dB µV]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading [dB µV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Type	Verdict
1	0.15	9.68	22.48	32.16	65.77	33.61	-11.89	-2.21	55.77	57.98	N	PASS
2	0.17	9.69	21.62	31.31	65.09	33.78	-10.80	-1.11	55.09	56.20	N	PASS
3	0.24	9.61	15.73	25.34	62.07	36.73	-14.12	-4.51	52.07	56.58	N	PASS
4	0.29	9.47	10.33	19.80	60.54	40.74	-16.17	-6.70	50.54	57.24	N	PASS
5	0.46	9.46	18.22	27.68	56.70	29.02	-11.31	-1.85	46.70	48.55	N	PASS
6	3.91	9.68	3.94	13.62	56.00	42.38	-17.93	-8.25	46.00	54.25	N	PASS

## 4.2 Minimum 6dB Bandwidth

### 4.2.1 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz

### 4.2.2 Test Setup



### 4.2.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW  $\geq$  3 RBW, peak detector with maximum hold) is implemented by the instrumentation function.

### 4.2.4 Deviation of Test Standard

No deviation.

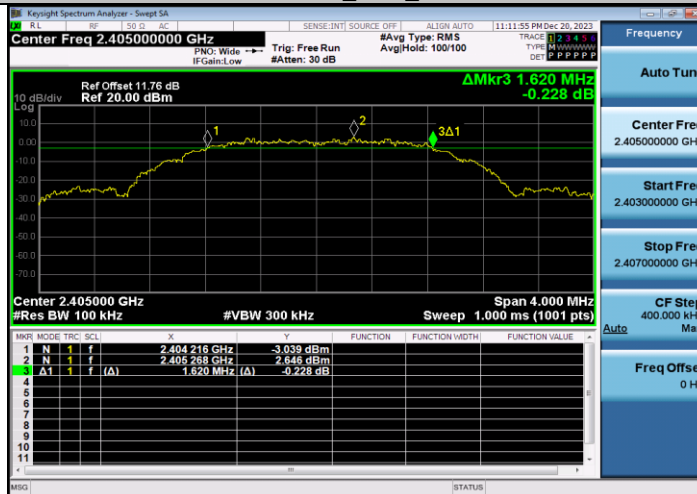


BUREAU  
VERITAS

#### 4.2.5 Test Results

TestMode	Antenna	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
ZIGBEE	Ant1	2405	1.620	2404.216	2405.836	0.5	PASS
		2440	1.640	2439.196	2440.836	0.5	PASS
		2480	1.640	2479.196	2480.836	0.5	PASS

### ZIGBEE\_Ant1\_2405



### ZIGBEE\_Ant1\_2440



### ZIGBEE\_Ant1\_2480

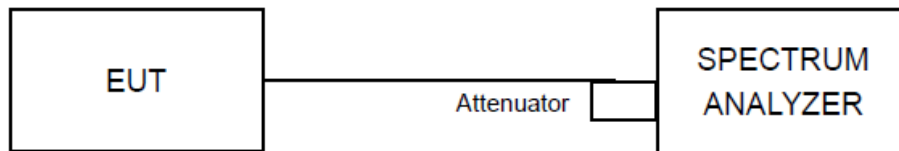


### 4.3 Conducted Output Power

#### 4.3.1 Limit

For systems using digital modulation in the 2400 – 2483.5 MHz bands: 1 Watt (30 dBm)

#### 4.3.2 Test Setup



#### 4.3.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 9.2.2.4).

- a) Set RBW  $\geq$  DTS bandwidth
- b) Set VBW  $\geq$  3 RBW.
- c) Set Span  $\geq$  3 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.

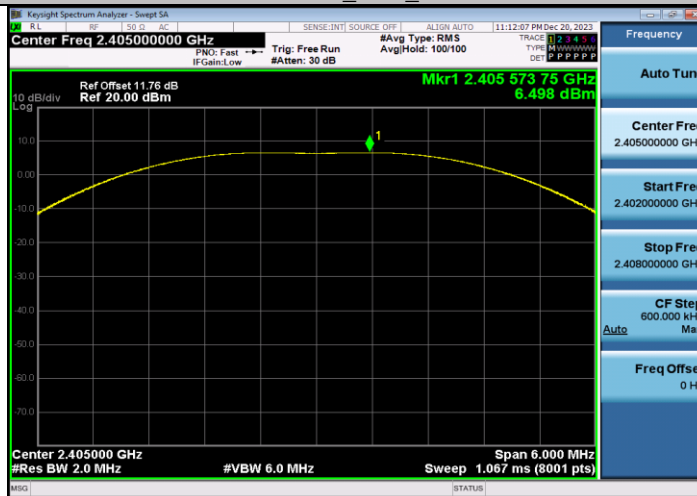
#### 4.3.4 Deviation of Test Standard

No deviation.

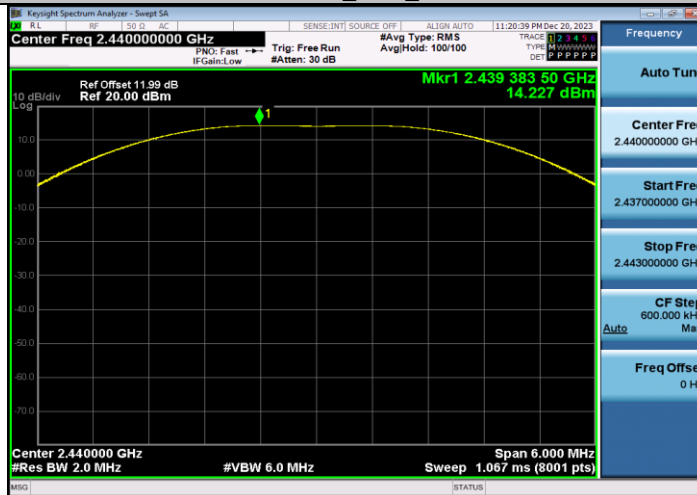
#### 4.3.5 Test Results

TestMode	Antenna	Freq(MHz)	Conducted Peak Power[dBm]	Conducted Limit[dBm]	EIRP[dBm]	EIRP Limit[dBm]	Verdict
ZIGBEE	Ant1	2405	6.5	≤30	7.5	≤36	PASS
		2440	14.23	≤30	15.23	≤36	PASS
		2480	-0.24	≤30	0.76	≤36	PASS

### ZIGBEE\_Ant1\_2405



### ZIGBEE\_Ant1\_2440



### ZIGBEE\_Ant1\_2480

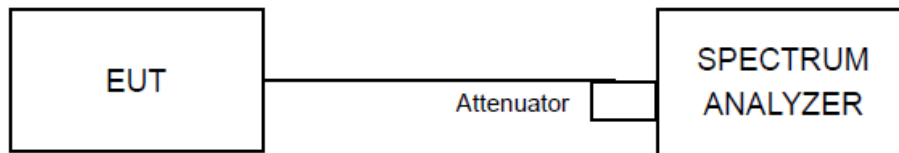


## 4.4 Power Spectral Density

### 4.4.1 Limit

The Maximum of Power Spectral Density Measurement is 8 dBm.

### 4.4.2 Test Setup



### 4.4.3 Test Procedures

The power output per FCC § 15.247(e) was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

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

### 4.4.4 Deviation of Test Standard

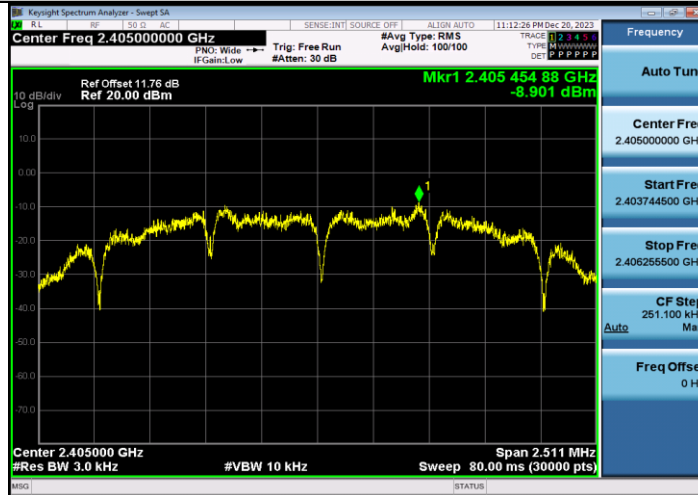
No deviation.



#### 4.4.5 Test Results

TestMode	Antenna	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
ZIGBEE	Ant1	2405	-8.9	≤8.00	PASS
		2440	-1.19	≤8.00	PASS
		2480	-15.63	≤8.00	PASS

### ZIGBEE\_Ant1\_2405



### ZIGBEE\_Ant1\_2440



### ZIGBEE\_Ant1\_2480

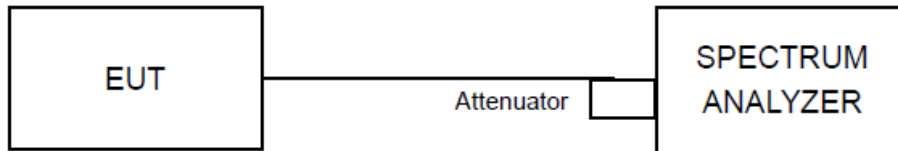


## 4.5 Conducted Band Edges Measurement

### 4.5.1 Limit

Below 20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.5.2 Test Setup



### 4.5.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

#### MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

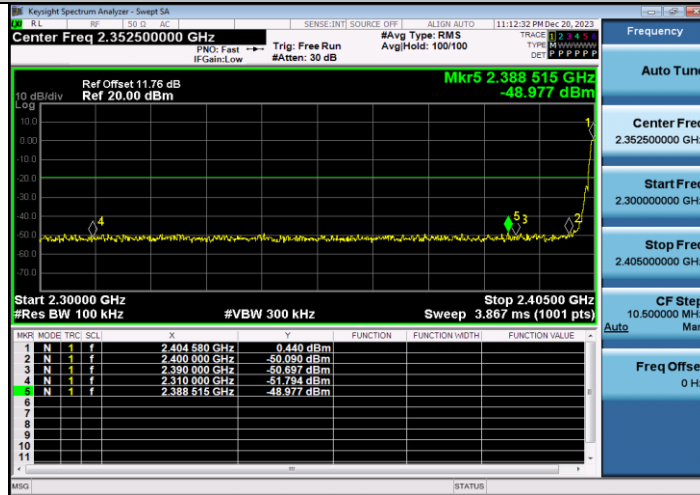
### 4.5.4 Deviation of Test Standard

No deviation.

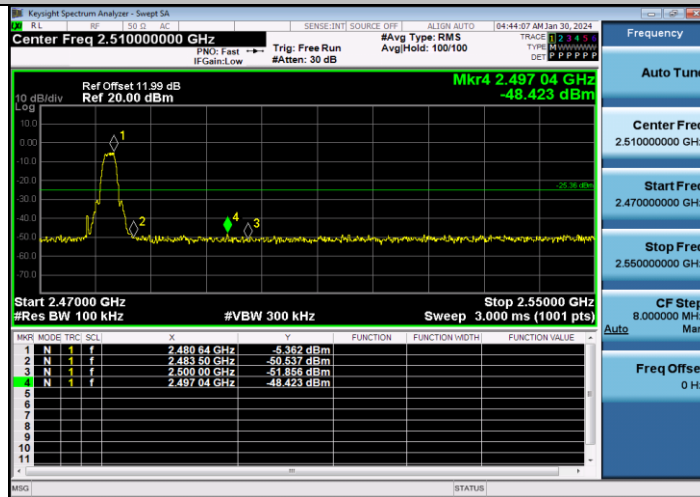
### 4.5.5 Test Results

TestMode	Antenna	ChName	Freq(MHz)	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
ZIGBEE	Ant1	Low	2405	0.44	-48.98	≤-19.56	PASS
		High	2480	-5.36	-48.42	≤-25.36	PASS

#### ZIGBEE \_Ant1\_Low\_2405



#### ZIGBEE \_Ant1\_High\_2480

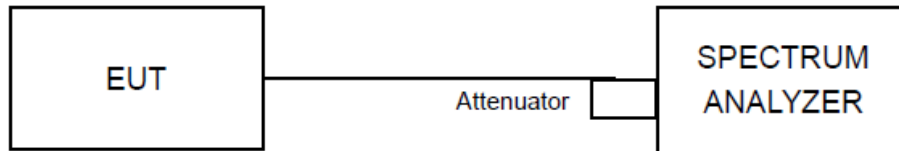


## 4.6 Conducted Spurious Emissions

### 4.6.1 Limit

Below 20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.6.2 Test Setup



### 4.6.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

#### MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

### 4.6.4 Deviation of Test Standard

No deviation.

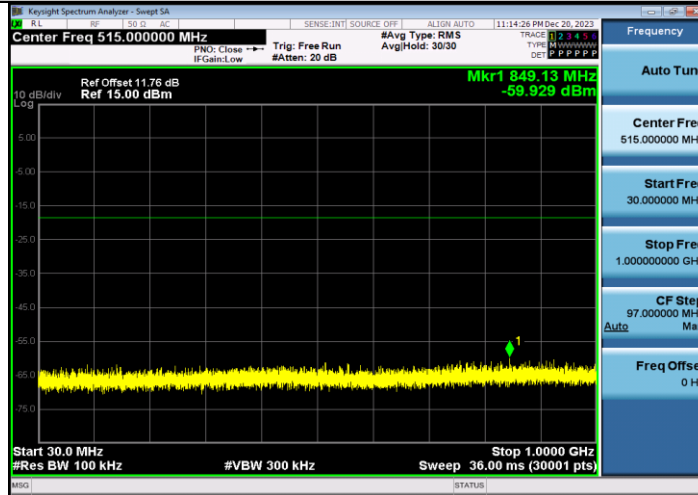
#### 4.6.5 Test Results

TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2405	Reference	1.38	1.38	---	PASS
			30~1000	1.38	-59.93	≤-18.62	PASS
			1000~26500	1.38	-43.48	≤-18.62	PASS
		2440	Reference	10.00	10.00	---	PASS
			30~1000	10.00	-58.71	≤-10	PASS
			1000~26500	10.00	-43.78	≤-10	PASS
		2480	Reference	-5.03	-5.03	---	PASS
			30~1000	-5.03	-59.24	≤-25.03	PASS
			1000~26500	-5.03	-43.87	≤-25.03	PASS

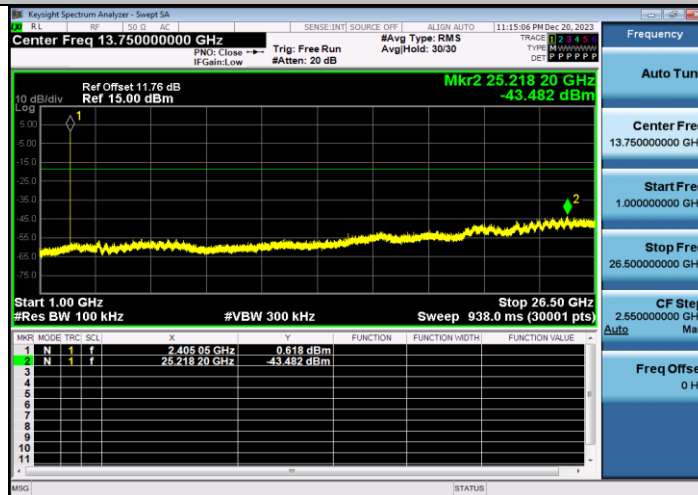
BLE\_1M\_Ant1\_2405\_0~Reference



BLE\_1M\_Ant1\_2405\_30~1000



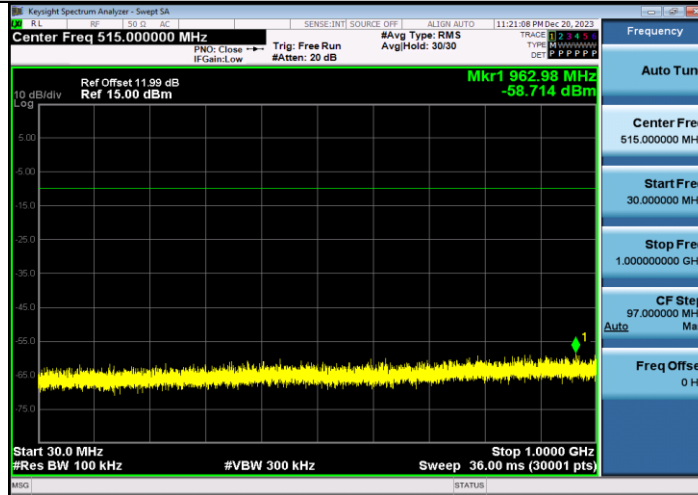
BLE\_1M\_Ant1\_2405\_1000~26500



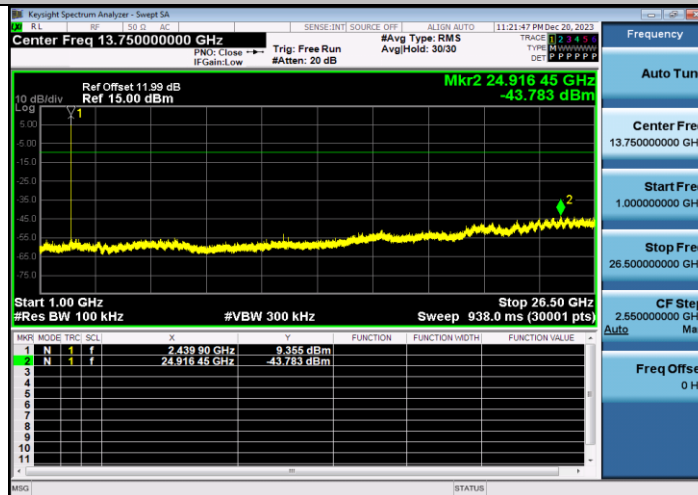
BLE\_1M\_Ant1\_2440\_0~Reference



BLE\_1M\_Ant1\_2440\_30~1000



BLE\_1M\_Ant1\_2440\_1000~26500

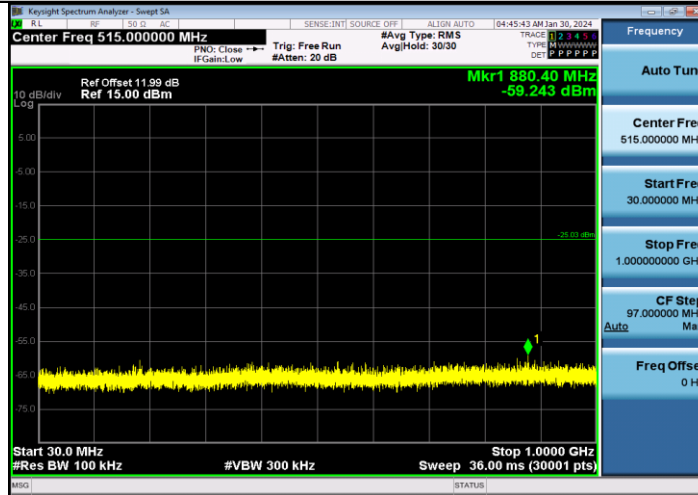




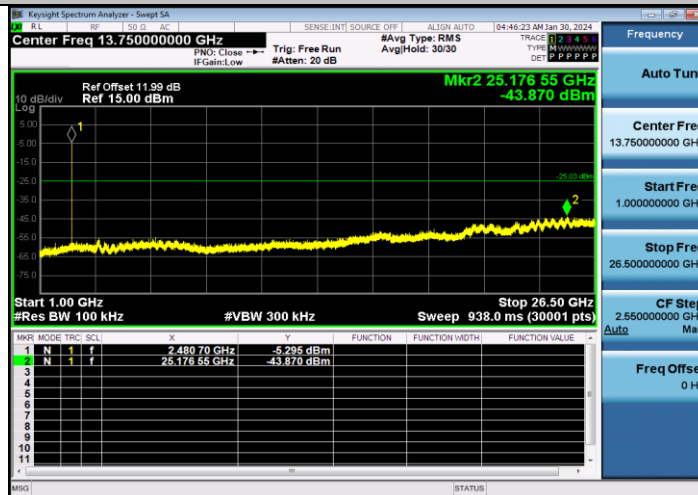
BLE\_1M\_Ant1\_2480\_0~Reference



BLE\_1M\_Ant1\_2480\_30~1000



BLE\_1M\_Ant1\_2480\_1000~26500





## 4.7 Emissions in restricted frequency bands

### 4.7.1 Test Limit

#### **For 15.205 requirement:**

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part15, must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
1 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(2)
13.36 - 13.41	--	--	--



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

<b>FCC Part 15 Subpart C Paragraph 15.209</b>		
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

#### **4.7.2 Test Procedure Reference**

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

#### **4.7.3 Test Procedures**

##### **Peak Field Strength Measurements**

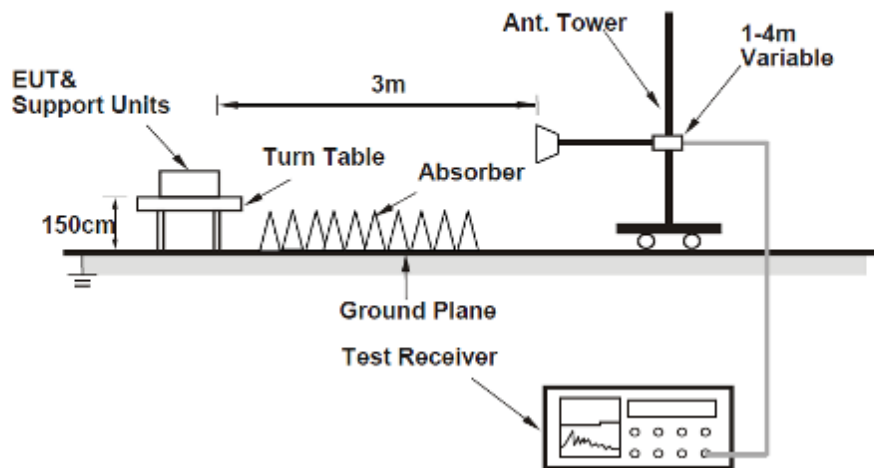
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

### Average Measurements above 1GHz (Method VB)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle  $\geq 98\%$ , set VBW = 10 Hz.  
If the EUT duty cycle is  $< 98\%$ , set VBW  $\geq 1/T$ . T is the minimum transmission duration.
3. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Trace was allowed to stabilize

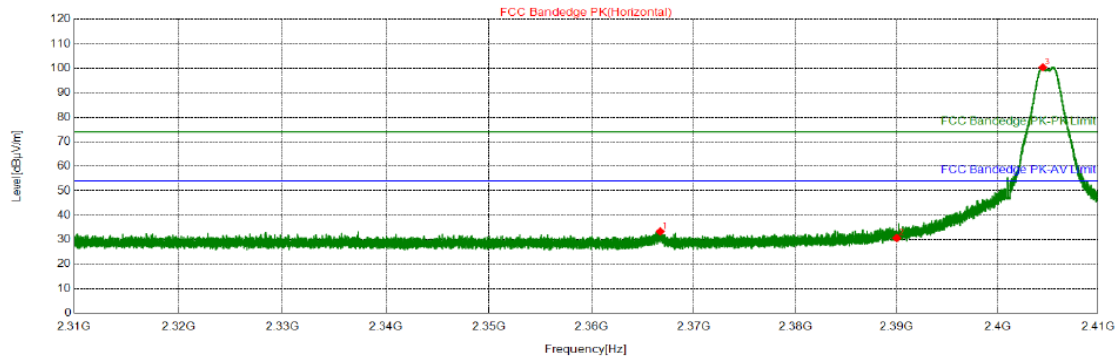
#### 4.7.4 Test Setup

For Radiated emission above 1GHz



#### 4.7.5 Test Results

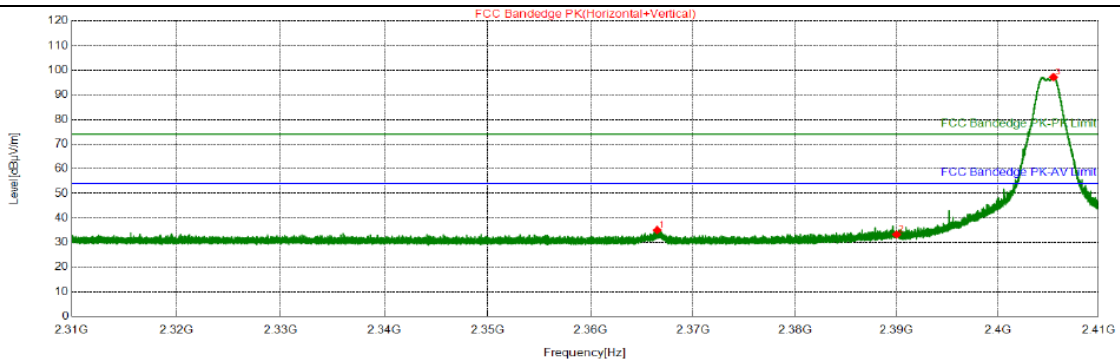
##### Zigbee\_Ant1\_2405 / Horizontal



##### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2366.73	51.00	33.34	74.00	40.66	155	2	Horizontal	PK
2	2390	48.38	30.65	74.00	43.35	155	2	Horizontal	PK
3	2404.5	118.12	100.36	74.00	-26.36	155	2	Horizontal	PK

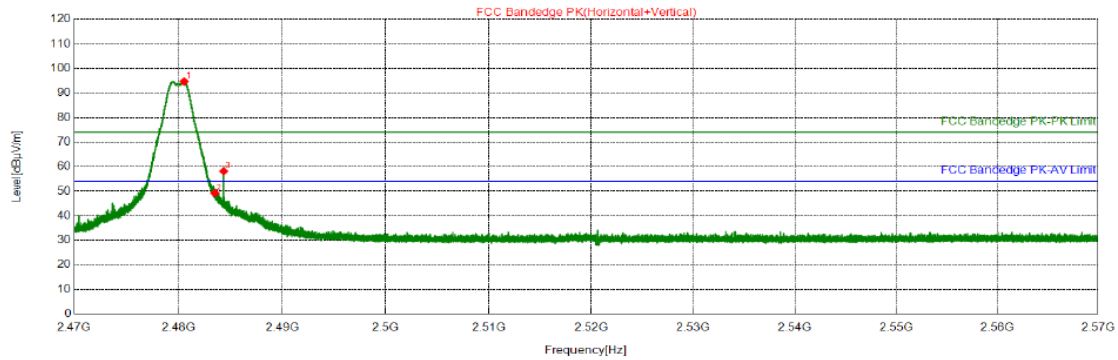
##### Zigbee\_Ant1\_2405 / Vertical



##### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2366.505	52.71	35.05	74.00	38.95	155	268	Vertical	PK
2	2390	51.02	33.29	74.00	40.71	155	44	Vertical	PK
3	2405.52	114.90	97.13	74.00	-23.13	155	47	Vertical	PK

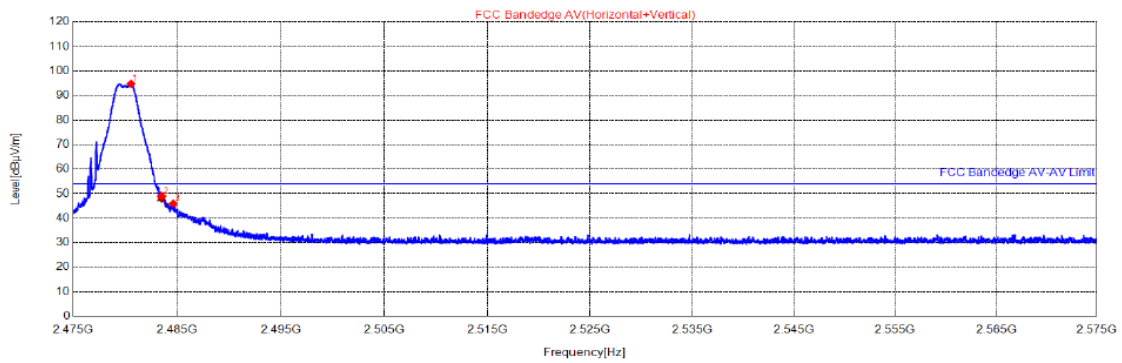
### Zigbee\_Ant1\_2480 / Horizontal PK



#### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.56	112.52	94.67	74.00	-20.67	155	65	Horizontal	PK
2	2483.5	67.08	49.23	74.00	24.77	155	65	Horizontal	PK
3	2484.355	75.95	58.10	74.00	15.90	155	6	Horizontal	PK

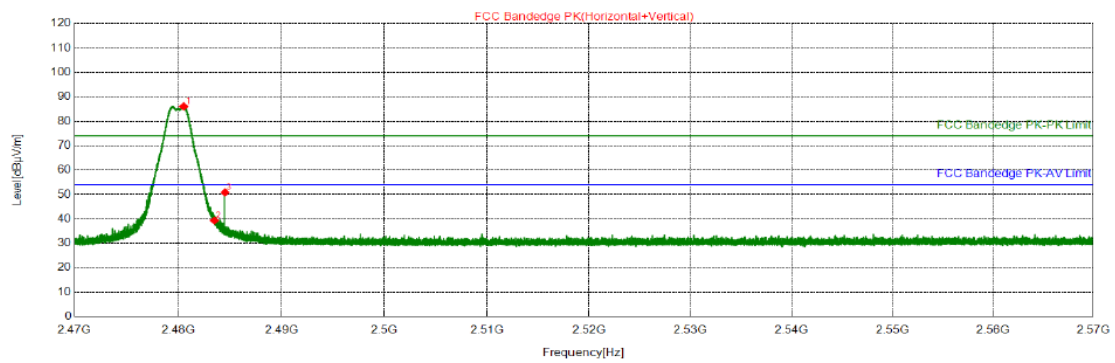
### Zigbee\_Ant1\_2480 / Horizontal AV



#### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.5625	112.62	94.77	54.00	-40.77	155	65	Horizontal	AV
2	2483.5	66.77	48.92	54.00	5.08	155	74	Horizontal	AV
3	2484.6125	63.76	45.91	54.00	8.09	155	112	Horizontal	AV

### Zigbee\_Ant1\_2480 / Vertical



#### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.545	103.90	86.05	74.00	-12.05	155	62	Vertical	PK
2	2483.5	57.19	39.34	74.00	34.66	155	59	Vertical	PK
3	2484.53	68.67	50.82	74.00	23.18	155	113	Vertical	PK

## 4.8 Radiated Emission Measurement

### 4.8.1 Limits

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

### 4.8.2 Test Procedures

#### For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degree to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned from 0 degree to 360 degree to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

**Note:**

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.



### **For Radiated emission above 30MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

### **Note:**

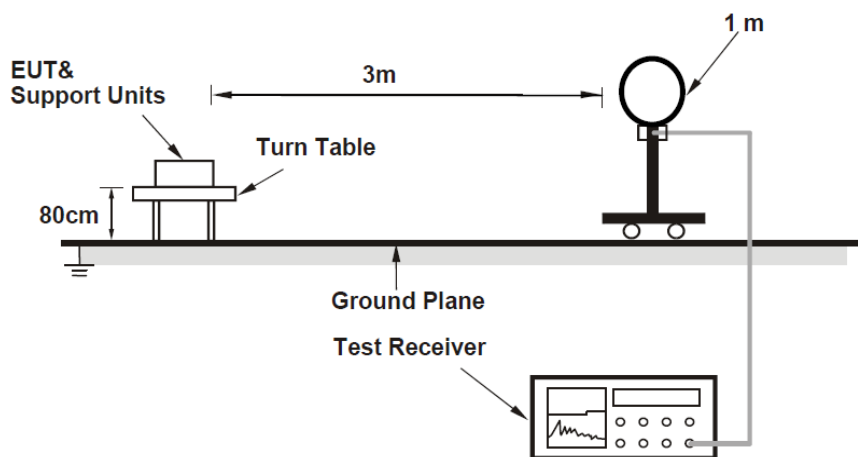
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle  $\geq$  98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

### **4.8.3 Deviation from Test Standard**

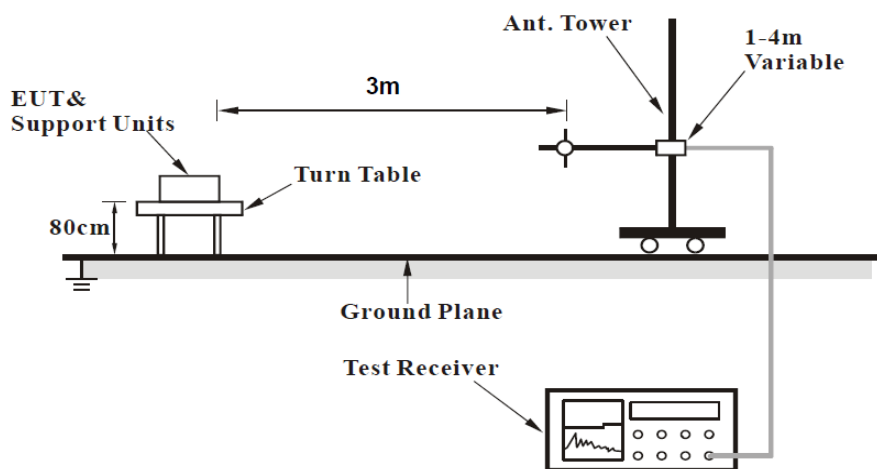
No deviation.

#### 4.8.4 Test Setup

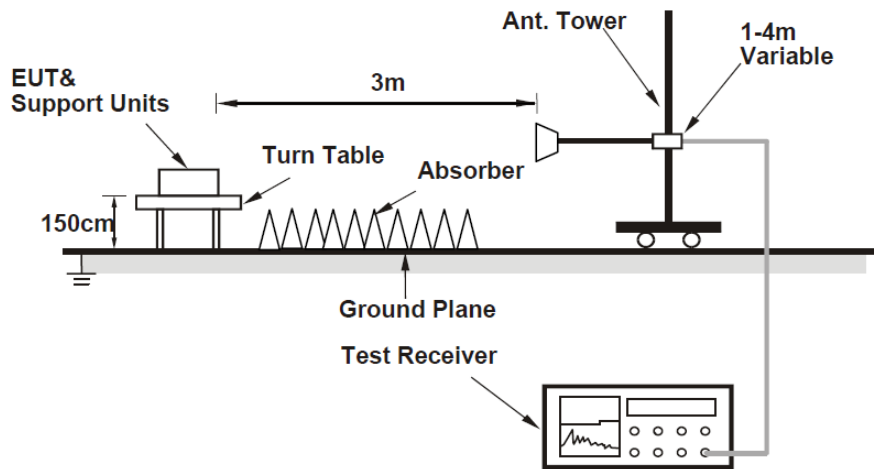
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



**For Radiated emission above 1GHz**



For the actual test configuration, please refer to the attached file (Test Setup Photo).

**4.8.5 EUT Operating Conditions**

- a. Placed the EUT on a testing table.
- b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

**4.8.6 Test Results**

**Radiated Emissions Range 9kHz~30MHz**

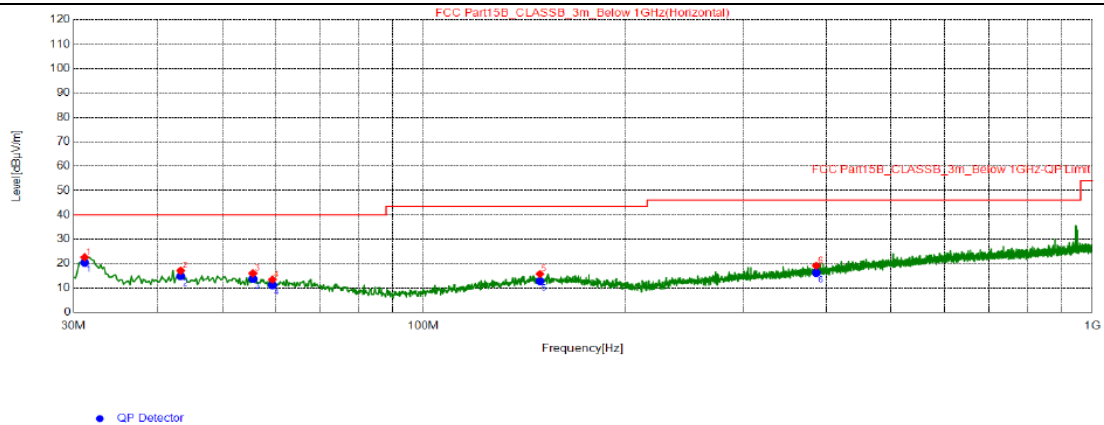
The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

## Radiated Emissions Range 30MHz~1GHz

Below is the worst test data

<b>Channel</b>	Zigbee _Ant1_2405	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Horizontal

Test Plot:



### Suspected List

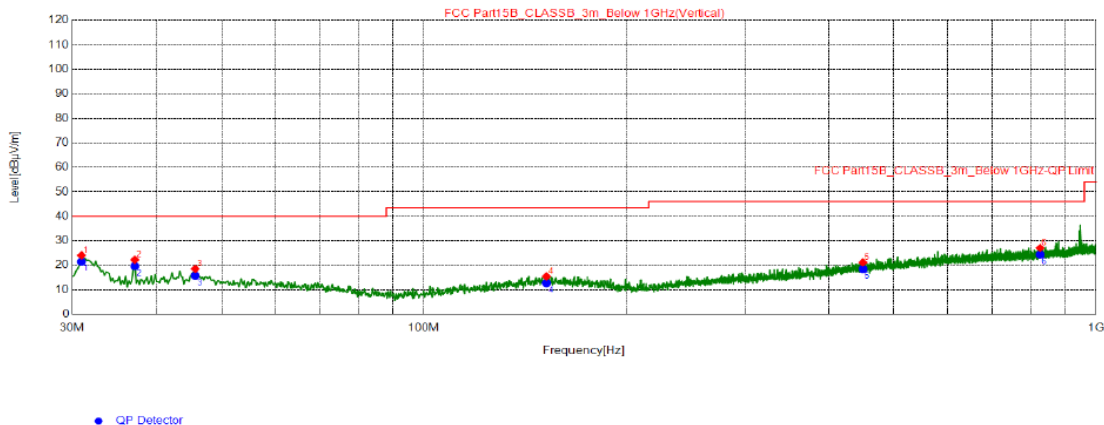
NO.	Freq. [MHz]	Reading [dBuV/m]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	31.164	34.29	22.61	40.00	17.39	200	20	Horizontal	PK
2	43.386	27.82	17.09	40.00	22.91	200	290	Horizontal	PK
3	55.608	26.55	16.03	40.00	23.97	200	210	Horizontal	PK
4	59.488	24.08	13.45	40.00	26.55	200	350	Horizontal	PK
5	149.31	25.59	15.73	43.50	27.77	200	270	Horizontal	PK
6	386.572	25.69	19.15	46.00	26.85	200	350	Horizontal	PK

### REMARKS:

1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(Db/m)
2. Correction Factor(Db/m) = Antenna Factor(Db/m) + Cable Factor(Db) – Pre-Amplifier Factor(Db)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level

<b>Channel</b>	Zigbee _Ant1_2405	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Vertical

Test Plot:



#### Suspected List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	30.97	35.72	24.03	40.00	15.97	100	350	Vertical	PK
2	37.178	33.40	22.24	40.00	17.76	100	50	Vertical	PK
3	45.714	29.09	18.49	40.00	21.51	100	110	Vertical	PK
4	152.22	25.32	15.45	43.50	28.05	100	60	Vertical	PK
5	449.816	26.04	21.14	46.00	24.86	100	320	Vertical	PK
6	825.4	26.27	27.04	46.00	18.96	100	260	Vertical	PK

#### REMARKS:

- Emission Level(dBuV/m) = Original Spectrum reading (dBUV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Limit value – Emission Level

### Radiated Emission Range 1GHz~10th Harmonic

Below is the worst test data

<b>Channel</b>	Zigbee _Ant1_2405	<b>Detector Function</b>	Peak (PK)
<b>Frequency Range</b>	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	7215.2000	41.58	74.00	32.42	-8.80	H	PK
2	7215.2000	30.17	54.00	23.83	-8.80	H	AV
3	7215.2000	38.94	74.00	35.06	-8.80	V	PK
4	7215.2000	25.26	54.00	28.74	-8.80	V	AV

#### REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level

<b>Channel</b>	Zigbee _Ant1_2440	<b>Detector Function</b>	Peak (PK)
<b>Frequency Range</b>	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	7321.2000	49.67	74.00	24.33	-8.82	H	PK
2	7321.2000	40.58	54.00	13.42	-8.82	H	AV
3	7321.2000	47.45	74.00	26.55	-8.82	V	PK
4	7321.2000	38.34	54.00	15.66	-8.82	V	AV

#### REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level

<b>Channel</b>	Zigbee _Ant1_2480	<b>Detector Function</b>	Peak (PK)
<b>Frequency Range</b>	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	7440.6000	37.63	74.00	36.37	-8.77	H	PK
2	7440.6000	27.44	54.00	26.56	-8.77	H	AV
3	7440.6000	38.27	74.00	35.73	-8.77	V	PK
4	7440.6000	27.37	54.00	26.63	-8.77	V	AV

**REMARKS:**

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level

## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

--- END ---