

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



**FCC Applicant:** Shoreline IoT, Inc.  
15750 Winchester Blvd., Ste 206, Los Gatos CA, 95030 USA

**FCC Manufacturer:** Shoreline IoT, Inc.  
15750 Winchester Blvd., Ste 206, Los Gatos CA, 95030 USA

**Product Name:** iCastSense

**Brand Name:** iCastSense

**Model No.:** iCastSense 1A

**Model Difference:** N/A

**Report Number:** E2/2022/10068

**FCC ID** 2AQSRSSNS1A

**Issue Date:** Apr. 13, 2022

**Date of Test:** Jan. 19, 2022~Feb. 21, 2022

**Date of EUT Received:** Jan. 13, 2022

*Vito. Pei*  
**Approved By** \_\_\_\_\_

*Vito Pei*

### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247.

The results of this report relate only to the sample identified in this report.

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## Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
E2/2022/10068	00	Original.	Apr. 01, 2022	Yi-Shan Tsai	
E2/2022/10068	01	Update Conduction Data	Apr. 13, 2022	Yi-Shan Tsai	*

**Note:**

- 1、The remark "\*" indicates modification of the report upon requests from certification body.

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## 1 GENERAL INFORMATION

### 1.1 Product Description

Product Name:	iCastSense
Brand Name:	iCastSense
Model No.:	iCastSense 1A
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	21122006GNS00 (Conducted) PJ221084002 (Radiated)
Power Supply:	Battery 3.6Vdc x 2 External power 10Vdc to 26Vdc
Test Software (Name/Version)	nRF Connect / 3.9.3 (Conducted) nRF Connect / 3.7.1 (Radiated)

### 1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: 3.55 dBm BLE 2M: 4.12 dBm

### 1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
PIFA	2402~2480	4

**Note:** Antenna information is provided by the applicant.

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## 1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10:2013

## 1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1 SAC 3 Conduction 1 Conducted 1 Conducted 2 Conducted 3 Conducted 4 Conducted 5 Conducted 6	TW0027	
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C SAC C SAC D SAC G Conducted A Conducted B Conducted C Conducted D Conducted E Conducted F Conducted G	TW3702	TW0028

**Note:** Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

## 1.6 Special Accessories

There are no special accessories used while test was conducted.

## 1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

#### 2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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## 2.4 Measurement Results Explanation Example

### 2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m\*6m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### 2.4.2 For all conducted test items:

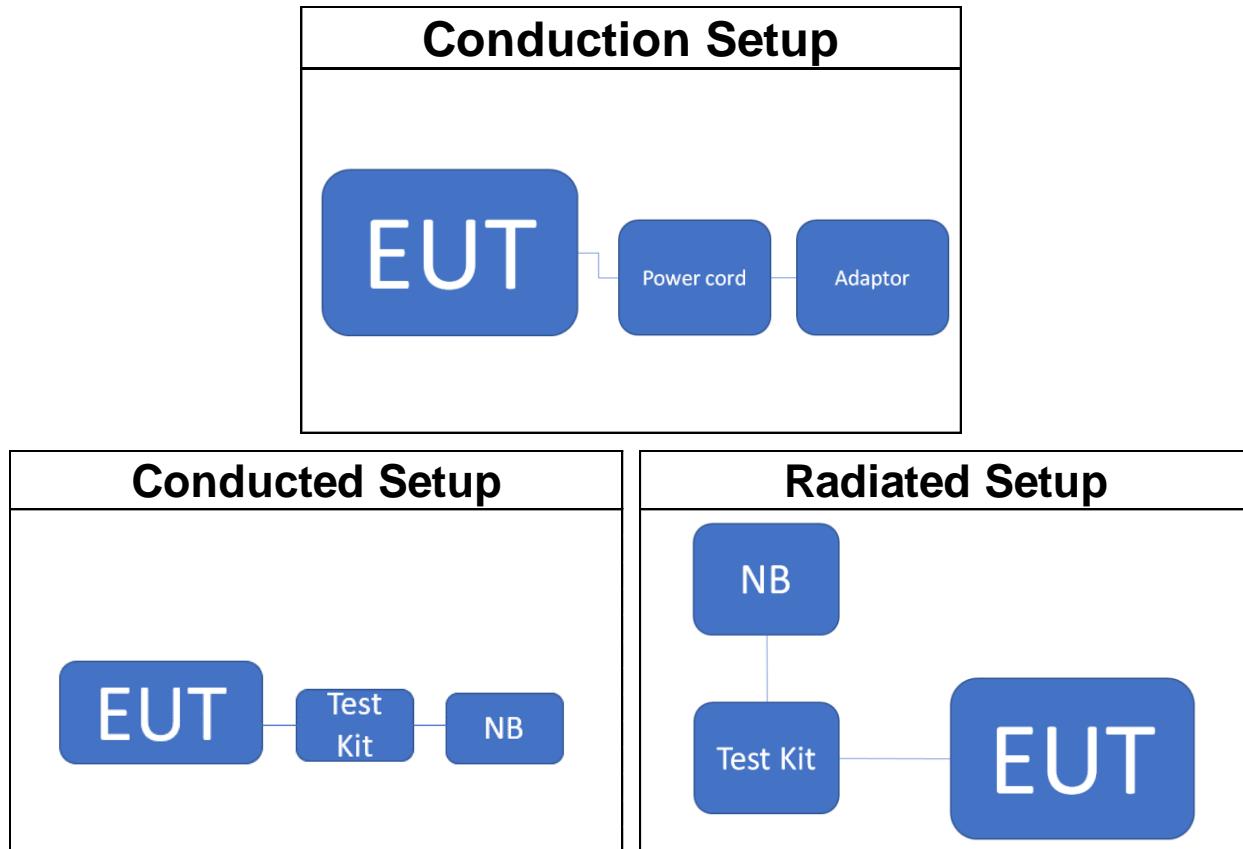
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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## 2.5 Test Configuration



## 2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
AC Adaptor	DVE	DSA-12PFT-12	N/A	N/A	N/A
Power cord	Phoenix Contact	CBL 4POS MALE TO WIRE 4.92	N/A	N/A	N/A
Conducted Emission Test Site: Conducted A					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Kit	Generic build Silicob Lab CP2102	ST-2001SM0040	N/A	N/A	N/A
Notebook	Lenovo	L480	PF-1PG38Y	N/A	N/A
Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
USB Cable	DIKE	SH-USB 3M	N.C.R	N.C.R	N.C.R
Notebook	Lenovo	L420	S0011721	N/A	N/A
Test Kit	Generic bulid Silicob Lab CP2102	ST-2001SM0040	N/A	N.C.R	N.C.R

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### 3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	Emission Bandwidth	Compliant
§15.247(d) §15.205 §15.209	Radiated & Conducted Band Edge and Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

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## 4 DESCRIPTION OF TEST MODES

### 4.1 Operating Frequencies

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	15	2430 MHz	29	2458 MHz
2	2404 MHz	16	2432 MHz	30	2460 MHz
3	2406 MHz	17	2434 MHz	31	2462 MHz
4	2408 MHz	18	2436 MHz	32	2464 MHz
5	2410 MHz	19	2438 MHz	33	2466 MHz
6	2412 MHz	20	2440 MHz	34	2468 MHz
7	2414 MHz	21	2442 MHz	35	2470 MHz
8	2416 MHz	22	2444 MHz	36	2472 MHz
9	2418 MHz	23	2446 MHz	37	2474 MHz
10	2420 MHz	24	2448 MHz	38	2476 MHz
11	2422 MHz	25	2450 MHz	39	2478 MHz
12	2424 MHz	26	2452 MHz	40	2480 MHz
13	2426 MHz	27	2454 MHz		
14	2428 MHz	28	2456 MHz		

### 4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. The field strength of radiation emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
4. Investigation has been done on all the possible configurations for searching the worst case.

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RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	20	GFSK	1
Bluetooth LE	0 to 39	20	GFSK	2
RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
Bluetooth LE	0 to 39	0,20,39	GFSK	2
CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
Bluetooth LE	0 to 39	0,20,39	GFSK	2

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## 5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	
AC Power Line Conducted Emission	+/-	2.34 dB
Output Power measurement	+/-	1 dB
Emission Bandwidth	+/-	1.53 Hz
Undesignable radiated emission measurement	+/-	1.68 dB
Peak Power Density	+/-	1.62 dB
Temperature	+/-	0.4 °C
Humidity	+/-	3.5 %
DC / AC Power Source	+/-	1 %

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 2.57 dB	9kHz~30MHz
	+/- 4.85 dB	30MHz - 1000MHz
	+/- 4.45 dB	1GHz - 18GHz
	+/- 4.24 dB	18GHz - 40GHz
Polarization: Horizontal	+/- 2.57 dB	9kHz~30MHz
	+/- 4.37 dB	30MHz - 1000MHz
	+/- 4.45 dB	1GHz - 18GHz
	+/- 4.24 dB	18GHz - 40GHz

**Note:**

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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## 6 MEASUREMENT EQUIPMENT USED

### 6.1 Emission from AC power line:

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 6.11-20180419c	N.C.R	N.C.R
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	03/25/2021	03/24/2022
EMI Test Receiver	R&S	ESCI	101342	04/27/2021	04/26/2022
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2021	03/26/2022
DC Power Supply	DHA	DPS-3003	9411005787	08/20/2021	08/19/2022
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2021	03/26/2022

### 6.2 Conducted Measurement

Conducted Emission Test Site: Conducted A					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	08/12/2021	08/11/2022
Power Sensor	Anritsu	MA2411B	1315048	08/12/2021	08/11/2022
Power Sensor	Anritsu	MA2411B	1315049	08/12/2021	08/11/2022
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022
Attenuator	Marvelous	MVE2213-10	RF12	11/18/2021	11/17/2022
DC Block	PASTERNACK	PE8210	RF151	11/18/2021	11/17/2022

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## 6.3 Radiated Measurement

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	1206	02/22/2021	02/21/2022
Horn Antenna	Schwarzbeck	BBHA9170	185	08/06/2021	08/05/2022
Horn Antenna	Schwarzbeck	DRH18-E	210105A18E	04/09/2021	04/08/2022
Loop Antenna	ETS.LINDGREN	6502	143303	05/07/2021	05/06/2022
3m Site NSA	SGS	966 chamber G	N/A	03/30/2021	03/29/2022
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/22/2021	03/21/2022
Test Software	audix	e3	E3 20923 SGS Ver.9 ( C )	N.C.R	N.C.R
Pre-Amplifier	EMC Instruments	EMC330N	980781	03/15/2021	03/14/2022
Pre-Amplifier	EMC Instruments	EMC118A45SE	980815	03/15/2021	03/14/2022
Pre-Amplifier	EMC Instruments	EM26400	971576	10/02/2021	10/01/2022
Highpass Filter	WI	WHKX10-2624-3200-1800-80SS	1	05/10/2021	05/09/2022
Highpass Filter	WI	WHKX10-6090-7000-17000-80SS	1	05/10/2021	05/09/2022
Highpass Filter	WI	WHKX10-1066-1300-1500-80SS	18	05/10/2021	05/09/2022
Coaxial Cable	EMC Instruments	EMCCFD400-NM-NM-8000-5000-2000	210216、210217、210218	03/15/2021	03/14/2022
Coaxial Cable	EMC Instruments	EMC104-SM-SM-8000-5000-5000	210219、210220、210221	03/15/2021	03/14/2022
Coaxial Cable	EMC Instruments	EMC105-NM-NM-5000-15000	210224、210306	03/15/2021	03/14/2022

**NOTE:** N.C.R refers to Not Calibrated Required.

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## 7 CONDUCTED EMISSION TEST

### 7.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

**Note**

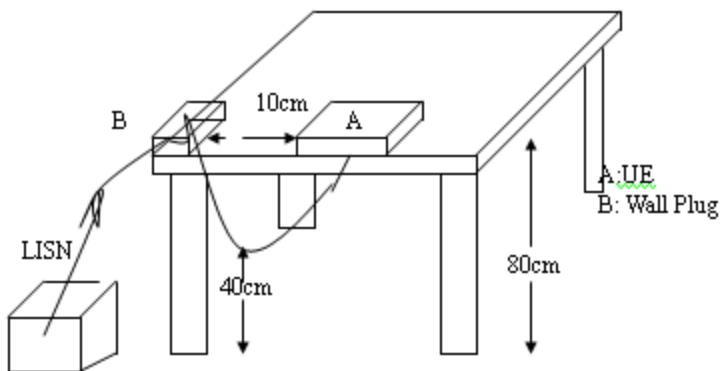
1. The lower limit shall apply at the transition frequencies

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

### 7.2 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

### 7.3 Test Setup



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#### 7.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

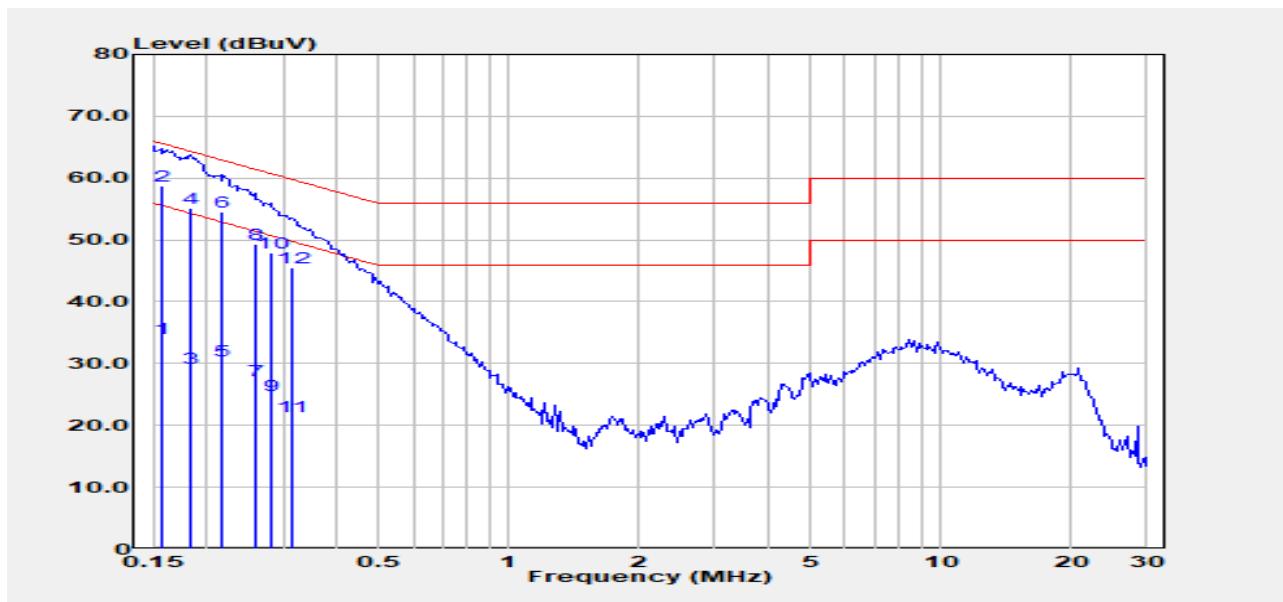
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## 7.5 Measurement Result:

Report Number :E2/2022/10068 Test Site :Conduction C  
 Test Mode :BLE 1M Test Date :2022-02-21  
 Power :120V/60Hz Temp./Humi. :19.4/52  
 Probe :L1 Engineer :Jason Yeh



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V	Limit dB $\mu$ V	Margin dB
0.156	Average	23.80	10.30	34.10	55.65	-21.55
0.156	QP	48.40	10.30	58.70	65.65	-6.95
0.183	Average	18.90	10.30	29.20	54.33	-25.13
0.183	QP	44.80	10.30	55.10	64.33	-9.23
0.215	Average	20.20	10.30	30.50	53.01	-22.51
0.215	QP	44.30	10.30	54.60	63.01	-8.41
0.258	Average	17.00	10.30	27.30	51.51	-24.21
0.258	QP	39.00	10.30	49.30	61.51	-12.21
0.280	Average	14.50	10.30	24.80	50.81	-26.00
0.280	QP	37.70	10.30	48.00	60.81	-12.80
0.315	Average	11.20	10.30	21.50	49.84	-28.33
0.315	QP	35.20	10.30	45.50	59.84	-14.33

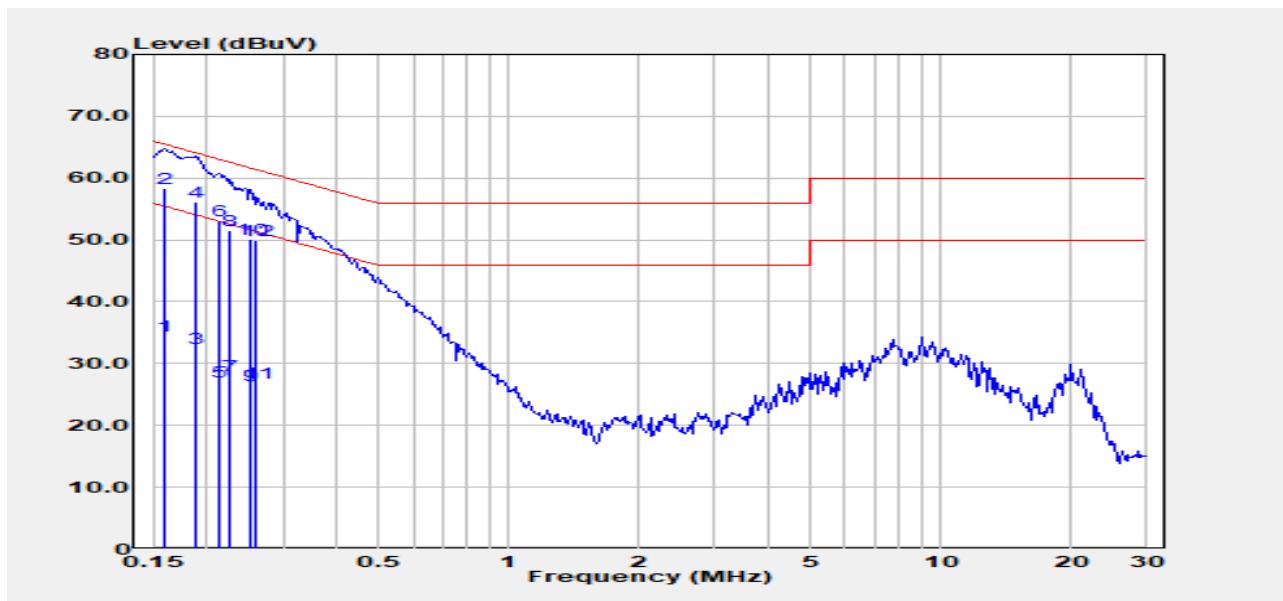
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Report Number :E2/2022/10068  
Test Mode :BLE 1M  
Power :120V/60Hz  
Probe :N

Test Site :Conduction C  
Test Date :2022-02-21  
Temp./Humi. :19.4/52  
Engineer :Jason Yeh



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V	Limit dB $\mu$ V	Margin dB
0.160	Average	24.10	10.31	34.41	55.47	-21.06
0.160	QP	48.00	10.31	58.31	65.47	-7.16
0.187	Average	22.20	10.30	32.50	54.15	-21.65
0.187	QP	45.80	10.30	56.10	64.15	-8.05
0.213	Average	16.80	10.30	27.10	53.10	-25.99
0.213	QP	42.80	10.30	53.10	63.10	-9.99
0.227	Average	17.70	10.30	28.00	52.57	-24.56
0.227	QP	41.30	10.30	51.60	62.57	-10.96
0.252	Average	16.20	10.31	26.51	51.69	-25.18
0.252	QP	39.80	10.31	50.11	61.69	-11.58
0.260	Average	16.50	10.31	26.81	51.42	-24.62
0.260	QP	39.60	10.31	49.91	61.42	-11.52

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## 8 PEAK OUTPUT POWER MEASUREMENT

### 8.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

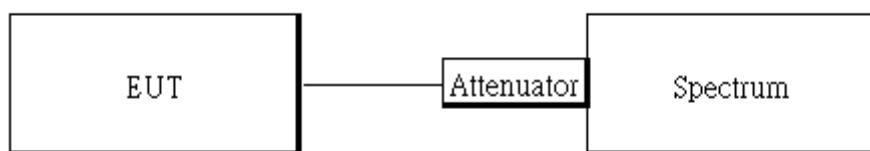
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

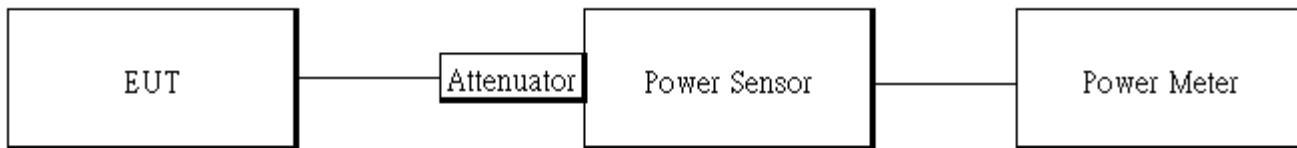
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

### 8.2 Test Setup

#### 8.2.1 Duty Cycle



#### 8.2.2 Output Power



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## 8.3 Measurement Procedure:

### 8.3.1 Duty Cycle

1. Place the EUT on the table and set it in transmitting mode.
2. Set span = Zero
3. RBW = 8MHz, VBW = 8MHz,
4. Detector = Peak

### 8.3.2 Output Power

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

## 8.4 Duty Factor:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)
BLE 1M	63.20	1.99	2.53	3.00
BLE 2M	33.60	4.74	4.76	5.00

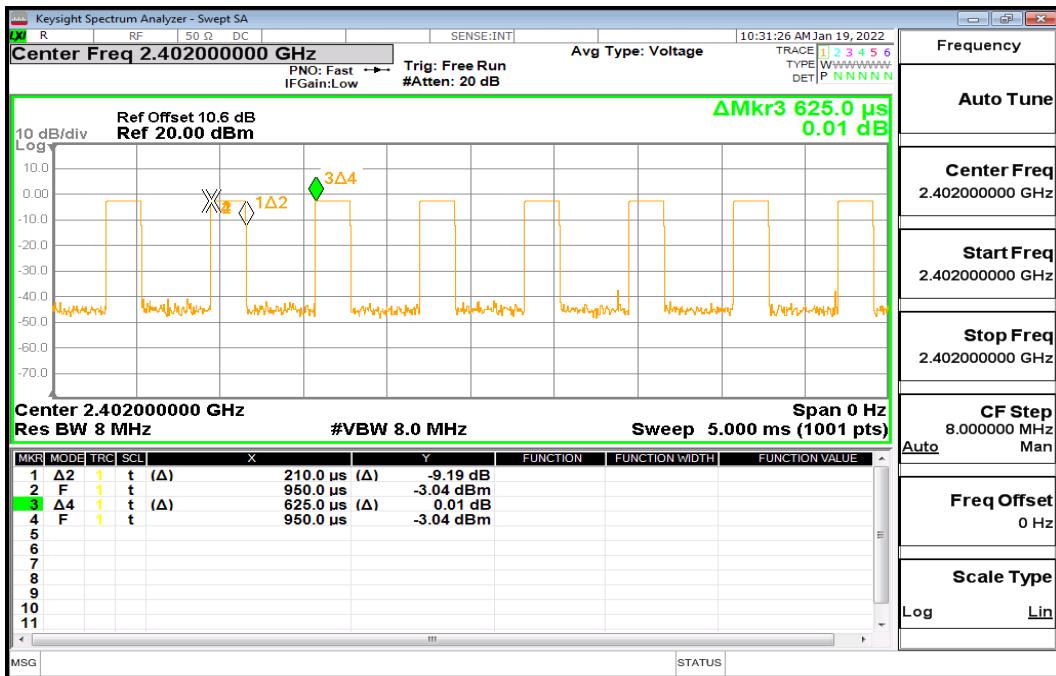
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## BLE\_1M\_LowCH00-2402



## BLE\_2M\_LowCH00-2402



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## 8.5 Output Power:

### 8.5.1 Peak & Avg

#### BLE 1M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	2	3.55	30
Mid	2442	3	2.37	30
High	2480	6	1.75	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	2	-0.03	30
Mid	2442	3	-0.15	30
High	2480	6	-0.31	30

*\*Note: Measured by power meter, cable loss dB + Duty cycle factor has been offset to the power meter for Avg. power and cable loss has been offset for Peak power measurement.*

#### BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	4	4.12	30
Mid	2442	6	3.07	30
High	2480	6	1.74	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	4	-0.05	30
Mid	2442	6	-0.15	30
High	2480	6	-0.24	30

*\*Note: Measured by power meter, cable loss 10.6 dB + Duty cycle factor has been offset to the power meter for Avg. power and cable loss has been offset for Peak power measurement.*

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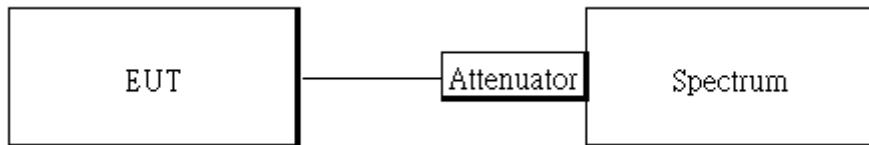
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## 9 EMISSION BANDWIDTH MEASUREMENT

### 9.1 Standard Applicable

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

### 9.2 Test Setup



### 9.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as  
RBW= 100 kHz ,  
VBW = 3 X RBW,  
Span= 2 to 5 times of the OBW,  
Sweep=auto,  
Detector = Peak, and Max hold for -6dB Bandwidth test.
5. Repeat above procedures until all test default channel is completed

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#### 9.4 Measurement Result:

##### BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7036	$\geq 0.5$	PASS
2442	0.7062	$\geq 0.5$	PASS
2480	0.7063	$\geq 0.5$	PASS

##### BLE 2M mode

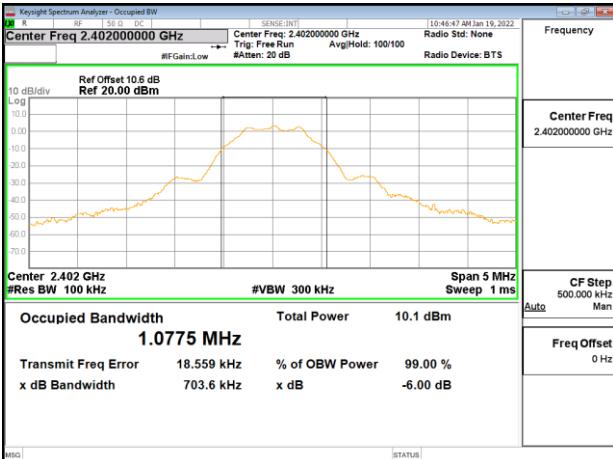
Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.144	$\geq 0.5$	PASS
2442	1.139	$\geq 0.5$	PASS
2480	1.14	$\geq 0.5$	PASS

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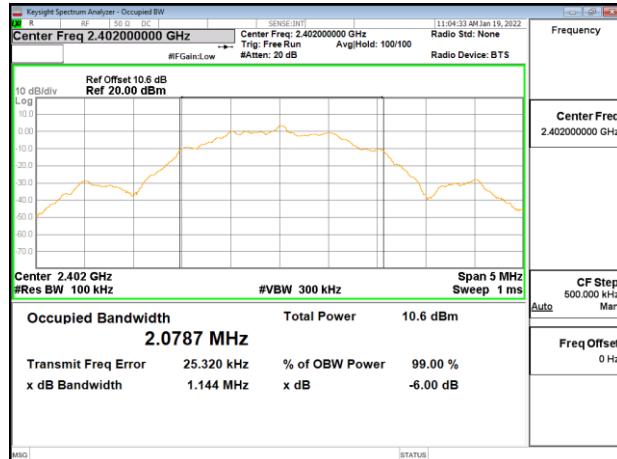
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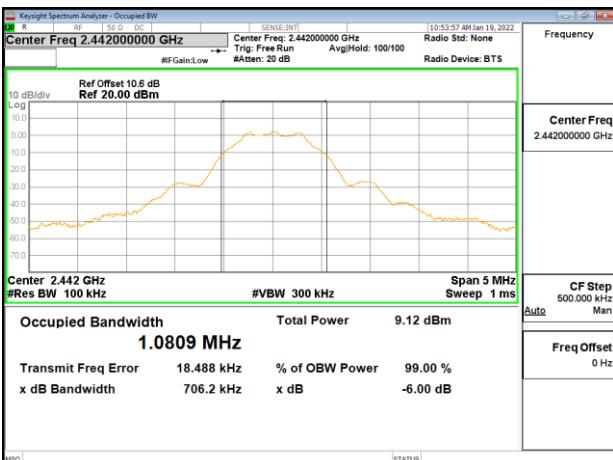
OBW\_BLE 1M\_LowCH00-2402MHz



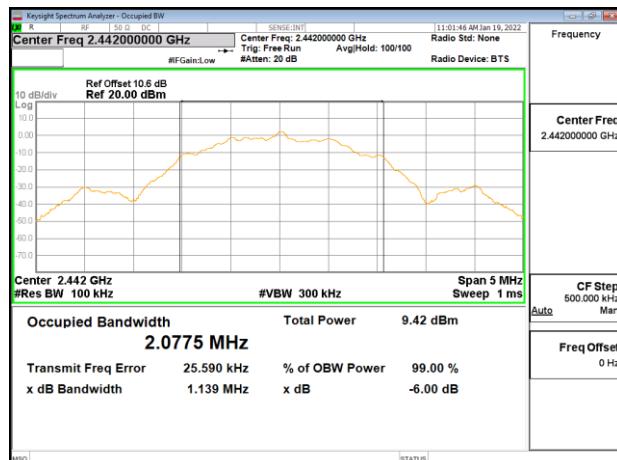
OBW\_BLE 2M\_LowCH00-2402MHz



OBW\_BLE 1M\_MidCH20-2442MHz



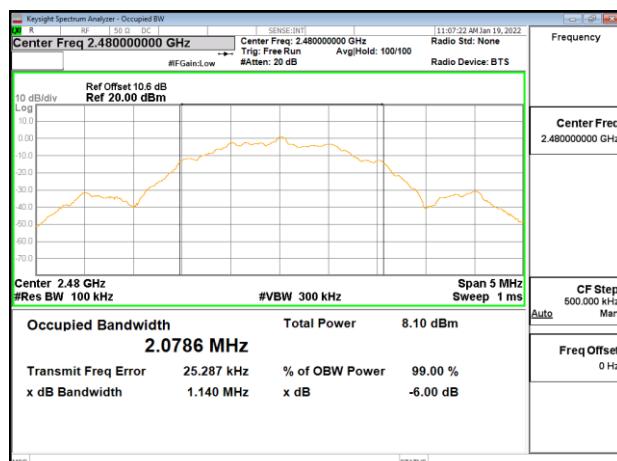
OBW\_BLE 2M\_MidCH20-2442MHz



OBW\_BLE 1M\_HighCH39-2480MHz



OBW\_BLE 2M\_HighCH39-2480MHz



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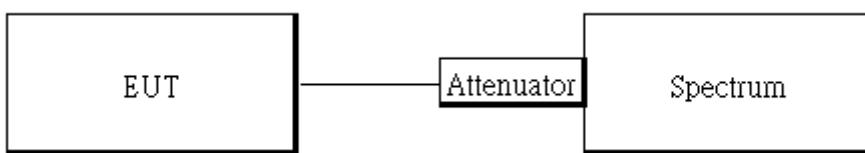
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## 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 10.1 Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 10.2 Test Setup



### 10.3 Measurement Procedure

#### 10.3.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

#### 10.3.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass

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the spectrum to be examined.

5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Set DL as the limit = reading on marker of reference level measurement – 20dBm
7. Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
8. Repeat above procedures until all default test channel (low and high) was complete.

#### 10.3.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

#### 10.4 Measurement Result

##### BLE 1M\_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	3.14	-16.86
2442	2.31	-17.69
2480	0.65	-19.35

*NOTE: cable loss as dB that offsets in the spectrum*

*NOTE: Refer to next page for plots.*

##### BLE 2M\_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	3.40	-16.60
2442	2.37	-17.63
2480	0.90	-19.10

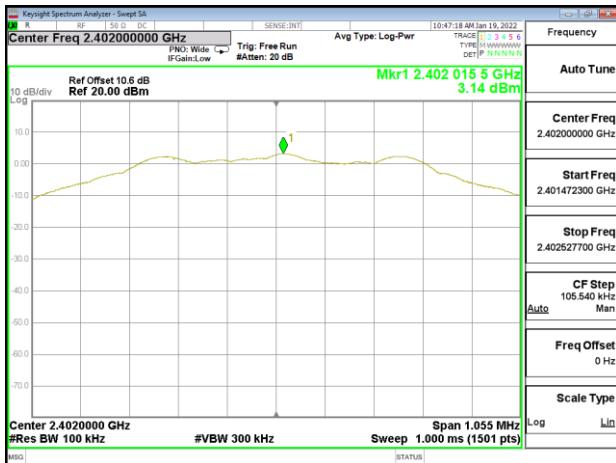
*NOTE: cable loss as 10.6dB that offsets in the spectrum*

*NOTE: Refer to next page for plots.*

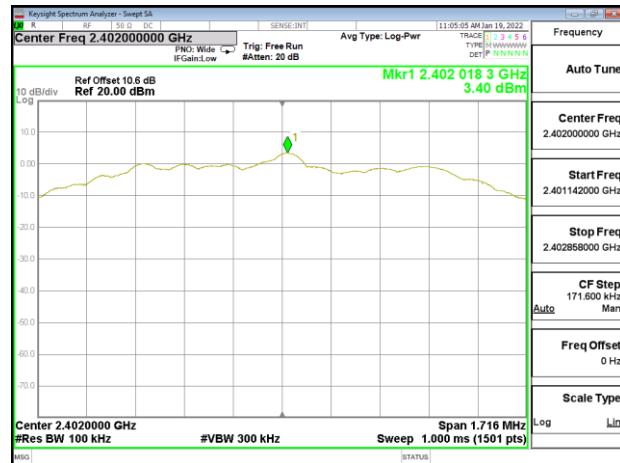
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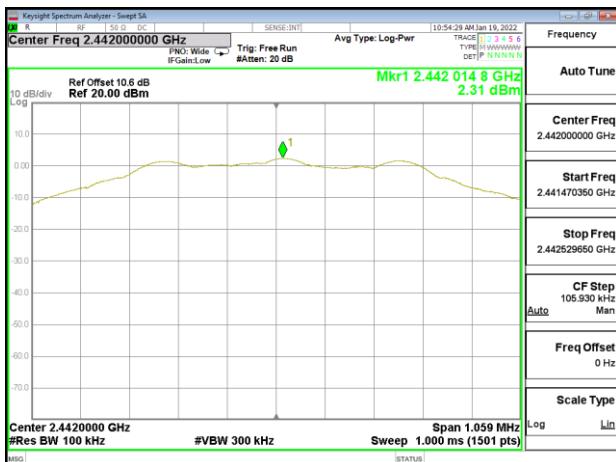
Reference Level\_BLE 1M\_LowCH00-2402MHz



Reference Level\_BLE 2M\_LowCH00-2402MHz



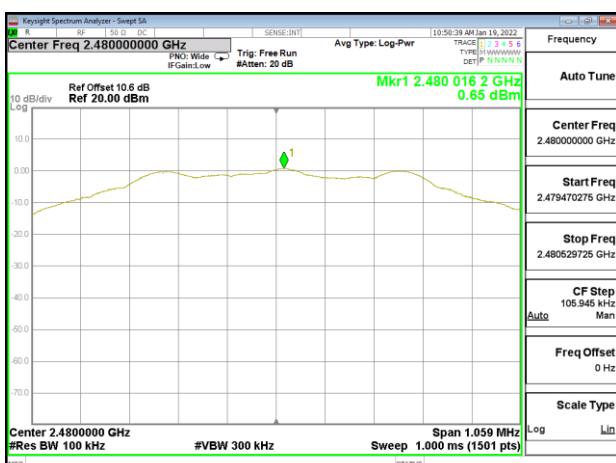
Reference Level\_BLE 1M\_MidCH20-2442MHz



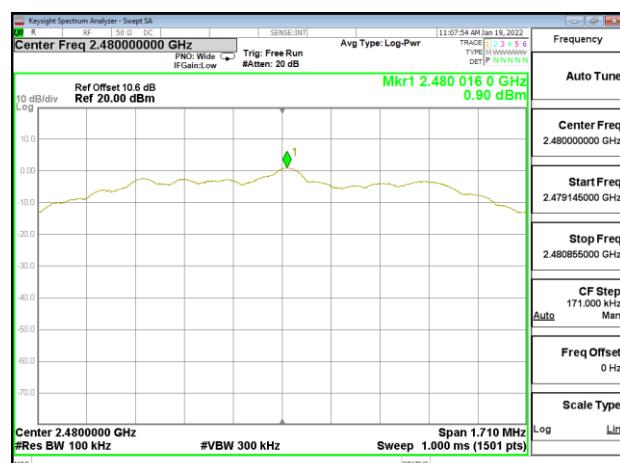
Reference Level\_BLE 2M\_MidCH20-2442MHz



Reference Level\_BLE 1M\_HighCH39-2480MHz



Reference Level\_BLE 2M\_HighCH39-2480MHz

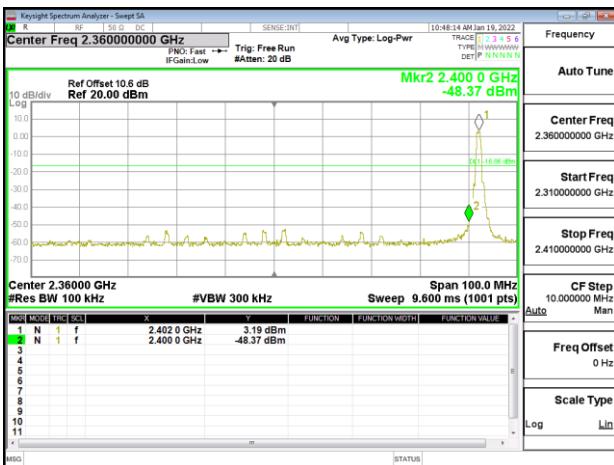


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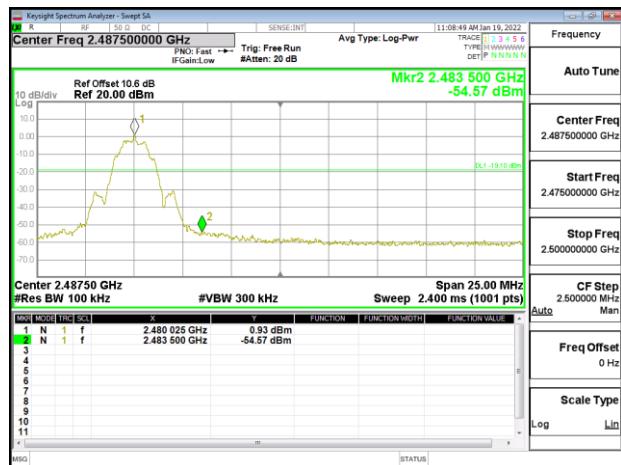
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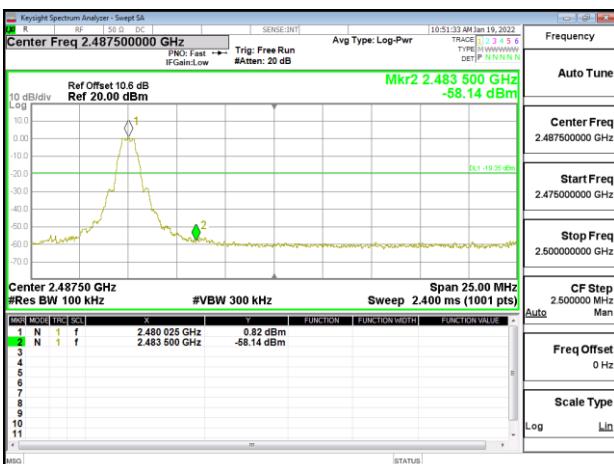
Band Edge\_BLE 1M\_LowCH00-2402MHz



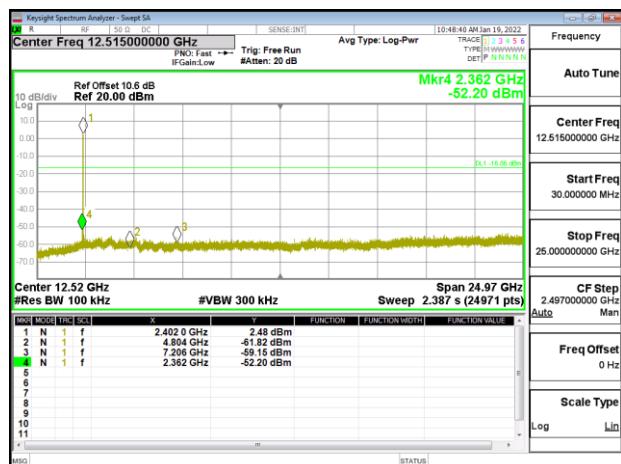
Band Edge\_BLE 2M\_HighCH39-2480MHz



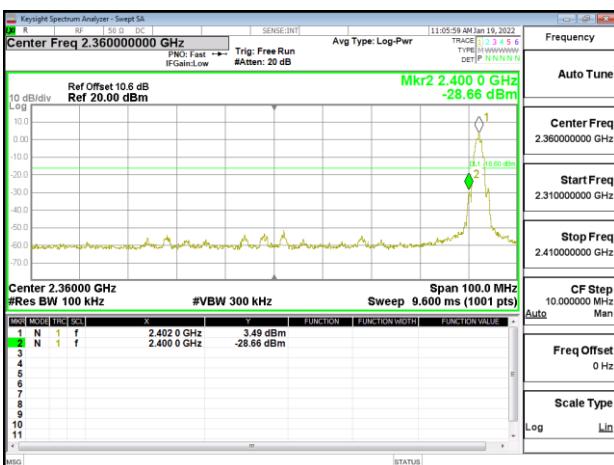
Band Edge\_BLE 1M\_HighCH39-2480MHz



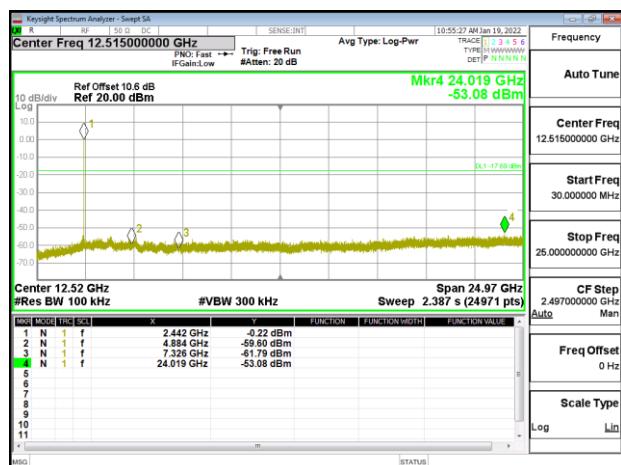
Spurious Emission\_BLE 1M\_LowCH00-2402MHz



Band Edge\_BLE 2M\_LowCH00-2402MHz



Spurious Emission\_BLE 1M\_MidCH20-2442MHz

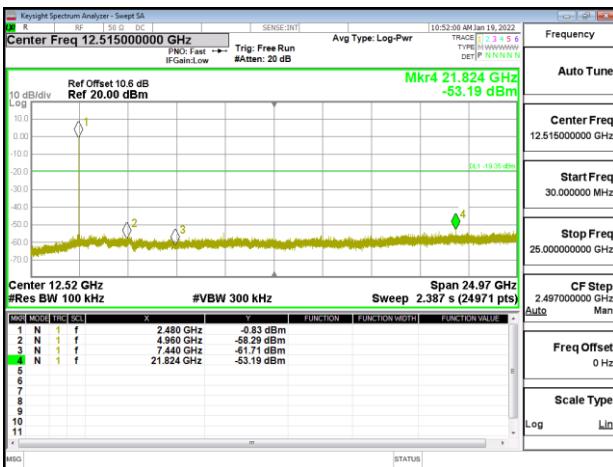


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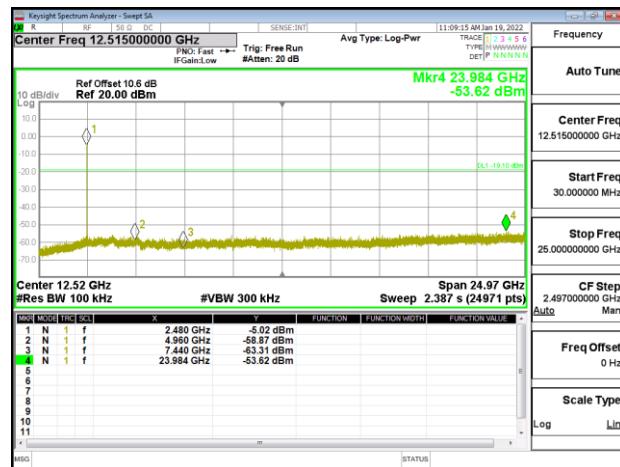
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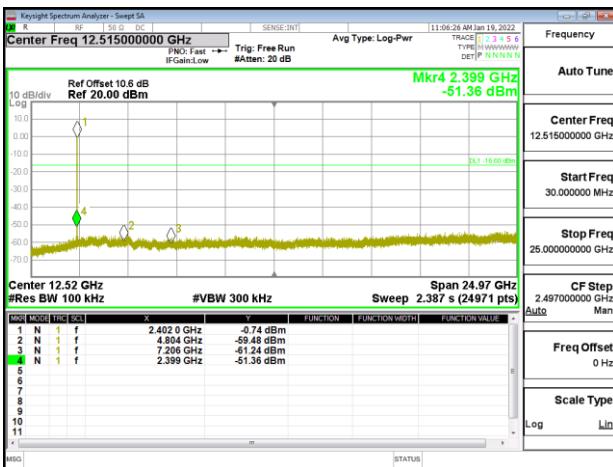
Spurious Emission\_BLE 1M\_HighCH39-2480MHz



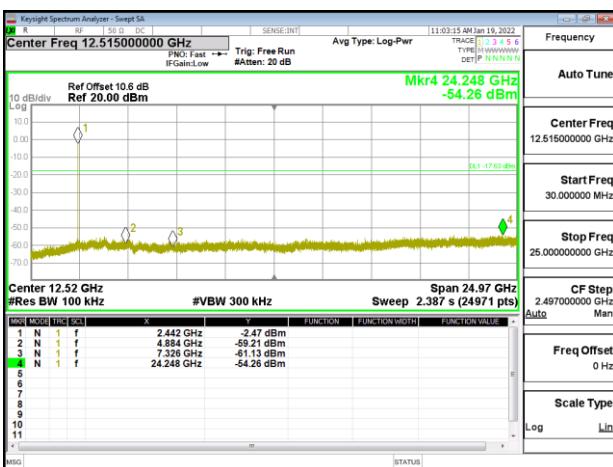
Spurious Emission\_BLE 2M\_HighCH39-2480MHz



Spurious Emission\_BLE 2M\_LowCH00-2402MHz



Spurious Emission\_BLE 2M\_MidCH20-2442MHz



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## 11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

### 11.1 Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

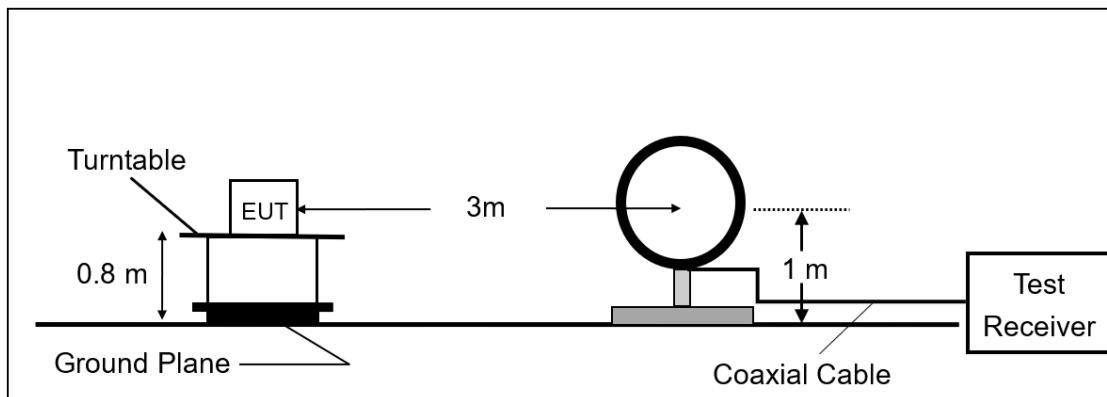
And according to §15.33(a) (1) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	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

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

### 11.2 Test Setup

#### (A) Radiated Emission Test Set-Up, Frequency Below 30MHz.

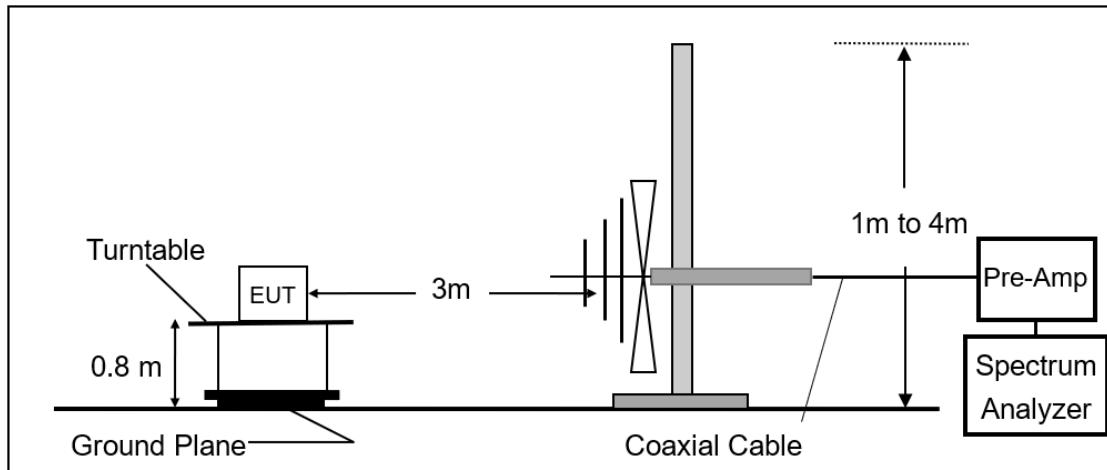


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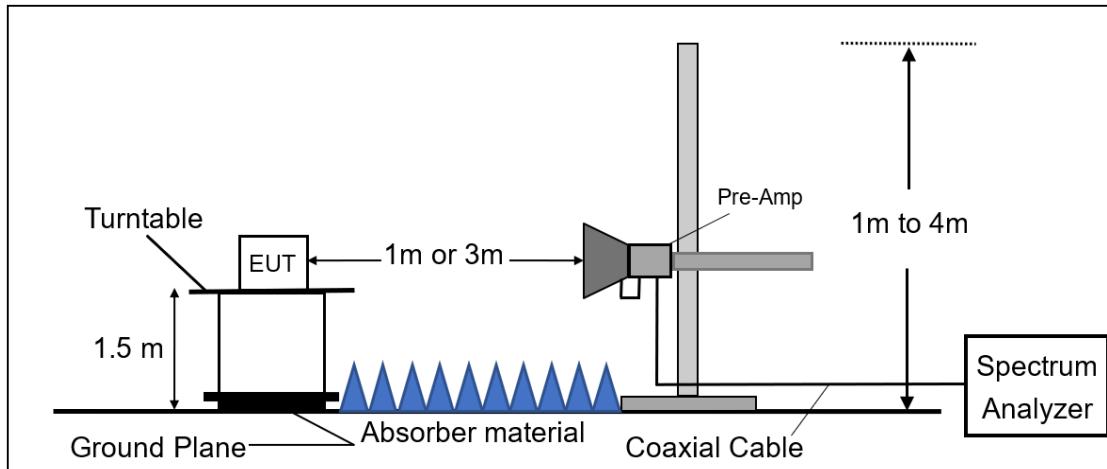
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(C) Radiated Emission Test Set-Up, Frequency Above 1GHz.



### 11.3 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=100 kHz and VBW=300 kHz for Peak Detector (PK) at frequency between 30MHz and 1 GHz.
6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.

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7. Set the spectrum analyzer as  $RBW=1$  MHz,  $VBW=3$  MHz for Maximum Emission Measurements at frequency above 1 GHz.
8. Set the spectrum analyzer as  $RBW=1$  MHz,  $VBW=10$  Hz (Duty cycle > 98%) or  $VBW \geq 1/T$  (Duty cycle < 98%) for Average Emission Measurements at frequency above 1 GHz.
9. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
12. Repeat above procedures until all default test channel measured were complete.

#### 11.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

**Where**  $FS$  = Field Strength

$CL$  = Cable Attenuation Factor (Cable Loss)

$RA$  = Reading Amplitude

$AG$  = Amplifier Gain

$AF$  = Antenna Factor

*The limit of the emission level is expressed in  $dB\mu V/m$ , which converts  $20 * \log(uV/m)$*

*Actual  $FS(dB\mu V/m) = SPA \cdot Reading\ level(dB\mu V) + Factor(dB)$*

*$Factor(dB) = Antenna\ Factor(dB\mu V/m) + Cable\ Loss(dB) - Pre\_Amplifier\ Gain(dB)$*

#### 11.5 Test Results of Radiated Spurious Emissions from 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

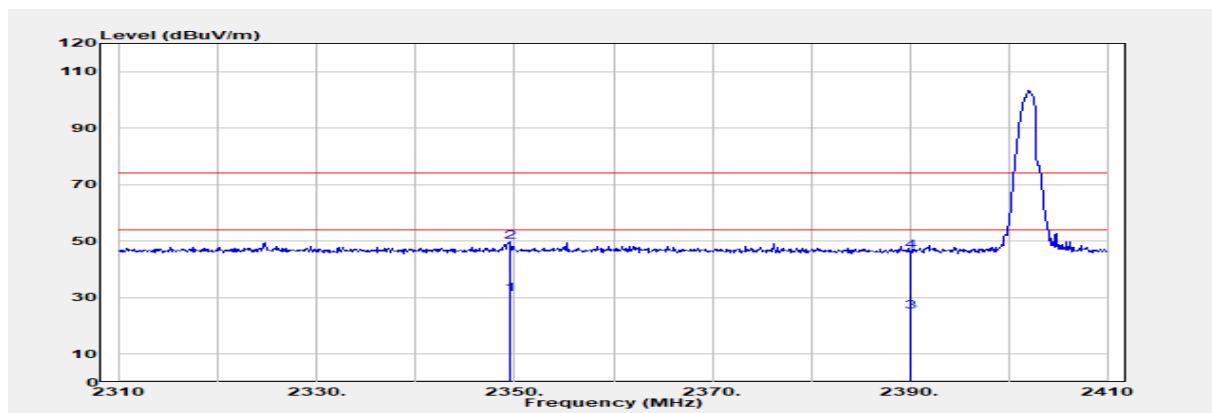
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## 11.6 Measurement Result:

### 11.6.1 Radiated Band Edge Measurement Result

Report Number :E2/2022/10068 Test Site :SAC G  
Operation Mode :BLE 1M Test Date :2022-01-25  
Test Frequency :2402 MHz Temp./Humi. :24.9/60  
Test Mode :BE CH LOW Antenna Pol. :Vertical  
EUT Pol :E1 Plane Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2349.600	Average	34.96	-3.62	31.33	54.00	-22.67
2349.600	Peak	53.47	-3.62	49.85	74.00	-24.15
2390.000	Average	28.78	-3.80	24.98	54.00	-29.02
2390.000	Peak	50.35	-3.80	46.55	74.00	-27.45

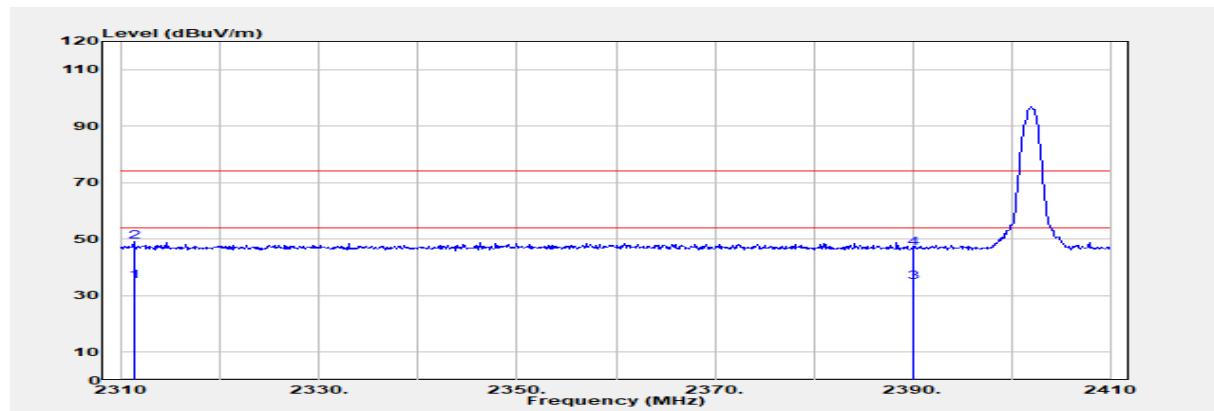
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2402 MHz  
Test Mode :BE CH LOW  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2311.200	Average	38.83	-3.69	35.14	54.00	-18.86
2311.200	Peak	52.74	-3.69	49.05	74.00	-24.95
2390.000	Average	38.72	-3.80	34.92	54.00	-19.08
2390.000	Peak	50.78	-3.80	46.98	74.00	-27.02

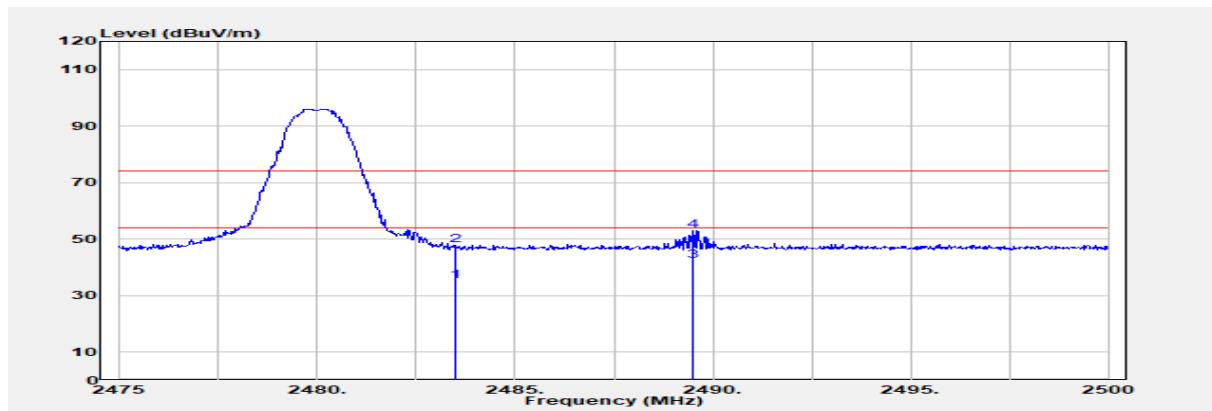
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Vertical  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.500	Average	39.05	-3.92	35.13	54.00	-18.87
2483.500	Peak	51.62	-3.92	47.70	74.00	-26.30
2489.475	Average	46.05	-3.88	42.17	54.00	-11.83
2489.475	Peak	57.05	-3.88	53.17	74.00	-20.83

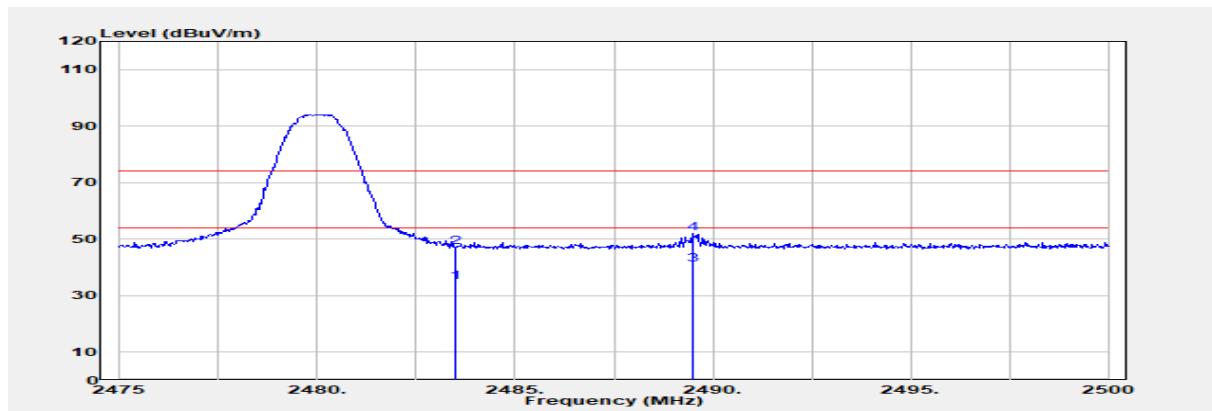
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.500	Average	38.87	-3.92	34.95	54.00	-19.05
2483.500	Peak	51.12	-3.92	47.20	74.00	-26.80
2489.500	Average	44.84	-3.88	40.96	54.00	-13.04
2489.500	Peak	55.76	-3.88	51.88	74.00	-22.12

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Report Number :E2/2022/10068

Test Site :SAC G

Operation Mode :BLE 2M

Test Date :2022-01-25

Test Frequency :2402 MHz

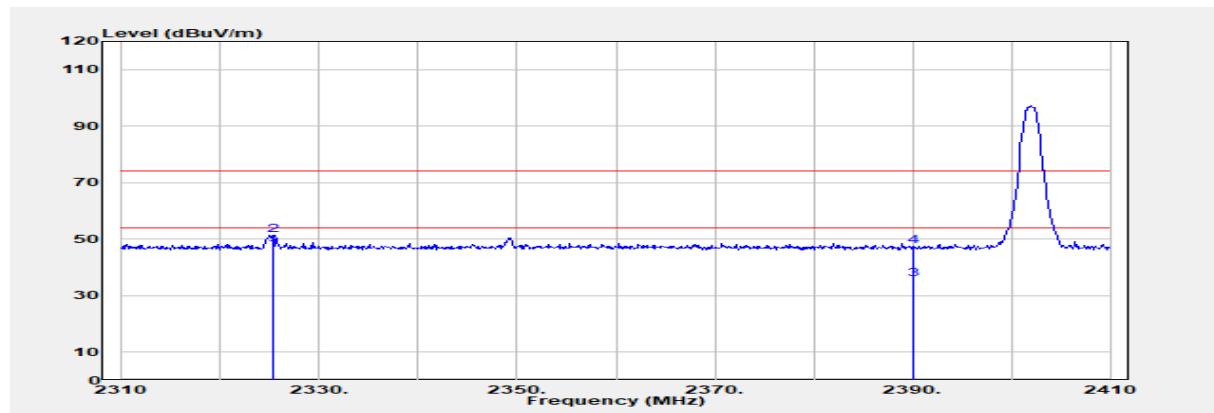
Temp./Humi. :24.9/60

Test Mode :BE CH LOW

Antenna Pol. :Vertical

EUT Pol :E1 Plane

Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2325.300	Average	49.89	-3.70	46.20	54.00	-7.80
2325.300	Peak	55.19	-3.70	51.49	74.00	-22.51
2390.000	Average	39.50	-3.80	35.69	54.00	-18.31
2390.000	Peak	51.23	-3.80	47.43	74.00	-26.57

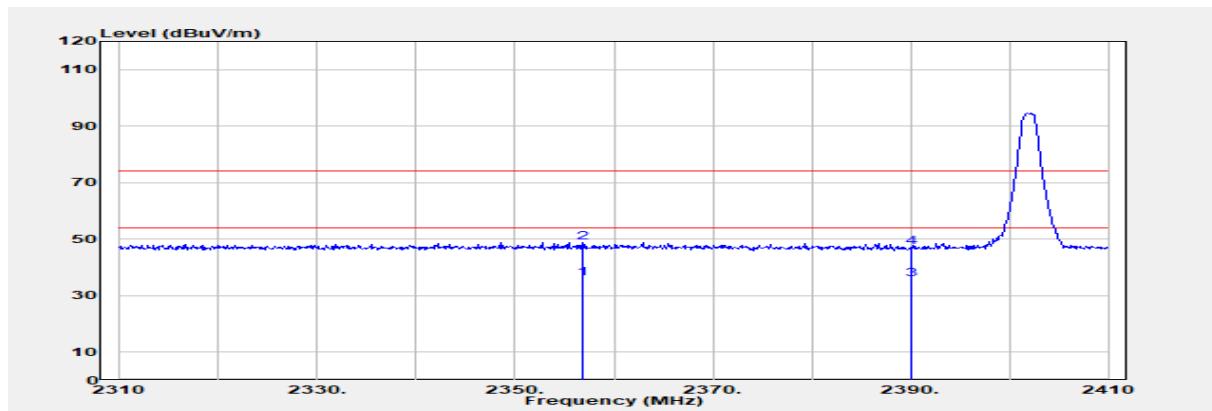
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2402 MHz  
Test Mode :BE CH LOW  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2356.800	Average	39.82	-3.61	36.20	54.00	-17.80
2356.800	Peak	52.49	-3.61	48.87	74.00	-25.13
2390.000	Average	39.73	-3.80	35.93	54.00	-18.07
2390.000	Peak	50.90	-3.80	47.10	74.00	-26.90

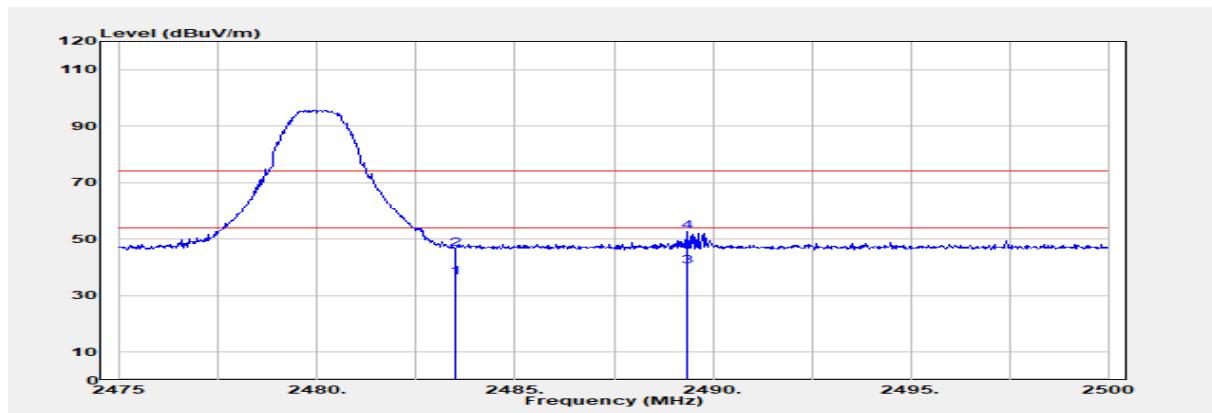
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Vertical  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.500	Average	40.24	-3.92	36.32	54.00	-17.68
2483.500	Peak	50.49	-3.92	46.57	74.00	-27.43
2489.350	Average	44.20	-3.88	40.32	54.00	-13.68
2489.350	Peak	56.66	-3.88	52.78	74.00	-21.22

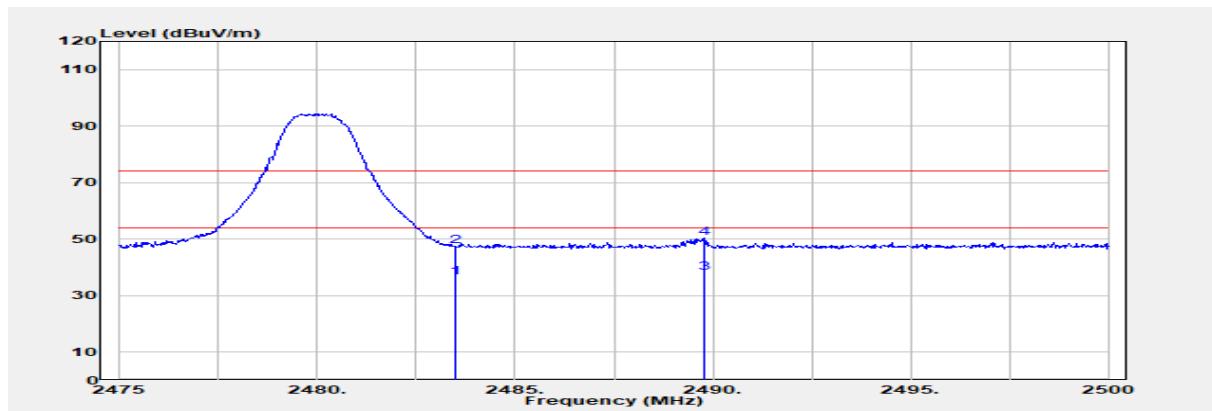
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
2483.500	Average	40.41	-3.92	36.49	54.00	-17.51
2483.500	Peak	51.44	-3.92	47.52	74.00	-26.48
2489.775	Average	41.92	-3.88	38.04	54.00	-15.96
2489.775	Peak	54.13	-3.88	50.25	74.00	-23.75

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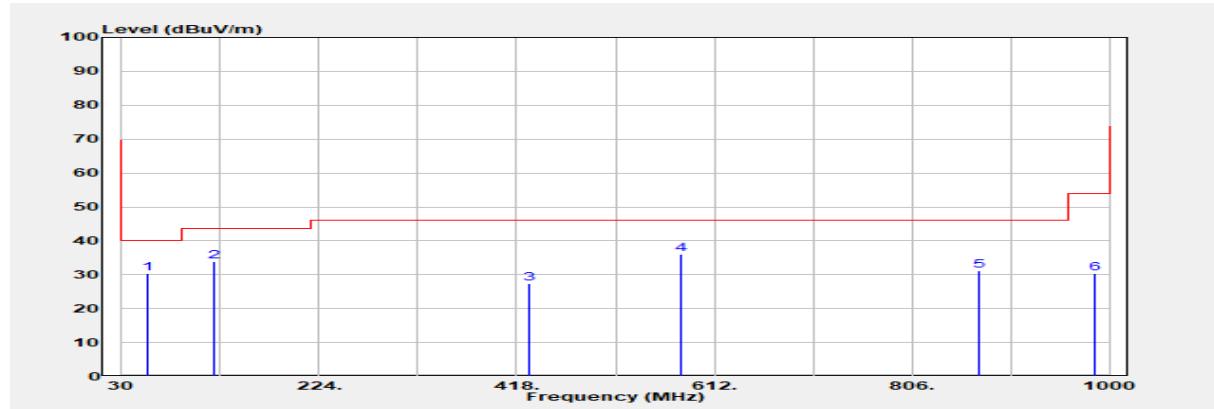
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### 11.6.2 Radiated Spurious Emission

Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Vertical  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
56.190	Peak	43.60	-13.32	30.28	40.00	-9.72
120.210	Peak	49.06	-15.29	33.77	43.50	-9.73
429.640	Peak	35.82	-8.34	27.48	46.00	-18.52
579.990	Peak	41.50	-5.56	35.93	46.00	-10.07
872.930	Peak	32.00	-0.73	31.27	46.00	-14.73
986.420	Peak	30.64	-0.28	30.36	54.00	-23.64

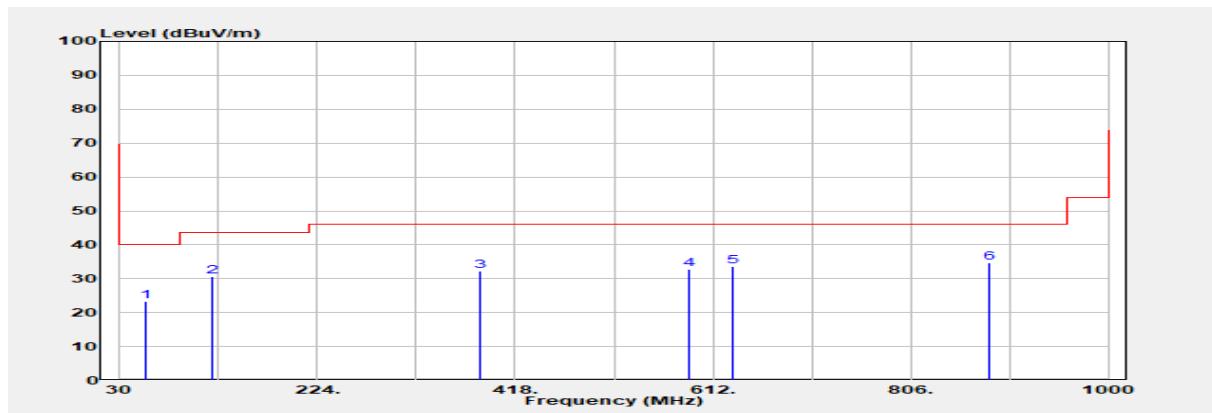
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Report Number :E2/2022/10068  
 Operation Mode :BLE 1M  
 Test Frequency :2442 MHz  
 Test Mode :TX CH MID  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Horizontal  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
55.220	Peak	36.55	-13.29	23.26	40.00	-16.74
120.210	Peak	45.93	-15.29	30.64	43.50	-12.86
384.050	Peak	42.62	-10.24	32.37	46.00	-13.63
588.720	Peak	38.53	-5.73	32.80	46.00	-13.20
632.370	Peak	38.44	-4.93	33.51	46.00	-12.49
883.600	Peak	36.33	-1.58	34.75	46.00	-11.25

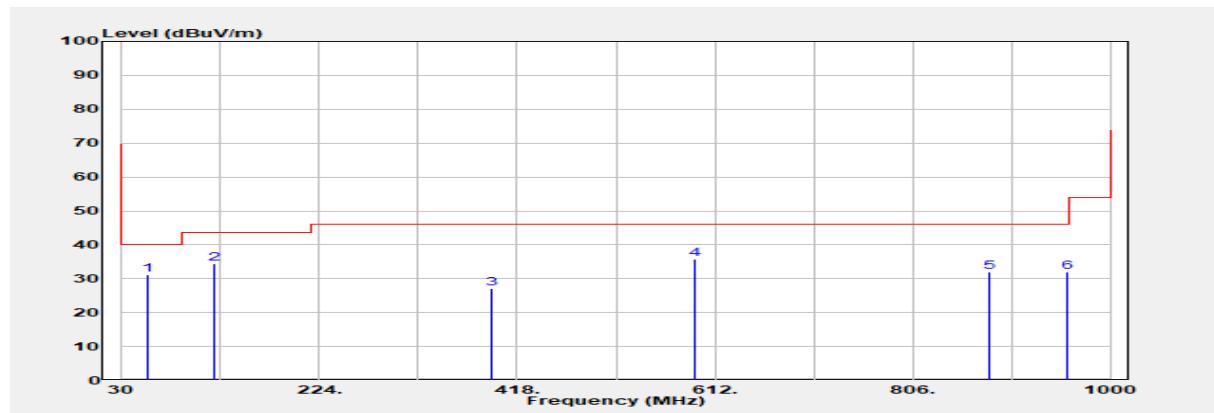
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Report Number :E2/2022/10068  
 Operation Mode :BLE 2M  
 Test Frequency :2442 MHz  
 Test Mode :TX CH MID  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Vertical  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
56.190	Peak	44.52	-13.32	31.20	40.00	-8.80
120.210	Peak	49.60	-15.29	34.31	43.50	-9.19
393.750	Peak	37.14	-9.97	27.16	46.00	-18.84
591.630	Peak	41.45	-5.75	35.70	46.00	-10.30
881.660	Peak	33.26	-1.38	31.87	46.00	-14.13
957.320	Peak	31.48	0.55	32.03	46.00	-13.97

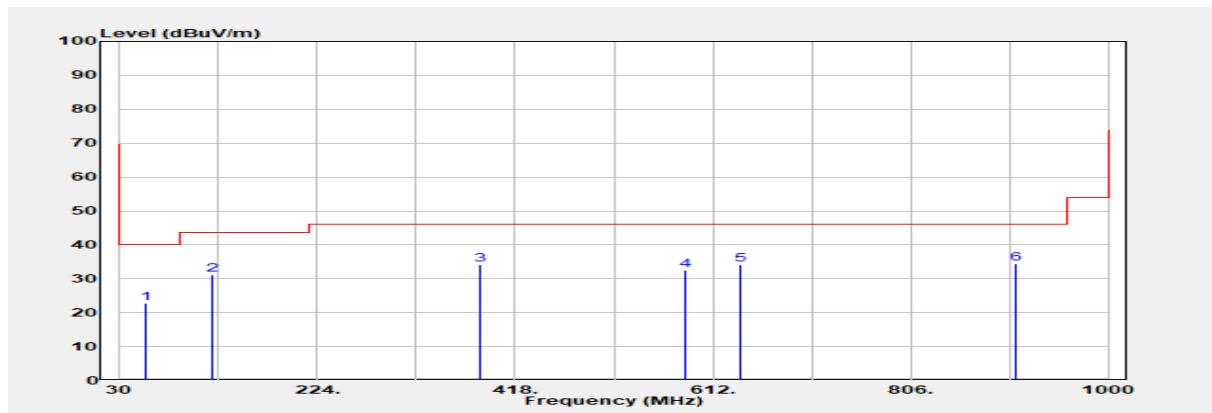
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
55.220	Peak	36.03	-13.29	22.74	40.00	-17.26
120.210	Peak	46.45	-15.29	31.16	43.50	-12.34
384.050	Peak	44.27	-10.24	34.02	46.00	-11.98
585.810	Peak	38.24	-5.73	32.51	46.00	-13.49
638.190	Peak	38.99	-4.76	34.23	46.00	-11.77
909.790	Peak	35.53	-1.24	34.29	46.00	-11.71

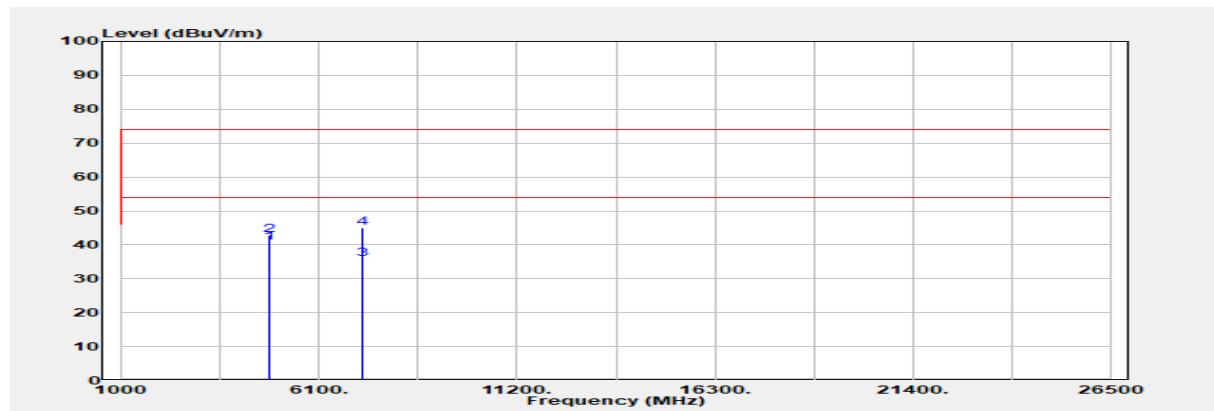
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Report Number :E2/2022/10068  
 Operation Mode :BLE 1M  
 Test Frequency :2402 MHz  
 Test Mode :TX CH LOW  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Vertical  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4804.000	Average	37.48	3.14	40.62	54.00	-13.38
4804.000	Peak	39.75	3.14	42.89	74.00	-31.11
7206.000	Average	28.62	7.22	35.84	54.00	-18.16
7206.000	Peak	37.85	7.22	45.07	74.00	-28.93

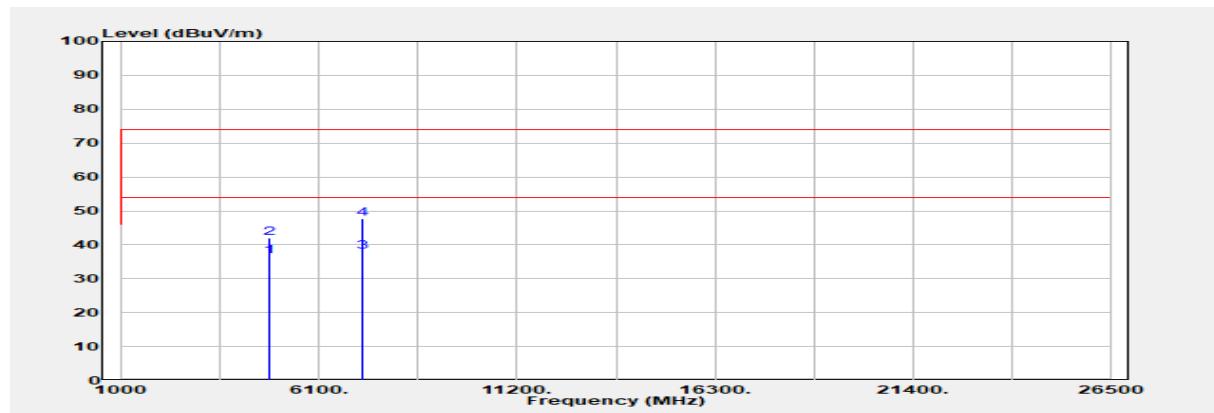
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2402 MHz  
Test Mode :TX CH LOW  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4804.000	Average	33.50	3.14	36.64	54.00	-17.36
4804.000	Peak	38.89	3.14	42.03	74.00	-31.97
7206.000	Average	30.67	7.22	37.89	54.00	-16.11
7206.000	Peak	40.49	7.22	47.71	74.00	-26.29

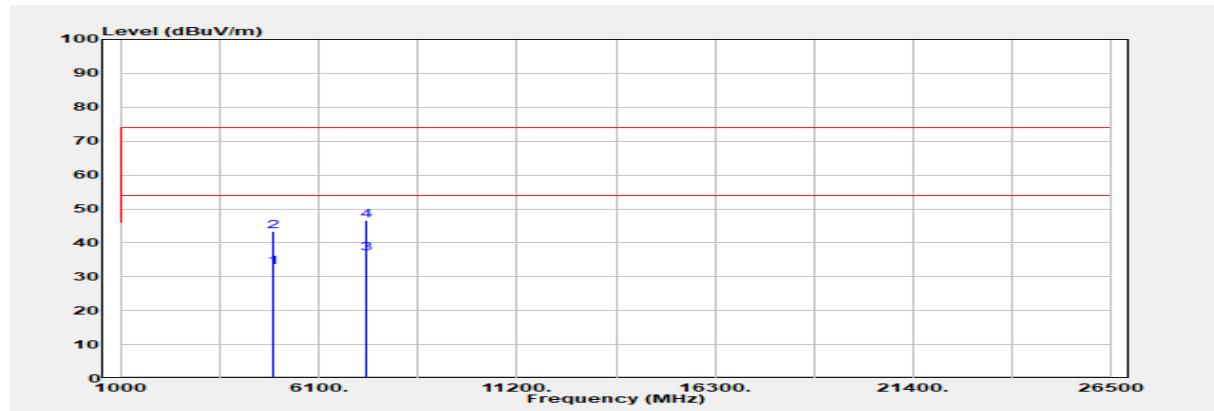
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Vertical  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4884.000	Average	29.58	3.30	32.87	54.00	-21.13
4884.000	Peak	39.97	3.30	43.26	74.00	-30.74
7326.000	Average	29.15	7.68	36.83	54.00	-17.17
7326.000	Peak	39.03	7.68	46.70	74.00	-27.30

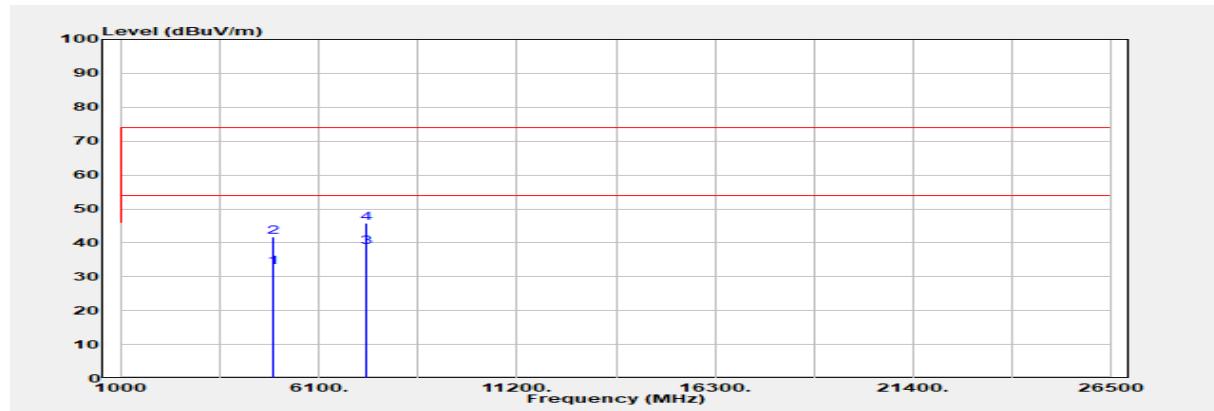
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Report Number :E2/2022/10068  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4884.000	Average	29.37	3.30	32.67	54.00	-21.33
4884.000	Peak	38.54	3.30	41.84	74.00	-32.16
7326.000	Average	31.18	7.68	38.86	54.00	-15.14
7326.000	Peak	38.09	7.68	45.77	74.00	-28.23

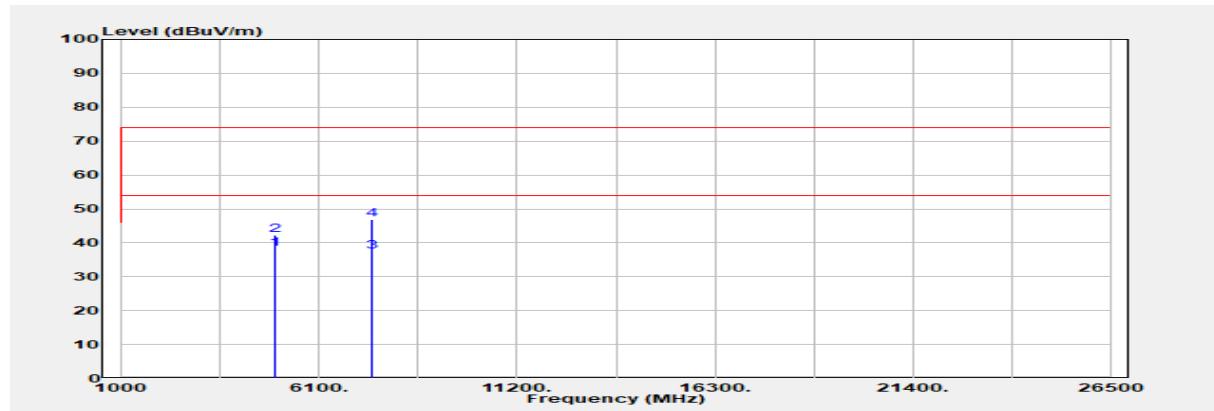
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Report Number :E2/2022/10068  
 Operation Mode :BLE 1M  
 Test Frequency :2480 MHz  
 Test Mode :TX CH HIGH  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Vertical  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.000	Average	34.68	3.42	38.10	54.00	-15.91
4960.000	Peak	38.86	3.42	42.28	74.00	-31.72
7440.000	Average	29.24	8.11	37.35	54.00	-16.65
7440.000	Peak	38.85	8.11	46.96	74.00	-27.04

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Report Number :E2/2022/10068

Test Site :SAC G

Operation Mode :BLE 1M

Test Date :2022-01-25

Test Frequency :2480 MHz

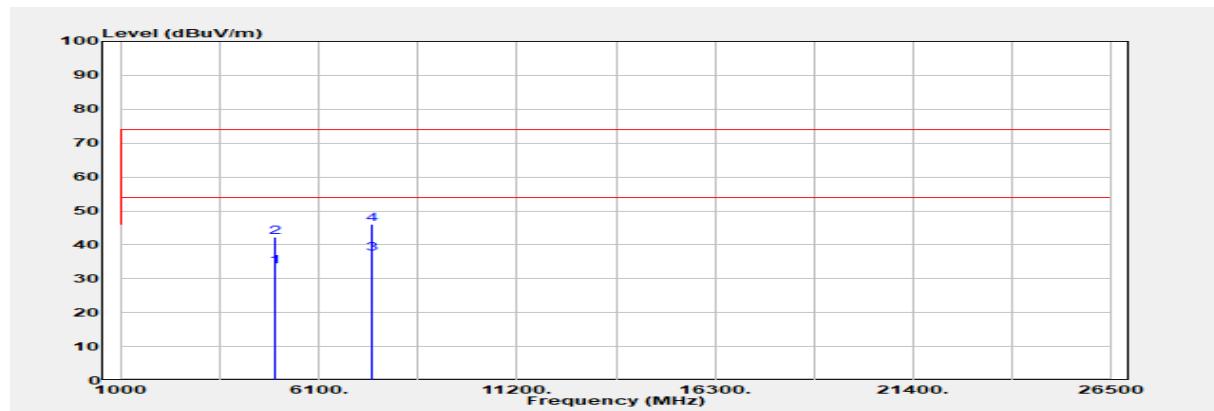
Temp./Humi. :24.9/60

Test Mode :TX CH HIGH

Antenna Pol. :Horizontal

EUT Pol :E1 Plane

Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.000	Average	30.08	3.42	33.50	54.00	-20.50
4960.000	Peak	38.94	3.42	42.36	74.00	-31.64
7440.000	Average	29.19	8.11	37.30	54.00	-16.70
7440.000	Peak	37.97	8.11	46.08	74.00	-27.92

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Report Number :E2/2022/10068

Test Site :SAC G

Operation Mode :BLE 2M

Test Date :2022-01-25

Test Frequency :2402 MHz

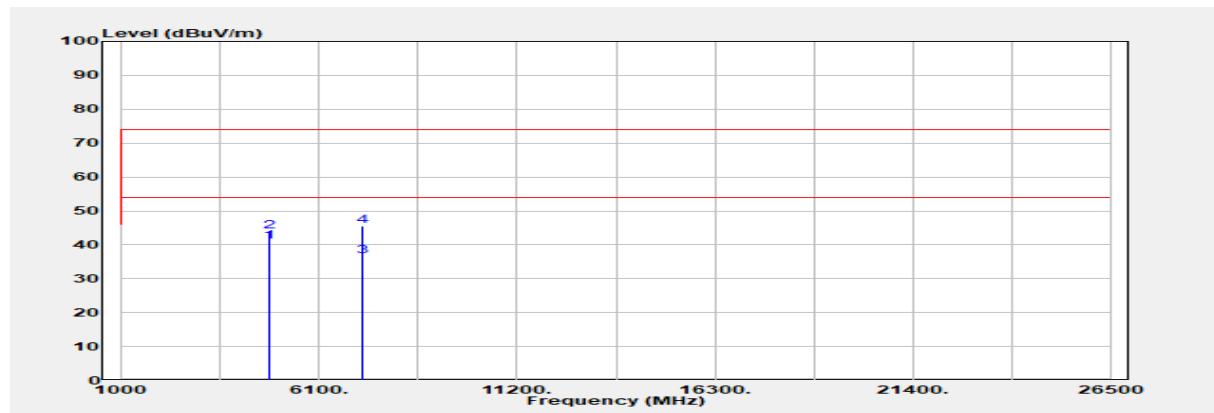
Temp./Humi. :24.9/60

Test Mode :TX CH LOW

Antenna Pol. :Vertical

EUT Pol :E1 Plane

Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4804.000	Average	37.65	3.14	40.79	54.00	-13.21
4804.000	Peak	40.82	3.14	43.96	74.00	-30.04
7206.000	Average	29.28	7.22	36.50	54.00	-17.50
7206.000	Peak	38.43	7.22	45.65	74.00	-28.35

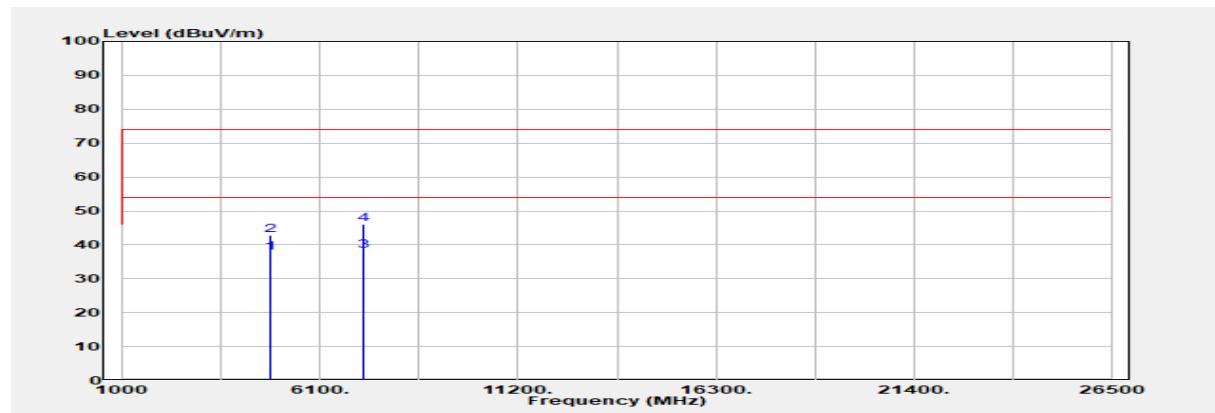
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Report Number :E2/2022/10068  
 Operation Mode :BLE 2M  
 Test Frequency :2402 MHz  
 Test Mode :TX CH LOW  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Horizontal  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4804.000	Average	34.43	3.14	37.57	54.00	-16.43
4804.000	Peak	39.74	3.14	42.88	74.00	-31.12
7206.000	Average	31.04	7.22	38.26	54.00	-15.74
7206.000	Peak	38.78	7.22	46.00	74.00	-28.00

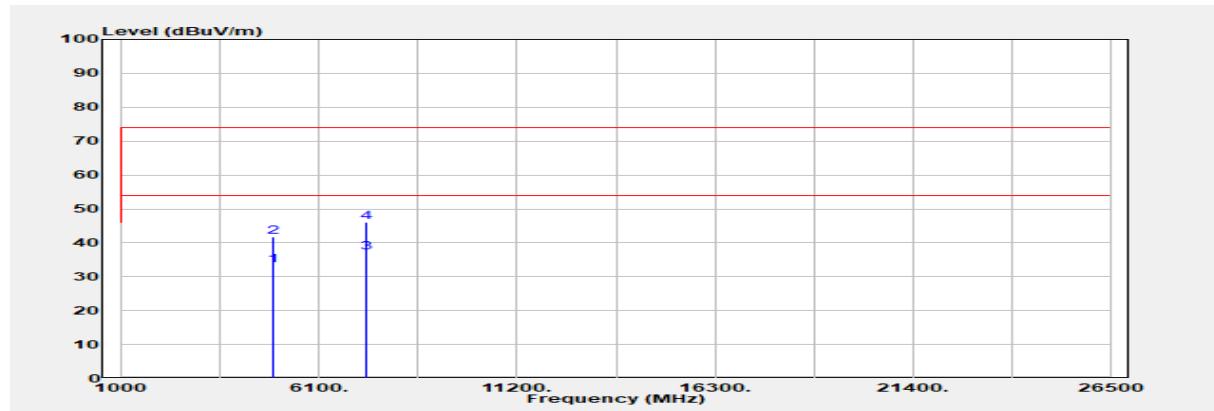
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Report Number :E2/2022/10068  
 Operation Mode :BLE 2M  
 Test Frequency :2442 MHz  
 Test Mode :TX CH MID  
 EUT Pol :E1 Plane

Test Site :SAC G  
 Test Date :2022-01-25  
 Temp./Humi. :24.9/60  
 Antenna Pol. :Vertical  
 Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4884.000	Average	29.91	3.30	33.21	54.00	-20.79
4884.000	Peak	38.43	3.30	41.73	74.00	-32.27
7326.000	Average	29.38	7.68	37.06	54.00	-16.94
7326.000	Peak	38.43	7.68	46.11	74.00	-27.89

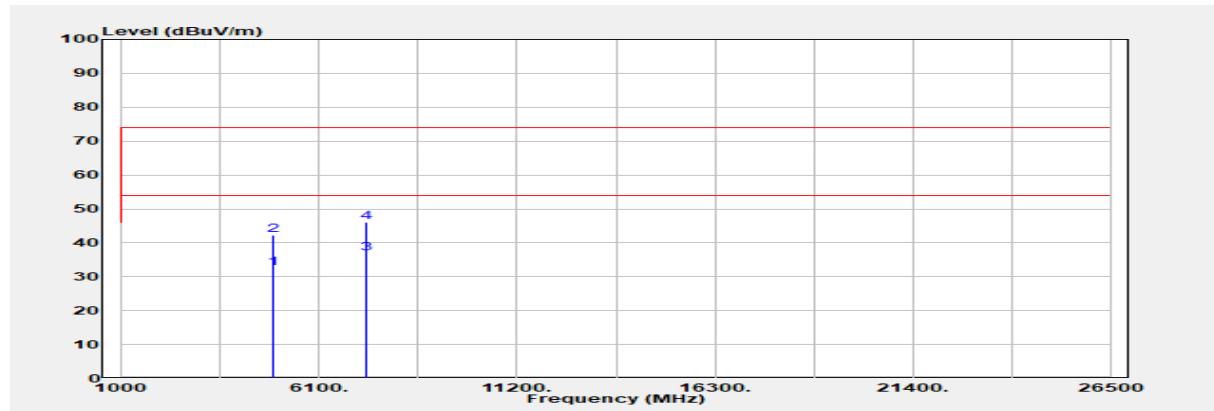
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4884.000	Average	29.21	3.30	32.51	54.00	-21.49
4884.000	Peak	39.09	3.30	42.39	74.00	-31.61
7326.000	Average	29.06	7.68	36.74	54.00	-17.26
7326.000	Peak	38.44	7.68	46.12	74.00	-27.88

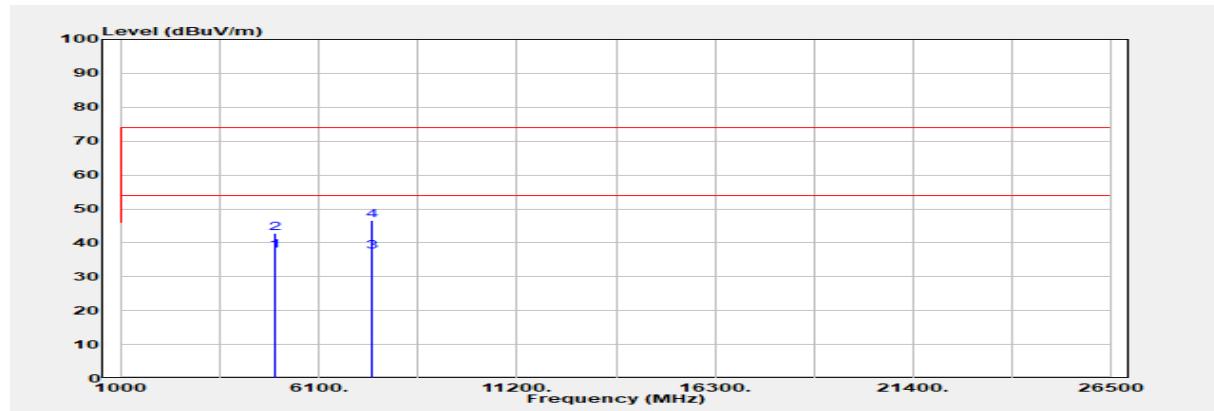
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Vertical  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.000	Average	34.23	3.42	37.65	54.00	-16.35
4960.000	Peak	39.51	3.42	42.93	74.00	-31.07
7440.000	Average	29.21	8.11	37.32	54.00	-16.68
7440.000	Peak	38.46	8.11	46.57	74.00	-27.43

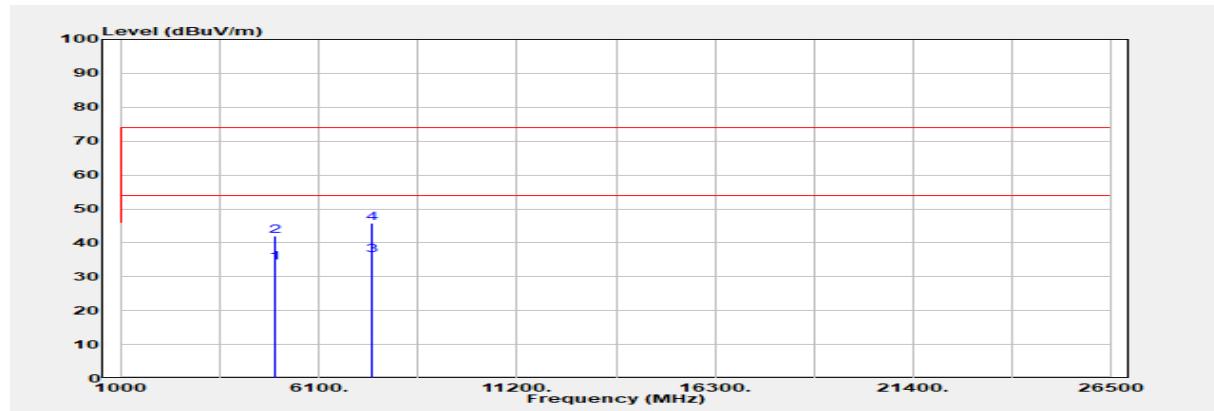
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Report Number :E2/2022/10068  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :E1 Plane

Test Site :SAC G  
Test Date :2022-01-25  
Temp./Humi. :24.9/60  
Antenna Pol. :Horizontal  
Engineer :Quentin Liu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
4960.000	Average	30.66	3.42	34.08	54.00	-19.92
4960.000	Peak	38.46	3.42	41.88	74.00	-32.12
7440.000	Average	28.11	8.11	36.22	54.00	-17.78
7440.000	Peak	37.75	8.11	45.86	74.00	-28.14

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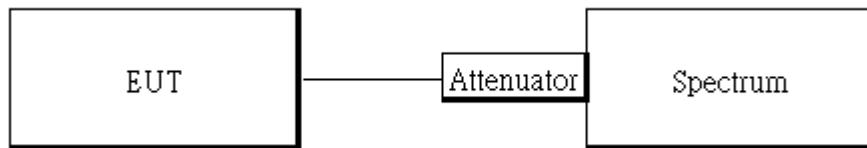
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## 12 POWER SPECTRAL DENSITY

### 12.1 Standard Applicable:

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

### 12.2 Test Setup



### 12.3 Measurement Procedure:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz. & the VBW = 10 kHz
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

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## 12.4 Measurement Result:

### BLE 1M mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-12.250	8	PASS
2442	-13.008	8	PASS
2480	-14.702	8	PASS

*NOTE: cable loss as dB that offsets in the spectrum*

### BLE 2M mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-14.290	8	PASS
2442	-15.340	8	PASS
2480	-16.831	8	PASS

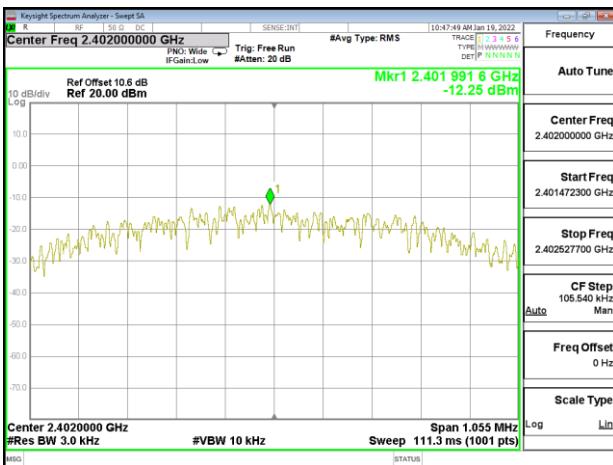
*NOTE: cable loss as dB that offsets in the spectrum*

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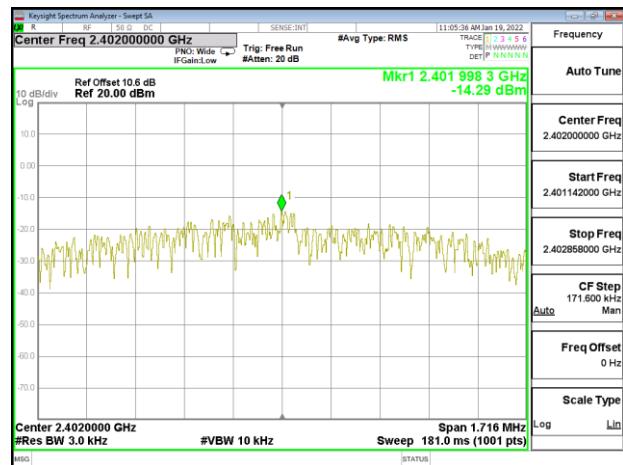
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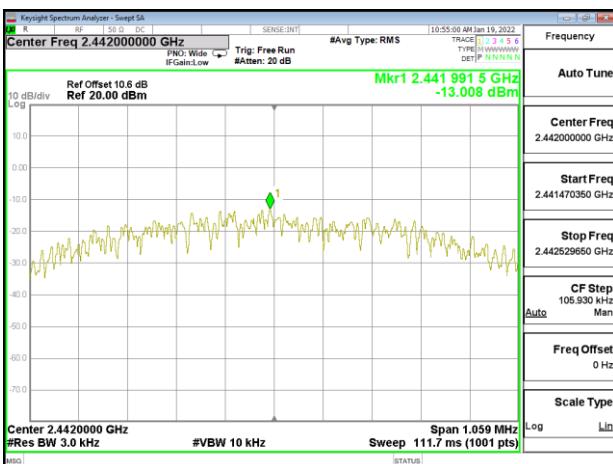
PSD\_BLE 1M\_LowCH00-2402MHz



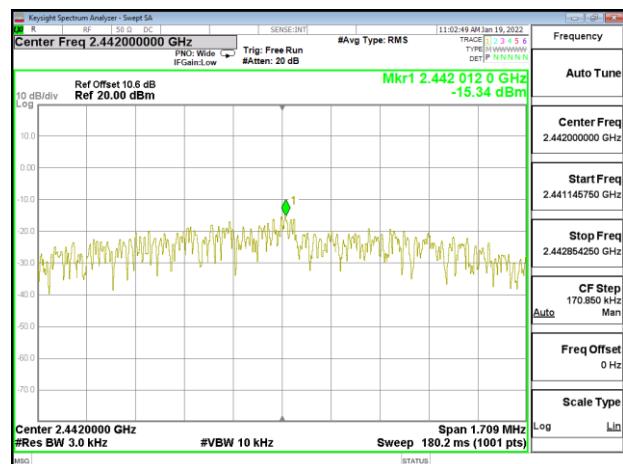
PSD\_BLE 2M\_LowCH00-2402MHz



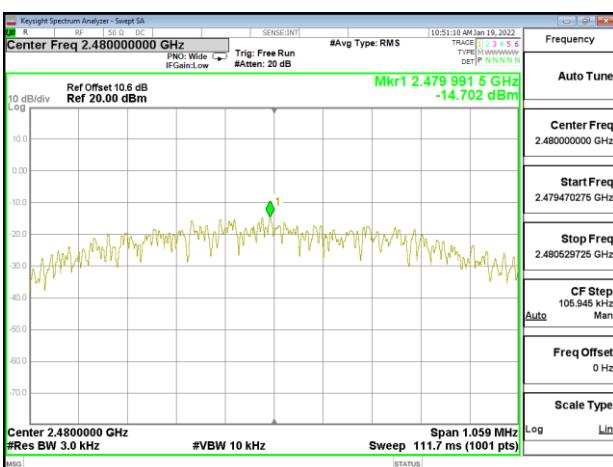
PSD\_BLE 1M\_MidCH20-2442MHz



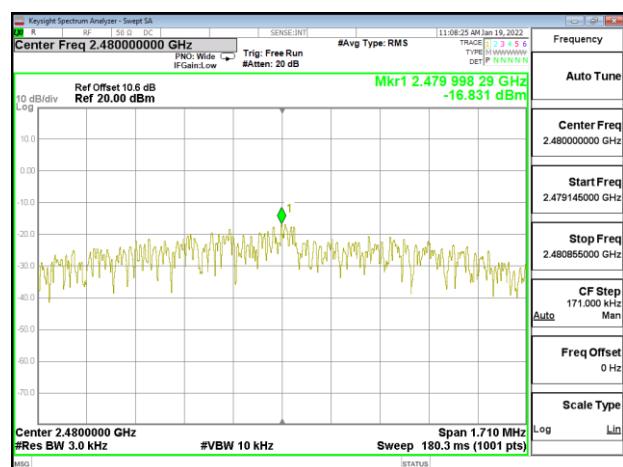
PSD\_BLE 2M\_MidCH20-2442MHz



PSD\_BLE 1M\_HighCH39-2480MHz



PSD\_BLE 2M\_HighCH39-2480MHz



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## 13 ANTENNA REQUIREMENT

### 13.1 Standard Applicable:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

### 13.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

*~ End of Report ~*

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