ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Testing Laboratory 3702

FCC Applicant:	RightCrowd Ferdinand Lousbergskaai 105/2 Ghent Oost-Vlaanderen 9000 Belgium
FCC Manufacturer:	RightCrowd Ferdinand Lousbergskaai 105/2 Ghent Oost-Vlaanderen 9000 Belgium
Product Name:	RightCrowd Badgeholder v2
Brand Name:	RightCrowd Badgeholder
Model No.:	HW3.1
Model Difference:	N/A
Report Number:	E2/2021/A0112
FCC ID	2A4P8-0310
Issue Date:	Jun. 08, 2022
Date of Test:	Oct. 27, 2021~Dec. 06, 2021
Date of EUT Received:	Oct. 27, 2021

Approved By _____
Jay Lin

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.

Revision History					
Report Number	**Revision**	**Description**	**Issue Date**	**Revised By**	**Remark**
E2/2021/A0112	00	Original.	Mar. 22, 2022	Yi-Shan Tsai	
E2/2021/A0112	01	Add Manufacturer	Jun. 08, 2022	Yi-Shan Tsai	*

Note:

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

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	RightCrowd Badgeholder v2
Brand Name:	RightCrowd Badgeholder
Model No.:	HW3.1
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	PJ21A147011
Power Supply:	Battery 3.7Vdc Adapter 12Vdc USB 5Vdc
Test Software (Name/Version)	nRF Connect v3.7.1

1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: -3.85 dBm

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Chip	2402 – 2480	0

Note: Antenna information is provided by the applicant.

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	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		
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.

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 a 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 a 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.

2.4 Measurement Results Explanation Example

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

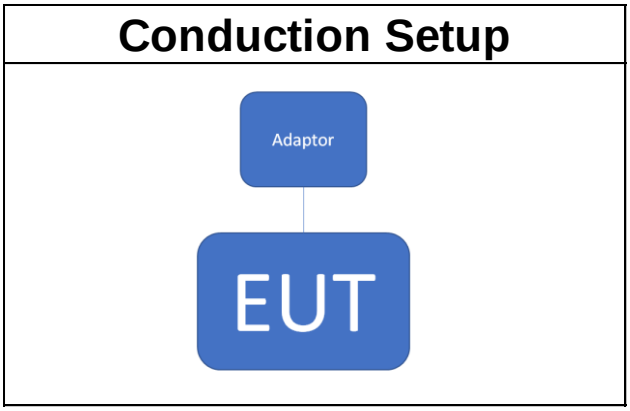
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

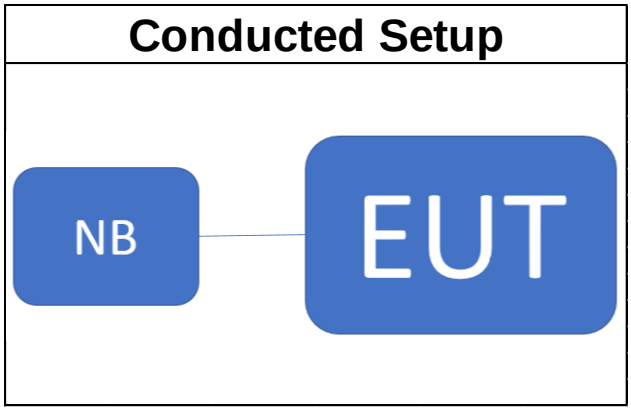
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

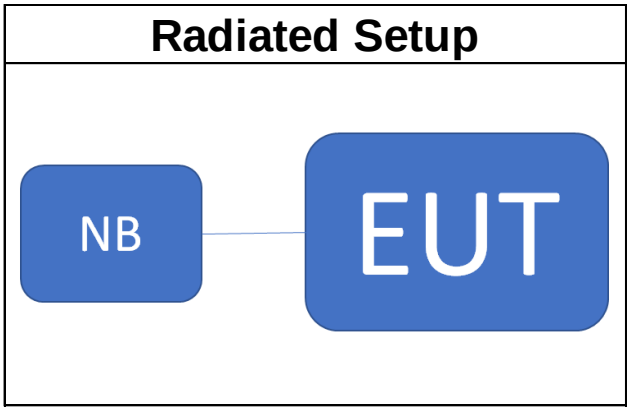
2.4.2 For all conducted test items:

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.

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.
Adapter	Lapo	WT-02CA	4712966931002	N.C.R	N.C.R

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T420	S0012599	N/A	N/A

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	DELL	P66F	CZ2HTC2	N.C.R	N.C.R

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

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	2416MHz	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.

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	20	GFSK	1
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
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case E2 position was reported.				

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.34	dB
Peak Output Power	+/-	1	dB
6dB Bandwidth & 99% Bandwidth	+/-	1.53	Hz
100 kHz Bandwidth Of Frequency Band Edges	+/-	1.69	dB
Peak Power Density	+/-	1.53	dB
Temperature	+/-	0.4	°C
Humidity	+/-	3.5	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**2.64**	**dB**	9kHz~30MHz
	+/-	**4.93**	**dB**	30MHz - 1000MHz
	+/-	**4.81**	**dB**	1GHz - 18GHz
	+/-	**4.52**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**2.64**	**dB**	9kHz~30MHz
	+/-	**4.45**	**dB**	30MHz - 1000MHz
	+/-	**4.81**	**dB**	1GHz - 18GHz
	+/-	**4.52**	**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.

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
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2021	03/26/2022

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/13/2021	07/12/2022
Power Meter	Anritsu	ML2496A	2138002	11/12/2021	11/11/2022
Power Sensor	Anritsu	MA2411B	1911390	09/20/2021	09/19/2022
Power Sensor	Anritsu	MA2411B	1911398	09/22/2021	09/21/2022
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Marvelous	WATT-218FS-10	RF15	11/18/2021	11/17/2022
DC Block	PASTERNACK	PE8210	RF158	11/18/2021	11/17/2022

6.3 Radiated Measurement

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Broadband Antenna	SCHWAZBECK	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
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.*

7 CONDUCTED EMISSION TEST

7.1 Standard Applicable:

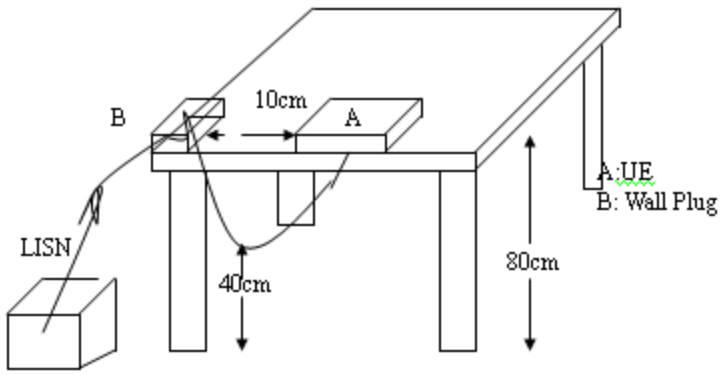
Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBμV)	
	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



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

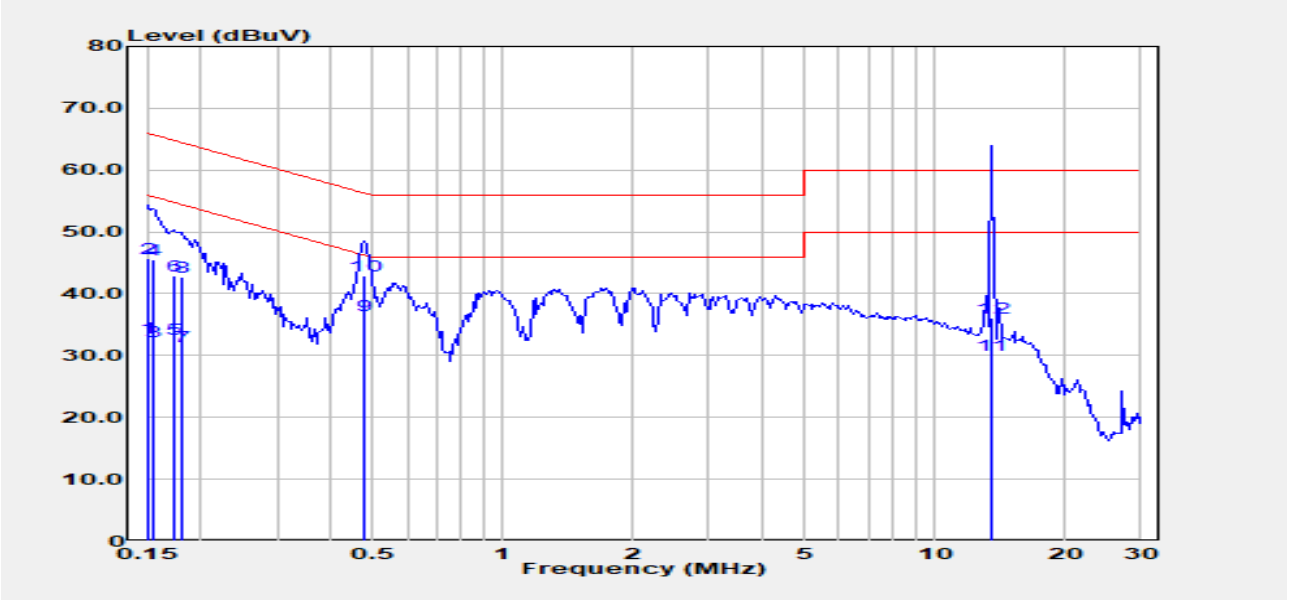
7.5 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

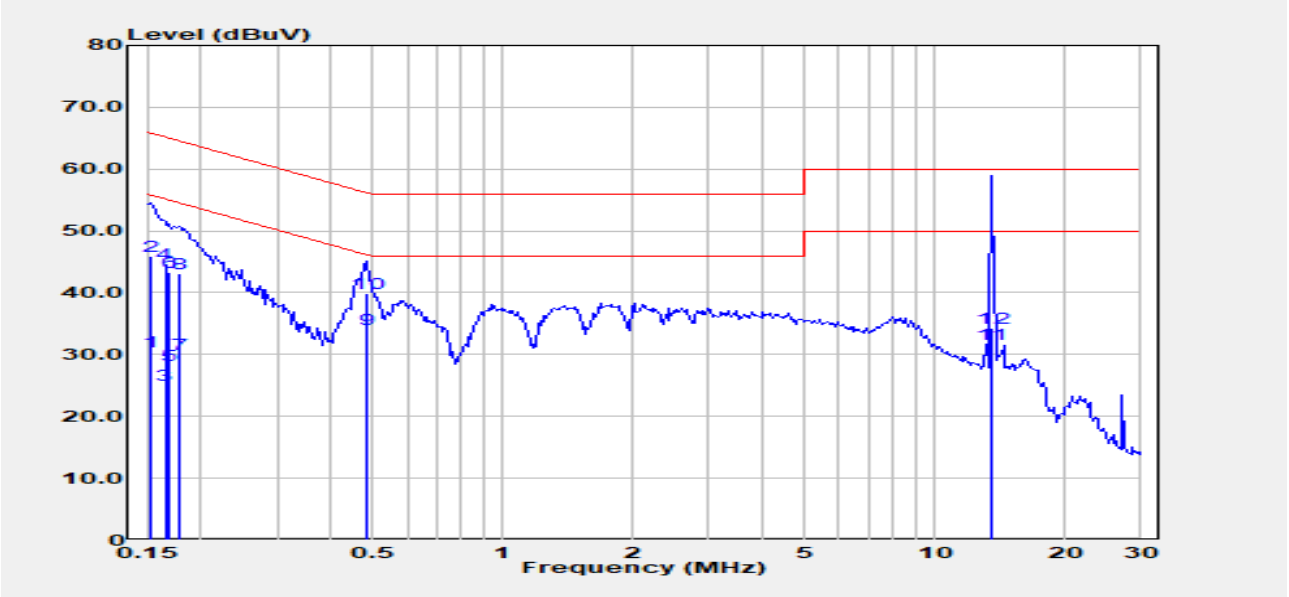
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:E2/2021/A0112	Test Site	:Conduction C
Test Mode	:BLE	Test Date	:2021-12-03
Power	:120V/60Hz	Temp./Humi.	:22.0/41
Probe	:L1	Engineer	:Jason Yeh



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.152	Average	22.60	10.30	32.90	55.91	-23.01
0.152	QP	35.40	10.30	45.70	65.91	-20.21
0.155	Average	22.00	10.30	32.30	55.74	-23.44
0.155	QP	35.20	10.30	45.50	65.74	-20.24
0.172	Average	22.40	10.30	32.70	54.86	-22.16
0.172	QP	32.60	10.30	42.90	64.86	-21.96
0.182	Average	21.20	10.30	31.50	54.42	-22.92
0.182	QP	32.50	10.30	42.80	64.42	-21.62
0.476	Average	26.10	10.31	36.41	46.41	-10.00
0.476	QP	32.60	10.31	42.91	56.41	-13.50
13.551	Average	19.30	10.75	30.05	50.00	-19.95
13.551	QP	25.40	10.75	36.15	60.00	-23.85

Report Number	:E2/2021/A0112	Test Site	:Conduction C
Test Mode	:BLE	Test Date	:2021-12-03
Power	:120V/60Hz	Temp./Humi.	:22.0/41
Probe	:N	Engineer	:Jason Yeh



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.153	Average	20.20	10.31	30.51	55.82	-25.31
0.153	QP	35.70	10.31	46.01	65.82	-19.81
0.165	Average	14.70	10.31	25.01	55.21	-30.20
0.165	QP	34.40	10.31	44.71	65.21	-20.50
0.169	Average	18.00	10.31	28.31	55.03	-26.73
0.169	QP	33.10	10.31	43.41	65.03	-21.63
0.178	Average	19.70	10.30	30.00	54.59	-24.59
0.178	QP	32.80	10.30	43.10	64.59	-21.49
0.481	Average	23.70	10.32	34.02	46.32	-12.30
0.481	QP	29.50	10.32	39.82	56.32	-16.50
13.551	Average	20.80	10.83	31.63	50.00	-18.37
13.551	QP	23.55	10.83	34.38	60.00	-25.62

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 form 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.

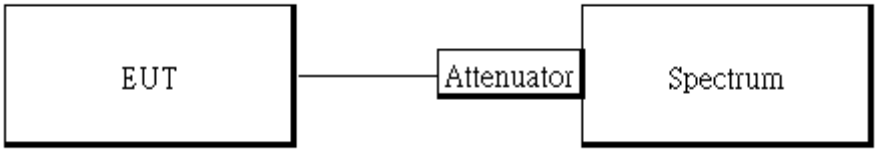
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

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.

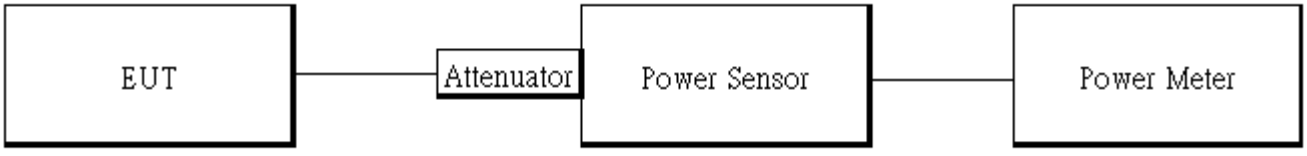
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



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

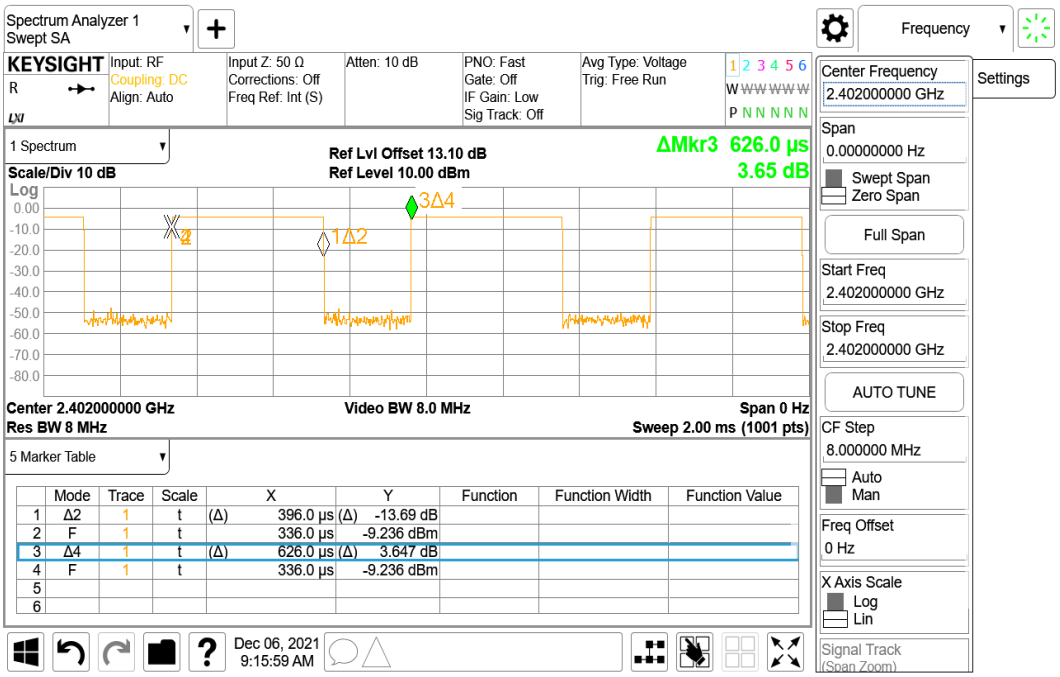
8.3.2 Output Power

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	63.00	2.01	2.53	3.00

BLE_1M_LowCH00-2402



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	4	-3.85	30
Mid	2442	4	-4.21	30
High	2480	4	-4.61	30
CH	**Frequency (MHz)**	**Power set**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit (dBm)**
Low	2402	4	-4.00	30
Mid	2442	4	-4.41	30
High	2480	4	-4.81	30

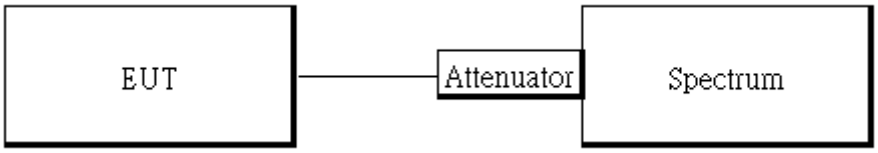
Note: Measured by power meter, cable loss 13.1 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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:

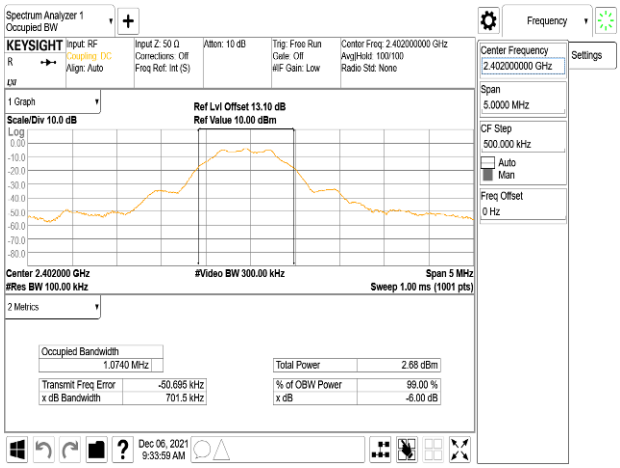
1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer 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

9.4 Measurement Result:

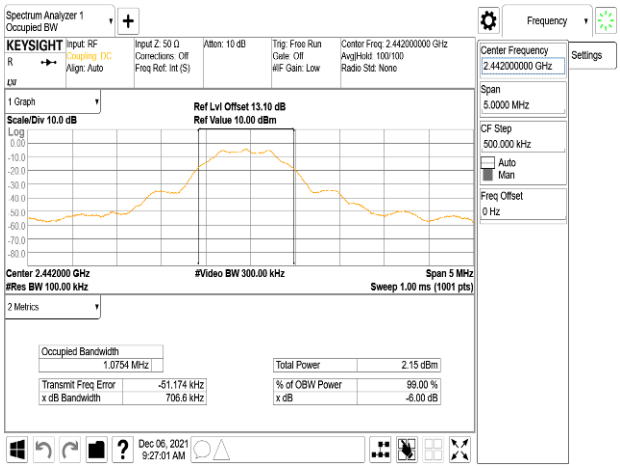
BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7015	≧ 0.5	PASS
2442	0.7066	≧ 0.5	PASS
2480	0.7043	≧ 0.5	PASS

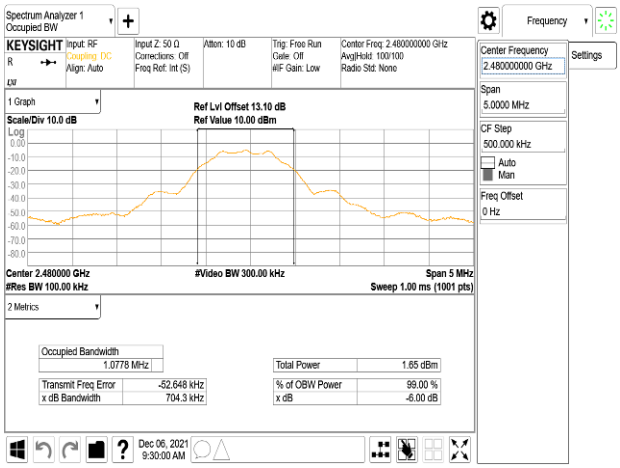
OBW_BLE 1M_LowCH00-2402MHz



OBW_BLE 1M_MidCH20-2442MHz



OBW_BLE 1M_HighCH39-2480MHz

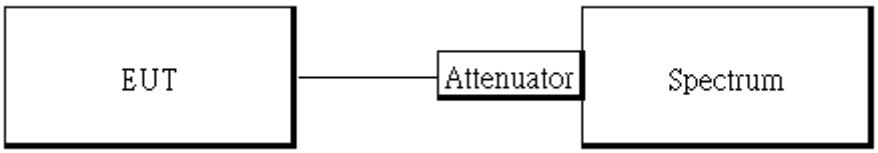


10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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 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

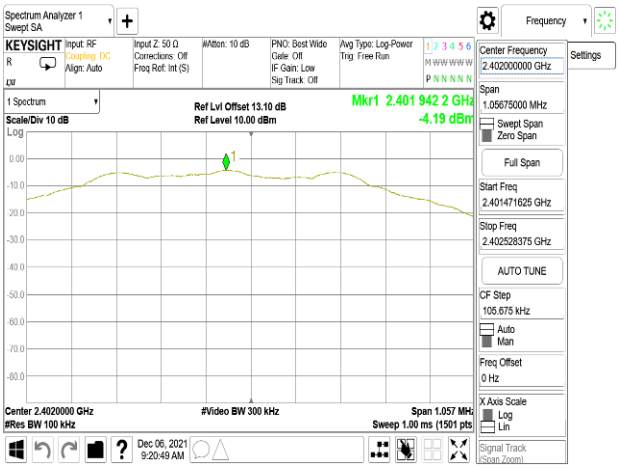
BLE 1M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	-4.19	-24.19
2442	-4.73	-24.73
2480	-5.22	-25.22

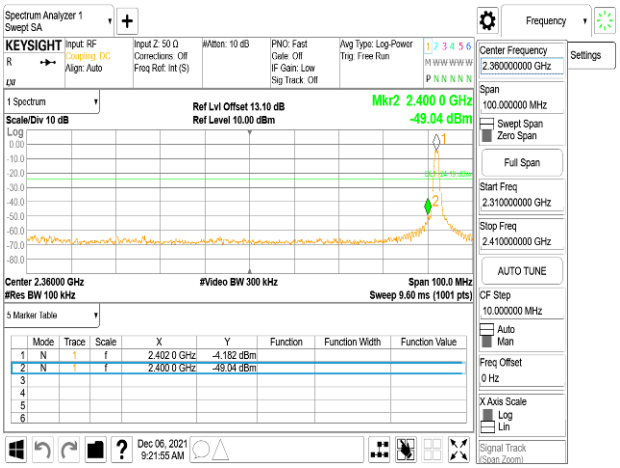
NOTE: cable loss as 13.1dB that offsets in the spectrum

NOTE: Refer to next page for plots.

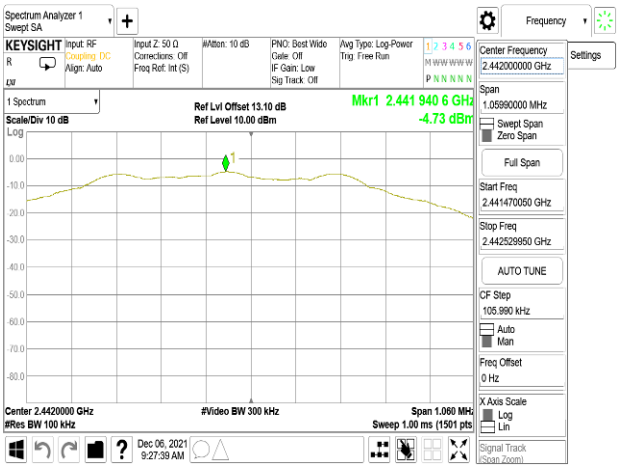
Reference Level_BLE 1M_LowCH00-2402MHz



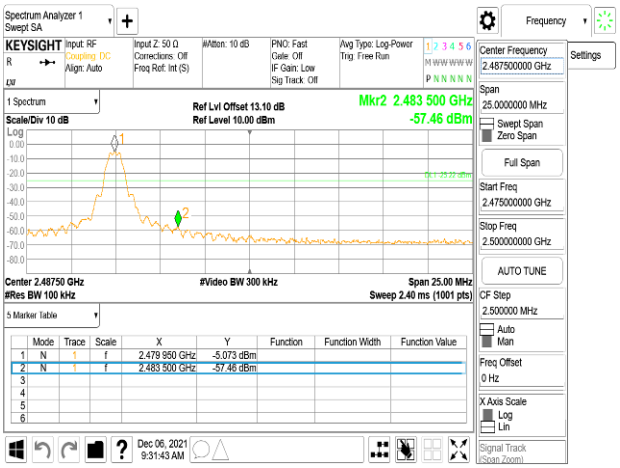
Band Edge_BLE 1M_LowCH00-2402MHz



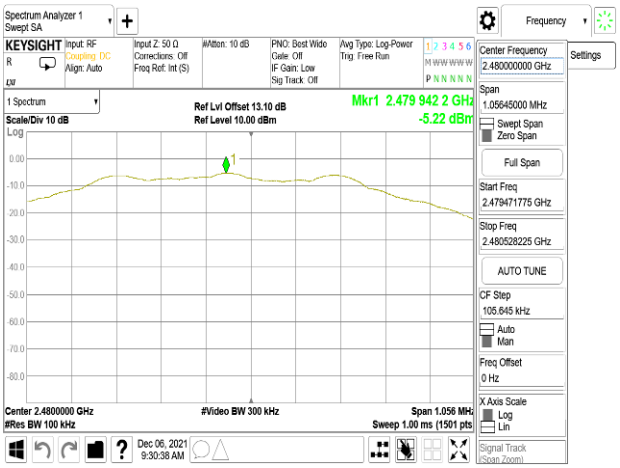
Reference Level_BLE 1M_MidCH20-2442MHz



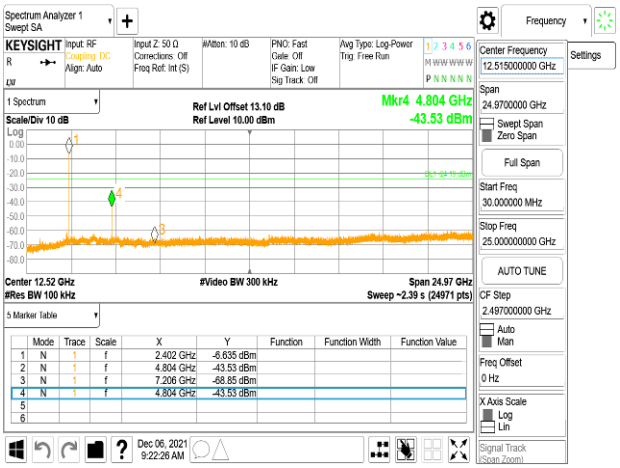
Band Edge_BLE 1M_HighCH39-2480MHz



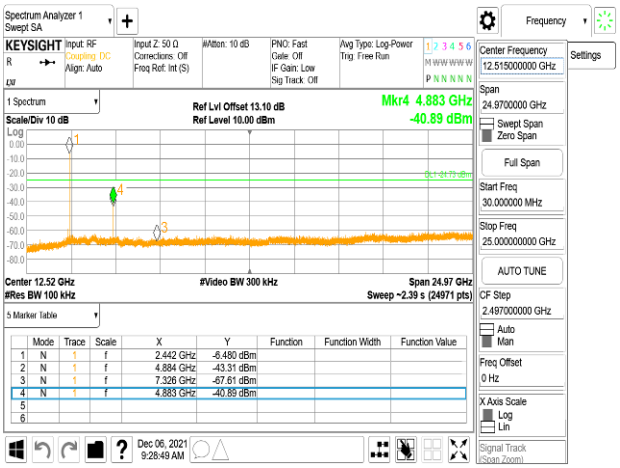
Reference Level_BLE 1M_HighCH39-2480MHz



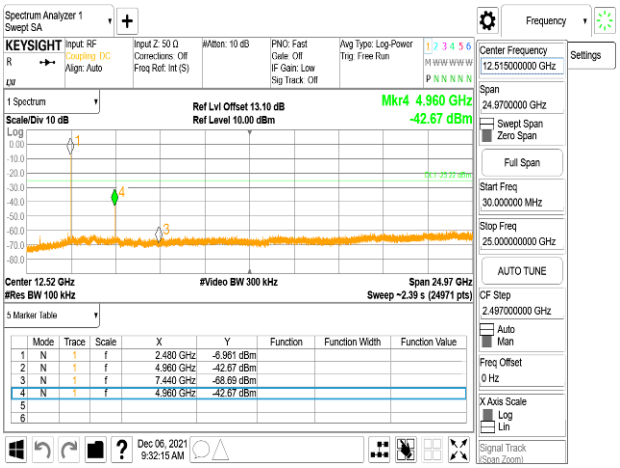
Spurious Emission_BLE 1M_LowCH00-2402MHz



Spurious Emission_BLE 1M_MidCH20-2442MHz



Spurious Emission_BLE 1M_HighCH39-2480MHz



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.

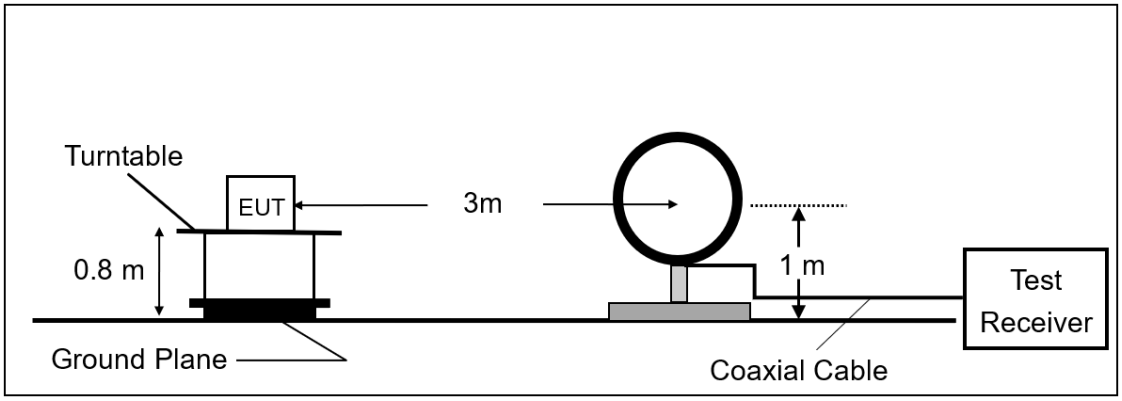
And according to §15.33(a) (1) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

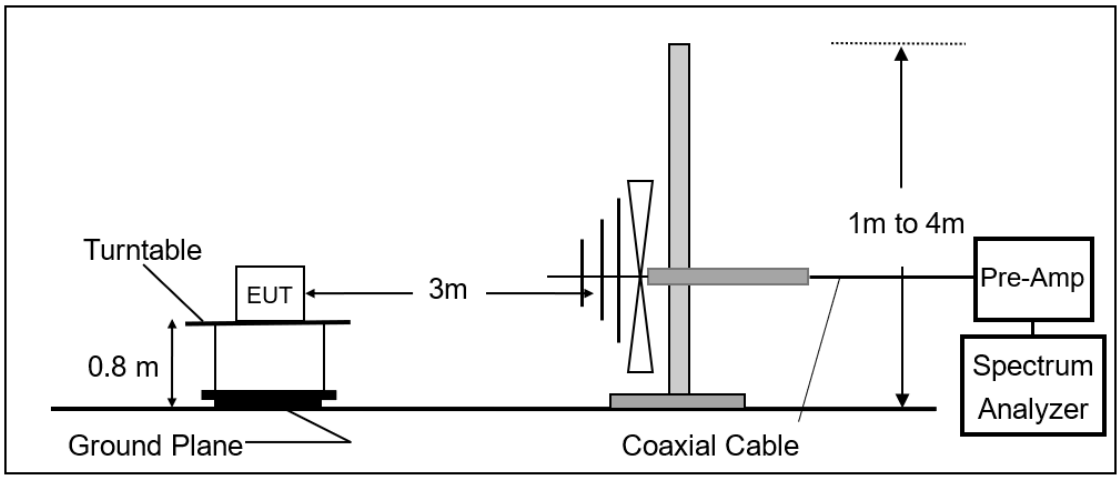
Note: The lower limit shall apply at the transition frequencies.

11.2 Test Setup

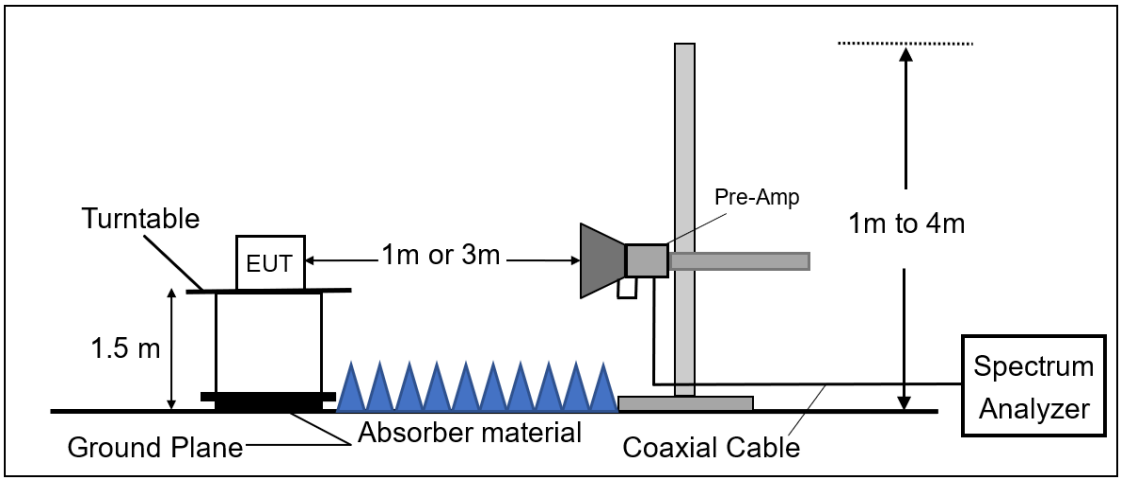
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(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.

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 ≥ 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 dBuV/m, which converts 20*log(uV/m)*

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

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

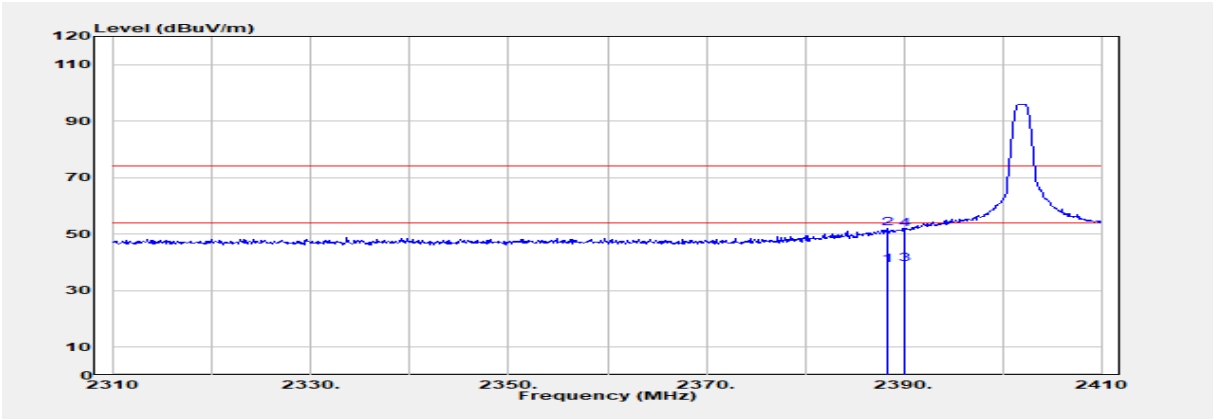
11.5 Test Results of Radiated Spurious Emissions from 9 kHz to 30 MHz

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.

11.6 Measurement Result:

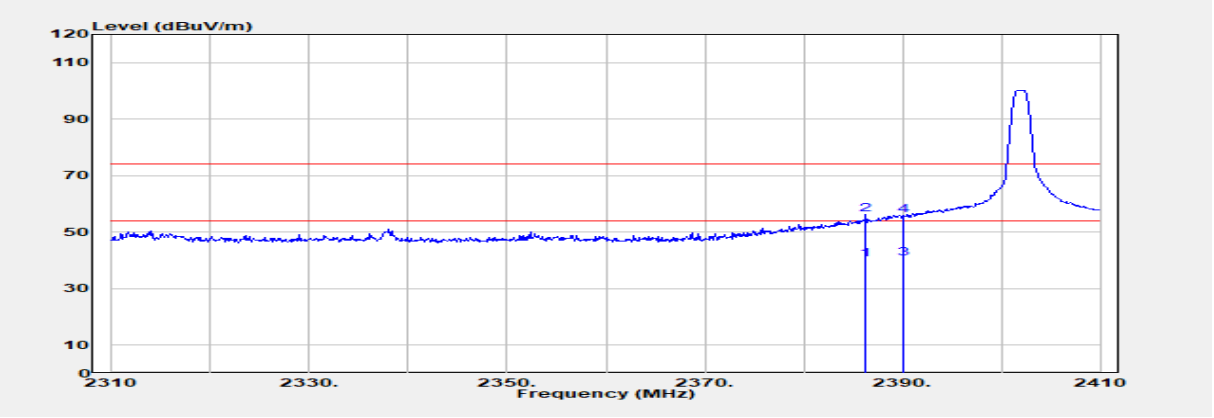
11.6.1 Radiated Band Edge Measurement Result

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2402 MHz	Temp./Humi.	:23.3/58
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



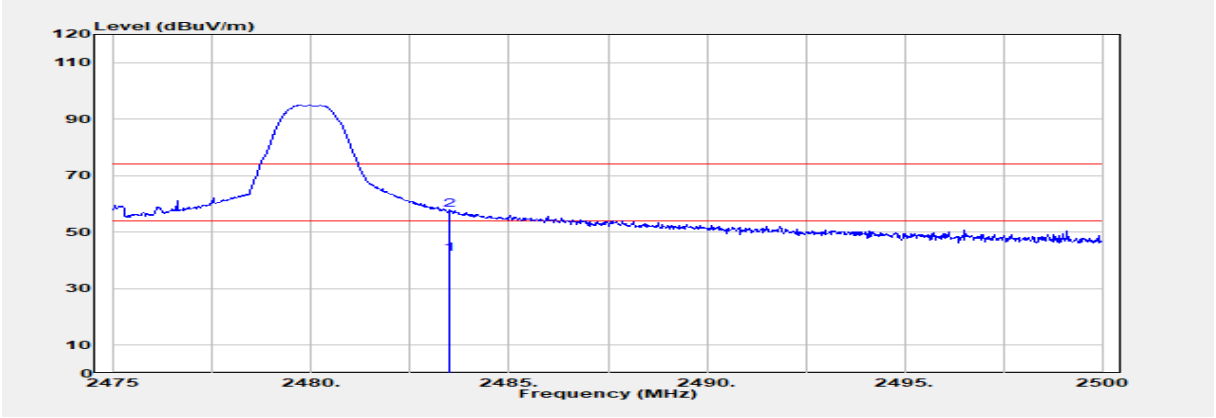
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2388.400	Average	42.82	-3.79	39.03	54.00	-14.97
2388.400	Peak	55.86	-3.79	52.06	74.00	-21.94
2390.000	Average	43.05	-3.80	39.25	54.00	-14.75
2390.000	Peak	55.59	-3.80	51.79	74.00	-22.21

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2402 MHz	Temp./Humi.	:23.3/58
Test Mode	:BE CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



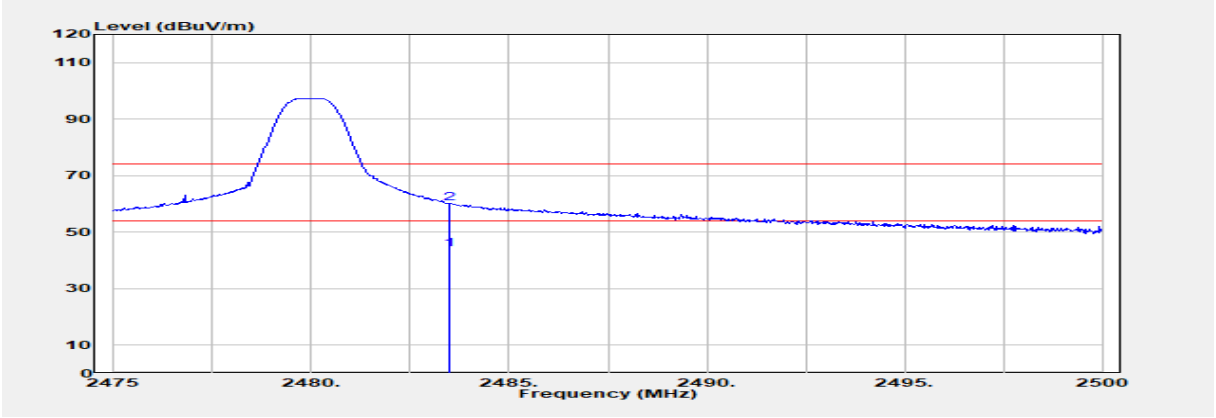
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2386.300	Average	44.06	-3.79	40.27	54.00	-13.73
2386.300	Peak	59.91	-3.79	56.13	74.00	-17.87
2390.000	Average	44.33	-3.80	40.53	54.00	-13.47
2390.000	Peak	59.79	-3.80	55.99	74.00	-18.01

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2480 MHz	Temp./Humi.	:23.3/58
Test Mode	:BE CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	46.22	-3.92	42.30	54.00	-11.70
2483.500	Peak	61.93	-3.92	58.01	74.00	-15.99

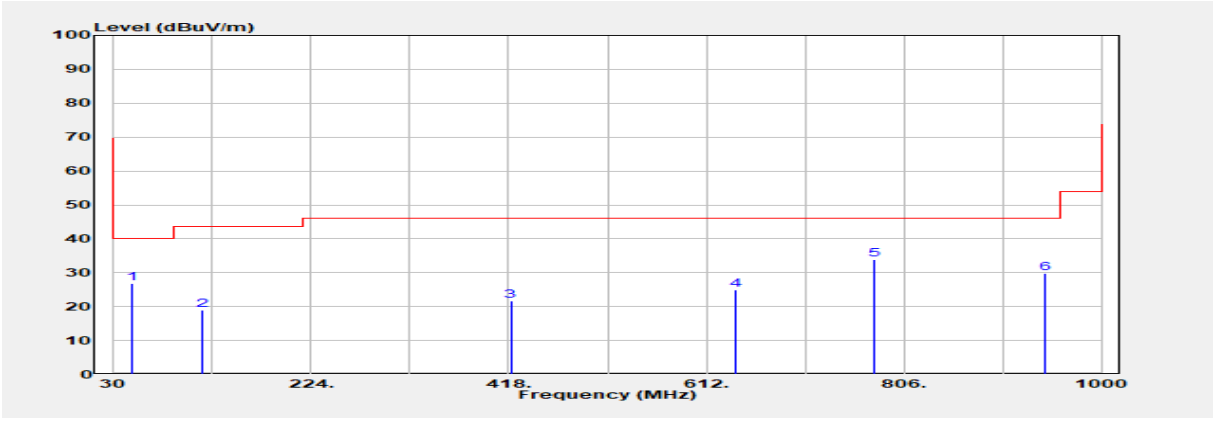
Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2480 MHz	Temp./Humi.	:23.3/58
Test Mode	:BE CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	47.91	-3.92	43.99	54.00	-10.01
2483.500	Peak	64.04	-3.92	60.12	74.00	-13.88

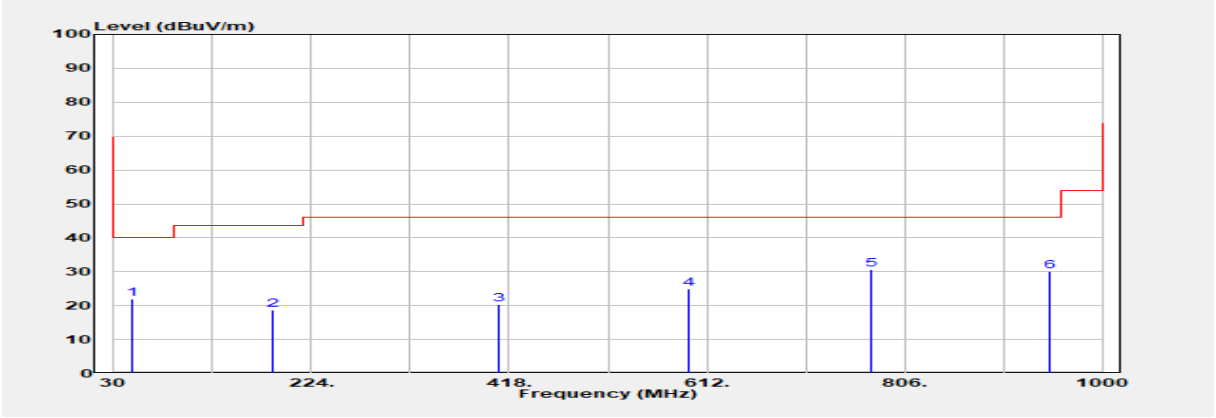
11.6.2 Radiated Spurious Emission

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2442 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Jason Yeh



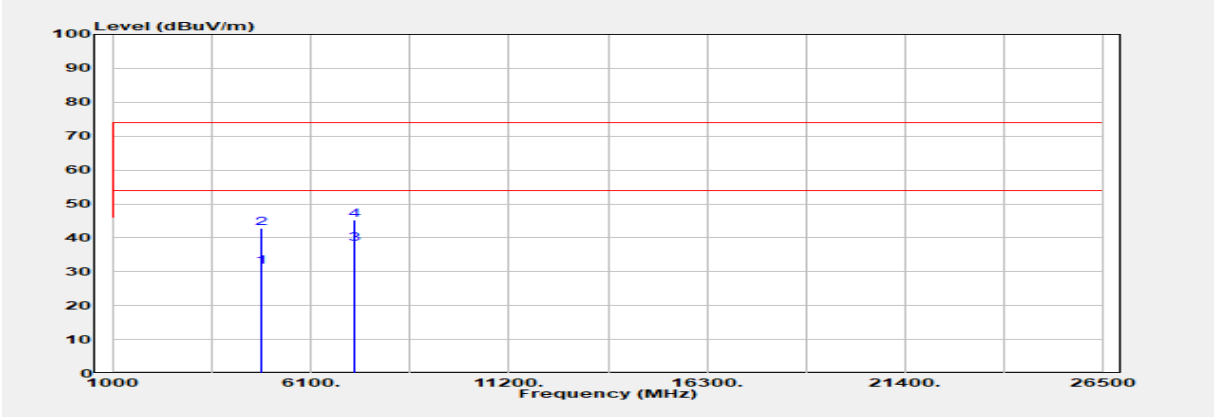
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
48.430	Peak	39.89	-12.98	26.90	40.00	-13.10
117.300	Peak	34.64	-15.59	19.05	43.50	-24.45
419.940	Peak	30.69	-8.99	21.71	46.00	-24.29
640.130	Peak	29.85	-4.82	25.03	46.00	-20.97
776.900	Peak	36.46	-2.59	33.87	46.00	-12.13
944.710	Peak	29.78	0.13	29.90	46.00	-16.10

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2442 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Jason Yeh



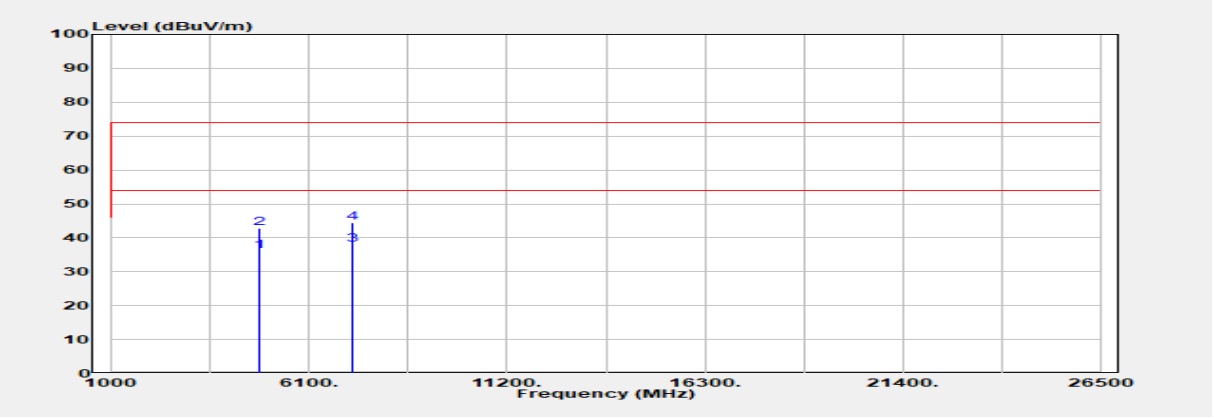
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
47.460	Peak	34.81	-12.89	21.92	40.00	-18.08
185.200	Peak	33.69	-15.06	18.62	43.50	-24.88
407.330	Peak	30.01	-9.76	20.26	46.00	-25.74
594.540	Peak	30.80	-5.78	25.03	46.00	-20.97
773.020	Peak	33.35	-2.83	30.51	46.00	-15.49
948.590	Peak	29.88	0.22	30.10	46.00	-15.90

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2402 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



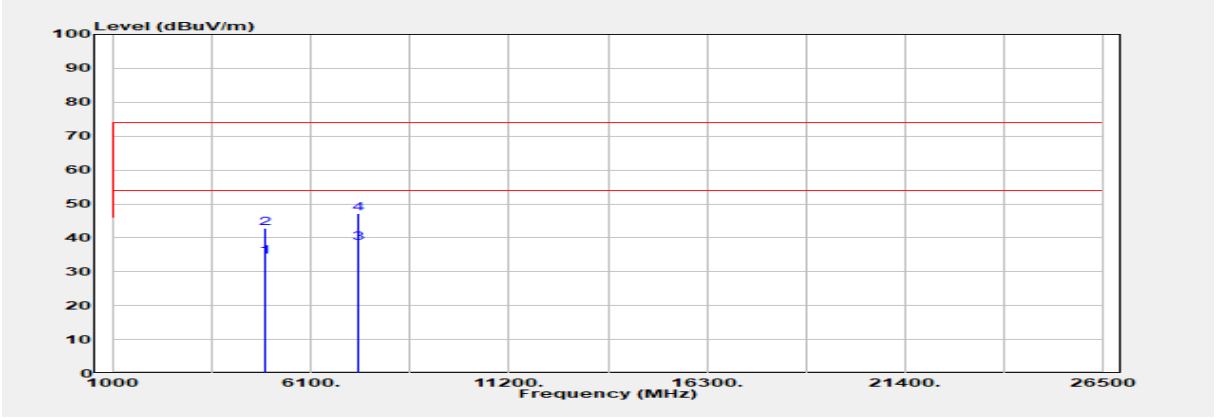
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4804.000	Average	28.36	3.14	31.50	54.00	-22.50
4804.000	Peak	39.55	3.14	42.69	74.00	-31.31
7206.000	Average	31.03	7.22	38.25	54.00	-15.75
7206.000	Peak	38.08	7.22	45.30	74.00	-28.70

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2402 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



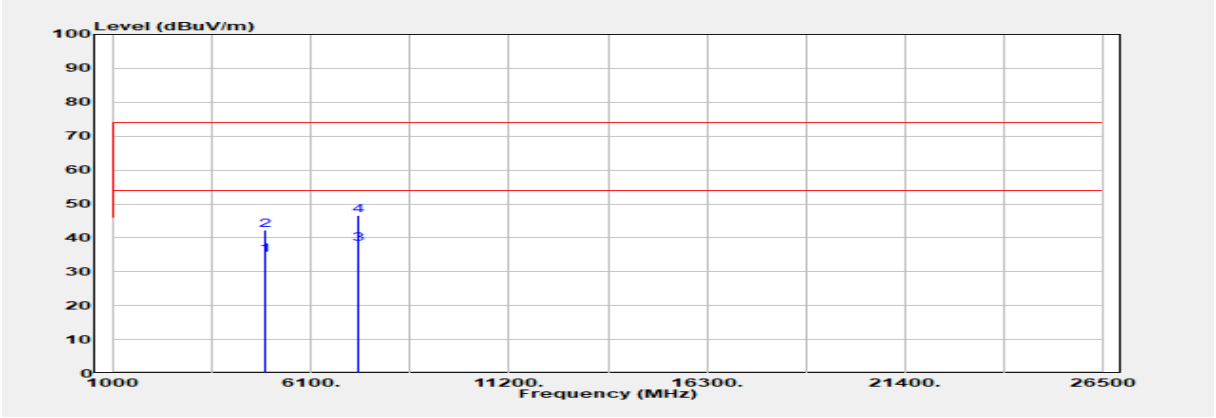
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4804.000	Average	32.90	3.14	36.03	54.00	-17.97
4804.000	Peak	39.70	3.14	42.83	74.00	-31.17
7206.000	Average	30.80	7.22	38.01	54.00	-15.99
7206.000	Peak	37.27	7.22	44.49	74.00	-29.51

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2442 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



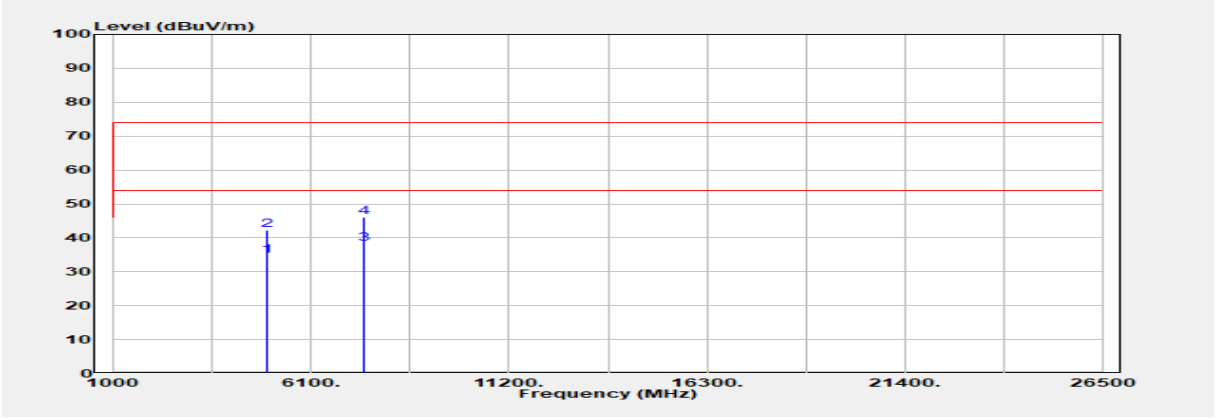
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4884.000	Average	31.24	3.30	34.53	54.00	-19.47
4884.000	Peak	39.59	3.30	42.89	74.00	-31.11
7326.000	Average	30.81	7.68	38.49	54.00	-15.51
7326.000	Peak	39.51	7.68	47.19	74.00	-26.81

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2442 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



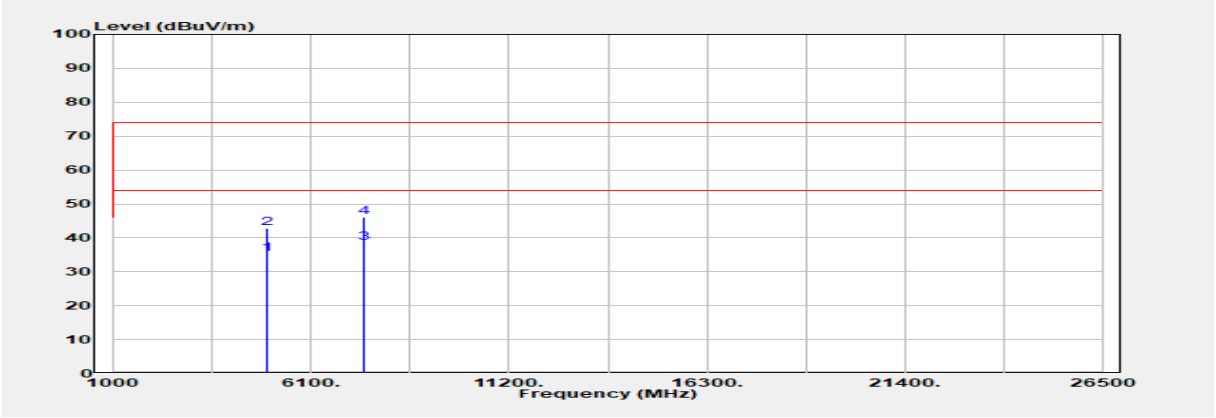
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4884.000	Average	31.64	3.30	34.94	54.00	-19.06
4884.000	Peak	39.01	3.30	42.30	74.00	-31.70
7326.000	Average	30.54	7.68	38.22	54.00	-15.78
7326.000	Peak	39.01	7.68	46.69	74.00	-27.31

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2480 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4960.000	Average	31.22	3.42	34.64	54.00	-19.36
4960.000	Peak	38.78	3.42	42.20	74.00	-31.80
7440.000	Average	30.00	8.11	38.11	54.00	-15.89
7440.000	Peak	38.06	8.11	46.17	74.00	-27.83

Report Number	:E2/2021/A0112	Test Site	:SAC G
Operation Mode	:BLE 1M	Test Date	:2021-12-02
Test Frequency	:2480 MHz	Temp./Humi.	:23.3/58
Test Mode	:TX CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Quentin Liu



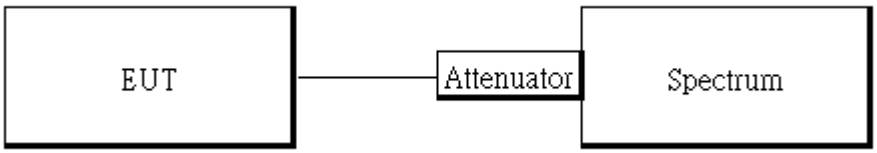
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4960.000	Average	31.70	3.42	35.12	54.00	-18.88
4960.000	Peak	39.39	3.42	42.81	74.00	-31.19
7440.000	Average	30.35	8.11	38.46	54.00	-15.55
7440.000	Peak	38.02	8.11	46.13	74.00	-27.87

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.

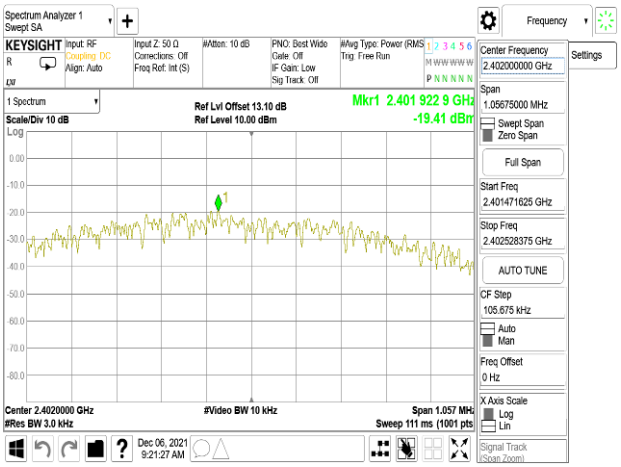
12.4 Measurement Result:

BLE 1M mode

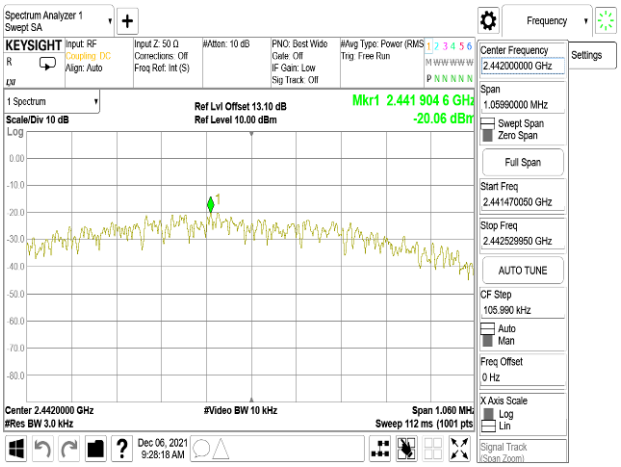
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-19.410	8	PASS
2442	-20.060	8	PASS
2480	-20.610	8	PASS

NOTE: cable loss as 13.1dB that offsets in the spectrum

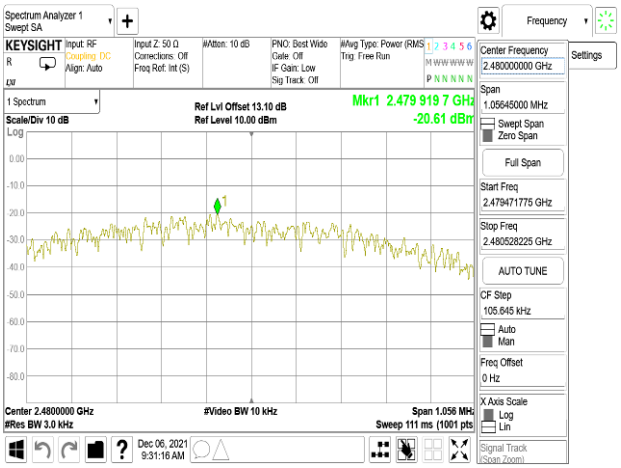
PSD_BLE 1M_LowCH00-2402MHz



PSD_BLE 1M_MidCH20-2442MHz



PSD_BLE 1M_HighCH39-2480MHz



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 ~