

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Murata Manufacturing Co., Ltd.
1-10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555
Japan

Product Name: Communication Module

Brand Name: muRata

Model No.: LBEE5XV1YM

Model Difference: N/A

Report Number: ER/2020/C0063

FCC ID: VPYLB1YM

IC: 772C-LB1YM

FCC Rule Part: §15.247, Cat: DTS

IC RSS: RSS-247 issue 2 Feb 2017

Issue Date: Dec. 30, 2020

Date of Test: Aug. 19, 2020 ~ Sep. 22, 2020

Date of EUT Received: Aug. 19, 2020

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 tested as described in this report is in compliance with conducted and radiated emission limits.

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

Approved By:

Jay Lin
Jay Lin / Asst. Supervisor



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Revision History

Report Number	Revision	Description	Issue Date	Remark
ER/2020/C0063	Rev.00	Original.	Dec. 30, 2020	Revised By: Elle Chang

Note:

1、Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

2、Measurement results in the original test report ER/2020/80120 are fully leveraged in this test report without further verification test.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5XV1YM
Model Difference:	N/A
Hardware Version:	1.0
Software Version:	1.0
Power Supply:	3.3Vdc

Radio Technology:	Bluetooth LE Dual mode
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: 5.91 dBm BLE 2M: 5.90 dBm

1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)	Worst Antenna Gain
Dipole	Molex	146153	2402~2480	3.2	
	Molex	146187	2402~2480	3.4	V
Note: Pre-scanned was done on the above 2 antennas, the peak gain 3.4dBi results higher emission at 2.4GHz. Therefore, the completed set of measurement was done on the antenna to be presented on this test report.					

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1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
RSS-247 issue 2 Feb. 2017
RSS-Gen. issue 5, Amendment 1, March 2019
ANSI C63.10:2013

1.4 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)
No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0028
ISED CAB identifier: TW3702

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 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 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50 μ H/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*9m*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 Configuration of Tested System

**Fig. 2-1 Conducted (Antenna Port)
Emission Configuration**

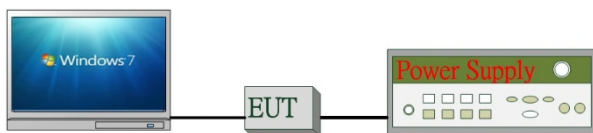


Fig 2-2 Radiated Emission

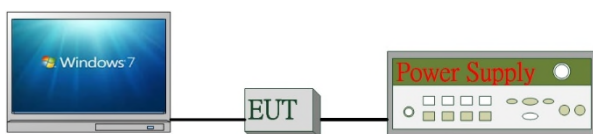


Fig 2-3 Conduction Emission

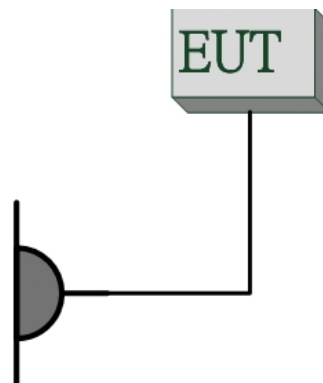


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	L420	S0011721	N/A	N/A
3	DC Power Supply	DHA	DPS-3003	9411005787	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	6dB & 99% Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2 b	Peak Power Density	Compliant
§15.203 §15.247(b)	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

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		

Note: EUT serial number is 1617633250 and sample number is DUT No. 20.

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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. Investigation has been done on all the possible configurations for searching the worst case.

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth LE	2402 to 2480	2442	GFSK	1
Bluetooth LE	2402 to 2480	2442	GFSK	2
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	1
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	2
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the worst case E2 position was reported.				

ANTENNA PORT CONDUCTED MEASUREMENT				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	1
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	2

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +/-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +/-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

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 CONDUCTED EMISSION TEST

6.1 Standard Applicable:

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

Frequency range MHz	Limits dB(μ 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.		

6.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	03/25/2020	03/24/2021
EMI Test Receiver	R&S	ESCI	101342	04/28/2020	04/27/2021
Test Software	audix	e3	Ver. 6.11-20180419c	N.C.R	N.C.R

6.3 EUT Setup:

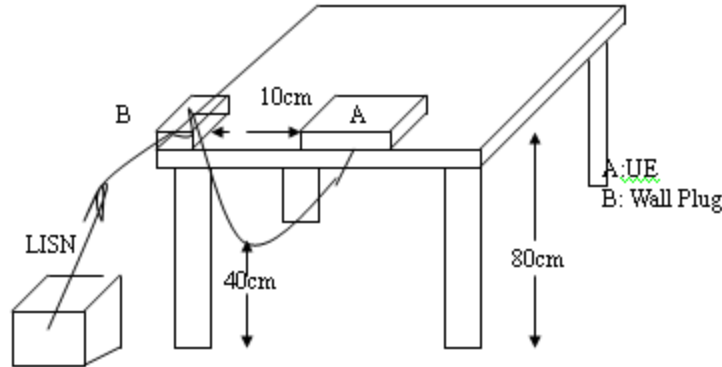
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plan.
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

6.6 Measurement Result:

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

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

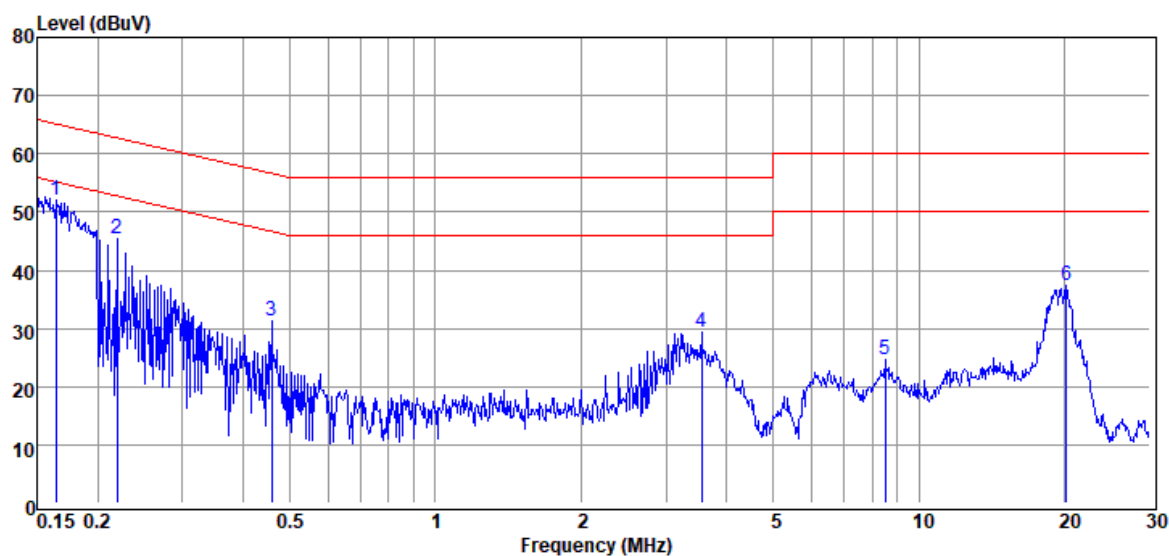
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:ER/2020/80120	Test Site	:Conduction Room C
Test Mode	:BLE 1M	Test Date	:2020-09-04
Power	:120V/60Hz	Temp./Humi.	:25.1/68
Probe	:L1	Engineer	:Kailin Lee
Note:	: Adapter: FSP065-REB		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.16	Peak	41.86	10.22	52.08	65.25	-13.17
0.22	Peak	35.26	10.22	45.48	62.83	-17.35
0.46	Peak	21.04	10.22	31.26	56.71	-25.45
3.55	Peak	18.97	10.47	29.44	56.00	-26.56
8.50	Peak	13.93	10.66	24.59	60.00	-35.41
20.16	Peak	26.39	10.85	37.24	60.00	-22.76

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Report Number :ER/2020/80120

Test Site :Conduction Room C

Test Mode :BLE 1M

Test Date :2020-09-04

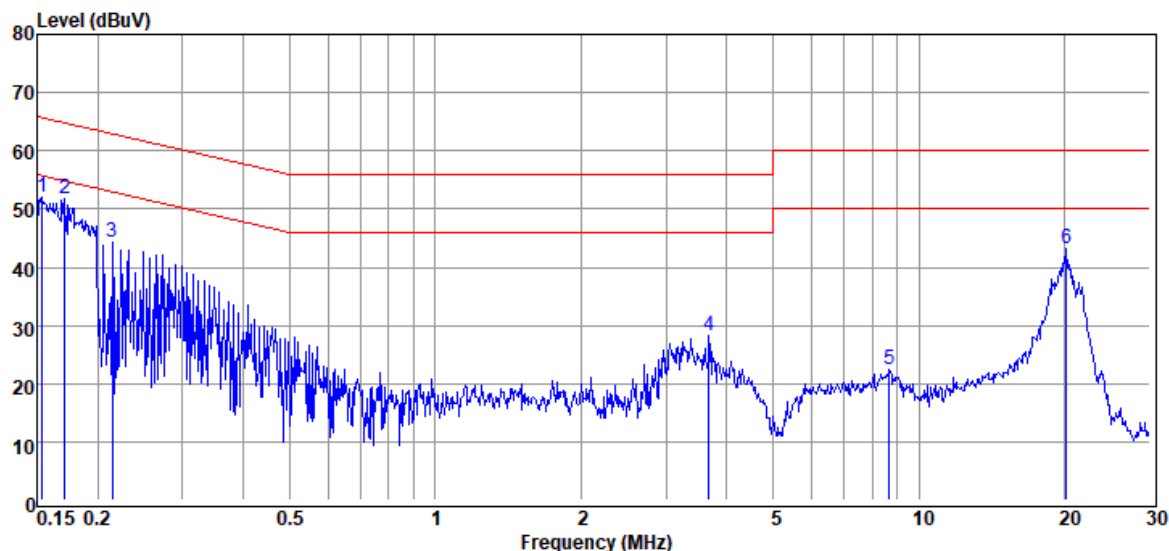
Power :120V/60Hz

Temp./Humi. :25.1/68

Probe :N

Engineer :Kailin Lee

Note: : Adapter: FSP065-REB



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV	Limit dBUV	Margin dB
0.15	Peak	41.85	10.21	52.06	65.78	-13.72
0.17	Peak	41.64	10.21	51.85	64.90	-13.05
0.22	Peak	34.09	10.21	44.30	63.01	-18.71
3.68	Peak	17.64	10.49	28.13	56.00	-27.87
8.68	Peak	11.62	10.67	22.29	60.00	-37.71
20.16	Peak	32.42	10.86	43.28	60.00	-16.72

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Report Number :ER/2020/80120

Test Site :Conduction Room C

Test Mode :BLE 2M

Test Date :2020-09-04

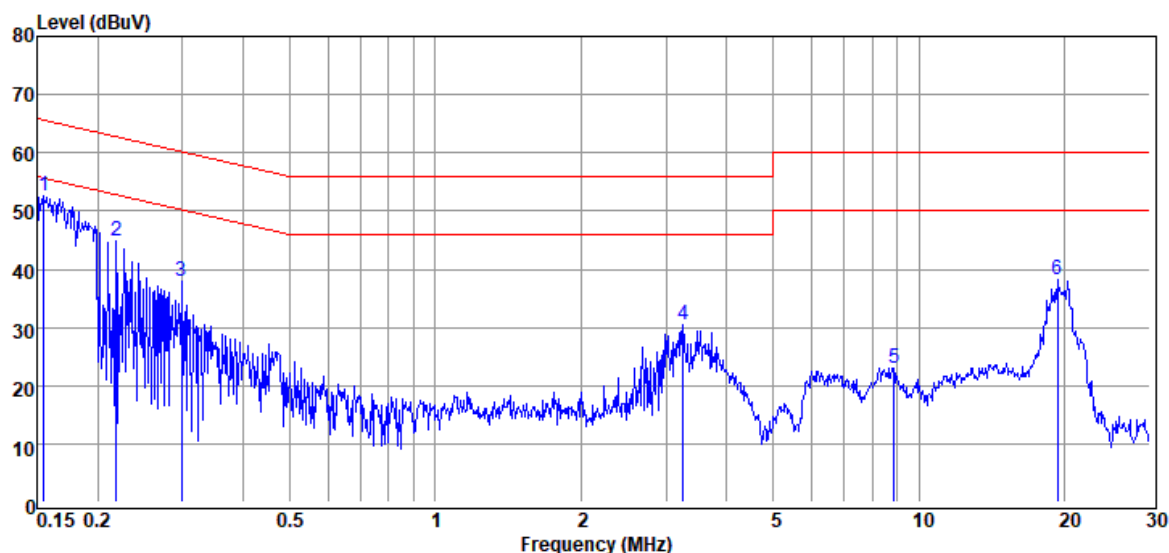
Power :120V/60Hz

Temp./Humi. :25.1/68

Probe :L1

Engineer :Kailin Lee

Note: : Adapter: FSP065-REB



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.15	Peak	42.32	10.22	52.54	65.74	-13.20
0.22	Peak	34.51	10.22	44.73	62.88	-18.15
0.30	Peak	27.60	10.22	37.82	60.28	-22.46
3.26	Peak	20.08	10.47	30.55	56.00	-25.45
8.87	Peak	12.44	10.66	23.10	60.00	-36.90
19.33	Peak	27.38	10.84	38.22	60.00	-21.78

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Report Number :ER/2020/80120

Test Site :Conduction Room C

Test Mode :BLE 2M

Test Date :2020-09-04

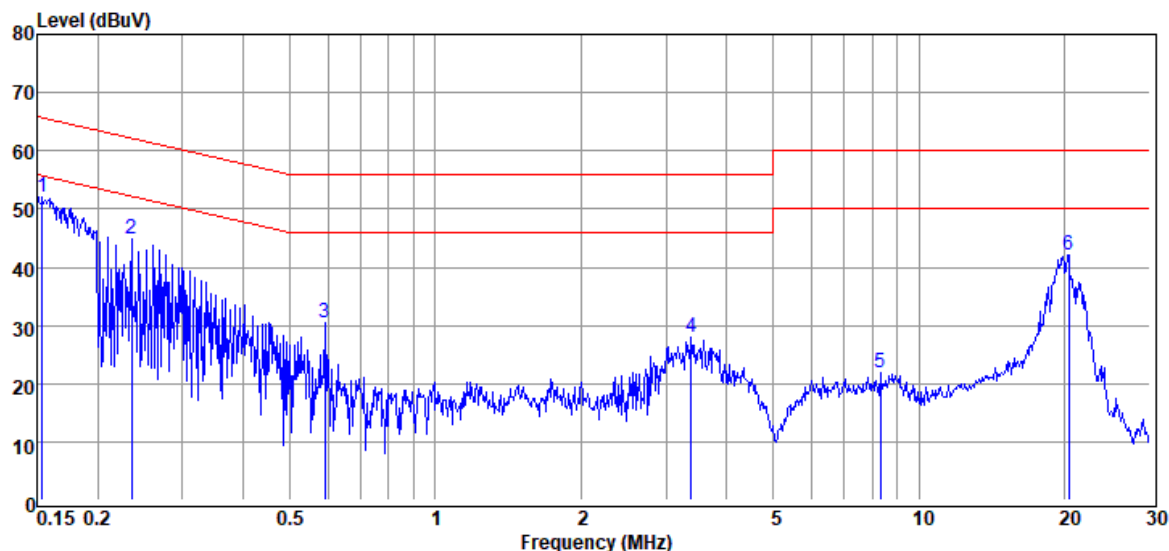
Power :120V/60Hz

Temp./Humi. :25.1/68

Probe :N

Engineer :Kailin Lee

Note: : Adapter: FSP065-REB



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.15	Peak	41.86	10.21	52.07	65.78	-13.71
0.24	Peak	34.54	10.21	44.75	62.26	-17.51
0.59	Peak	20.26	10.26	30.52	56.00	-25.48
3.38	Peak	17.47	10.48	27.95	56.00	-28.05
8.32	Peak	11.18	10.66	21.84	60.00	-38.16
20.38	Peak	31.18	10.87	42.05	60.00	-17.95

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7 PEAK OUTPUT POWER MEASUREMENT

7.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

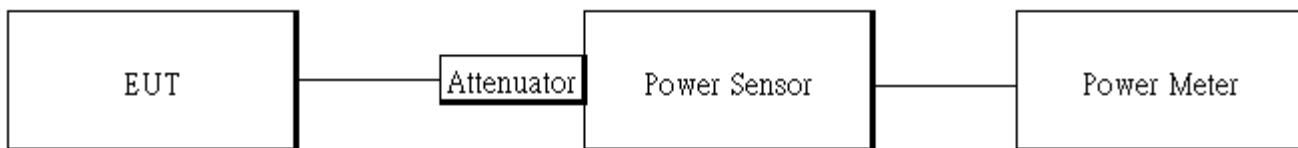
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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.

7.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
Power Meter	Anritsu	ML2496A	1804002	04/06/2020	04/05/2021
Power Sensor	Anritsu	MA2411B	1726105	04/06/2020	04/05/2021
Power Sensor	Anritsu	MA2411B	1726106	04/06/2020	04/05/2021
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

7.3 Test Set-up:



7.4 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 power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

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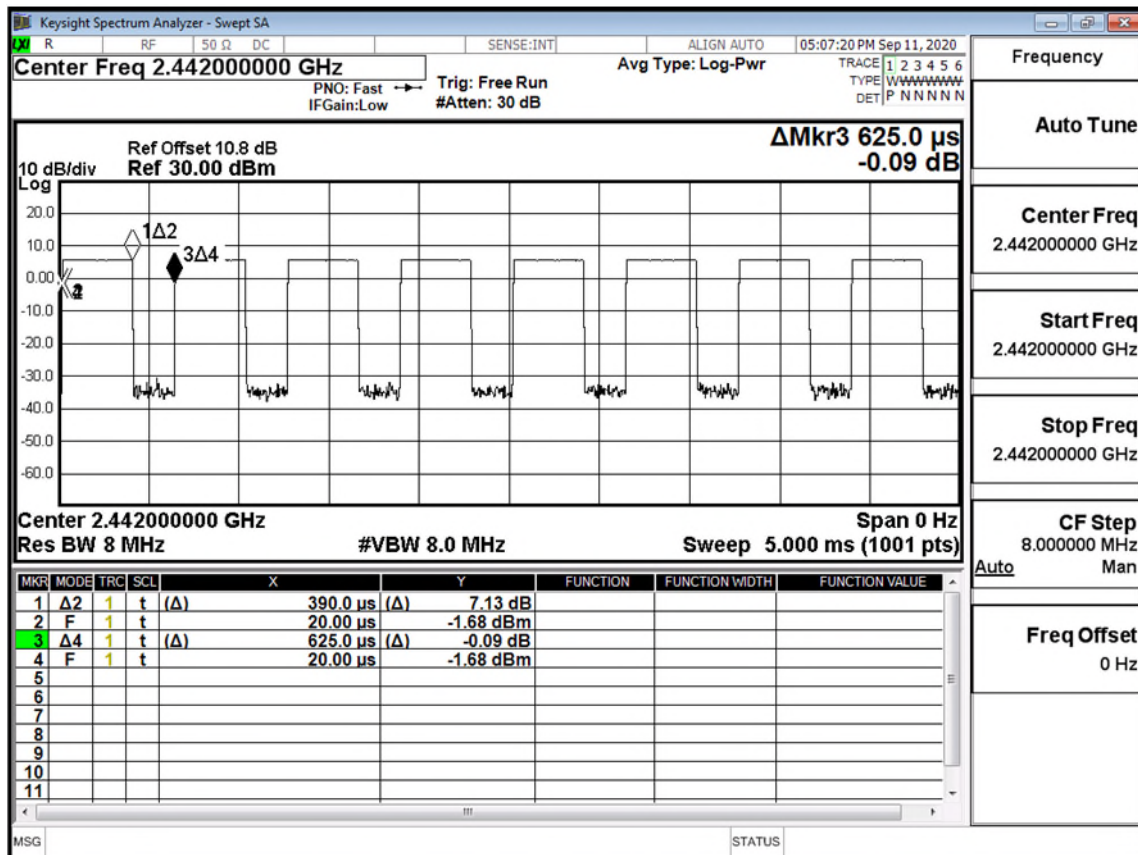
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7.5 Duty Factor:

BLE 1M

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE	62.00	2.08	2.56	3.00

Duty Cycle Factor: $10 \cdot \log(1/(62/100)) = 2.08$



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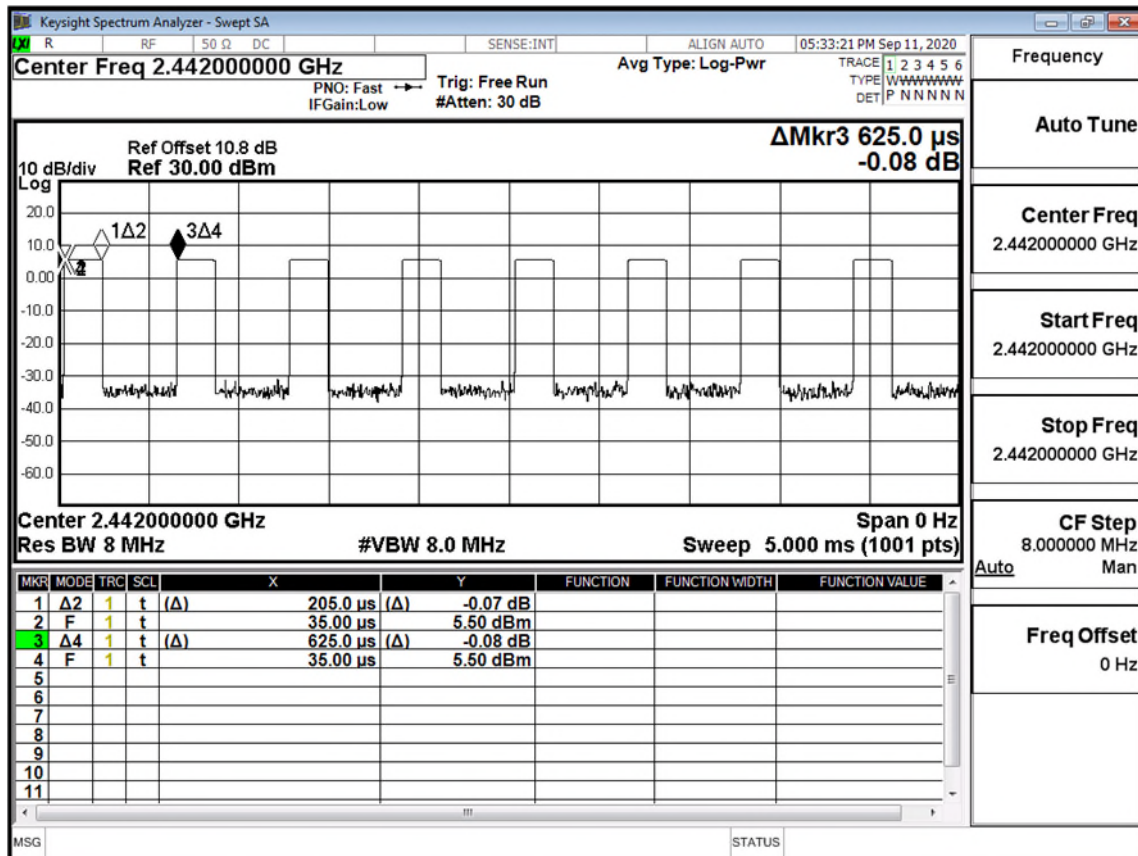
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BLE 2M

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) = 10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE	33.00	4.81	4.88	5.00

Duty Cycle Factor: $10 \cdot \log(1/(33/100)) = 4.81$



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7.6 Output Power:

7.6.1 Peak & Avg

BLE 1M

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2402	5.51	1 Watt = 30 dBm
Mid	2442	5.27	1 Watt = 30 dBm
High	2480	5.91	1 Watt = 30 dBm
CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2402	5.39	1 Watt = 30 dBm
Mid	2442	5.17	1 Watt = 30 dBm
High	2480	5.80	1 Watt = 30 dBm

**Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offsetted to power meter for Peak power measurement.*

BLE 2M

CH	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2402	5.48	1 Watt = 30 dBm
Mid	2442	5.41	1 Watt = 30 dBm
High	2480	5.90	1 Watt = 30 dBm
CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2402	5.40	1 Watt = 30 dBm
Mid	2442	5.07	1 Watt = 30 dBm
High	2480	5.69	1 Watt = 30 dBm

**Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offsetted to power meter for Peak power measurement.*

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7.6.2 EIRP

BLE 1M

EIRP

CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	5.39	3.40	8.79	4W= 36 dBm
Mid	2442	5.17	3.40	8.57	4W= 36 dBm
High	2480	5.80	3.40	9.20	4W= 36 dBm

* **Note:** EIRP = Average Power + Gain

BLE 2M

EIRP

CH	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	5.40	3.40	8.80	4W= 36 dBm
Mid	2442	5.07	3.40	8.47	4W= 36 dBm
High	2480	5.69	3.40	9.09	4W= 36 dBm

* **Note:** EIRP = Average Power + Gain

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8 6DB & 99% BANDWIDTH MEASUREMENT

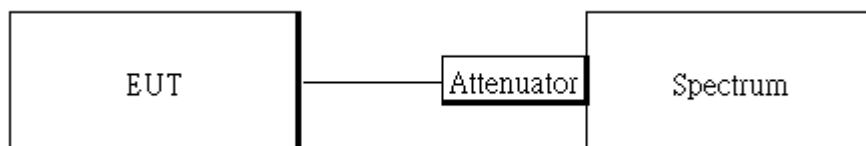
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

8.3 Test Set-up:



8.4 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= 1 % to 5% of OBW ,
 VBW = 3 X RBW,
 Span= 2 to 5 times of the OBW,
 Sweep=auto,
 Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and –20dB (upper and lower) frequency
6. Set the spectrum analyzer as
 RBW= 1 % to 5% of 99% Bandwidth ,
 VBW ≥ 3 X RBW,
 Span= large enough to capture all products of the modulation process,
 Sweep=auto,
 Detector = Peak, and Max hold for 99% Bandwidth test.
7. Mark the peak frequency and 99%dB (upper and lower) frequency
8. Repeat above procedures until all test default channel is completed

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8.5 Measurement Result:

BLE 1M

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6991	> 0.5	PASS
2442	0.6958	> 0.5	PASS
2480	0.6999	> 0.5	PASS

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0273
2442	1.0272
2480	1.0278

BLE 2M

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.177	> 0.5	PASS
2442	1.176	> 0.5	PASS
2480	1.173	> 0.5	PASS

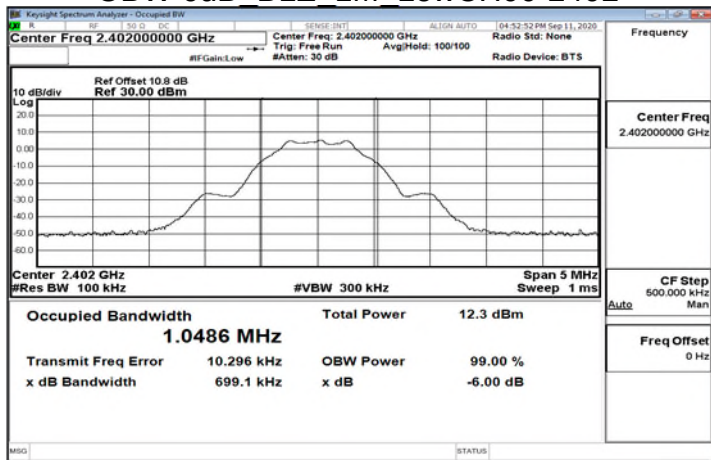
Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0392
2442	2.0392
2480	2.0384

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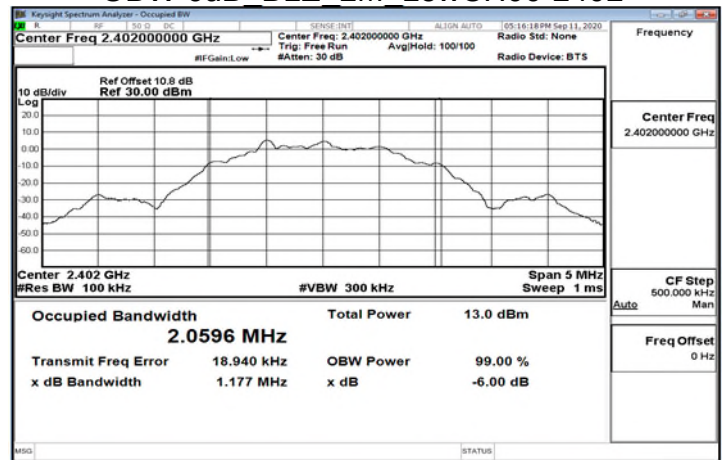
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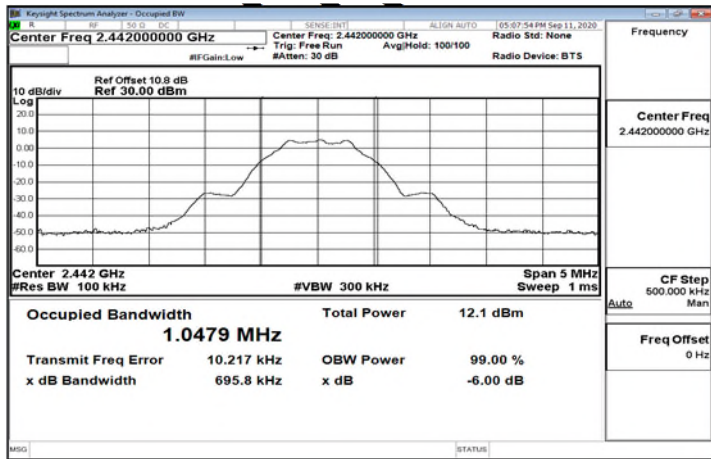
OBW 6dB BLE 1M LowCH00-2402



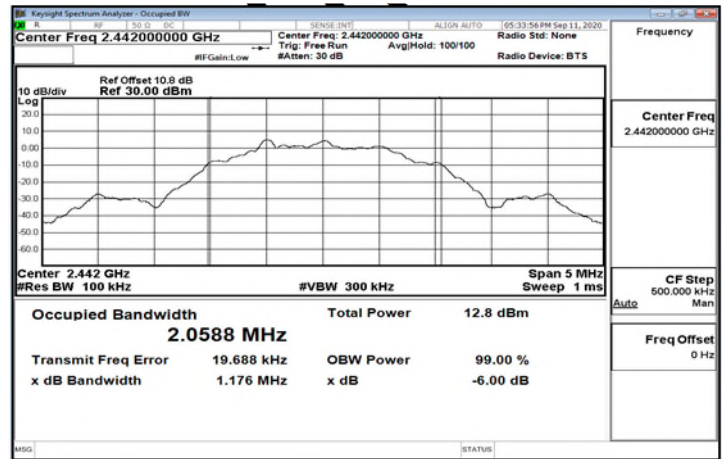
OBW 6dB BLE 2M LowCH00-2402



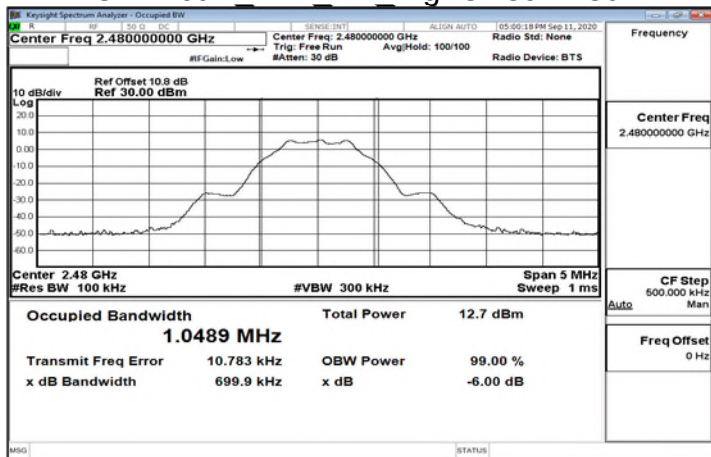
OBW 6dB BLE 1M MidCH20-2442



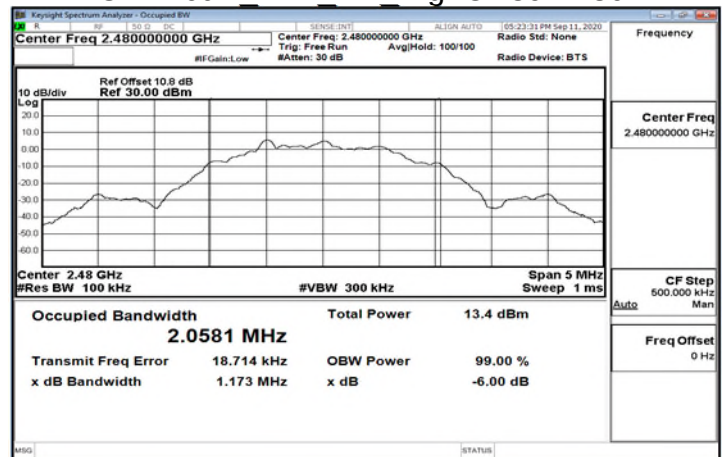
OBW 6dB BLE 2M MidCH20-2442



OBW 6dB BLE 1M HighCH39-2480



OBW 6dB BLE 2M HighCH39-2480

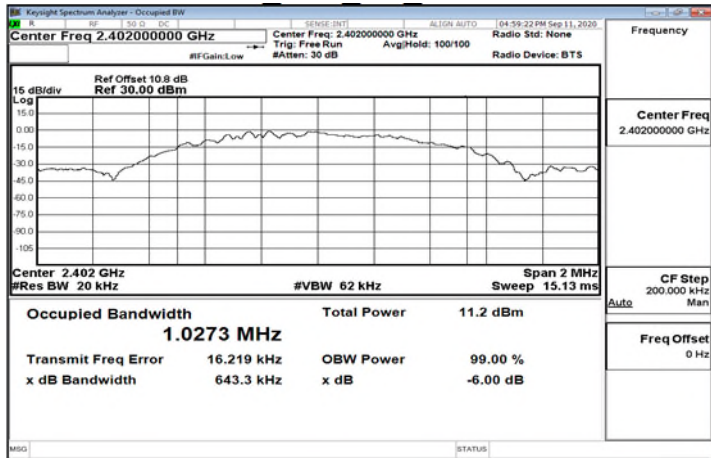


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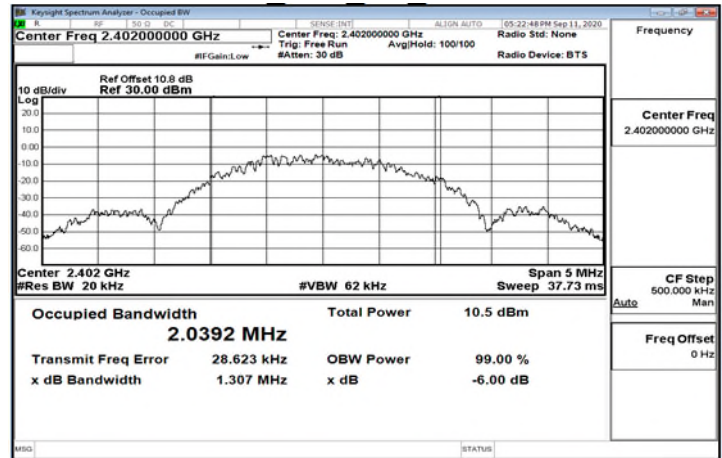
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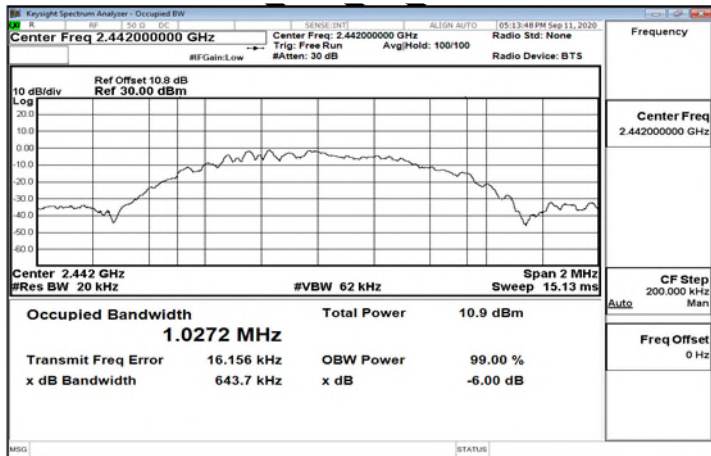
IC OBW 99% BLE 1M LowCH00-2402



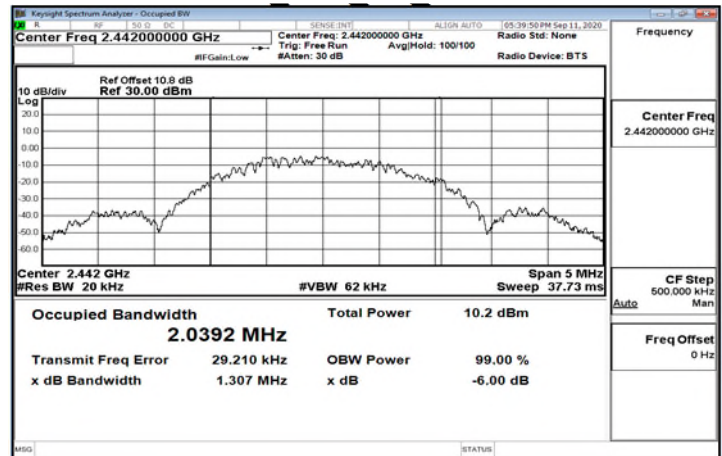
IC OBW 99% BLE 2M LowCH00-2402



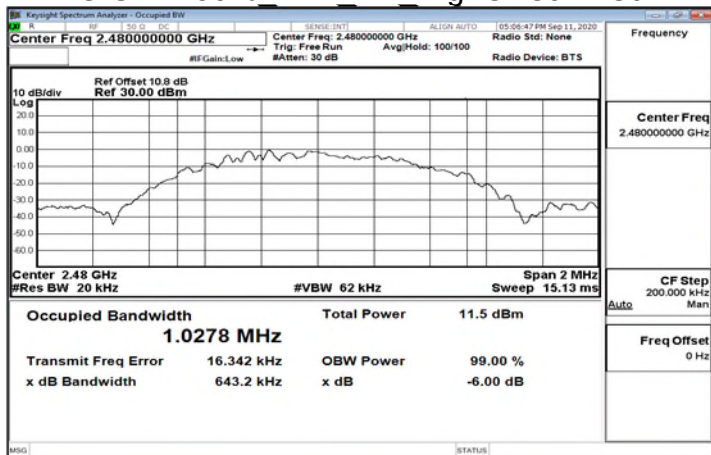
IC OBW 99% BLE 1M MidCH20-2442



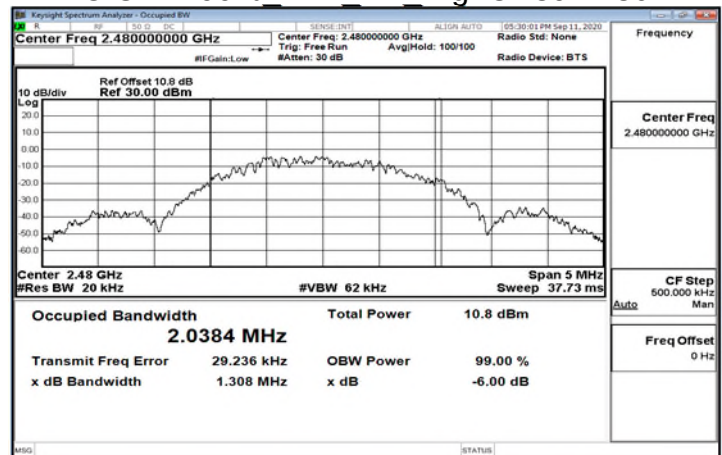
IC OBW 99% BLE 2M MidCH20-2442



IC OBW 99% BLE 1M HighCH39-2480



IC OBW 99% BLE 2M HighCH39-2480



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

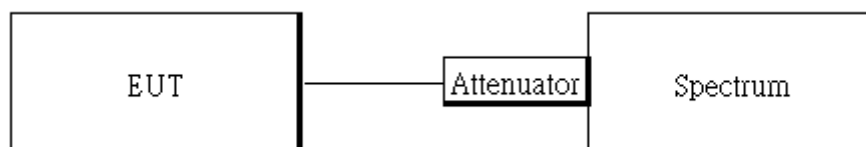
9.1 Standard Applicable

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) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

9.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

9.3 Test SET-UP:



9.4 Measurement Procedure

9.4.1 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.

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9. Use the peak marker function to determine the maximum amplitude level.

9.4.2 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. Mark the highest reading of the emission as the reference level measurement.
7. Marker on frequency, 2399.9MHz and 2483.6MHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5MHz) be attenuated by 20dB at least relative to the maximum emission of power.
8. Repeat above procedures until all default test channel (low and high) was complete.

9.4.3 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.

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9.5 Measurement Result

BLE 1M

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.25	-14.75
2442	4.97	-15.03
2480	5.63	-14.37

NOTE: cable loss as 10.8dB 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	5.23	-14.77
2442	4.98	-15.02
2480	5.60	-14.40

NOTE: cable loss as 10.8dB that offsets in the spectrum

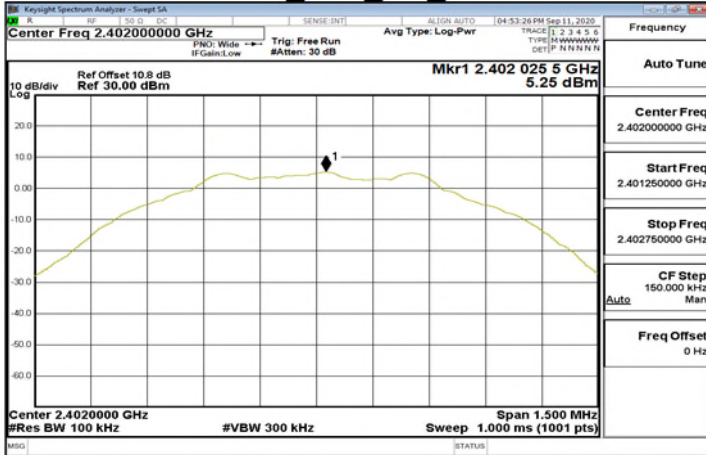
NOTE: Refer to next page for plots.

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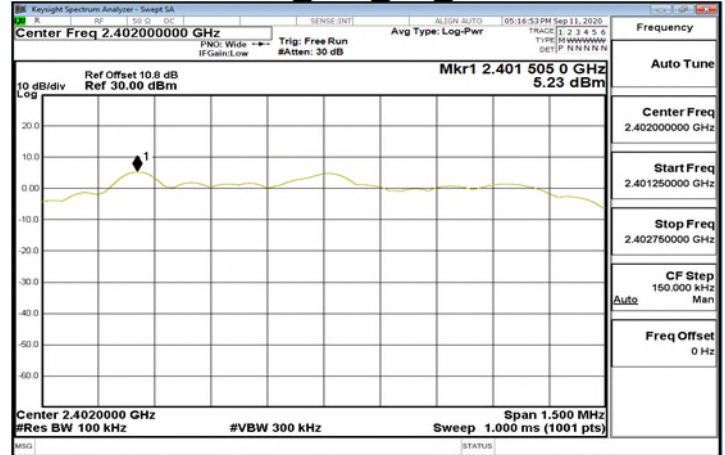
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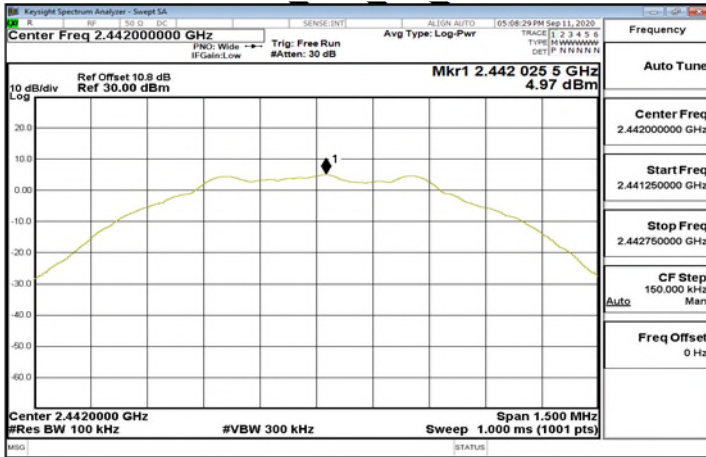
Reference Level BLE 1M LowCH00-2402



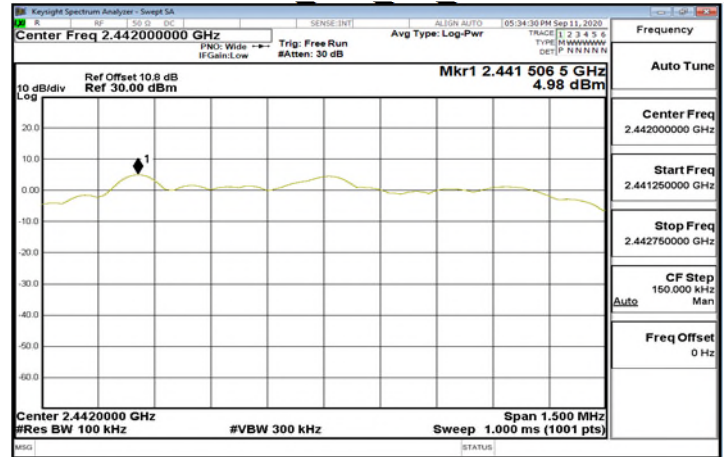
Reference Level BLE 2M LowCH00-2402



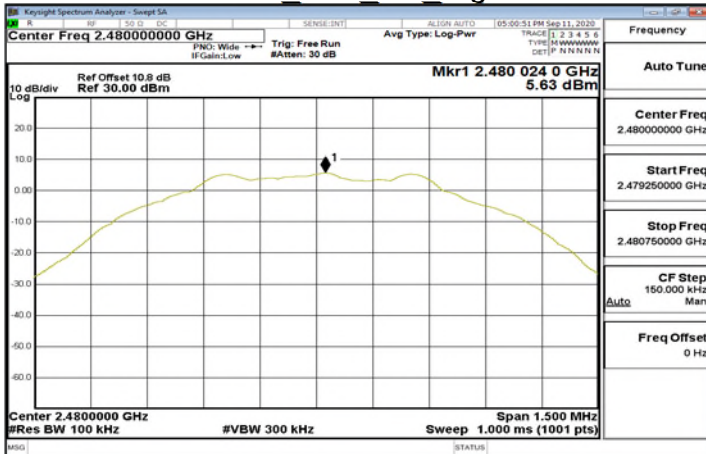
Reference Level BLE 1M MidCH20-2442



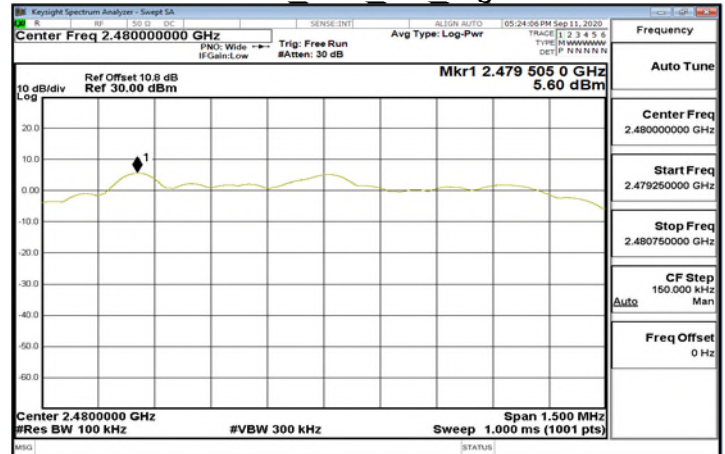
Reference Level BLE 2M MidCH20-2442



Reference Level BLE 1M HighCH39-2480



Reference Level BLE 2M HighCH39-2480

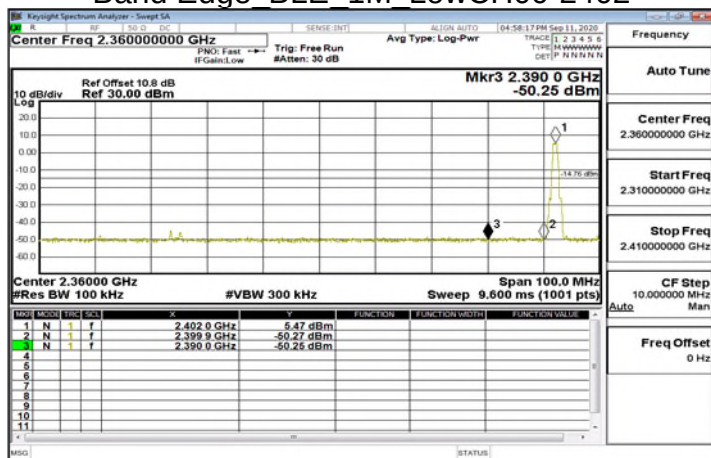


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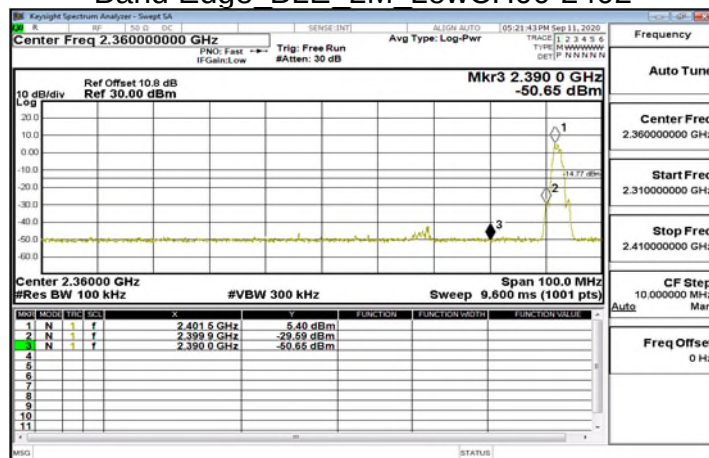
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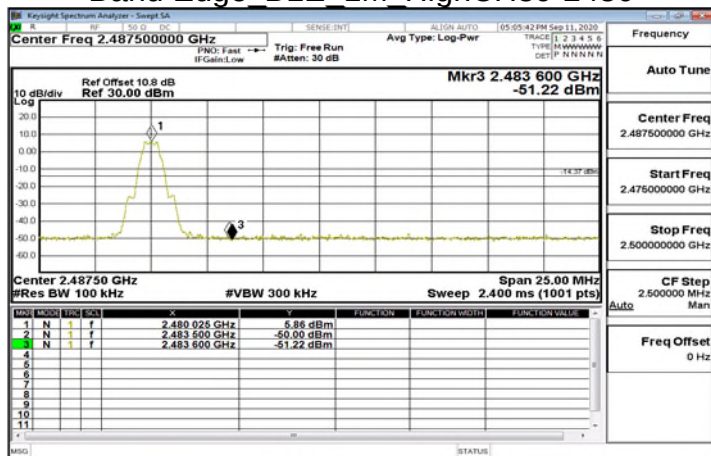
Band Edge BLE 1M LowCH00-2402



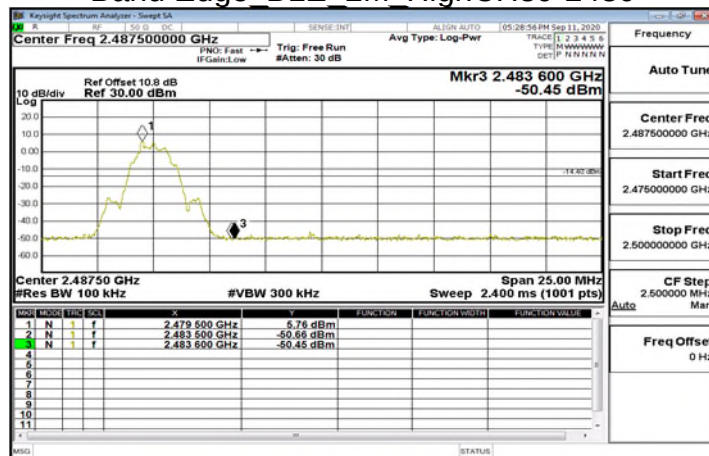
Band Edge BLE 2M LowCH00-2402



Band Edge BLE 1M HighCH39-2480



Band Edge BLE 2M HighCH39-2480

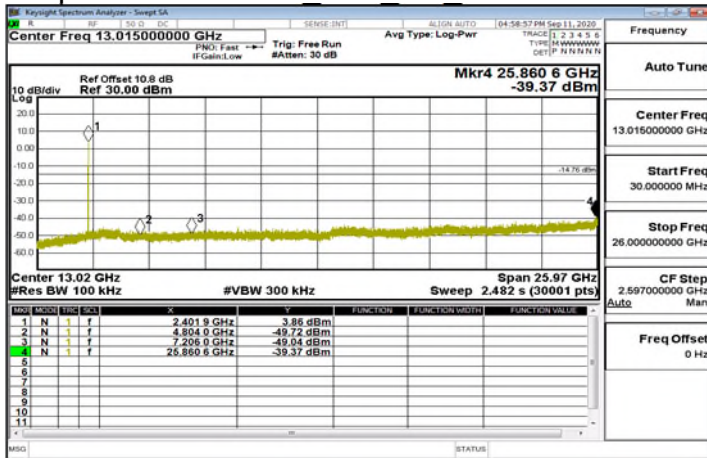


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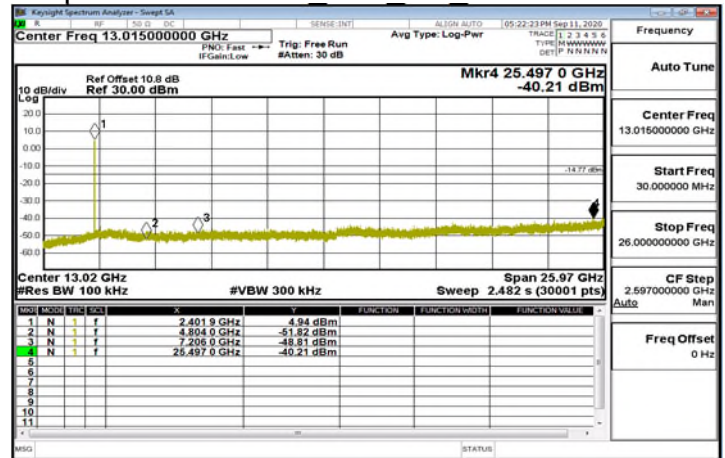
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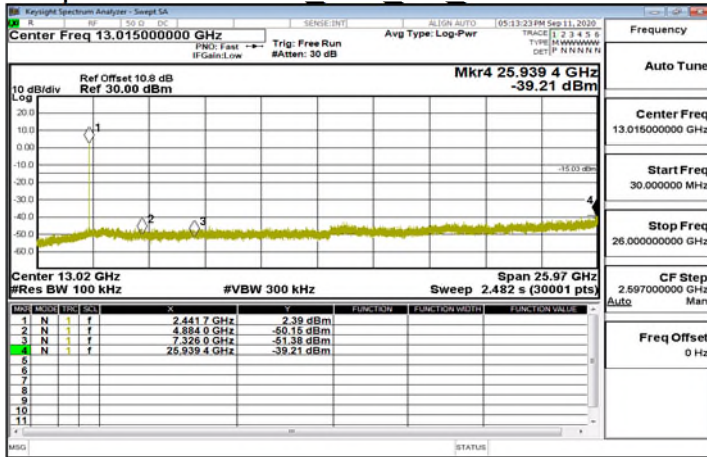
Spurious Emission BLE 1M LowCH00-2402



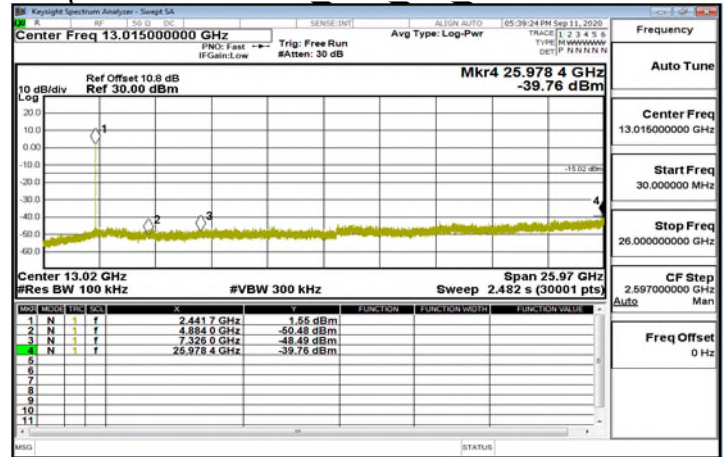
Spurious Emission BLE 2M LowCH00-2402



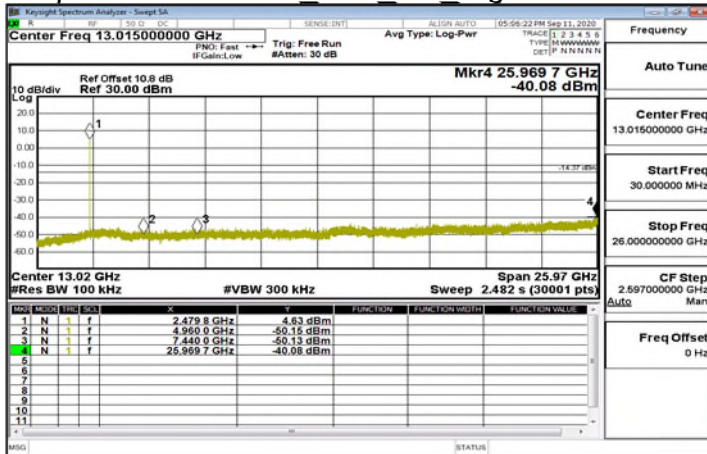
Spurious Emission BLE 1M MidCH20-2442



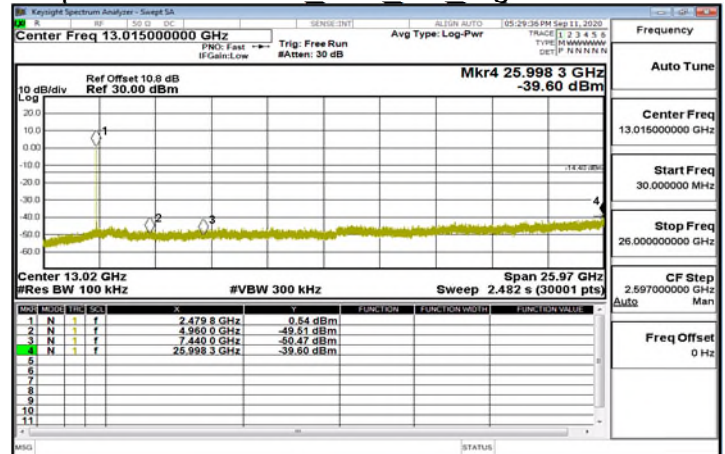
Spurious Emission BLE 2M MidCH20-2442



Spurious Emission BLE 1M HighCH39-2480



Spurious Emission BLE 2M HighCH39-2480



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10 RADIATED BANDEDGE 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 must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13.2.a 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:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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10.2 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	11/04/2019	11/03/2020
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020
Horn Antenna	Schwarzbeck	BBHA9120D	1341	06/22/2020	06/21/2021
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
3m Site NSA	SGS	966 chamber D	N/A	07/12/2020	07/11/2021
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	07/08/2020	07/07/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	11/20/2019	11/19/2020
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/20/2019	11/19/2020
Pre-Amplifier	EMC Instruments	EMC12630SE	980271	11/20/2019	11/19/2020
Attenuator	Woken	WATT-218FS-10	RF25	11/20/2019	11/19/2020
High Pass Filter	R&S	F13 HPF 3GHz	RF64	11/20/2019	11/19/2020
Low Pass Filter	EWT	EWT-56-0019	RF46	11/20/2019	11/19/2020
Notch Filter	EWT	EWT-54-0038	RF55	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/20/2019	11/19/2020

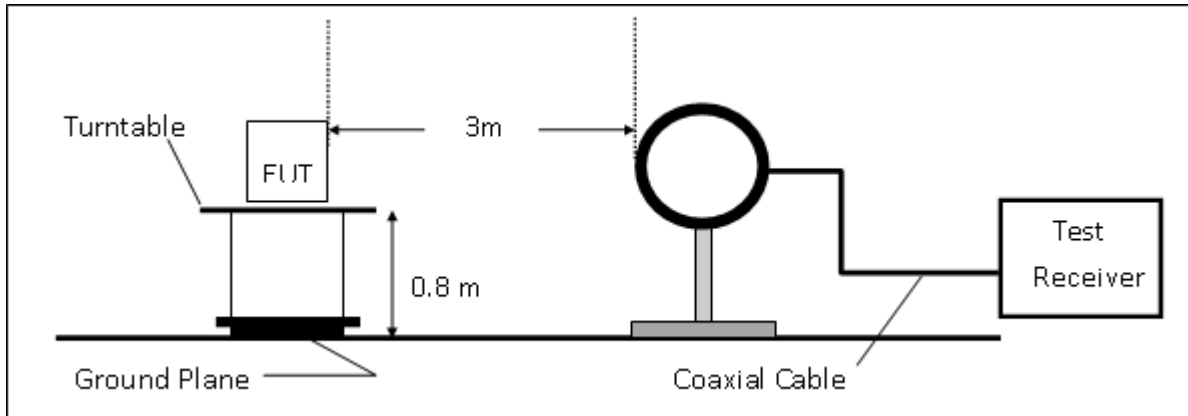
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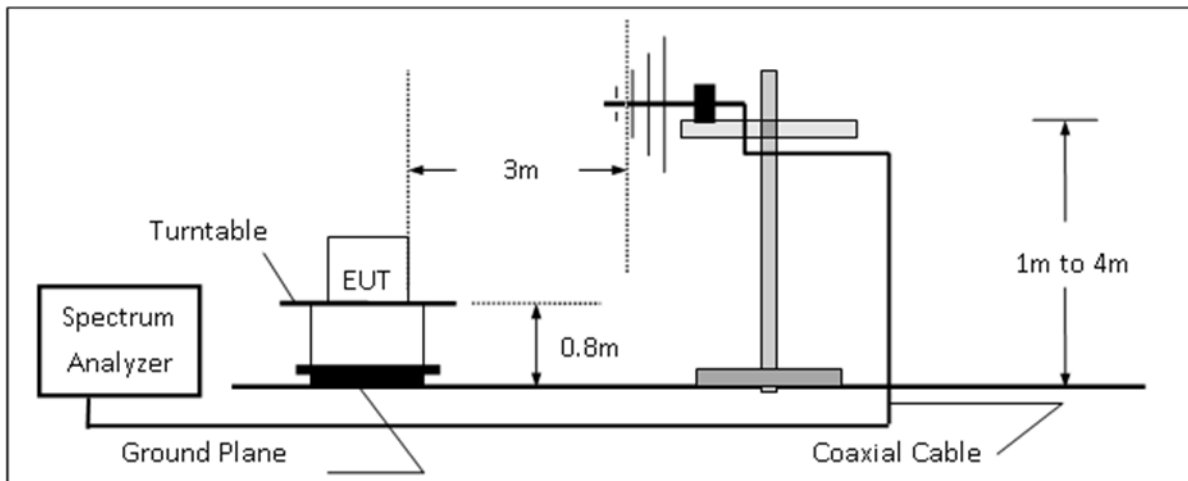
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10.3 Test SET-UP

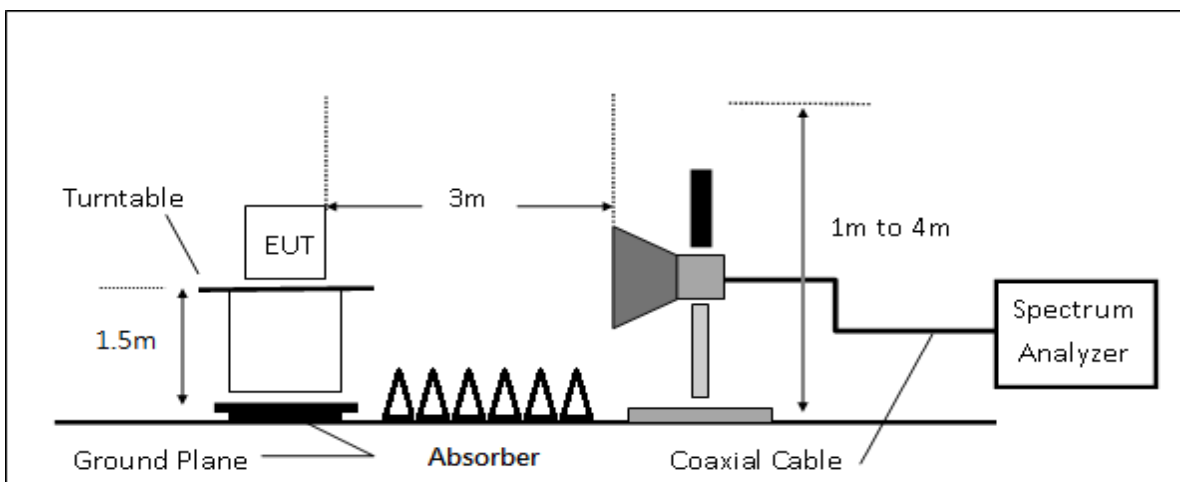
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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10.4 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 plan.
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=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. 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.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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10.5 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 $20 \cdot \log(\mu V/m)$

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

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

10.6 Test Results of Radiated Spurious Emissions form 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) & RSS-GEN §6.13.2 was not reported.

10.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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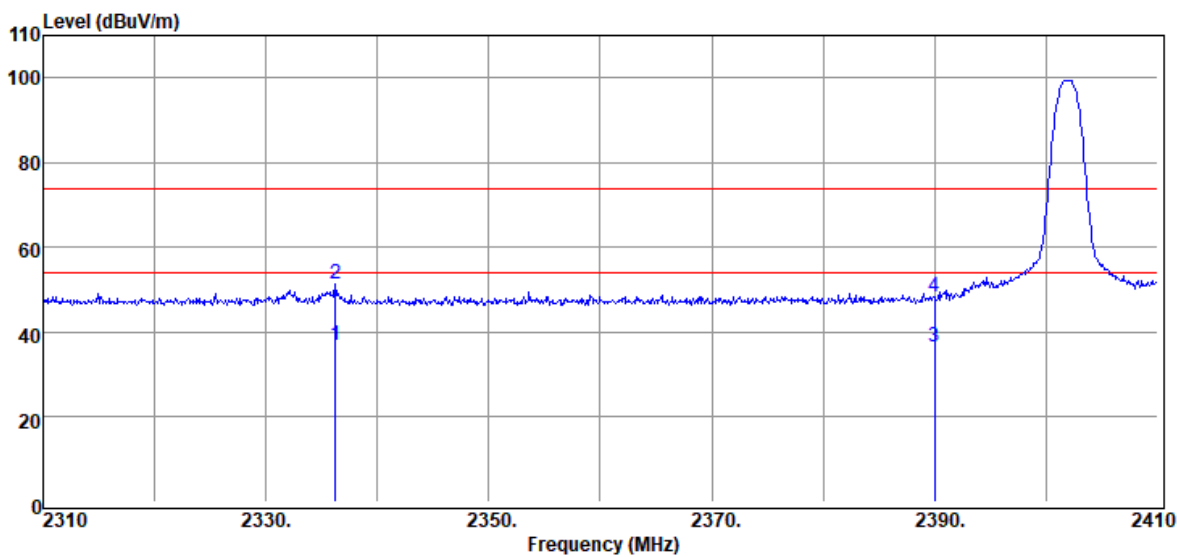
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10.7.1 Radiated Band Edge Measurement Result

BLE 1M

Report Number	:ER/2020/80120	Test Site	:966 Chamber D
Operation Mode	:BLE 1M	Test Date	:2020-08-29
Test Frequency	:2402 MHz	Temp./Humi.	:22.5/65
Test Mode	:BE CH LOW	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plan	Engineer	:Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2336.20	Average	42.68	-5.64	37.04	54.00	-16.96
2336.20	Peak	57.10	-5.64	51.46	74.00	-22.54
2390.00	Average	41.92	-5.50	36.42	54.00	-17.58
2390.00	Peak	53.67	-5.50	48.17	74.00	-25.83

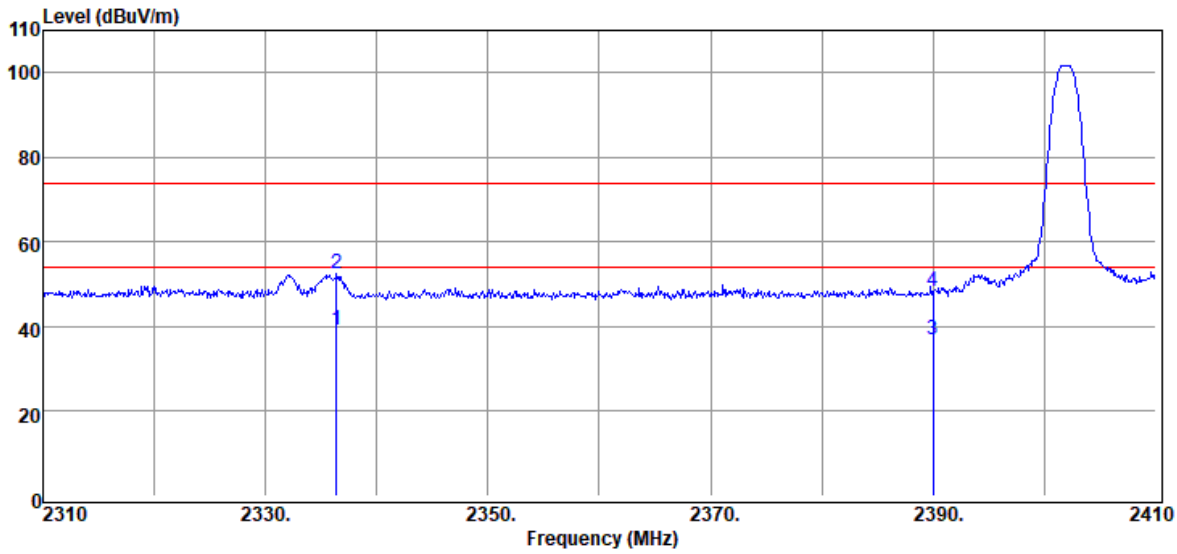
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2402 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2336.40	Average	44.78	-5.65	39.13	54.00	-14.87
2336.40	Peak	58.01	-5.65	52.36	74.00	-21.64
2390.00	Average	42.47	-5.50	36.97	54.00	-17.03
2390.00	Peak	53.85	-5.50	48.35	74.00	-25.65

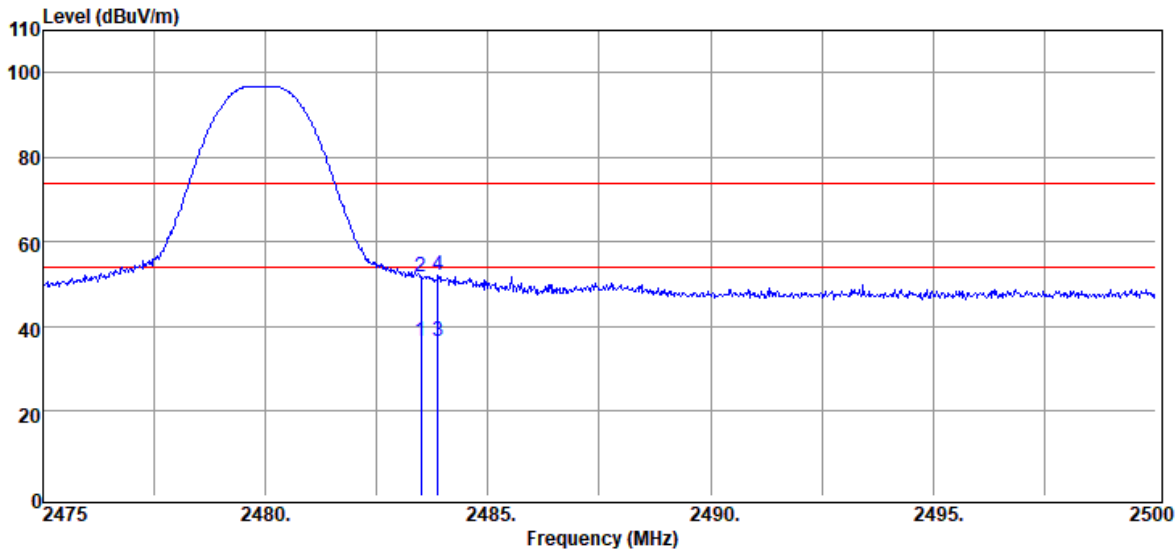
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2480 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	42.27	-5.56	36.71	54.00	-17.29
2483.50	Peak	57.45	-5.56	51.89	74.00	-22.11
2483.88	Average	42.22	-5.56	36.66	54.00	-17.34
2483.88	Peak	57.74	-5.56	52.18	74.00	-21.82

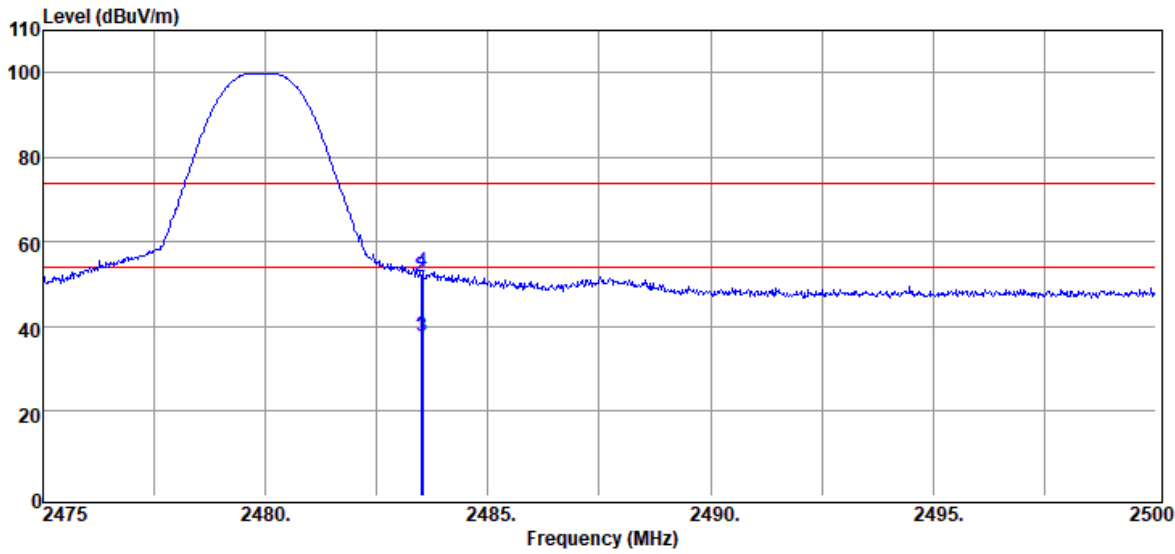
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2480 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	43.32	-5.56	37.76	54.00	-16.24
2483.50	Peak	57.51	-5.56	51.95	74.00	-22.05
2483.53	Average	43.14	-5.56	37.58	54.00	-16.42
2483.53	Peak	58.60	-5.56	53.04	74.00	-20.96

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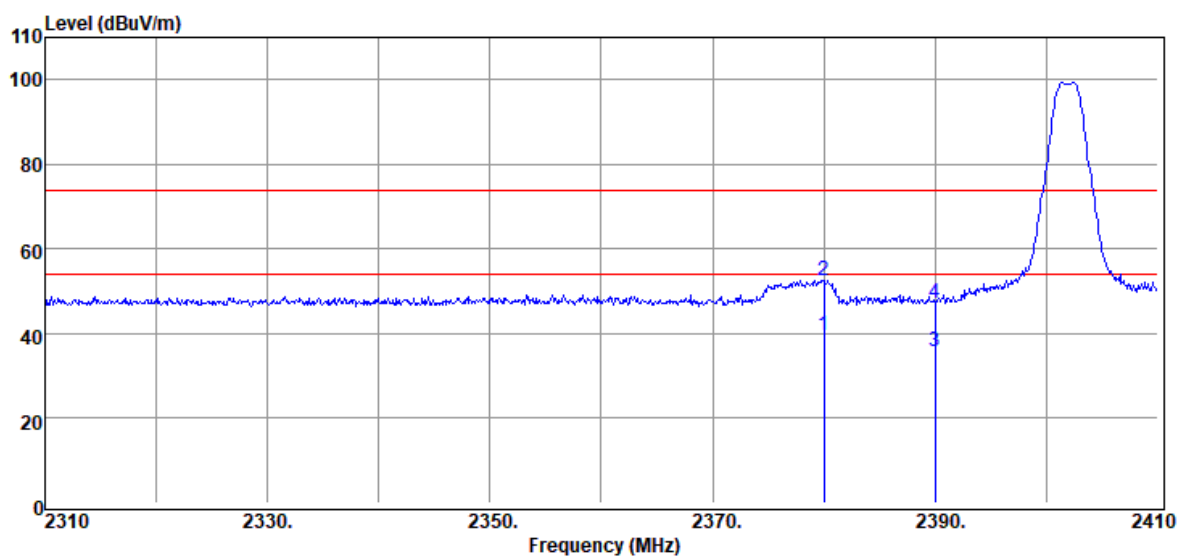
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BLE 2M

Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2402 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2380.00	Average	45.08	-5.52	39.56	54.00	-14.44
2380.00	Peak	58.10	-5.52	52.58	74.00	-21.42
2390.00	Average	41.45	-5.50	35.95	54.00	-18.05
2390.00	Peak	52.59	-5.50	47.09	74.00	-26.91

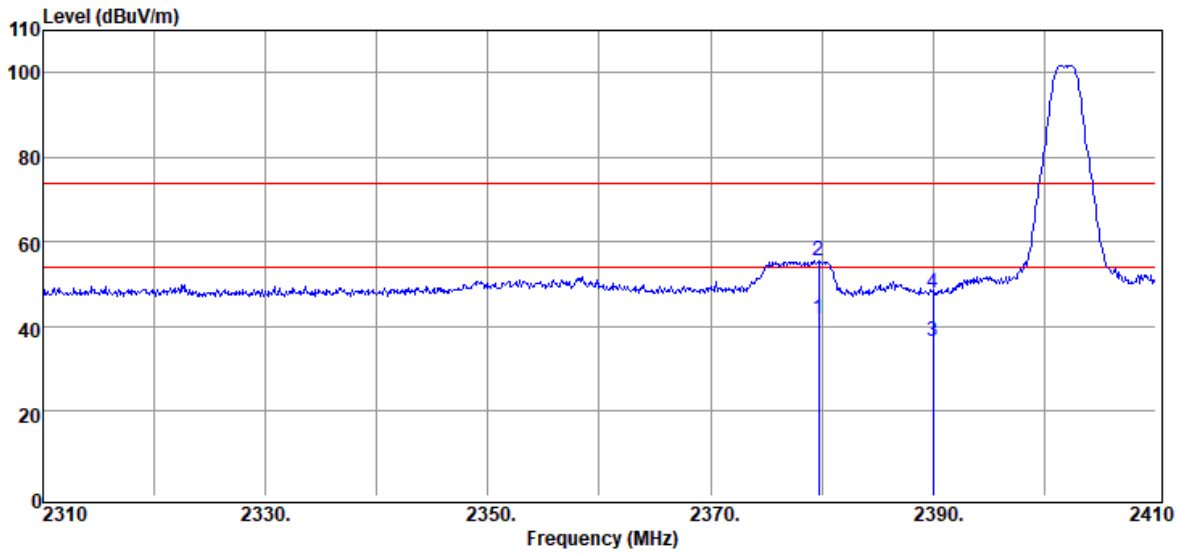
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2402 MHz
Test Mode :BE CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2379.70	Average	47.30	-5.53	41.77	54.00	-12.23
2379.70	Peak	61.22	-5.53	55.69	74.00	-18.31
2390.00	Average	42.06	-5.50	36.56	54.00	-17.44
2390.00	Peak	53.63	-5.50	48.13	74.00	-25.87

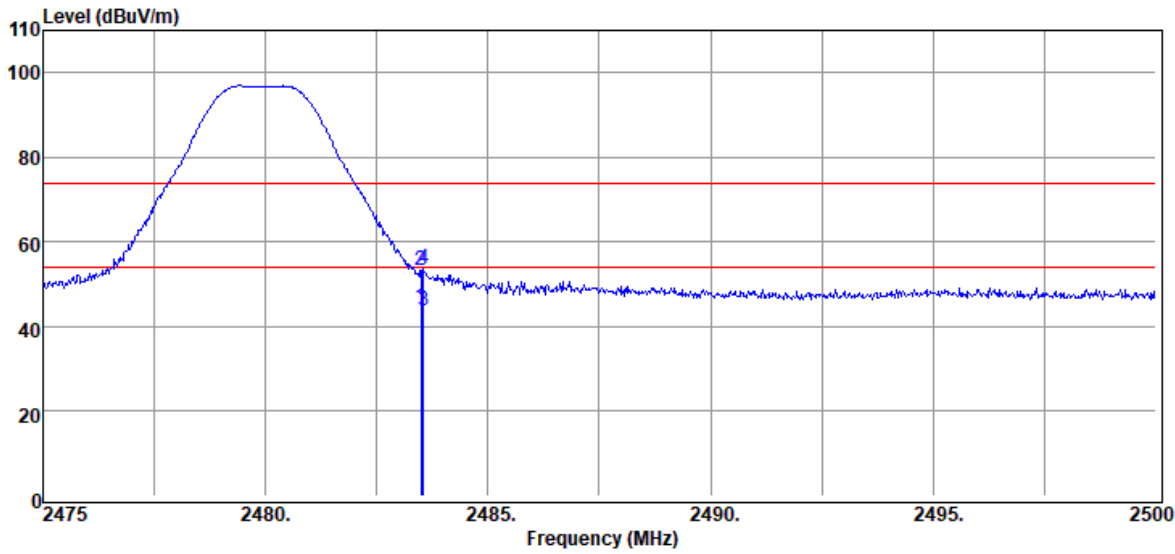
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Operation Mode :BLE 2M
Test Frequency :2480 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	50.10	-5.56	44.54	54.00	-9.46
2483.50	Peak	58.72	-5.56	53.16	74.00	-20.84
2483.55	Average	49.27	-5.56	43.71	54.00	-10.29
2483.55	Peak	59.16	-5.56	53.60	74.00	-20.40

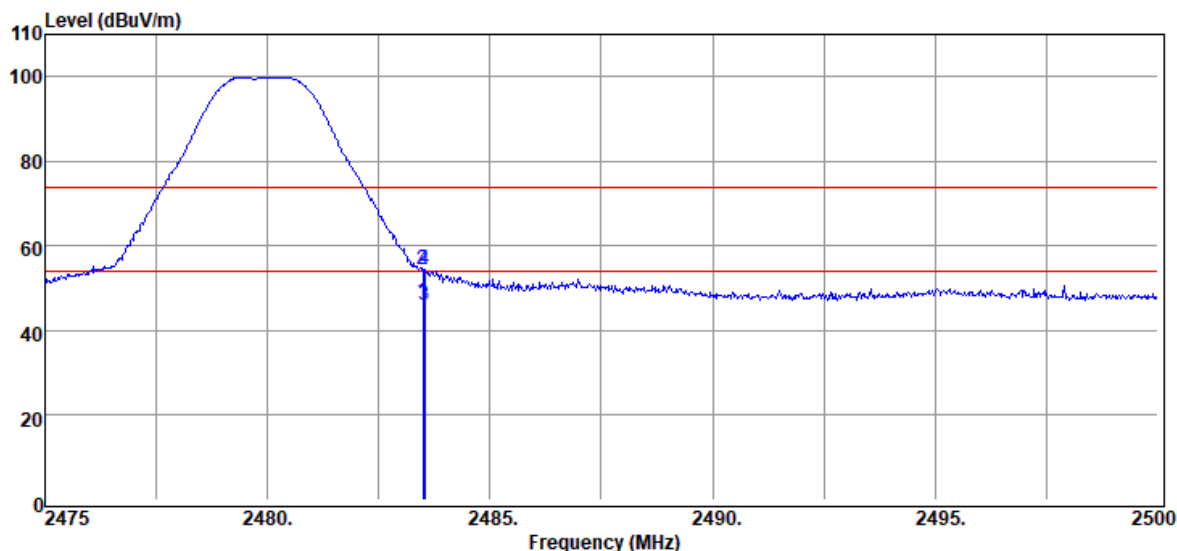
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2480 MHz
Test Mode :BE CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	52.31	-5.56	46.75	54.00	-7.25
2483.50	Peak	59.83	-5.56	54.27	74.00	-19.73
2483.53	Average	51.77	-5.56	46.21	54.00	-7.79
2483.53	Peak	60.04	-5.56	54.48	74.00	-19.52

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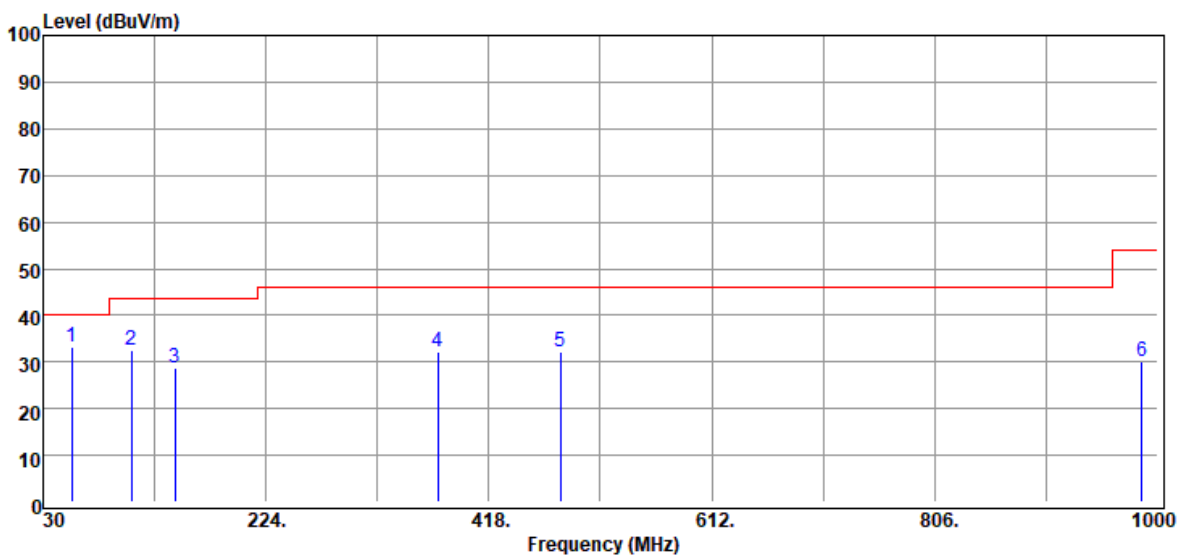
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10.7.2 Radiated Spurious Emission from 30MHz to 1000MHz

BLE 1M

Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/63
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



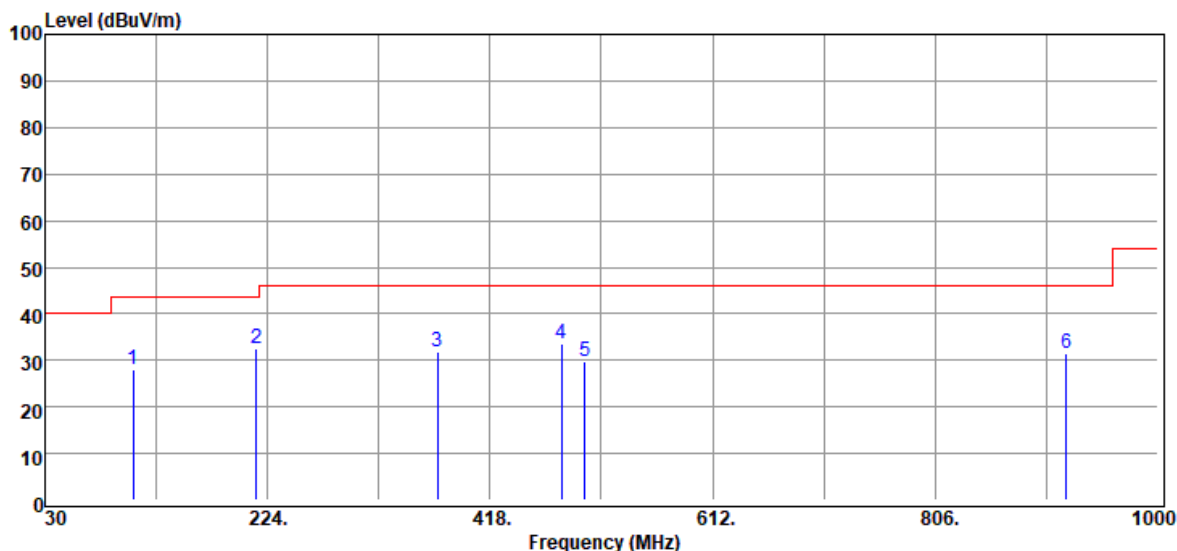
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
55.22	Peak	50.22	-17.05	33.17	40.00	-6.83
106.63	Peak	52.47	-20.07	32.40	43.50	-11.10
144.46	Peak	45.28	-16.66	28.62	43.50	-14.88
373.38	Peak	45.63	-13.42	32.21	46.00	-13.79
480.08	Peak	43.35	-11.23	32.12	46.00	-13.88
986.42	Peak	34.20	-4.10	30.10	54.00	-23.90

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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/63
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
106.63	Peak	47.96	-20.07	27.89	43.50	-15.61
214.30	Peak	51.14	-18.64	32.50	43.50	-11.00
372.41	Peak	45.46	-13.48	31.98	46.00	-14.02
480.08	Peak	44.88	-11.23	33.65	46.00	-12.35
500.45	Peak	40.87	-11.11	29.76	46.00	-16.24
920.46	Peak	36.27	-4.76	31.51	46.00	-14.49

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BLE 2M

Report Number :ER/2020/80120

Test Site :966 Chamber D

Operation Mode :BLE 2M

Test Date :2020-08-31

Test Frequency :2442 MHz

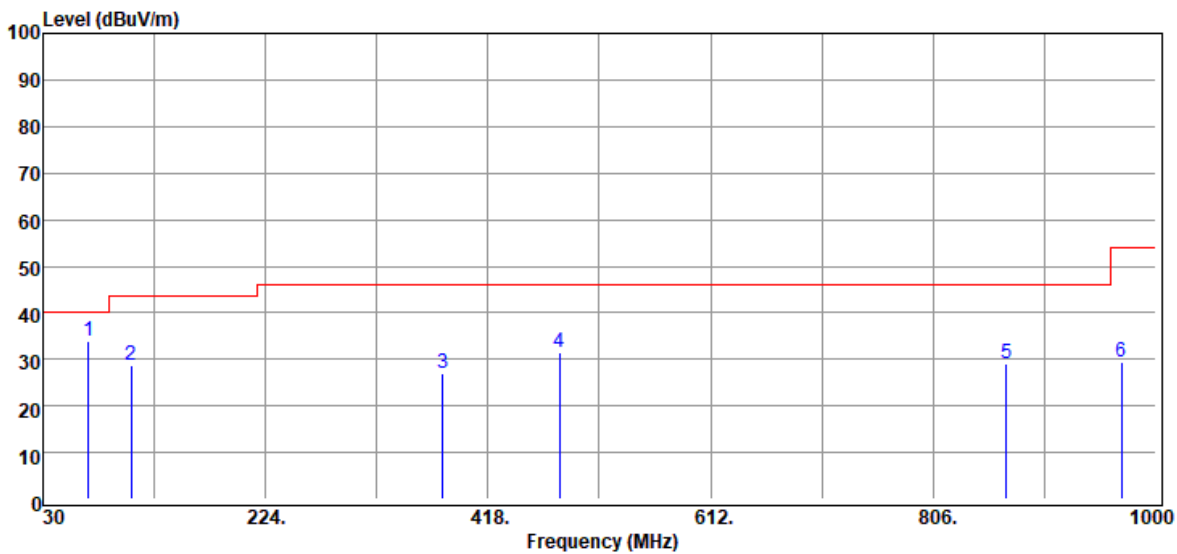
Temp./Humi. :22.4/64

Test Mode :TX CH MID

Antenna Pol. :VERTICAL

EUT Pol :E2 Plan

Engineer :Kailin Lee



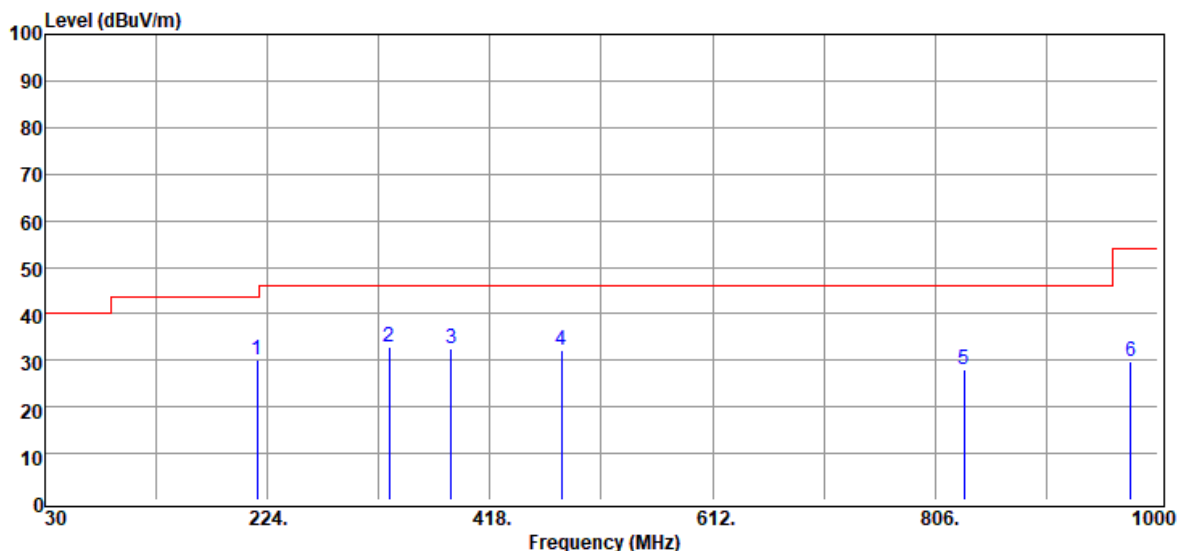
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
69.77	Peak	52.91	-19.07	33.84	40.00	-6.16
106.63	Peak	48.75	-20.07	28.68	43.50	-14.82
378.23	Peak	40.07	-13.23	26.84	46.00	-19.16
480.08	Peak	42.56	-11.23	31.33	46.00	-14.67
870.02	Peak	34.90	-5.89	29.01	46.00	-16.99
969.93	Peak	33.59	-4.08	29.51	54.00	-24.49

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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-31
Temp./Humi. :22.4/64
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
215.27	Peak	48.80	-18.62	30.18	43.50	-13.32
329.73	Peak	47.38	-14.37	33.01	46.00	-12.99
384.05	Peak	45.45	-13.06	32.39	46.00	-13.61
480.08	Peak	43.31	-11.23	32.08	46.00	-13.92
831.22	Peak	34.21	-6.20	28.01	46.00	-17.99
976.72	Peak	33.93	-4.11	29.82	54.00	-24.18

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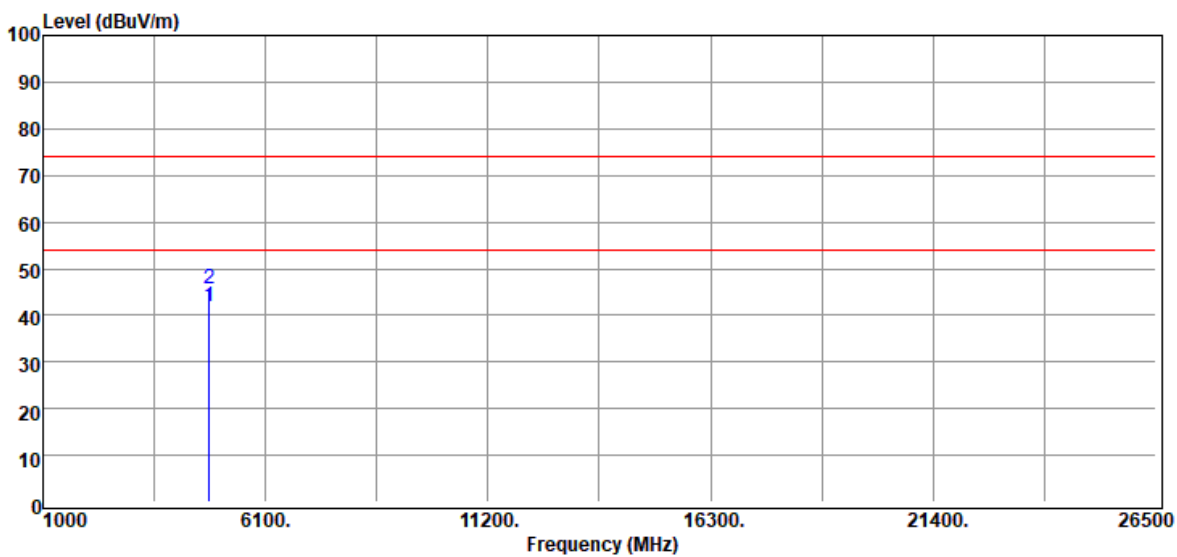
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10.7.3 Radiated Spurious Emission above 1GHz

BLE 1M

Report Number	:ER/2020/80120	Test Site	:966 Chamber D
Operation Mode	:BLE 1M	Test Date	:2020-08-29
Test Frequency	:2402 MHz	Temp./Humi.	:22.5/65
Test Mode	:TX CH LOW	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plan	Engineer	:Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	42.25	-0.35	41.90	54.00	-12.10
4804.00	Peak	45.92	-0.35	45.57	74.00	-28.43

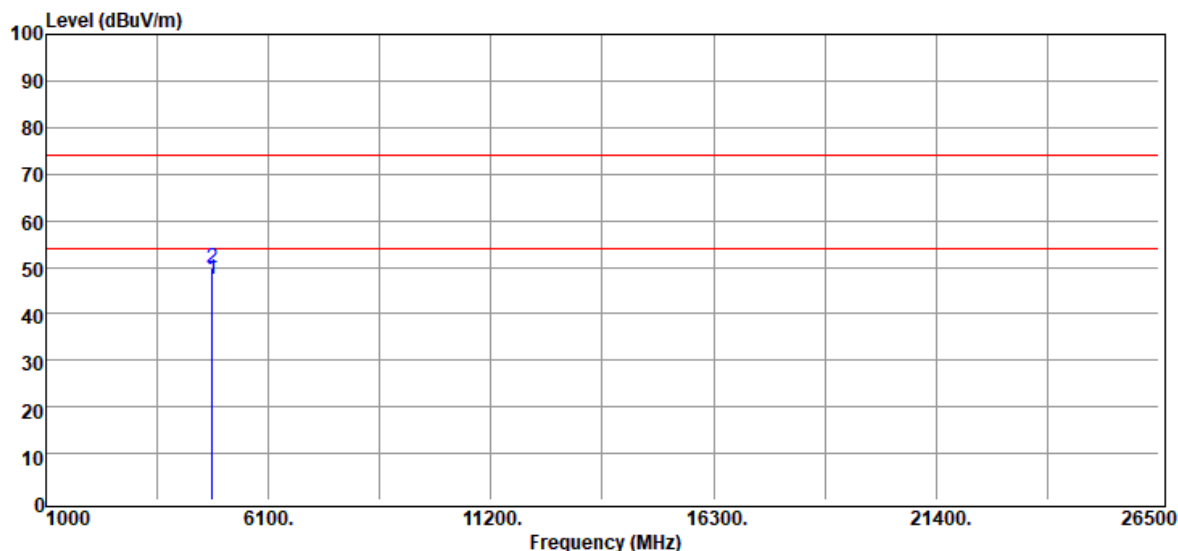
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2402 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	47.66	-0.35	47.31	54.00	-6.69
4804.00	Peak	50.16	-0.35	49.81	74.00	-24.19

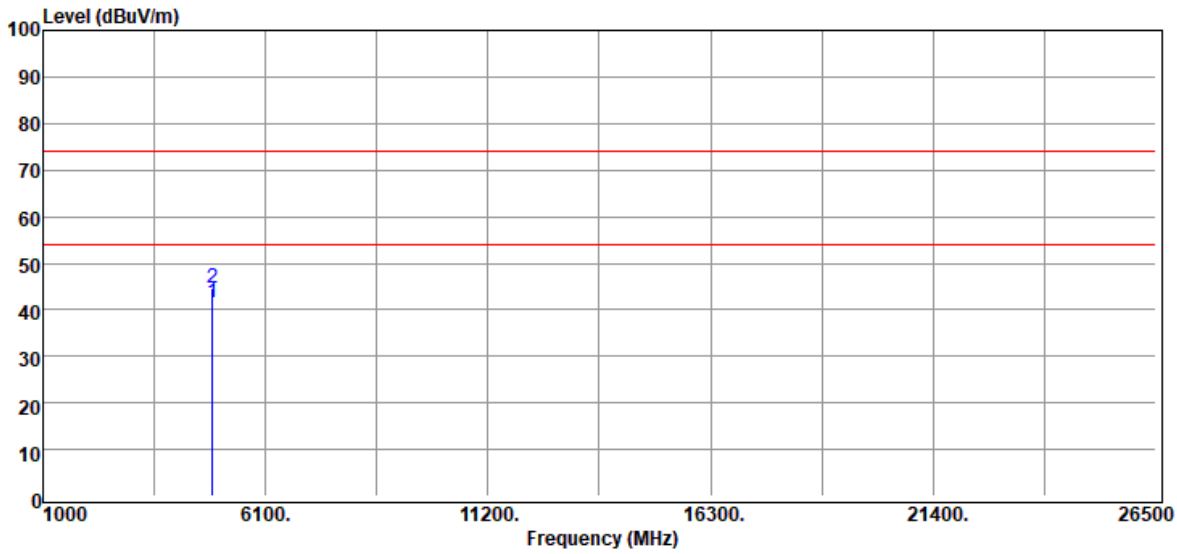
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
4884.00	Average	41.92	-0.45	41.47	54.00	-12.53
4884.00	Peak	45.10	-0.45	44.65	74.00	-29.35

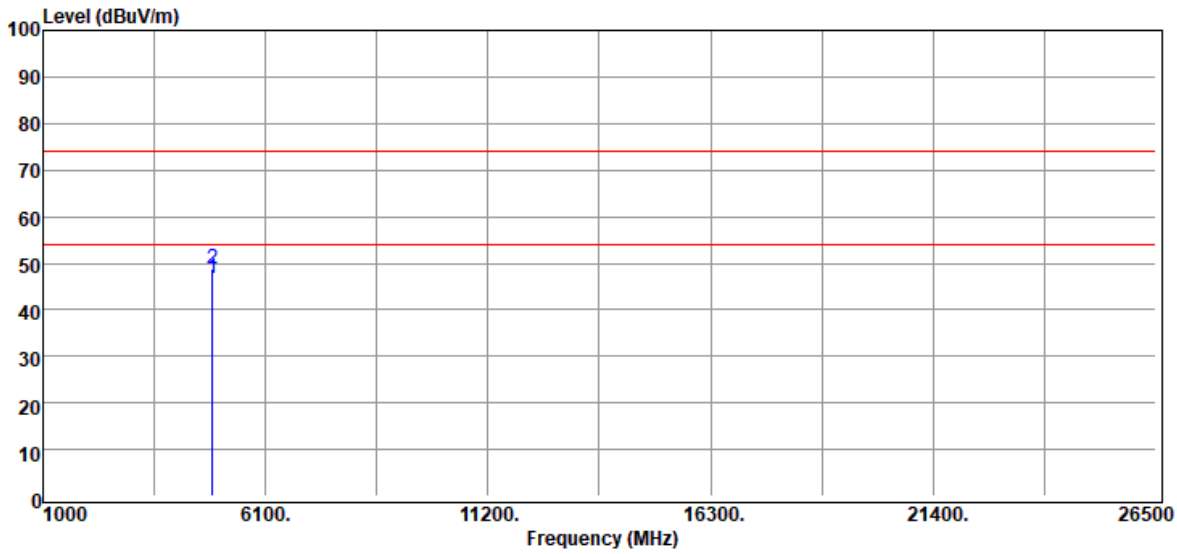
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Report Number :ER/2020/80120
 Operation Mode :BLE 1M
 Test Frequency :2442 MHz
 Test Mode :TX CH MID
 EUT Pol :E2 Plan

Test Site :966 Chamber D
 Test Date :2020-08-29
 Temp./Humi. :22.5/65
 Antenna Pol. :HORIZONTAL
 Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4884.00	Average	47.00	-0.45	46.55	54.00	-7.45
4884.00	Peak	49.15	-0.45	48.70	74.00	-25.30

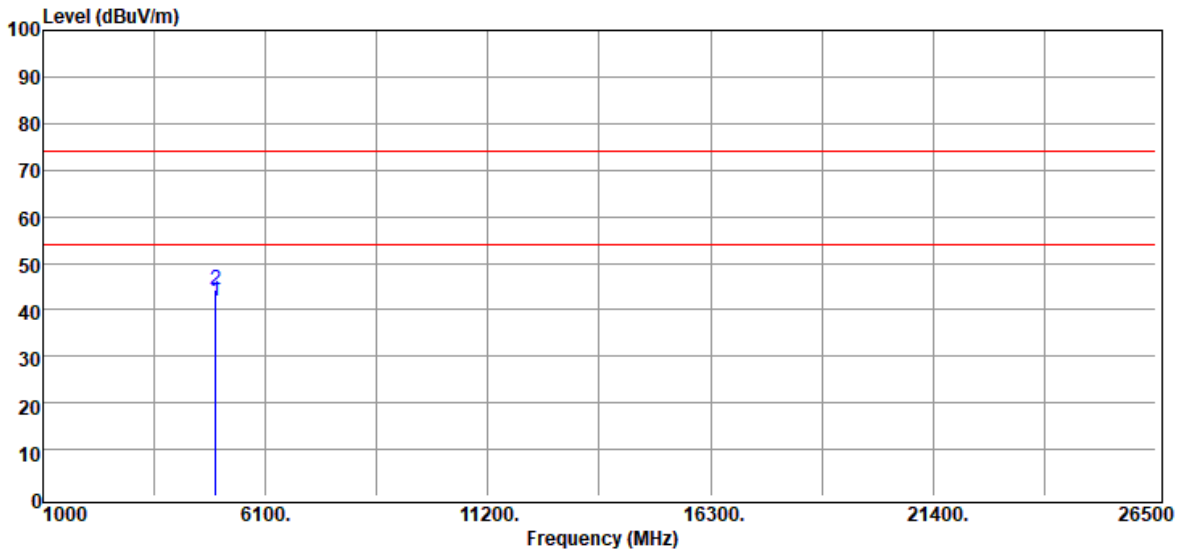
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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2480 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



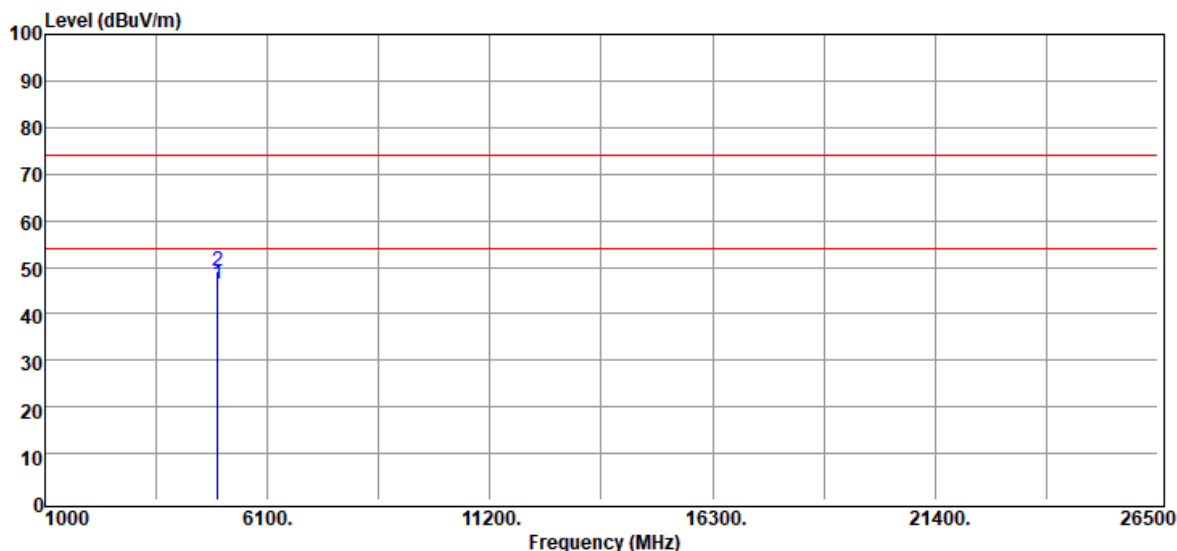
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	42.57	-0.79	41.78	54.00	-12.22
4960.00	Peak	44.99	-0.79	44.20	74.00	-29.80

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Report Number :ER/2020/80120
Operation Mode :BLE 1M
Test Frequency :2480 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	47.09	-0.79	46.30	54.00	-7.70
4960.00	Peak	49.87	-0.79	49.08	74.00	-24.92

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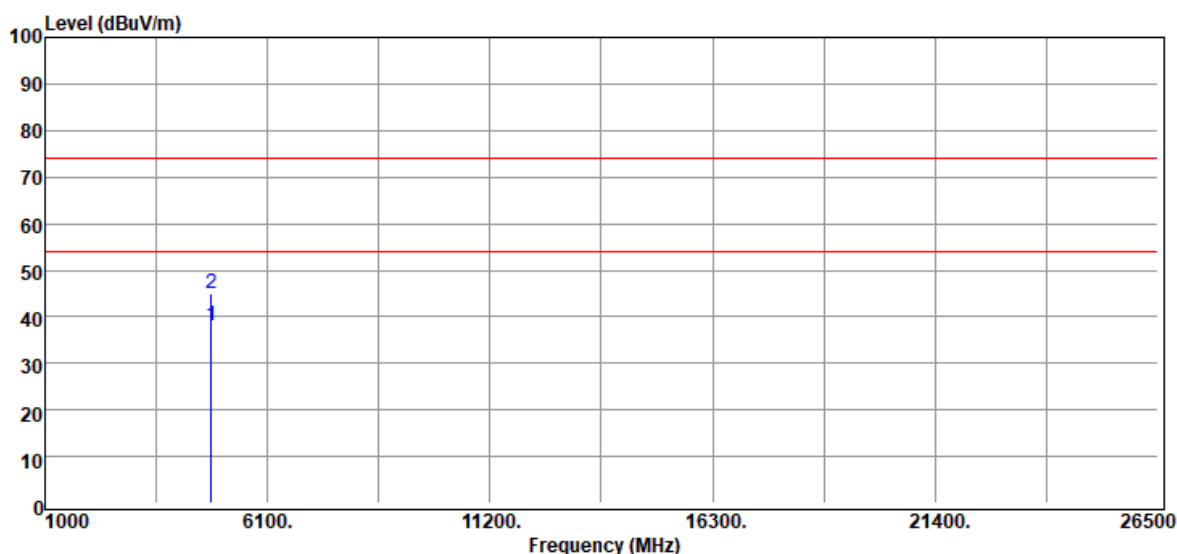
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BLE 2M

Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2402 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	38.26	-0.35	37.91	54.00	-16.09
4804.00	Peak	45.20	-0.35	44.85	74.00	-29.15

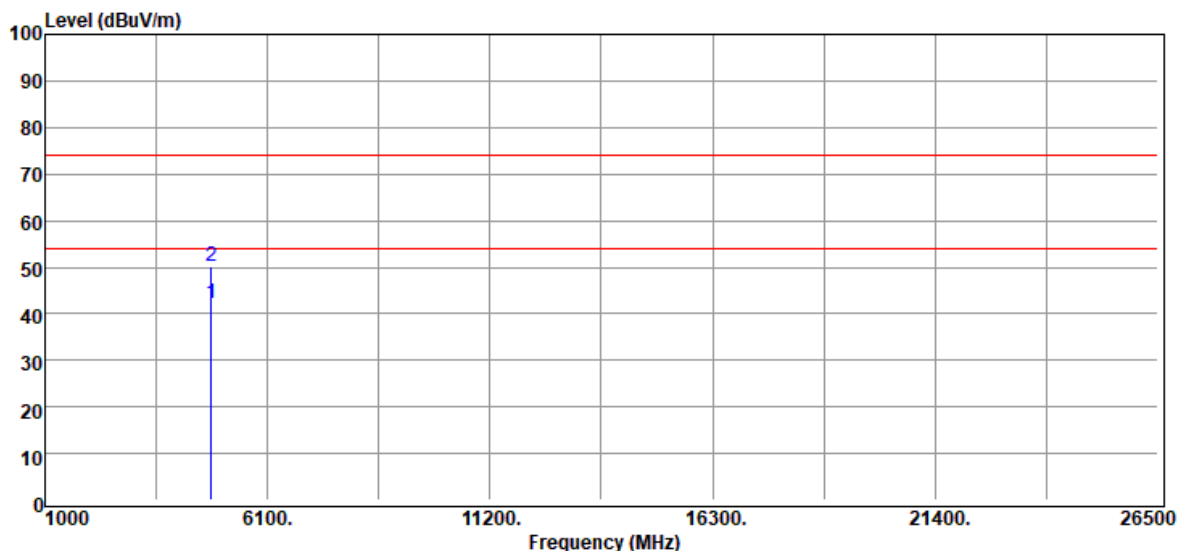
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2402 MHz
Test Mode :TX CH LOW
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	42.71	-0.35	42.36	54.00	-11.64
4804.00	Peak	50.54	-0.35	50.19	74.00	-23.81

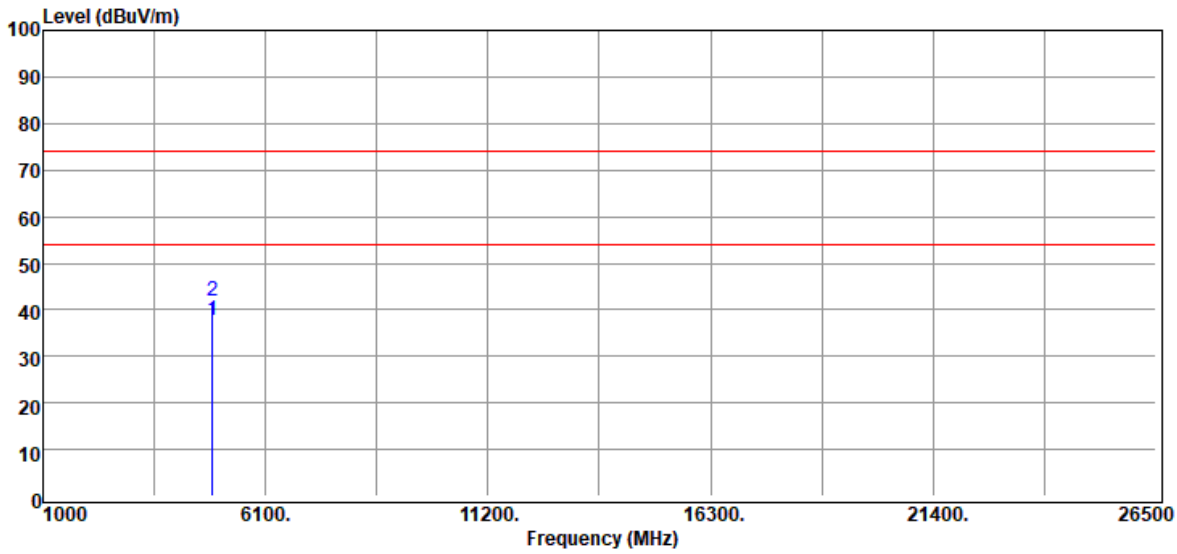
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4884.00	Average	38.02	-0.45	37.57	54.00	-16.43
4884.00	Peak	42.37	-0.45	41.92	74.00	-32.08

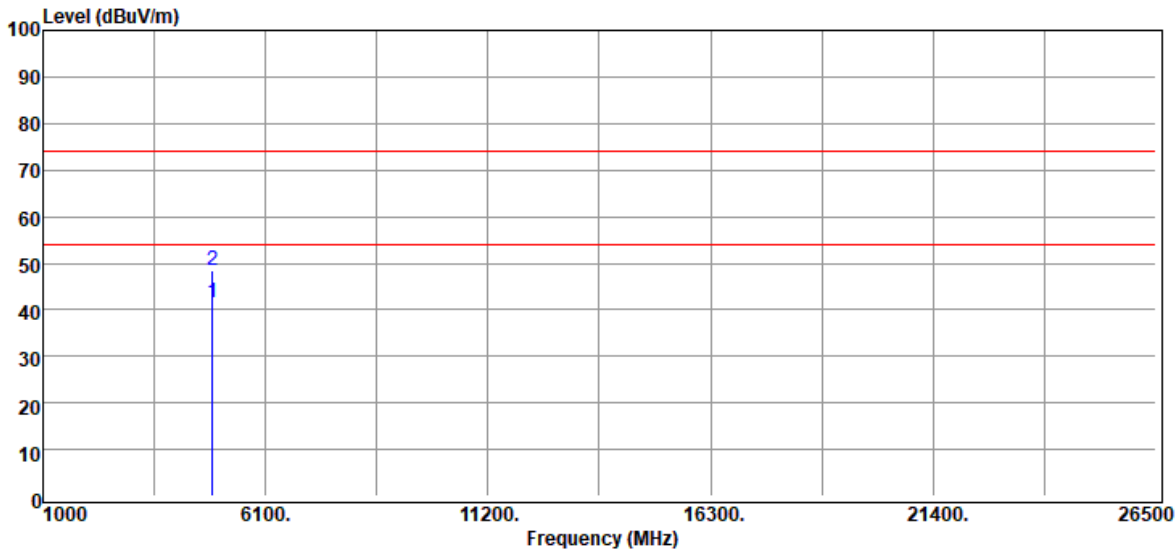
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2442 MHz
Test Mode :TX CH MID
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4884.00	Average	41.97	-0.45	41.52	54.00	-12.48
4884.00	Peak	48.96	-0.45	48.51	74.00	-25.49

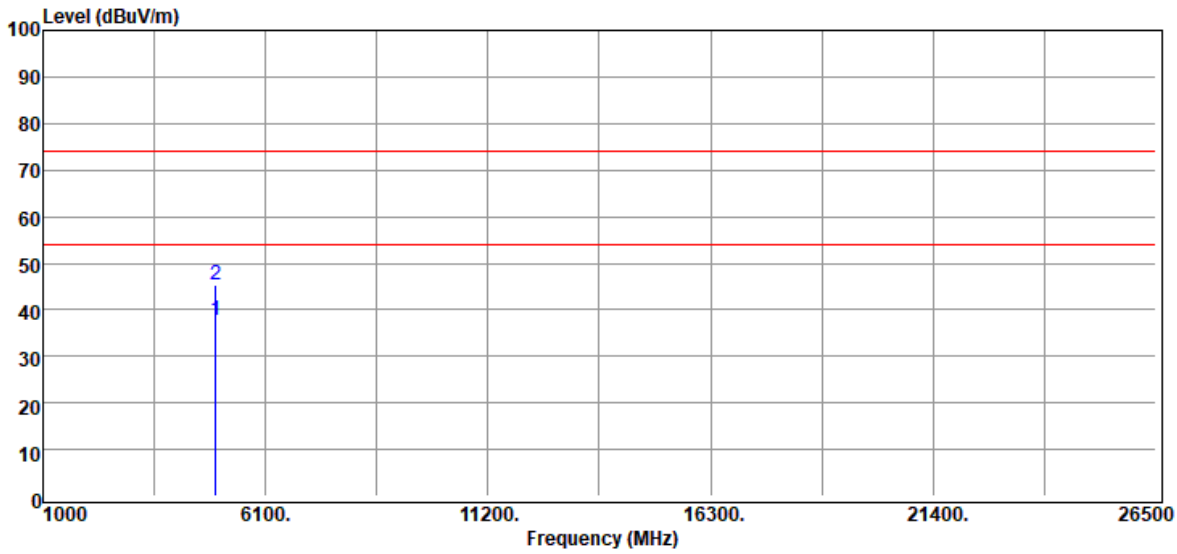
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2480 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :VERTICAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	38.49	-0.79	37.70	54.00	-16.30
4960.00	Peak	46.05	-0.79	45.26	74.00	-28.74

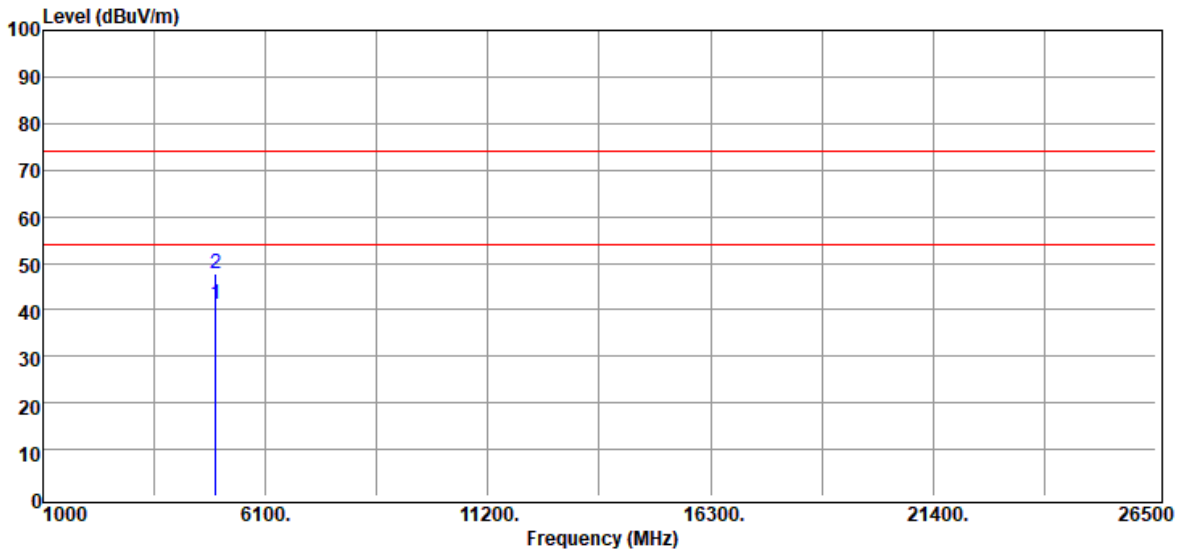
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Report Number :ER/2020/80120
Operation Mode :BLE 2M
Test Frequency :2480 MHz
Test Mode :TX CH HIGH
EUT Pol :E2 Plan

Test Site :966 Chamber D
Test Date :2020-08-29
Temp./Humi. :22.5/65
Antenna Pol. :HORIZONTAL
Engineer :Kailin Lee



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	41.99	-0.79	41.20	54.00	-12.80
4960.00	Peak	48.65	-0.79	47.86	74.00	-26.14

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11 POWER SPECTRAL DENSITY

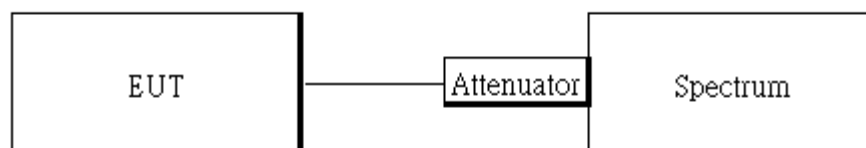
11.1 Standard Applicable:

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.

11.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
DC Block	PASTERNAK	PE8210	RF256	11/20/2019	11/19/2020
Attenuator	Marvelous	WATT-218FS-10	RF245	11/20/2019	11/19/2020

11.3 Test Set-up:



11.4 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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11.5 Measurement Result:

BLE 1M

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2402	-9.52	8	PASS
2442	-9.81	8	PASS
2480	-9.15	8	PASS

NOTE: cable loss as 10.8dB that offsets in the spectrum

BLE 2M

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2402	-12.43	8	PASS
2442	-12.68	8	PASS
2480	-12.07	8	PASS

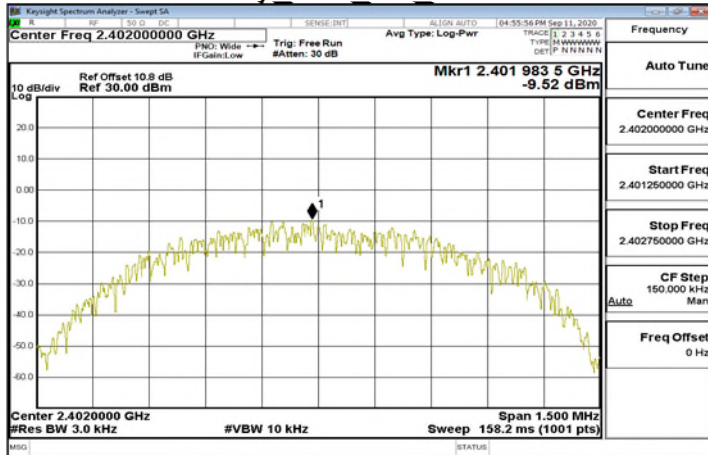
NOTE: cable loss as 10.8dB that offsets in the spectrum

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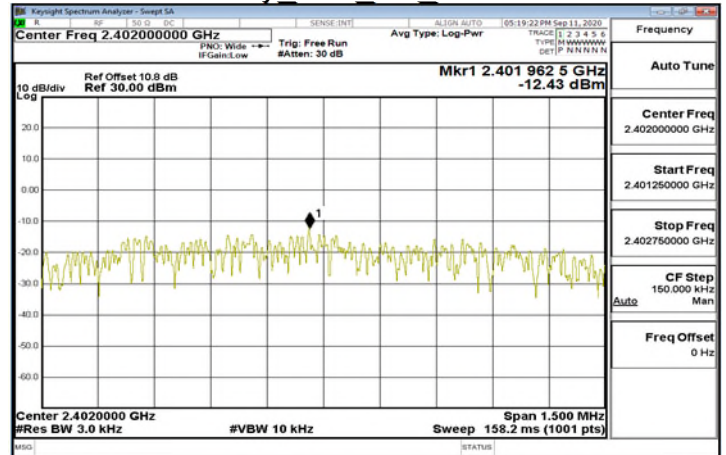
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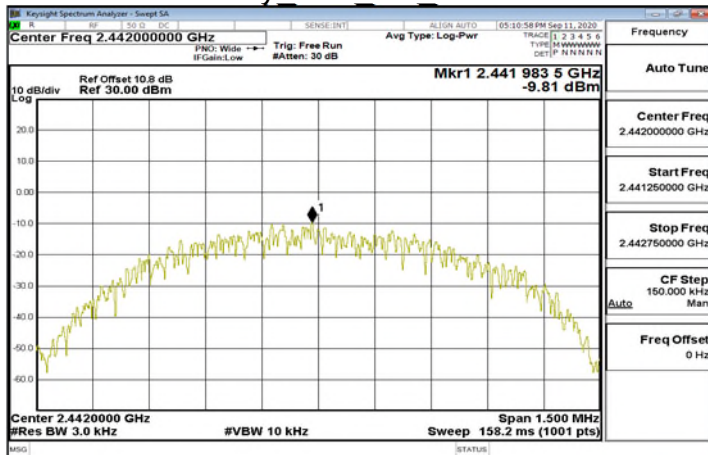
Power Density BLE 1M LowCH00-2402



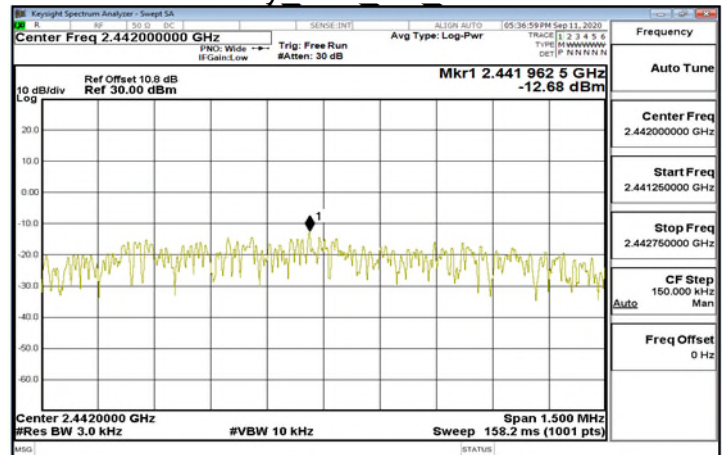
Power Density BLE 2M LowCH00-2402



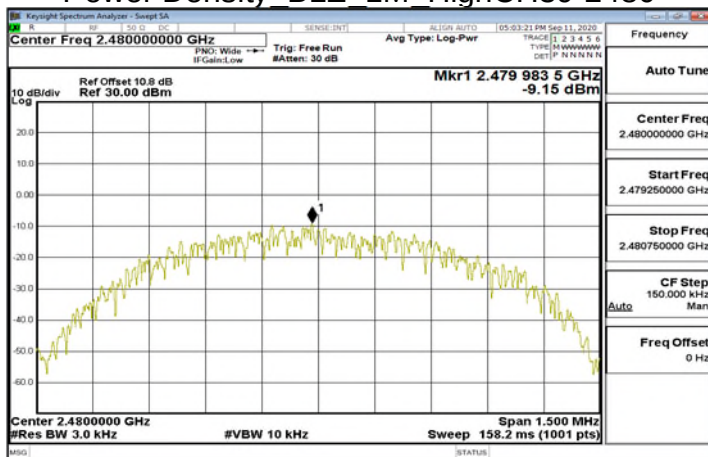
Power Density BLE 1M MidCH20-2442



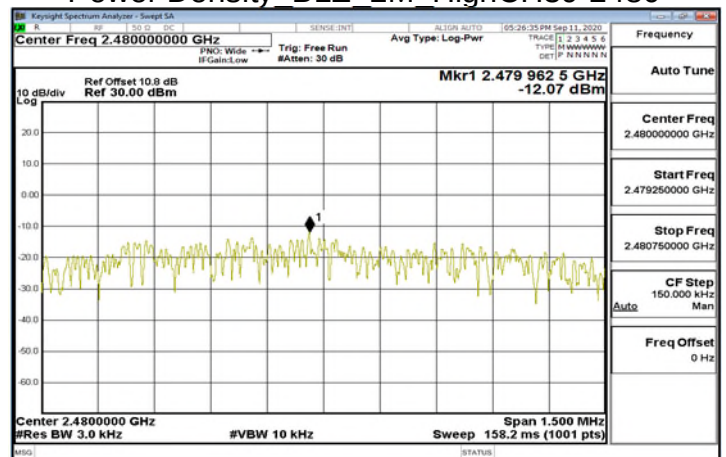
Power Density BLE 2M MidCH20-2442



Power Density BLE 1M HighCH39-2480



Power Density BLE 2M HighCH39-2480



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12 ANTENNA REQUIREMENT

12.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

12.2 Antenna Connected Construction:

The antenna is designed with unique RF connector and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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