

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
FCC Model No.: LBEE5CJ1XK, LBEE5CJ2XK
IC Model No.: LBEE5CJ1XK, LBEE5CJ2XK
Model Difference: Different Antenna type
Report Number: E2/2021/30017
FCC ID VPYLB1XK
IC: 772C-LB1XK
Issue Date: Aug.13,2021
Date of Test: Mar.11,2021~Aug.04,2021

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, ISSED RSS-247.

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

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Revision History

Report Number	Revision	Description	Issue Date	Revised By
E2/2021/30017	Rev.00	Original	Aug.13,2021	Viola Su

Note:

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

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module
Brand Name:	muRata
FCC Model No.:	LBEE5CJ1XK, LBEE5CJ2XK
IC Model No.:	LBEE5CJ1XK, LBEE5CJ2XK
Model Difference:	Different Antenna type
Hardware Version:	1.0
Firmware Version:	1.0
EUT Series No.:	EVN NO.12
Power Supply:	3.3Vdc

1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: 6.05 dBm BLE 2M: 6.11 dBm

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1.3 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)	Worst Antenna Gain
Monopole	Murata	LBEE5CJ1XK-Antenna	2402~2480	3.6	V
Dipole	Molex	146187	2402~2480	3.4	V
Dipole	Molex	146153	2402~2480	3.2	

Note:

1. Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
2. Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

RSS-247 issue 2 Feb. 2017

RSS-Gen Issue 5, Amendment 2, February 2021

ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designa- tion 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 A	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 indica- tion where measurements occurred in specific test site and address.				

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1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

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

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 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 Setup & Radiated Setup

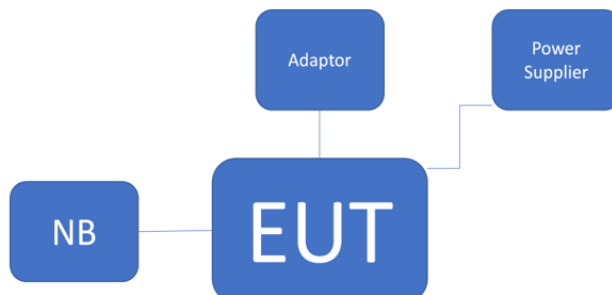


Table 2-1 Equipment Used in Tested System

Item	Equipment	MRF/Brand	Model/Type No.	Series No.
1	Notebook	Lenovo	T420	S0012599
2	DutApiSisoBt	N/A	N/A	N/A
3	Test Software	SGS Taiwan	Radio Test Software	Ver.21
4	Notebook	Lenovo	T470	P0001293
5	Test Software	audix	e3	20923 sgs Ver.9

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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	N/A
§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	Emission Bandwidth	Compliant
§15.247(d) §15.205 §15.209	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Radiated & Conducted 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 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		

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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.
- DANT& SANT**

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

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

Note: The field strength of radiation emission was measured as EUT three orthogonal plans, E1 / E2 / H, are positioned to pre-scan the emission generating the highest one. The worst **E2** position is tested, and recorded.

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

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE 2M	0 to 39	0,20,39	GFSK	2

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.34 dB
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.

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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(μV)	
	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.

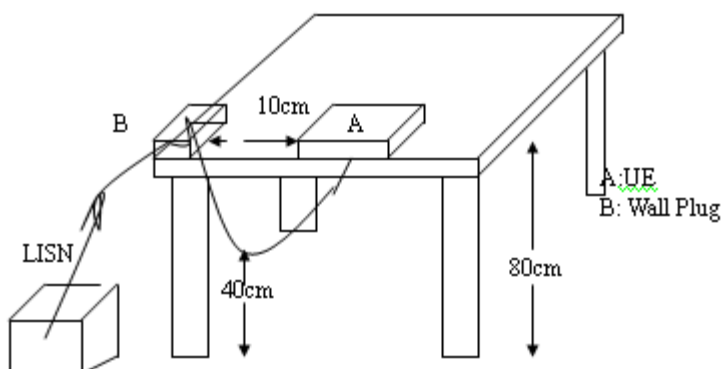
6.2 Measurement Equipment Used:

N/A

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.

6.4 Test SET-UP (Block Diagram of Configuration)



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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:

N/A; Powered from supply power.

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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.

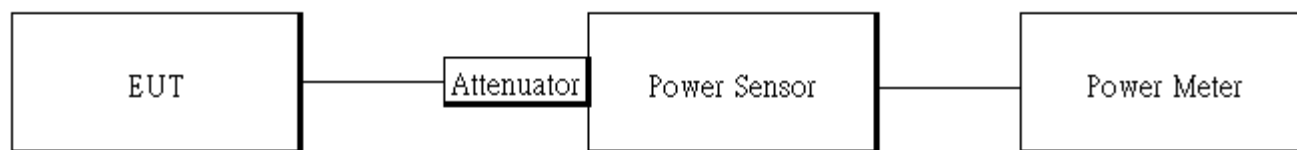
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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: Conducted A					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804002	04/14/2021	04/13/2022
Power Sensor	Anritsu	MA2411B	1726105	04/14/2021	04/13/2022
Power Sensor	Anritsu	MA2411B	1726106	04/14/2021	04/13/2022
DC Power Supply	Agilent	E3640A	MY53130054	09/07/2020	09/06/2021
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021
Attenuator	Marvelous	MVE2213-10	RF10	11/19/2020	11/18/2021

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.

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

7.5 Duty Factor:

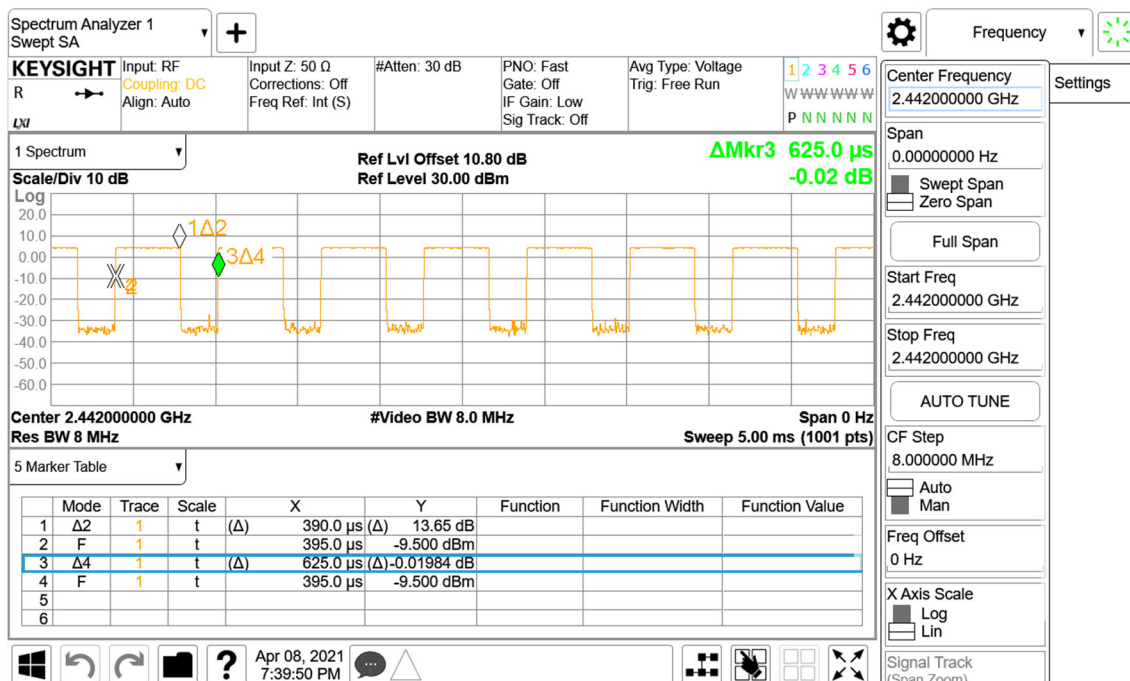
7.5.1 DANT-Dipole Ant No.5

Duty Cycle

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

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

Duty Cycle_BLE_1M_MidCH20-2442



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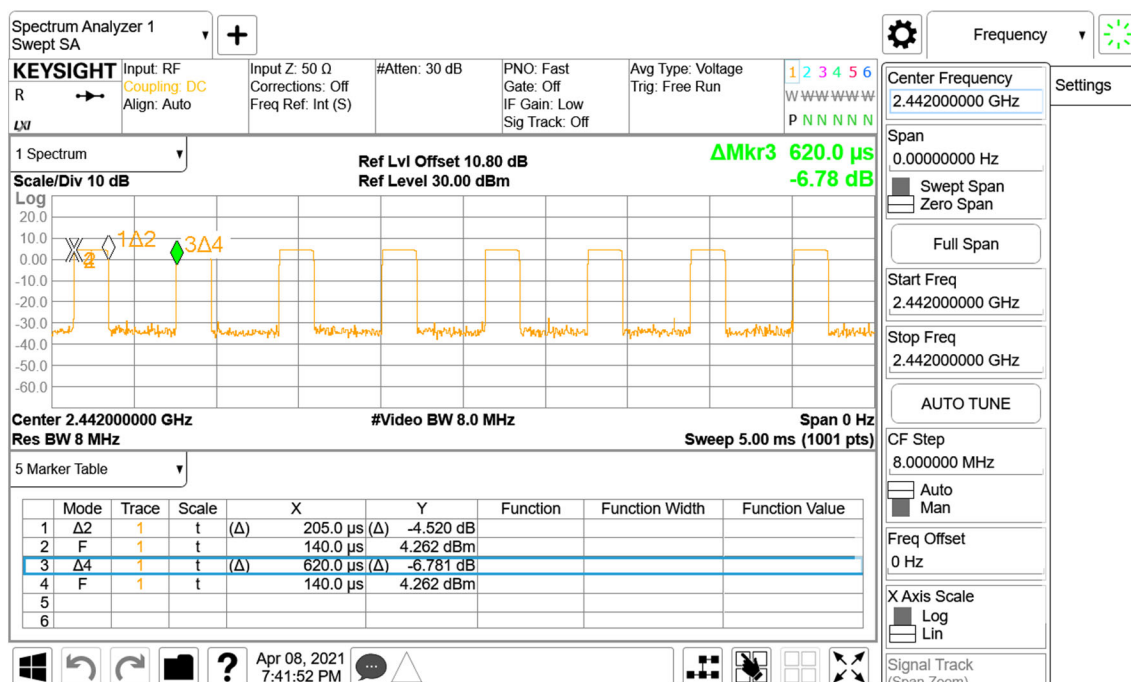
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Duty Cycle

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE 2M	33.00	4.81	4.88	5.00

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

Duty Cycle_BLE_2M_MidCH20-2442



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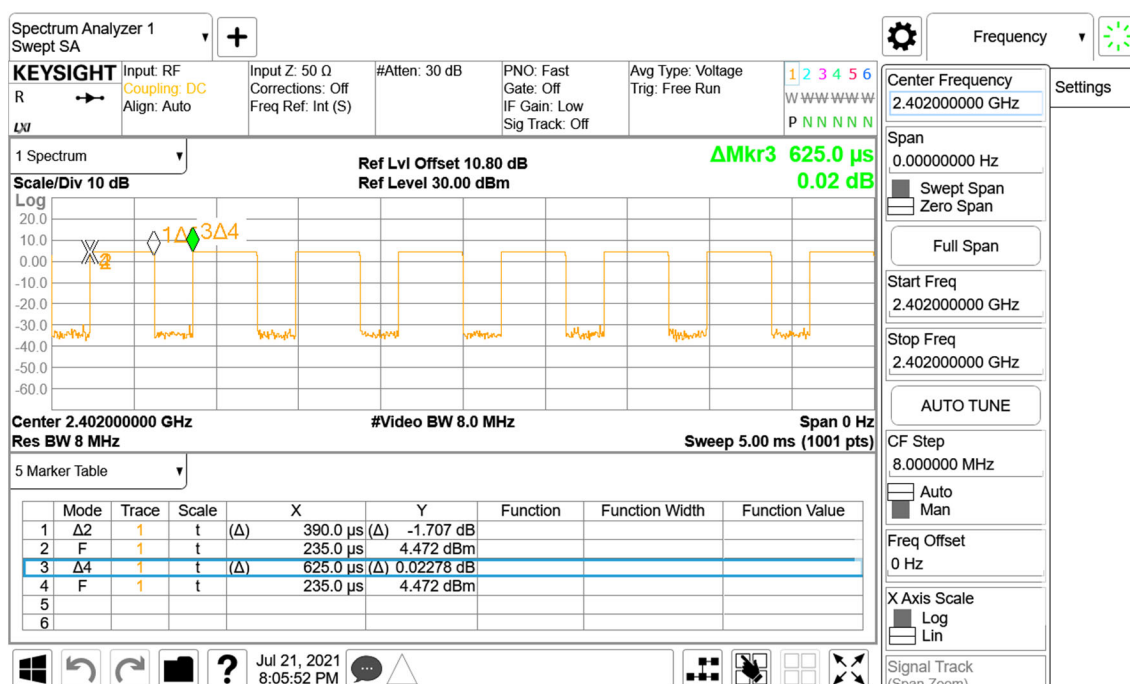
7.5.2 SANT-Dipole No.4 & SANT-Monopole No.7

Duty Cycle

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

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

Duty Cycle BLE 1M LowCH00-2402



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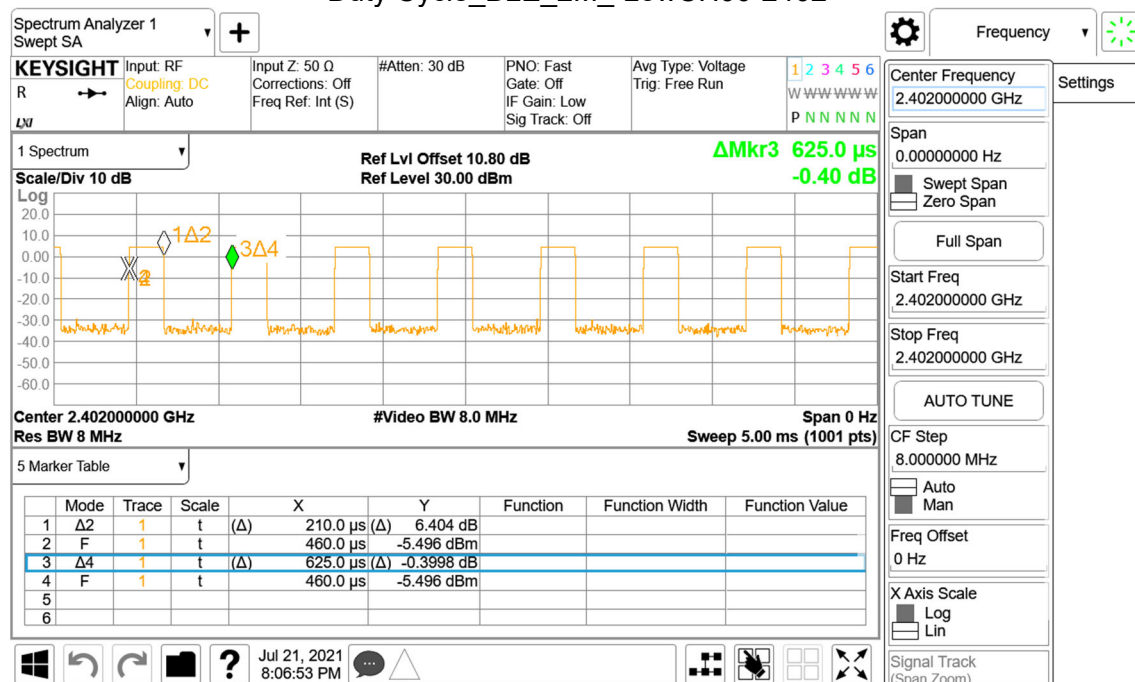
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Duty Cycle

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE 2M	34.00	4.69	4.76	5.00

Duty Cycle Factor: $10 \cdot \log(1/(34/100)) = 4.69$

Duty Cycle BLE 2M LowCH00-2402



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7.6 Output Power:

7.6.1 Peak & Avg

7.6.2 DANT-Dipole Ant No.5

BLE mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit
Low	2402	4.5	6.05	1 Watt = 30 dBm
Mid	2442	4.5	6.00	1 Watt = 30 dBm
High	2480	4.5	5.92	1 Watt = 30 dBm
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2402	4.5	6.03	1 Watt = 30 dBm
Mid	2442	4.5	5.99	1 Watt = 30 dBm
High	2480	4.5	5.89	1 Watt = 30 dBm

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

BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit
0	2402	4.5	6.11	1 Watt = 30 dBm
20	2442	4.5	5.99	1 Watt = 30 dBm
39	2480	4.5	6.03	1 Watt = 30 dBm
BLE 2M mode:				
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
0	2402	4.5	6.05	1 Watt = 30 dBm
20	2442	4.5	5.98	1 Watt = 30 dBm
39	2480	4.5	6.00	1 Watt = 30 dBm

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

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7.6.3 SANT-Dipole No.4 & SANT-Monopole No.7

BLE mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	6	5.72	30
Mid	2442	6	5.64	30
High	2480	6	5.57	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	6	5.67	30
Mid	2442	6	5.57	30
High	2480	6	5.50	30

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

BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	6	5.71	30
Mid	2442	6	5.63	30
High	2480	6	5.57	30
BLE 2M mode:				
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	6	5.67	30
Mid	2442	6	5.57	30
High	2480	6	5.52	30

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

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7.7 EIRP

7.7.1 DANT-Dipole Ant No.5

BLE1M

EIRP

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	4.5	6.03	3.40	9.43	4W= 36 dBm
Mid	2442	4.5	5.99	3.40	9.39	4W= 36 dBm
High	2480	4.5	5.89	3.40	9.29	4W= 36 dBm

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

BLE2M

EIRP

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
0	2402	4.5	6.05	3.40	9.45	4W= 36 dBm
20	2442	4.5	5.98	3.40	9.38	4W= 36 dBm
39	2480	4.5	6.00	3.40	9.40	4W= 36 dBm

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

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7.7.2 SANT

EIRP BLE mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	6	5.67	3.60	9.27	4W= 36 dBm
Mid	2442	6	5.57	3.60	9.17	4W= 36 dBm
High	2480	6	5.50	3.60	9.10	4W= 36 dBm

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

EIRP BLE 2M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	6	5.67	3.60	9.27	4W= 36 dBm
Mid	2442	6	5.57	3.60	9.17	4W= 36 dBm
High	2480	6	5.52	3.60	9.12	4W= 36 dBm

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

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8 EMISSION BANDWIDTH MEASUREMENT

8.1 Standard Applicable

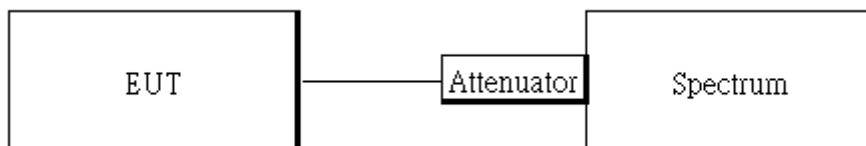
The minimum 6 dB bandwidth shall be at least 500 kHz .

8.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted A					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071573	06/26/2020	06/25/2021
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/01/2021	05/31/2022
DC Power Supply	Agilent	E3640A	MY53130054	09/07/2020	09/06/2021
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021
DC Block	PASTERNAK	PE8210	RF151	11/19/2020	11/18/2021
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R

Note: N.C.R refers to Not Calibrated Required

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= 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. Set the spectrum analyzer as
 RBW= 1 % to 5% of 99% Bandwidth ,

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VBW $\geq 3 \times$ RBW,

Span= large enough to capture all products of the modulation process,

Sweep=auto,

Detector = Peak, and Max hold for 99% Bandwidth test.

6. Mark the peak frequency and 99%dB (upper and lower) frequency

7. Repeat above procedures until all test default channel is completed

8.5 Measurement Result:

8.5.1 DANT-Dipole Ant No.5

BLE mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6924	≥ 0.5	PASS
2442	0.691	≥ 0.5	PASS
2480	0.6897	≥ 0.5	PASS

BLE mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0253
2442	1.0252
2480	1.0252

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BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	1.182	≥ 0.5	PASS
2442	1.182	≥ 0.5	PASS
2480	1.183	≥ 0.5	PASS

* Cable loss as 10.8dB that offsets on the spectrum.

* Note: The arrow “->” reveals X decibel level

Note: Refer to next page for plots.

BLE 2M mode

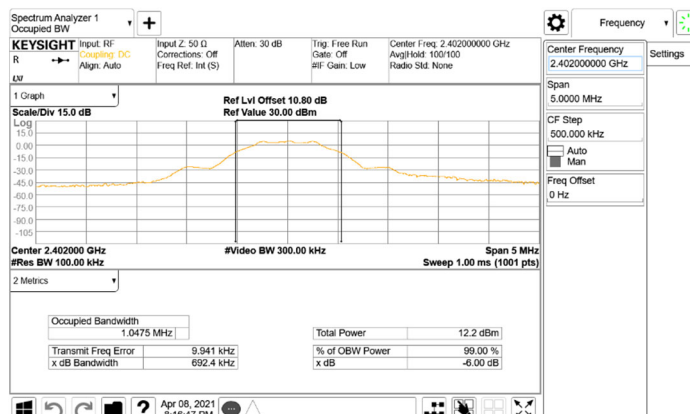
Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0393
2442	2.0388
2480	2.0399

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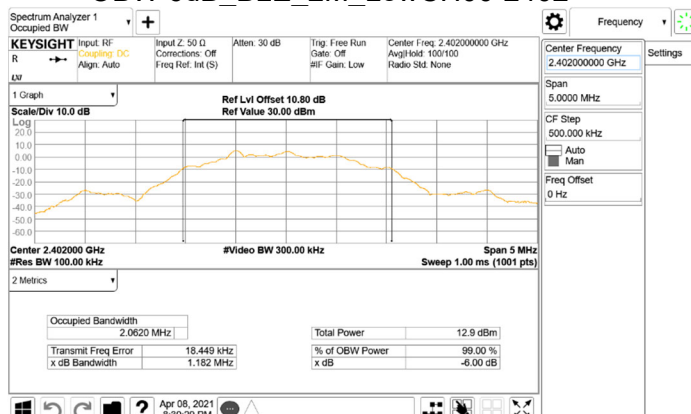
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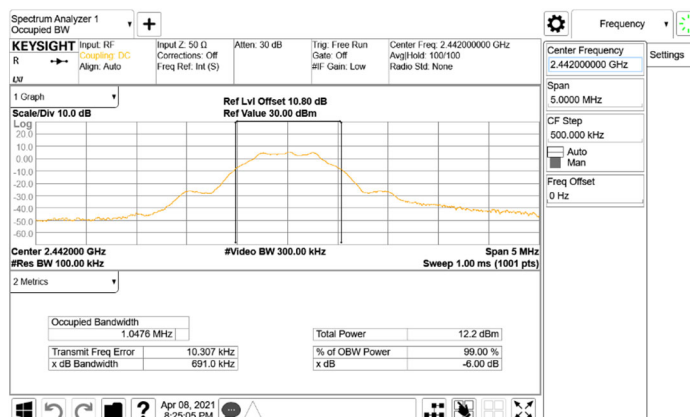
OBW 6dB_BLE_1M_LowCH00-2402



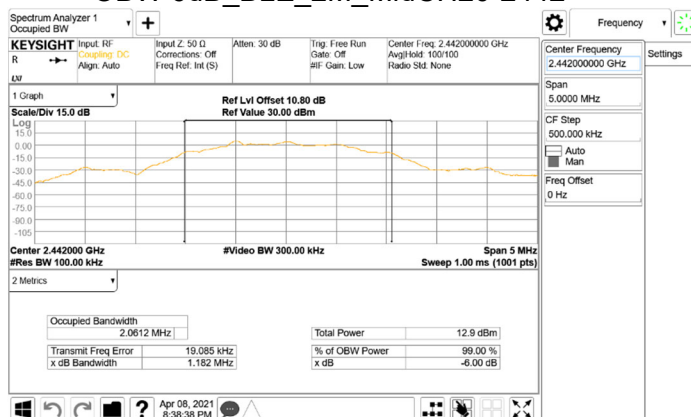
OBW 6dB_BLE_2M_LowCH00-2402



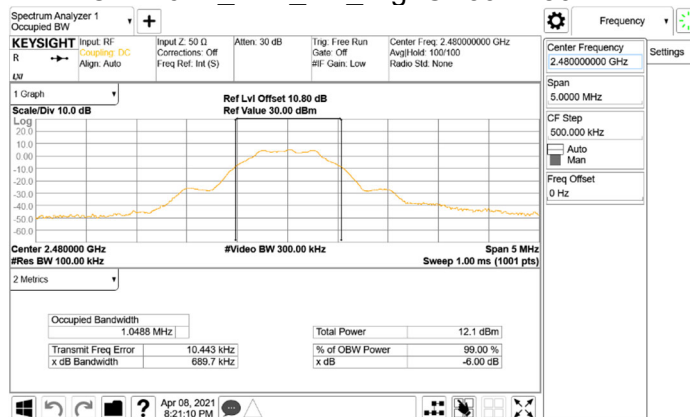
OBW 6dB_BLE_1M_MidCH20-2442



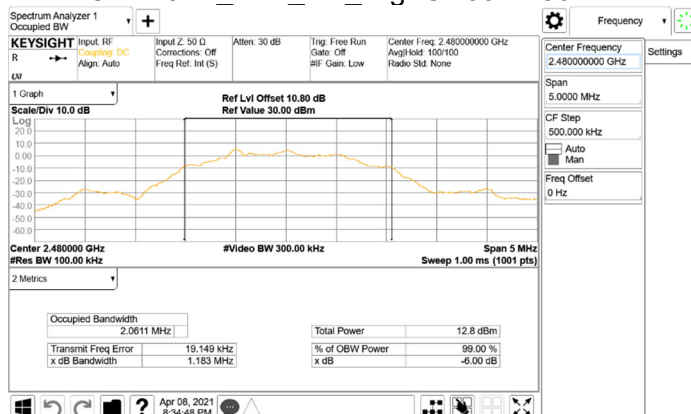
OBW 6dB_BLE_2M_MidCH20-2442



OBW 6dB_BLE_1M_HighCH39-2480



OBW 6dB_BLE_2M_HighCH39-2480

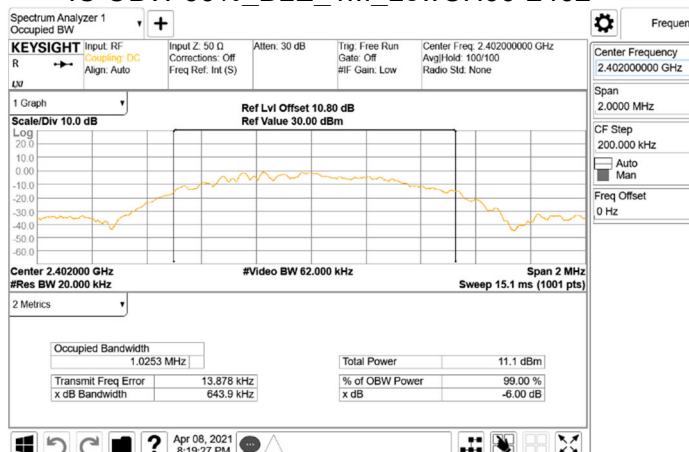


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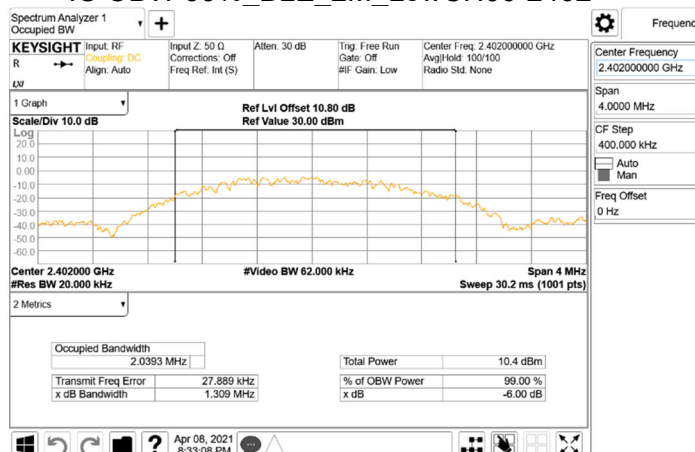
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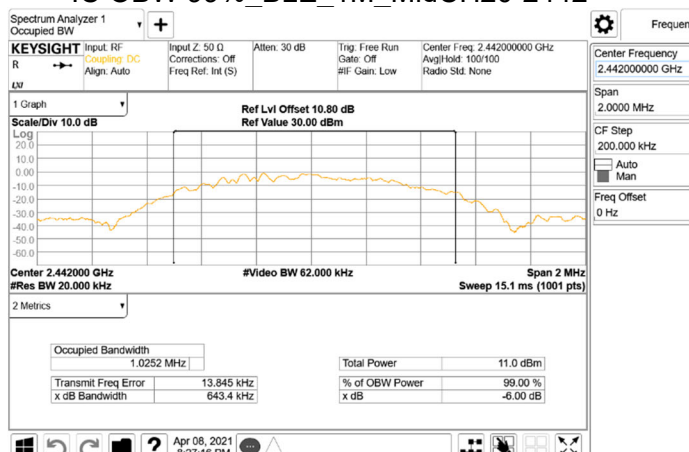
IC OBW 99%_BLE_1M_LowCH00-2402



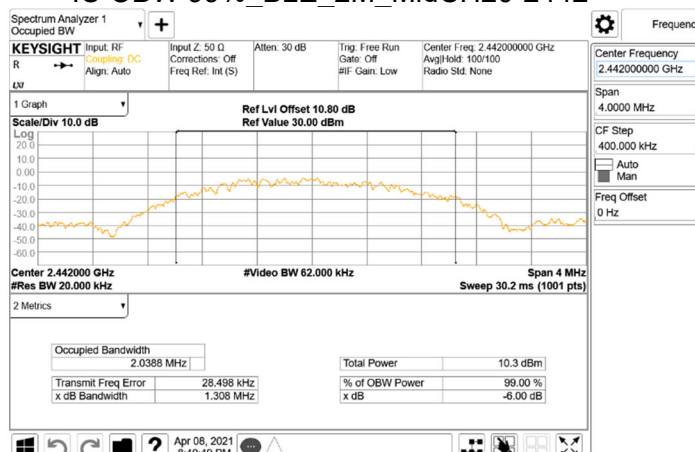
IC OBW 99%_BLE_2M_LowCH00-2402



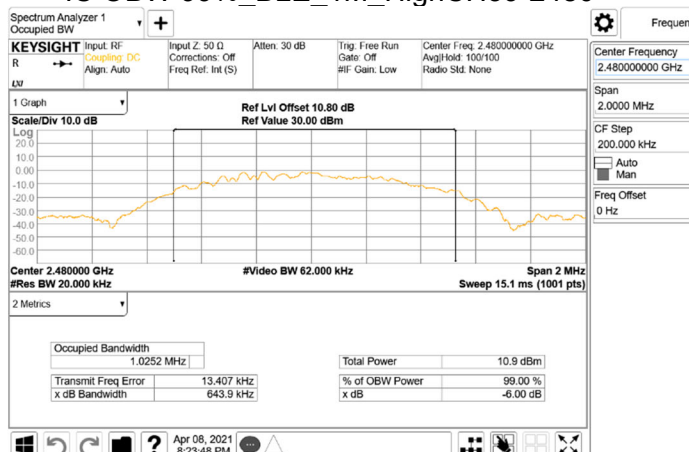
IC OBW 99%_BLE_1M_MidCH20-2442



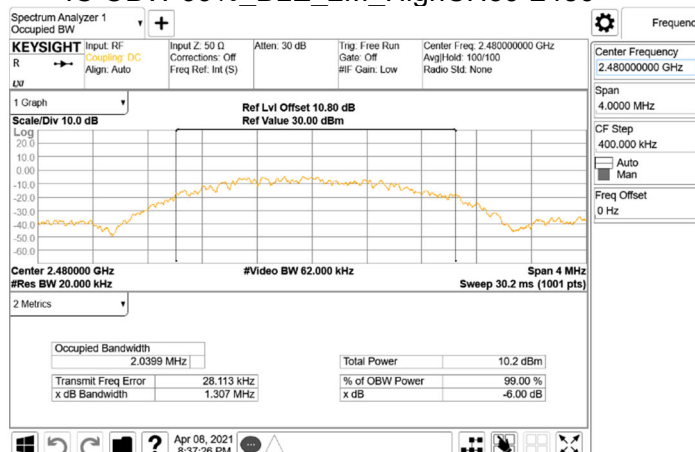
IC OBW 99%_BLE_2M_MidCH20-2442



IC OBW 99%_BLE_1M_HighCH39-2480



IC OBW 99%_BLE_2M_HighCH39-2480



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8.5.2 SANT-Dipole No.4 & SANT-Monopole No.7

BLE mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6922	≥ 0.5	PASS
2442	0.6894	≥ 0.5	PASS
2480	0.6897	≥ 0.5	PASS

BLE mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0243
2442	1.0238
2480	1.0239

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BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	1.182	≥ 0.5	PASS
2442	1.182	≥ 0.5	PASS
2480	1.179	≥ 0.5	PASS

* Cable loss as 10.8dB that offsets on the spectrum.

* Note: The arrow “->” reveals X decibel level

Note: Refer to next page for plots.

BLE 2M mode

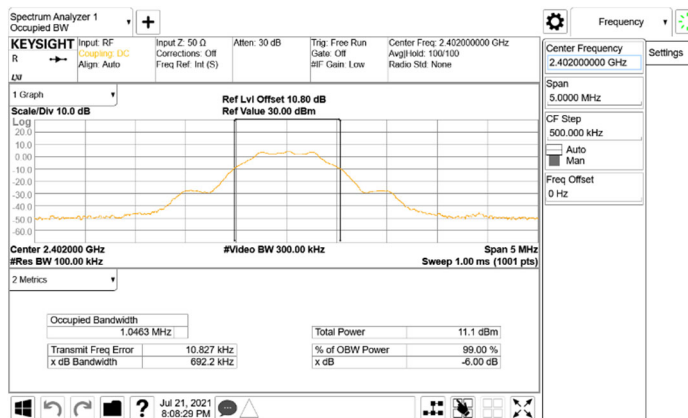
Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0337
2442	2.0344
2480	2.0352

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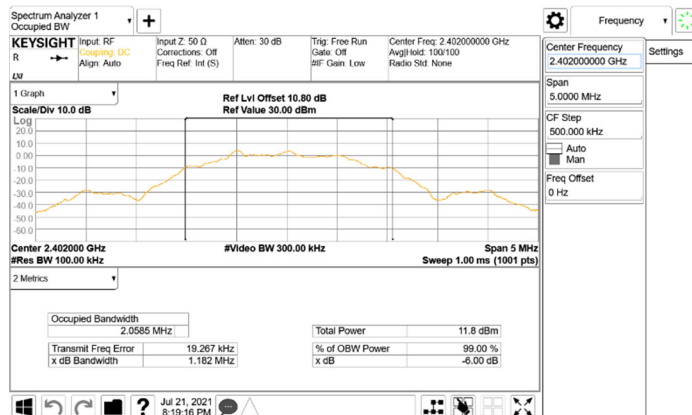
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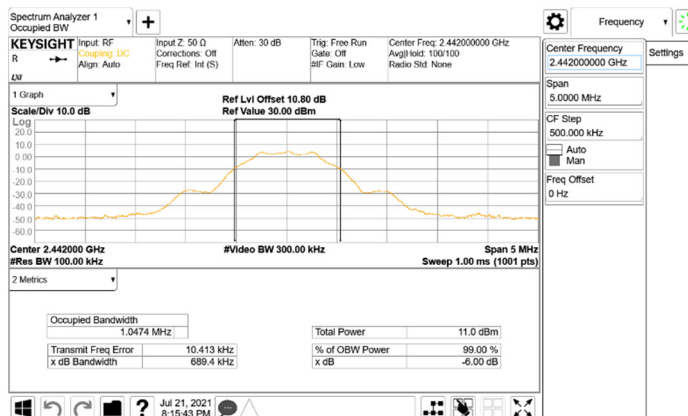
OBW 6dB_ BLE 1M_LowCH00-2402



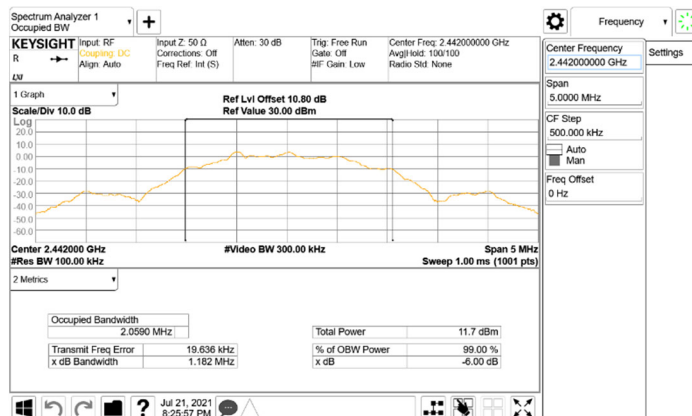
OBW 6dB_ BLE 2M_LowCH00-2402



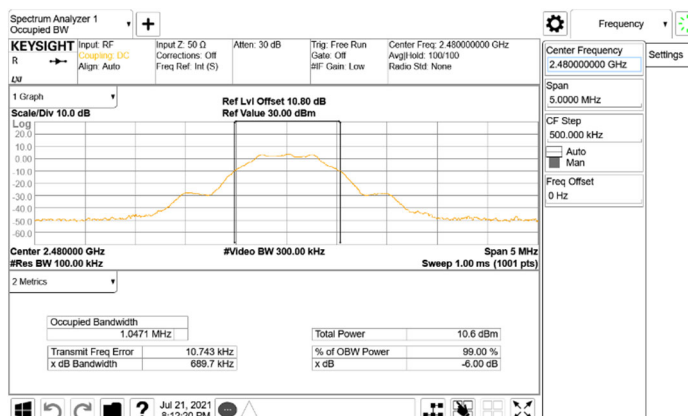
OBW 6dB_ BLE 1M_MidCH20-2442



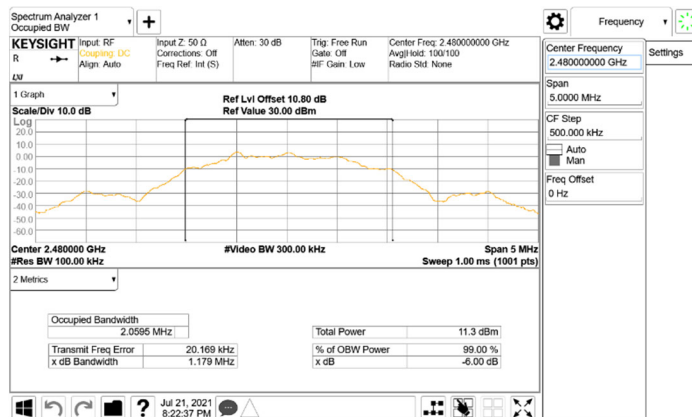
OBW 6dB_ BLE 2M_MidCH20-2442



OBW 6dB_ BLE 1M_HighCH39-2480



OBW 6dB_ BLE 2M_HighCH39-2480

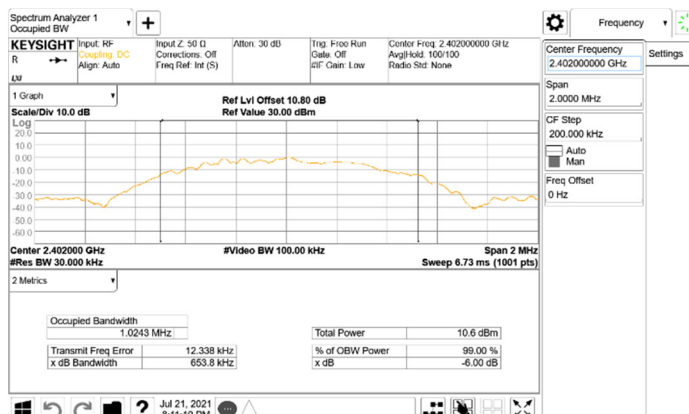


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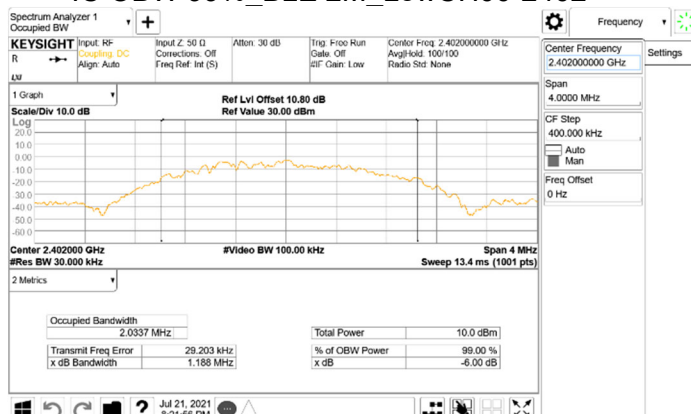
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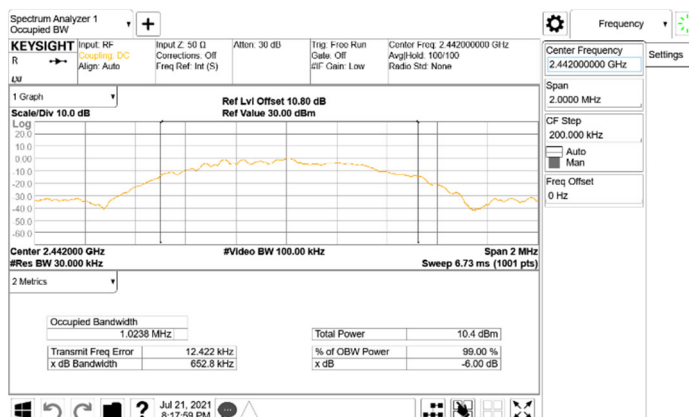
IC OBW 99%_ BLE 1M_LowCH00-2402



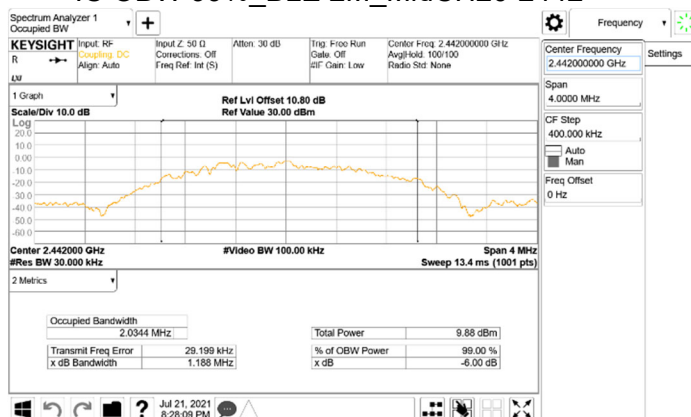
IC OBW 99%_ BLE 2M_LowCH00-2402



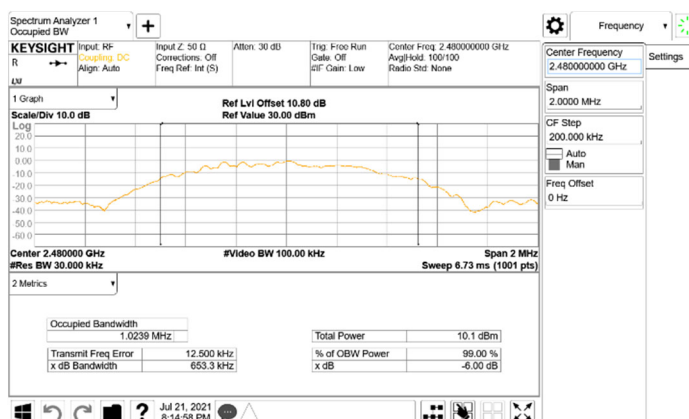
IC OBW 99%_ BLE 1M_MidCH20-2442



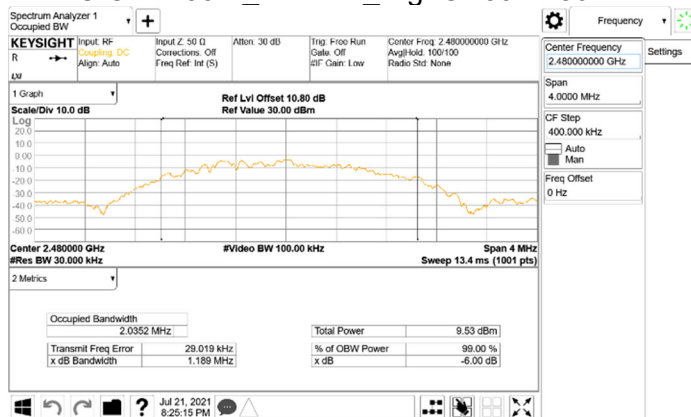
IC OBW 99%_ BLE 2M_MidCH20-2442



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

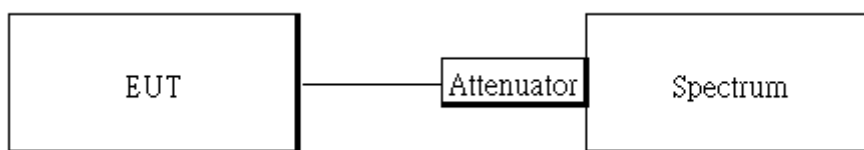
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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: Conducted A					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071573	06/26/2020	06/25/2021
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/01/2021	05/31/2022
DC Power Supply	Agilent	E3640A	MY53130054	09/07/2020	09/06/2021
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021
DC Block	PASTERNAK	PE8210	RF151	11/19/2020	11/18/2021
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R

Note: N.C.R refers to Not Calibrated Required

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.

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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.

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. 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.

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

9.5.1 DANT-Dipole Ant No.5

BLE1M

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.18	-14.82
2442	5.19	-14.81
2480	5.06	-14.94

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

NOTE: Refer to next page for plots.

BLE2M

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.00	-15.00
2442	4.97	-15.03
2480	4.84	-15.16

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

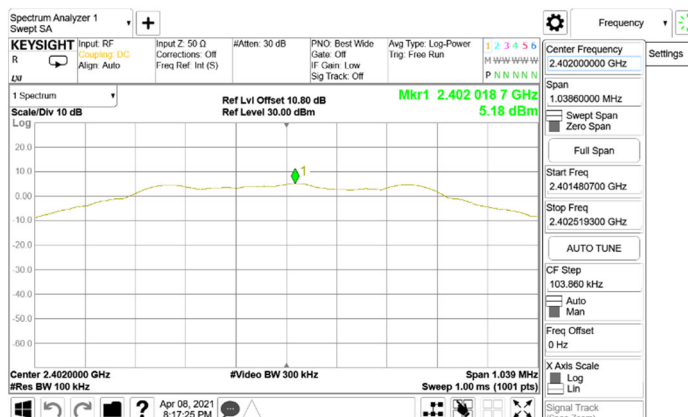
NOTE: Refer to next page for plots.

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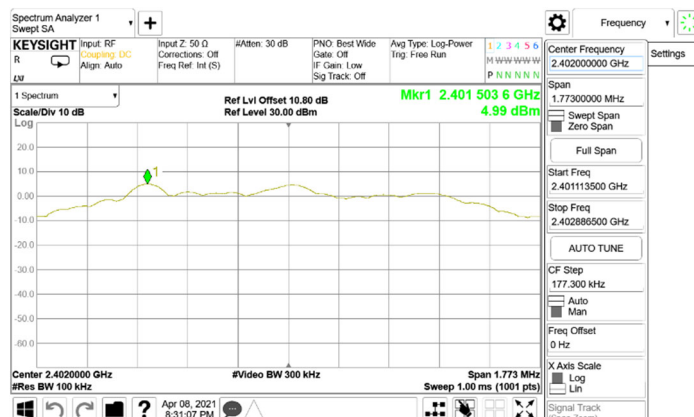
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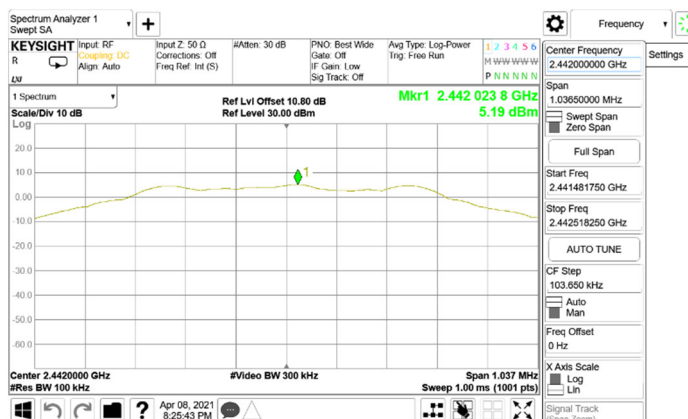
Reference Level_BLE_1M_LowCH00-2402



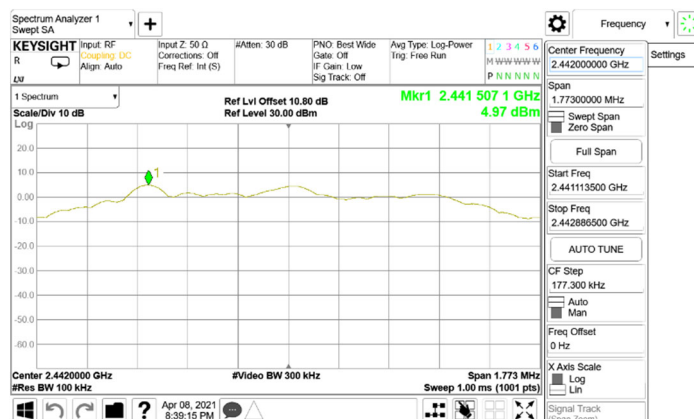
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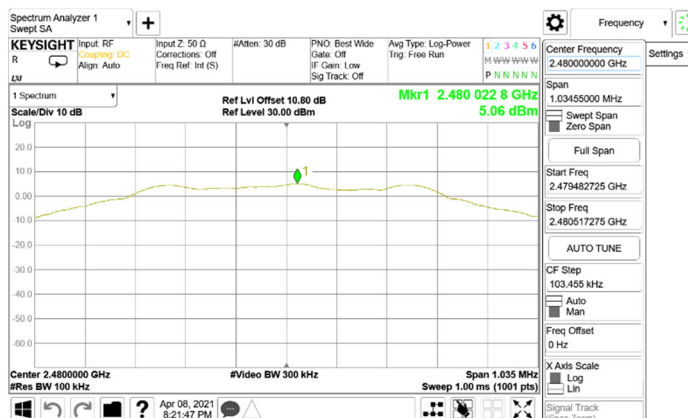
Reference Level_BLE_1M_MidCH20-2442



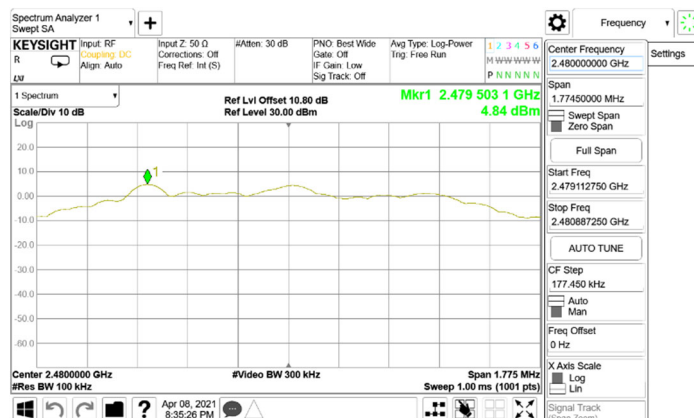
Reference Level_BLE_2M_MidCH20-2442



Reference Level_BLE_1M_HighCH39-2480



Reference Level_BLE_2M_HighCH39-2480

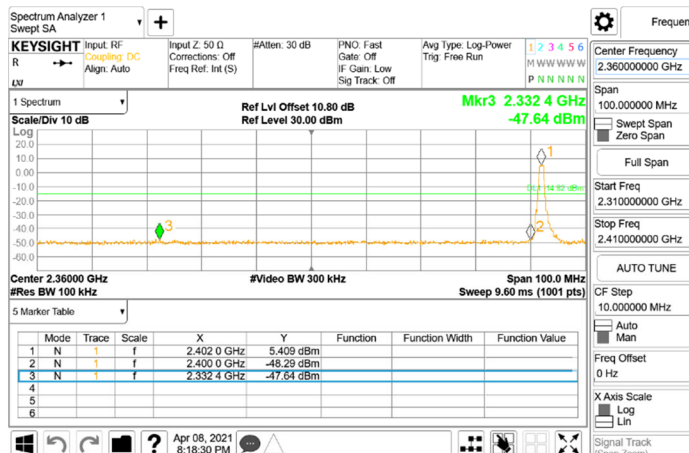


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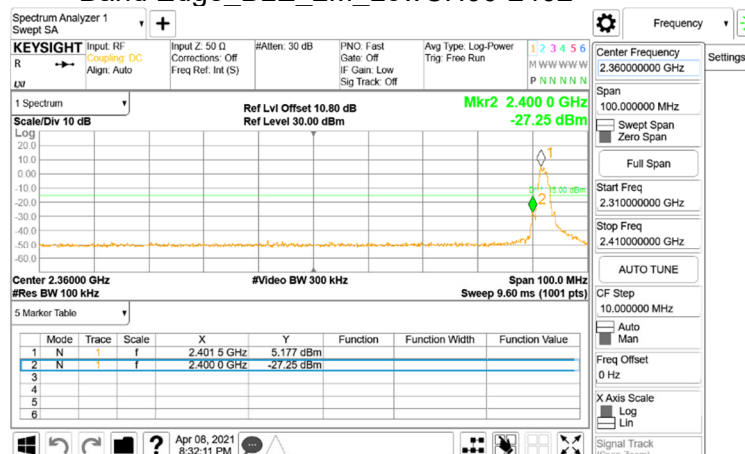
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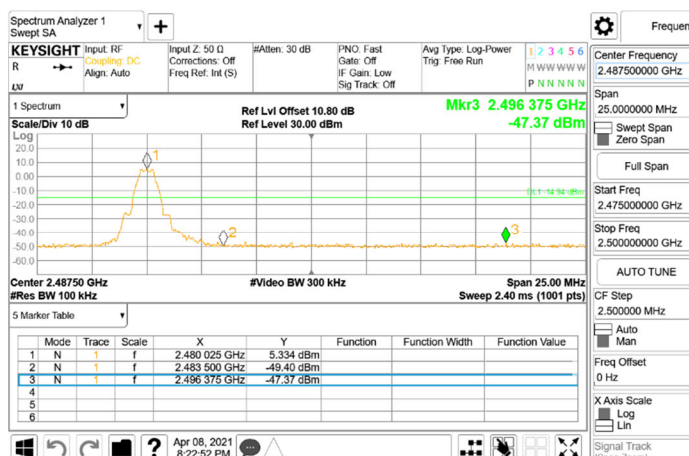
Band Edge_BLE_1M_LowCH00-2402



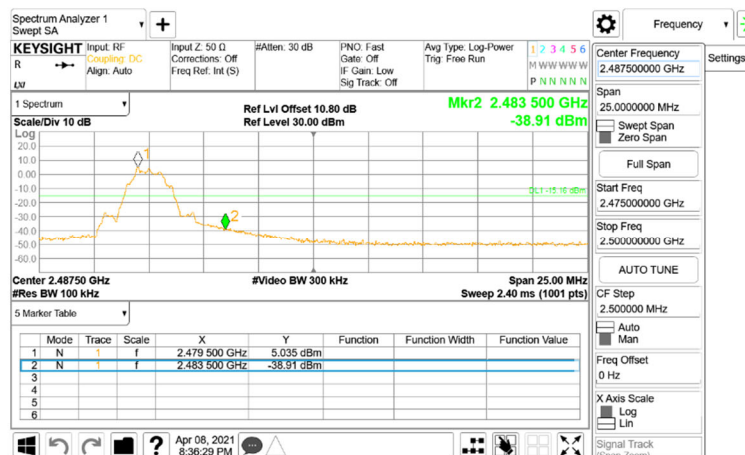
Band Edge_BLE_2M_LowCH00-2402



Band Edge_BLE_1M_HighCH39-2480



Band Edge_BLE_2M_HighCH39-2480



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