

**ELECTROMAGNETIC EMISSIONS  
COMPLIANCE REPORT**

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

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

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

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

**Product Name:** Communication Module

**Brand Name:** muRata

**Model No.:** LBEE5ZZ1XL, LBEE5ZZ2XS

**Model Difference:** Refer to section 1.8

**Report Number:** E2/2022/10037

**FCC ID** VPYLBEE5ZZ1XL

**IC:** 772C-LBEE5ZZ1XL

**Date of EUT Received:** January 11, 2022

**Date of Test:** January 19, 2022~ April 01, 2022

**Issue Date:** June 16, 2022

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, ISED 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	Remark
E2/2022/10037	00	Original.	June 16, 2022	Yami Kuo	

**Note:**

- 1、The remark "\*" indicates modification of the report upon requests from certification body.
- 2、Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received and assessments of RSE, output power, emission bandwidth and peak power density are conducted to ensure compliance.

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## 1 GENERAL INFORMATION

### 1.1 Product Description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5ZZ1XL, LBEE5ZZ2XS
Model Difference:	Refer to section 1.8
Hardware Version:	1
Firmware Version:	17.80.200.204
EUT Series No.:	1XL: Sample. No2 2XS: Sample. No5
Power Supply:	3.3Vdc, 1.8Vdc
Test Software (Name/Version)	Tera Term V4.105 / Dut labtool v2.0.0.85

### 1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	1XL: BLE 1M: 6.02 dBm BLE 2M: 5.96 dBm 2XS: BLE 1M: 6.45 dBm BLE 2M: 6.25 dBm

### 1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	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 Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
	Conducted 6			
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
Conducted G				

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

### 1.6 Special Accessories

There are no special accessories used while test was conducted.

### 1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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### 1.8 Model Difference

LBEE5ZZ1XL has a dedicated antenna port for BT.

LBEE5ZZ2XS BT shares same antenna port with WLAN.

Some passive components are different between models as below.

LBEE5ZZ1XL	LBEE5ZZ2XS
C 336 No mounted	C336 mounted
C337 mounted	C337 No mounted
L310 mounted	L310 No mounted

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## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

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

### 2.2 EUT Exercise

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

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

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

#### 2.3.2 Conducted Test (RF)

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

#### 2.3.3 Radiated Emissions

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

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## 2.4 Measurement Results Explanation Example

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

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

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

### 2.4.2 For all conducted test items:

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

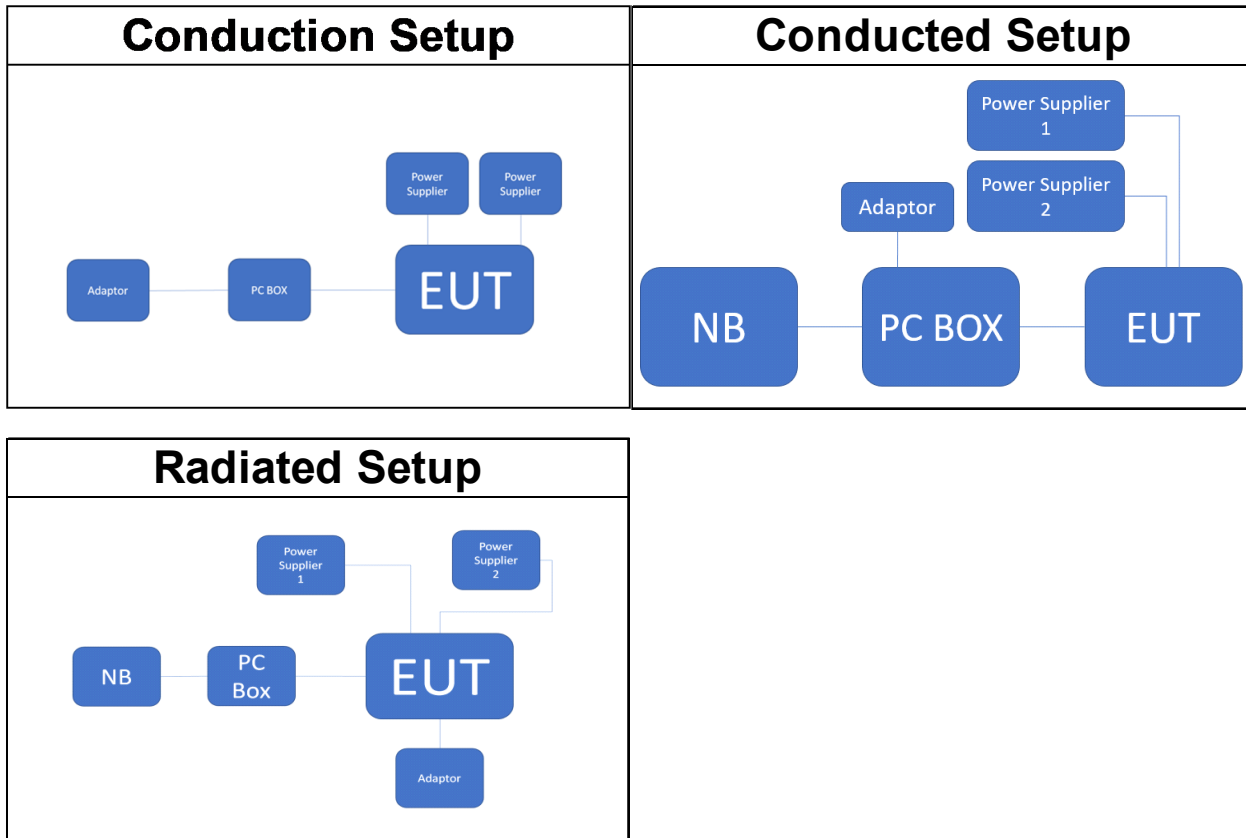
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## 2.5 Test Configuration



## 2.6 Control Unit(s)

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T420	S0012599	N/A	N/A
Notebook	Lenovo	L420	S0011721	N/A	N/A

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LAN Cable	向聯	VPH-02	1500021123	N.C.R	N.C.R
Notebook	Lenovo	T470	P0001293	N/A	N/A
Adapter	FSP	FSP065-REBN2	H6081012364	N.C.R	N.C.R

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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	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	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		

### 4.2 The Worst Test Modes and Channel Details

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

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

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

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## 5 MEASUREMENT UNCERTAINTY

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

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

**Note:**

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

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## 6 MEASUREMENT EQUIPMENT USED

### 6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess- Elektronik	NSLK8127	974	04/19/2021	04/18/2022
LISN	SCHWARZBECK Mess- Elektronik	NSLK8127	974	04/13/2022	04/12/2023
EMI Test Receiver	R&S	ESCI	101342	04/28/2021	04/27/2022
EMI Test Receiver	R&S	ESCI	101342	04/25/2022	04/24/2023
DC Power Supply	Gwinstek	SPS-3610	GEV856769	08/04/2021	08/03/2022
DC Power Supply	DHA	DPS-3003	9411005787	08/20/2021	08/19/2022
Coaxial Cable	EC Lab	RF-HY-CAB- 250	RF-HY-CAB- 250-01	03/27/2022	03/26/2023
Pulse Limiter	EC Lab	VTSD 9561F- N	04/29/1901	03/27/2022	03/26/2023
Test Software	audix	e3	E3 20923 SGS Ver.9 ( C )	N.C.R	N.C.R

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## 6.2 Conducted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071574	06/25/2021	06/24/2022
Power Meter	Anritsu	ML2496A	1512003	07/27/2021	07/26/2022
Power Sensor	Anritsu	MA2411B	1339378	07/27/2021	07/26/2022
Power Sensor	Anritsu	MA2411B	1339379	07/27/2021	07/26/2022
DC Power Supply	Agilent	E3640A	MY53130054	09/30/2021	09/29/2022
DC Power Supply	Agilent	E3640A	MY53140006	05/28/2021	05/27/2022
DC Power Supply	HOLA	DP-3003	D7070035	05/28/2021	05/27/2022
DC Power Supply	Gwinstek	SPS-3610	GEV856767	09/29/2021	09/28/2022
Attenuator	Marvelous	MVE2213-10	RF13	11/18/2021	11/17/2022
Attenuator	Marvelous	WATT-218FS-10	RF15	11/18/2021	11/17/2022
Attenuator	KEYSIGHT	8494B	TH60075424	05/07/2021	05/06/2022
Coupler	narda	MDC2044-20	RF36	11/18/2021	11/17/2022
DC Block	PASTERNAK	PE8210	RF158	11/18/2021	11/17/2022
Splitter	Marvelous Microwave	MVE8576	RF256	11/18/2021	11/17/2022
RF Switch	E-INSTRUMENT TECH LTD	ETF-1801	EC2100175	09/10/2021	09/09/2022
Coaxial Cables	Woken	00100A1F2A196C	RF62	11/18/2021	11/17/2022
Coaxial Cables	Woken	00100A1F2A196C	RF64	11/18/2021	11/17/2022
Coaxial Cables	Woken	00100A1F1A185C	RF71	11/18/2021	11/17/2022

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### 6.3 Radiated Measurement

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-617	11/12/2021	11/11/2022
Horn Antenna	Schwarzbeck	BBHA9170	185	08/06/2021	08/05/2022
Horn Antenna	Schwarzbeck	BBHA9120D	1341	06/04/2021	06/03/2022
Loop Antenna	ETS.LINDGREN	6502	148045	09/29/2021	09/28/2022
Loop Antenna	ETS.LINDGREN	6502	143303	05/07/2021	05/06/2022
3m Site NSA	SGS	966 chamber D	N/A	07/12/2021	07/11/2022
Test Software	audix	e3	E3 20923 SGS Ver.9 ( C )	N.C.R	N.C.R
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/24/2021	03/23/2022
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/24/2022	03/23/2023
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2021	10/26/2022
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/18/2021	11/17/2022
Pre-Amplifier	EMC Instruments	EMC12630SE	980273	11/18/2021	11/17/2022
DC Power Supply	Gwinstek	SPS-3610	GEV856769	08/04/2021	08/03/2022
DC Power Supply	DHA	DPS-3003	9411005787	08/20/2021	08/19/2022
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	11/18/2021	11/17/2022
Coaxial Cable	Huber Suhner	EMC106-SM-SM-7200	150703	11/18/2021	11/17/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/18/2021	11/17/2022
Attenuator	Marvelous	WATT-218FS-10	RF17	11/18/2021	11/17/2022

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

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## 7 CONDUCTED EMISSION TEST

### 7.1 Standard Applicable:

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

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

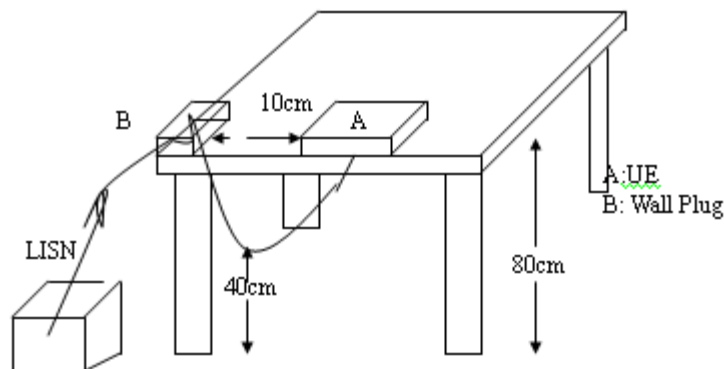
Note

- The lower limit shall apply at the transition frequencies
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

### 7.2 EUT Setup:

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

### 7.3 Test Setup



### 7.4 Measurement Procedure:

- The EUT was placed on a table which is 0.8m above ground plane.

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2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

## 7.5 Measurement Result:

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

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

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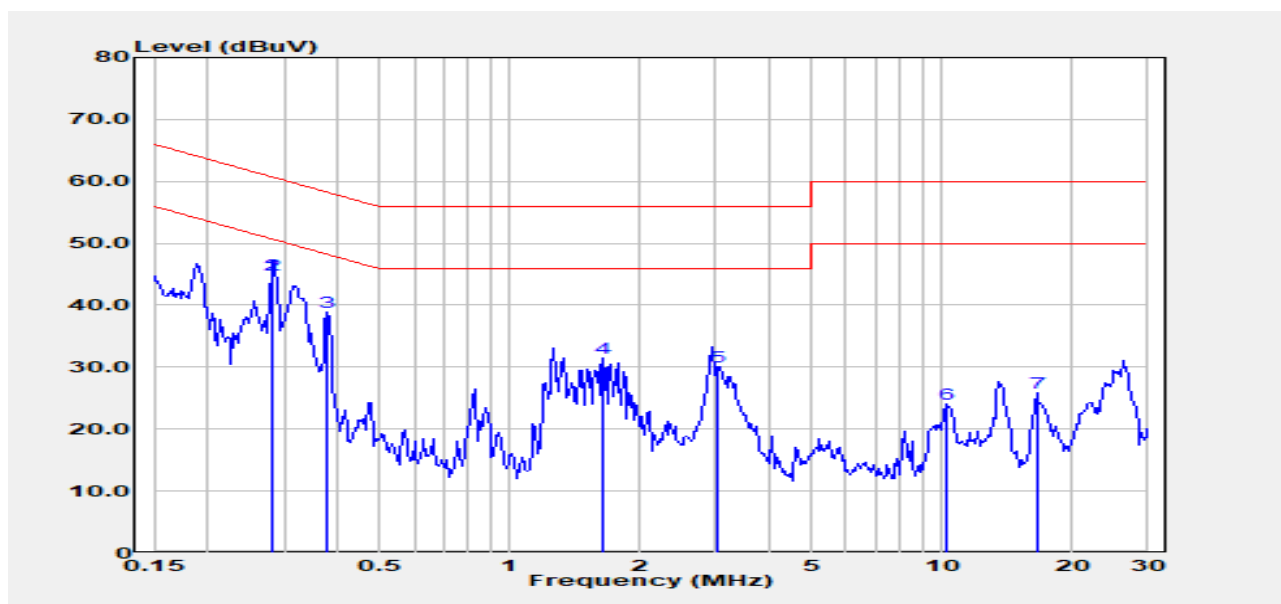
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## AC POWER LINE CONDUCTED EMISSION TEST DATA

1XL

Report Number :E2/2022/10037                      Test Site :Conduction C  
 Test Mode :BLE 1M                                      Test Date :2022-04-01  
 Power :120V/60Hz                                      Temp./Humi. :20.8/63  
 Probe :L1    Engineer :Jack Tseng  
 Note: :Adapter:FSP0065-REBN2 , 1XL



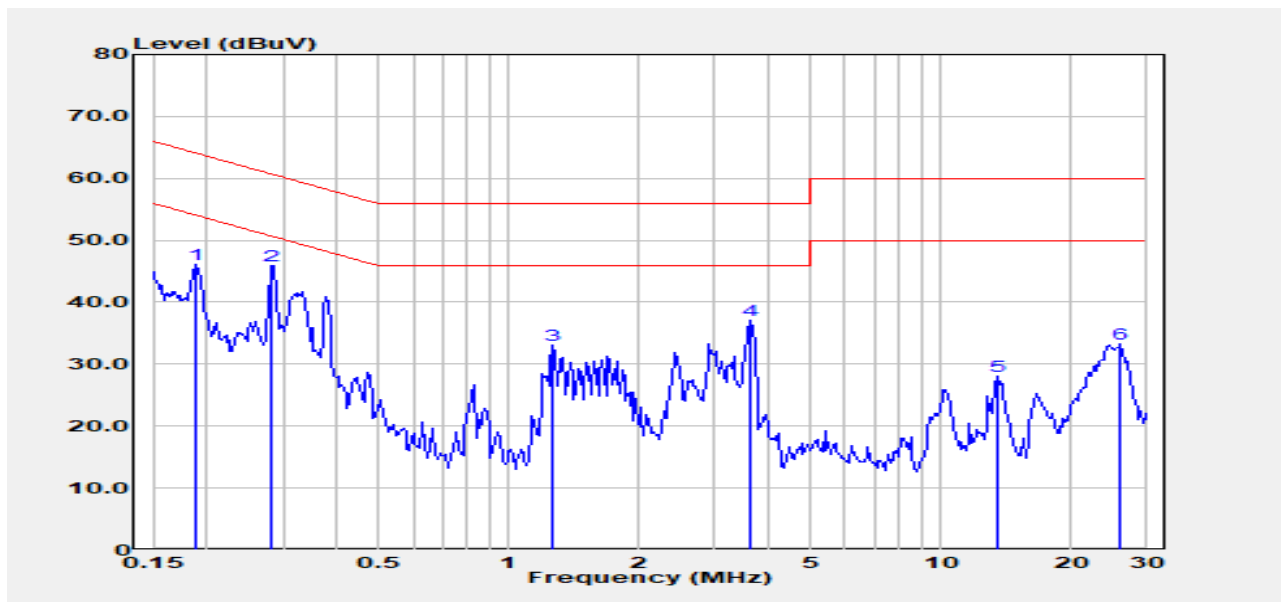
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.283	Average	34.60	10.29	44.89	50.72	-5.83
0.283	QP	34.70	10.29	44.99	60.72	-15.73
0.377	Peak	28.69	10.30	38.99	58.34	-19.35
1.645	Peak	20.56	10.95	31.51	56.00	-24.49
3.041	Peak	19.27	10.88	30.15	56.00	-25.85
10.288	Peak	13.30	10.67	23.97	60.00	-36.03
16.573	Peak	15.00	10.81	25.81	60.00	-34.19

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 Test Mode :BLE 1M                                      Test Date :2022-04-01  
 Power :120V/60Hz                                      Temp./Humi. :20.8/63  
 Probe :N    Engineer :Jack Tseng  
 Note: :Adapter:FSP0065-REBN2 , 1XL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.189	Peak	35.87	10.27	46.15	64.06	-17.92
0.283	Peak	35.70	10.28	45.98	60.72	-14.74
1.262	Peak	22.54	10.61	33.15	56.00	-22.85
3.603	Peak	26.39	10.72	37.11	56.00	-18.89
13.551	Peak	17.44	10.71	28.15	60.00	-31.85
26.139	Peak	22.22	11.02	33.24	60.00	-26.76

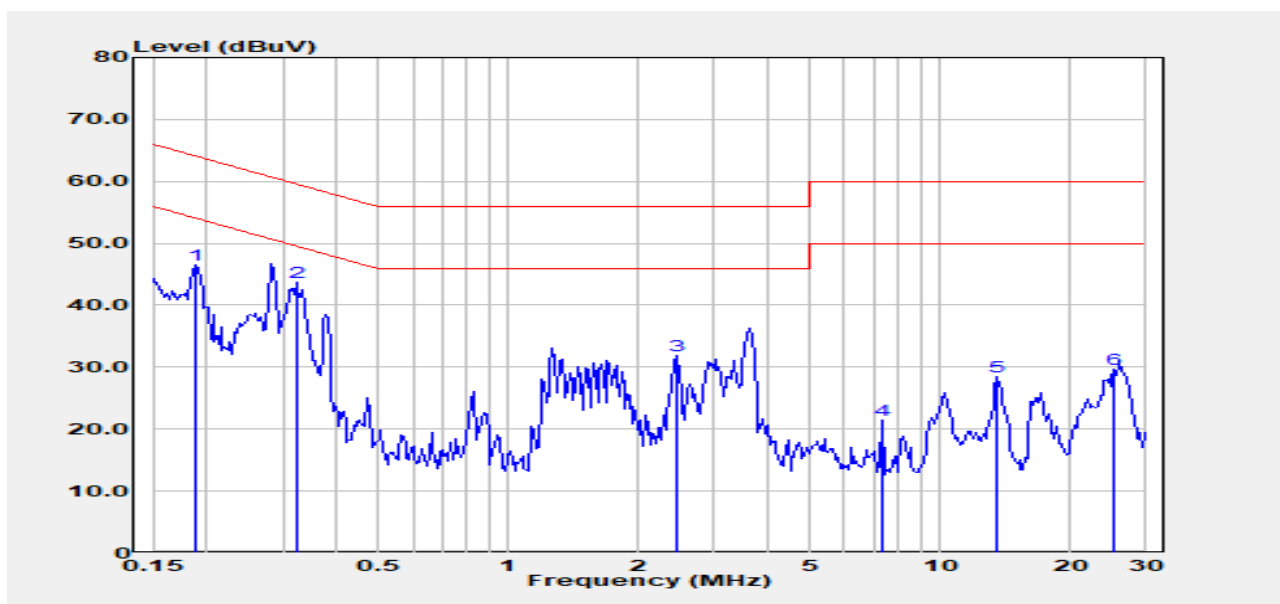
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2XS

Report Number :E2/2022/10037                      Test Site :Conduction C  
 Test Mode :BLE 1M                                      Test Date :2022-04-01  
 Power :120V/60Hz                                      Temp./Humi. :20.8/63  
 Probe :L1    Engineer :Jack Tseng  
 Note: :Adapter:FSP0065-REBN2 , 2XS



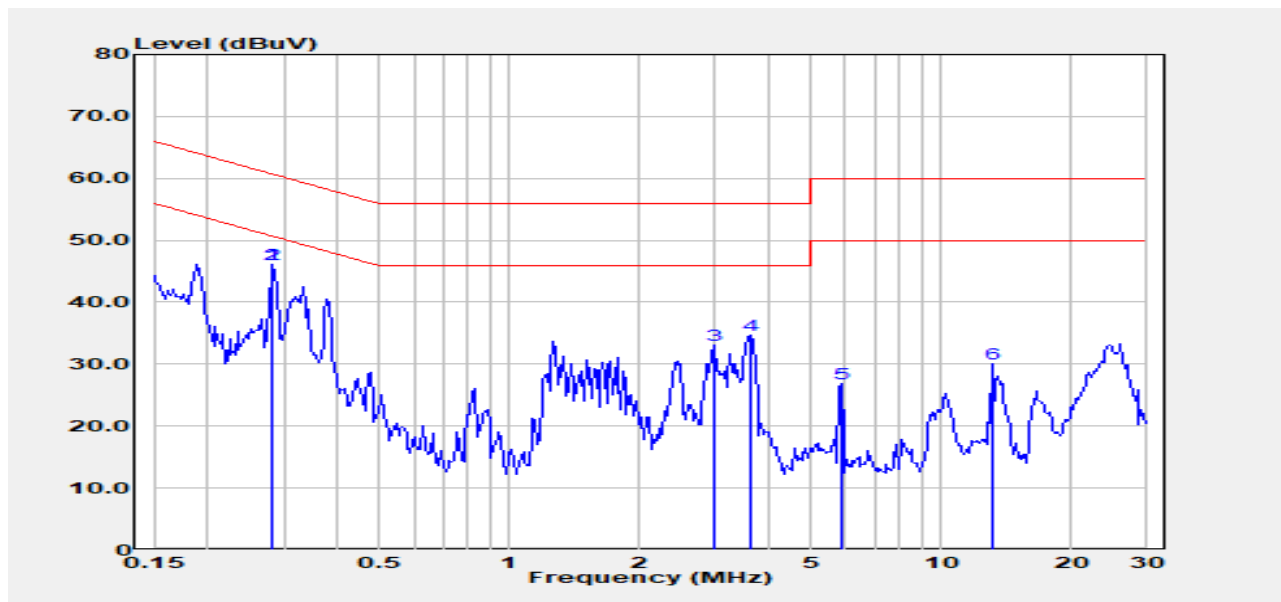
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.187	Peak	36.34	10.27	46.61	64.15	-17.54
0.322	Peak	33.35	10.29	43.65	59.66	-16.02
2.461	Peak	20.82	11.03	31.85	56.00	-24.15
7.329	Peak	10.75	10.61	21.36	60.00	-38.64
13.551	Peak	17.80	10.75	28.55	60.00	-31.45
25.321	Peak	18.62	11.01	29.63	60.00	-30.37

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 Power :120V/60Hz                                      Temp./Humi. :20.8/63  
 Probe :N    Engineer :Jack Tseng  
 Note: :Adapter:FSP0065-REBN2 , 2XS



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.283	Peak	35.80	10.28	46.08	60.72	-14.64
0.283	Peak	35.80	10.28	46.08	60.72	-14.64
2.978	Peak	22.22	10.85	33.07	56.00	-22.93
3.642	Peak	23.96	10.71	34.67	56.00	-21.33
5.867	Peak	16.25	10.52	26.78	60.00	-33.22
13.127	Peak	19.38	10.70	30.08	60.00	-29.92

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## 8 PEAK OUTPUT POWER MEASUREMENT

### 8.1 Standard Applicable:

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

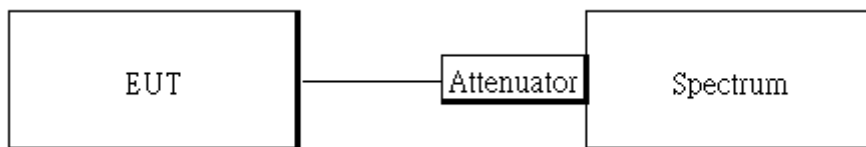
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

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

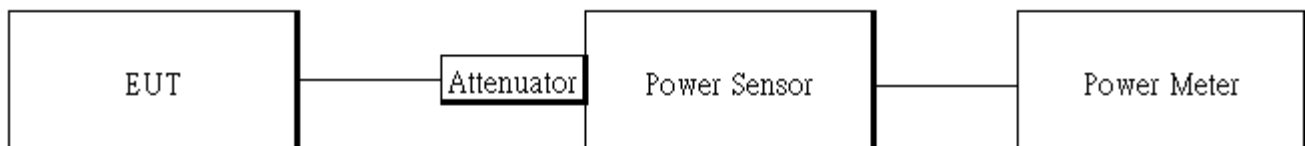
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

### 8.2 Test Setup

#### 8.2.1 Duty Cycle



#### 8.2.2 Output Power



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**8.3 Measurement Procedure:**

**8.3.1 Duty Cycle**

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

**8.3.2 Output Power**

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

**8.4 Duty Factor:**

**1XL**

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)
BLE 1M	63.20	1.99	2.53	3.00
BLE 2M	32.80	4.84	4.88	5.00

**2XS**

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)
BLE 1M	62.40	2.05	2.56	3.00
BLE 2M	32.80	4.84	4.88	5.00

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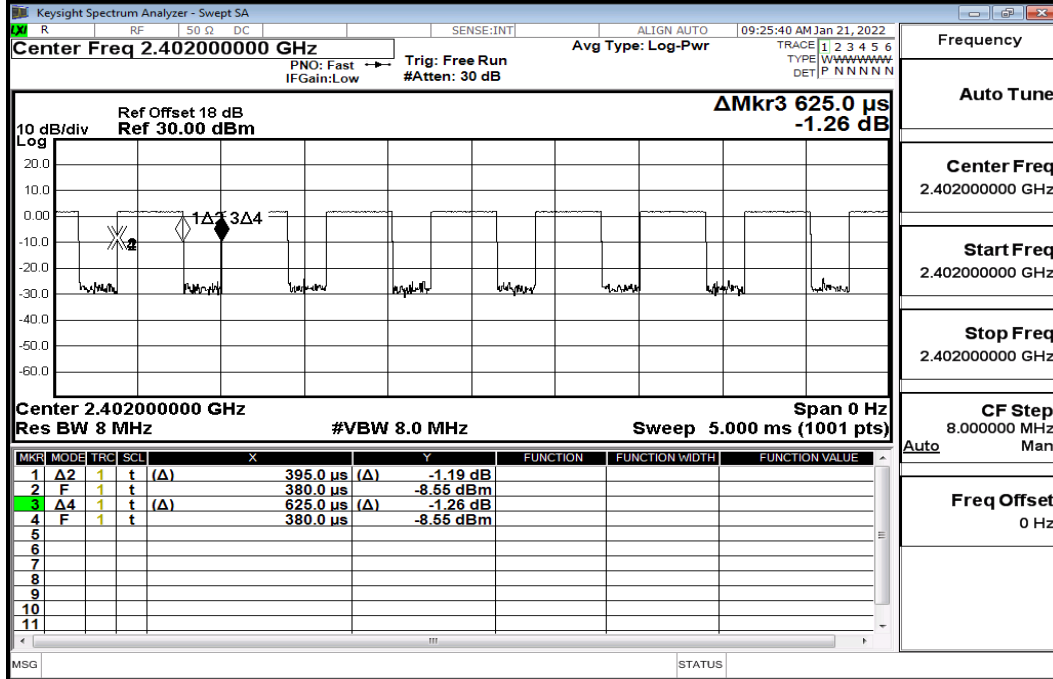
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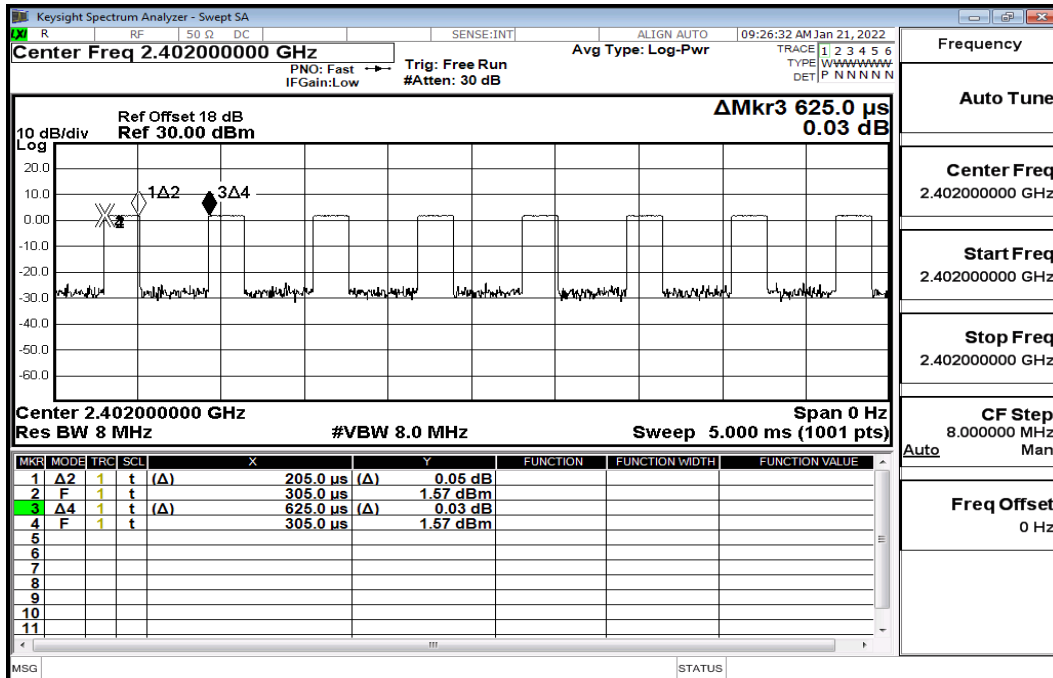


1XL

BLE\_1M\_LowCH00-2402



BLE\_2M\_LowCH00-2402



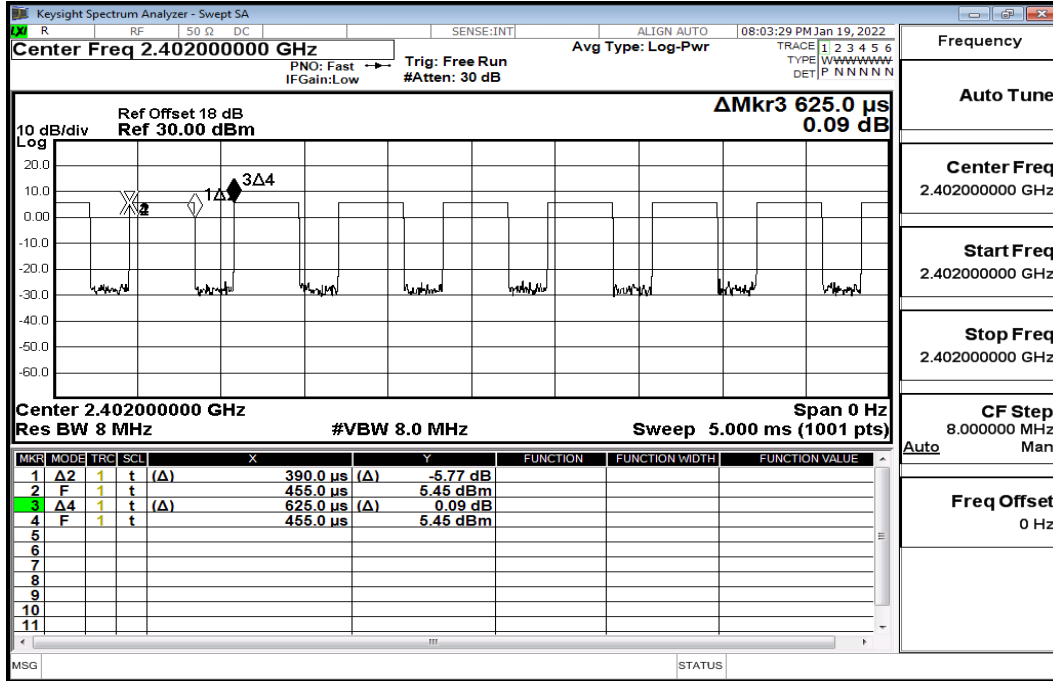
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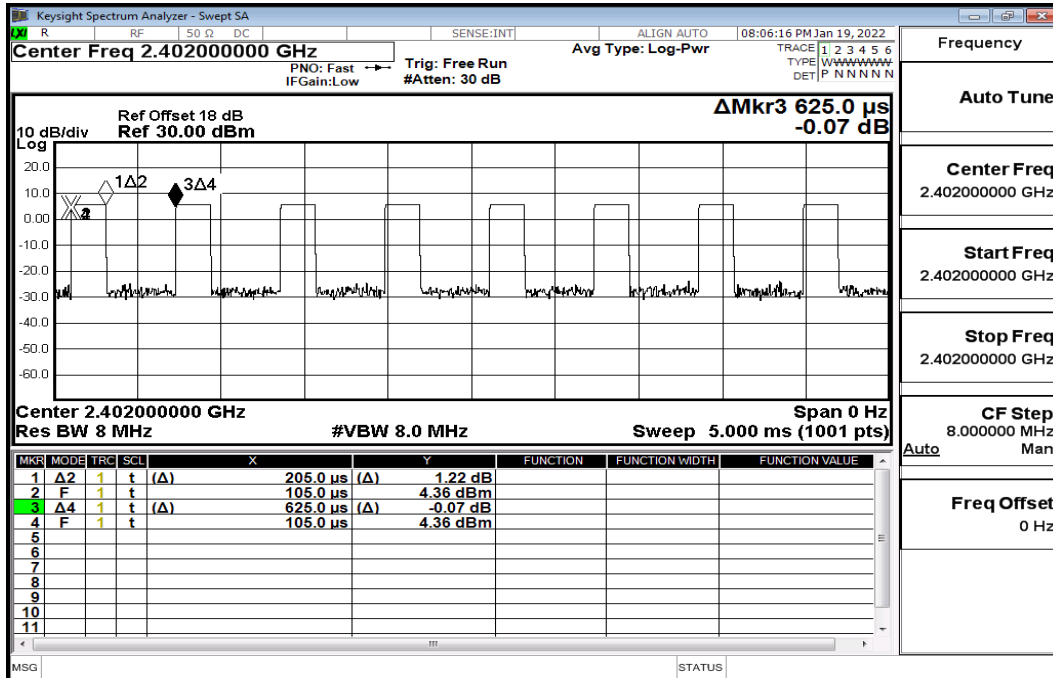
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2XS

BLE\_1M\_LowCH00-2402



BLE\_2M\_LowCH00-2402



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## 8.5 Output Power:

### 8.5.1 Peak & Avg

#### 1XL

##### BLE 1M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	5.5	<b>6.02</b>	30
Mid	2442	5.5	5.87	30
High	2480	5.5	5.95	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	5.5	5.94	30
Mid	2442	5.5	5.80	30
High	2480	5.5	5.86	30

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

##### BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	5.5	<b>5.96</b>	30
Mid	2442	5.5	5.82	30
High	2480	5.5	5.87	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	5.5	5.89	30
Mid	2442	5.5	5.74	30
High	2480	5.5	5.81	30

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

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**BLE 1M mode:**

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	0	<b>6.45</b>	30
Mid	2442	0	6.31	30
High	2480	0	6.13	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	0	5.95	30
Mid	2442	0	5.96	30
High	2480	0	5.93	30

*\*Note: Measured by power meter, cable loss 10.6 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	-1.5	6.13	30
Mid	2442	-1.5	<b>6.25</b>	30
High	2480	-1.5	6.10	30
CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	-1.5	5.87	30
Mid	2442	-1.5	5.92	30
High	2480	-1.5	5.86	30

*\*Note: Measured by power meter, cable loss 10.6 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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## 8.5.2 EIRP

### 1XL

#### EIRP BLE 1M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	5.5	5.94	3.20	9.14	4W= 36 dBm
Mid	2442	5.5	5.80	3.20	9.00	4W= 36 dBm
High	2480	5.5	5.86	3.20	9.06	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	5.5	5.89	3.20	9.09	4W= 36 dBm
Mid	2442	5.5	5.74	3.20	8.94	4W= 36 dBm
High	2480	5.5	5.81	3.20	9.01	4W= 36 dBm

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

### 2XS

#### EIRP BLE 1M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	2402	0	5.95	3.20	9.15	4W= 36 dBm
Mid	2442	0	5.96	3.20	9.16	4W= 36 dBm
High	2480	0	5.93	3.20	9.13	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	-1.5	5.87	3.20	9.07	4W= 36 dBm
Mid	2442	-1.5	5.92	3.20	9.12	4W= 36 dBm
High	2480	-1.5	5.86	3.20	9.06	4W= 36 dBm

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

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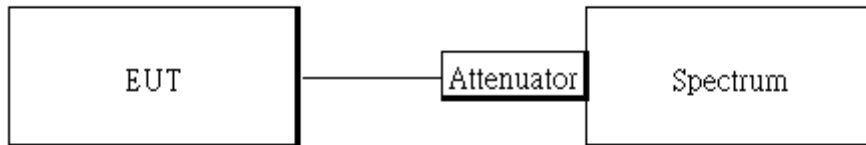
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## 9 EMISSION BANDWIDTH MEASUREMENT

### 9.1 Standard Applicable

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

### 9.2 Test Setup



### 9.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as  
RBW= 100 kHz ,  
VBW = 3 X RBW,  
Span= 2 to 5 times of the OBW,  
Sweep=auto,  
Detector = Peak, and Max hold for -6dB Bandwidth test.
5. 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.
6. Mark the peak frequency and 99%dB (upper and lower) frequency
7. Repeat above procedures until all test default channel is completed

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## 9.4 Measurement Result:

### 1XL

#### BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6971	$\geq 0.5$	PASS
2442	0.6952	$\geq 0.5$	PASS
2480	0.695	$\geq 0.5$	PASS

#### BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.174	$\geq 0.5$	PASS
2442	1.172	$\geq 0.5$	PASS
2480	1.172	$\geq 0.5$	PASS

### 2XS

#### BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7007	$\geq 0.5$	PASS
2442	0.6996	$\geq 0.5$	PASS
2480	0.6979	$\geq 0.5$	PASS

#### BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.174	$\geq 0.5$	PASS
2442	1.172	$\geq 0.5$	PASS
2480	1.173	$\geq 0.5$	PASS

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**BLE 1M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0282
2442	1.0291
2480	1.0282

**BLE 2M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0425
2442	2.042
2480	2.0433

2XS

**BLE 1M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0288
2442	1.0293
2480	1.0292

**BLE 2M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	2.04
2442	2.0405
2480	2.0403

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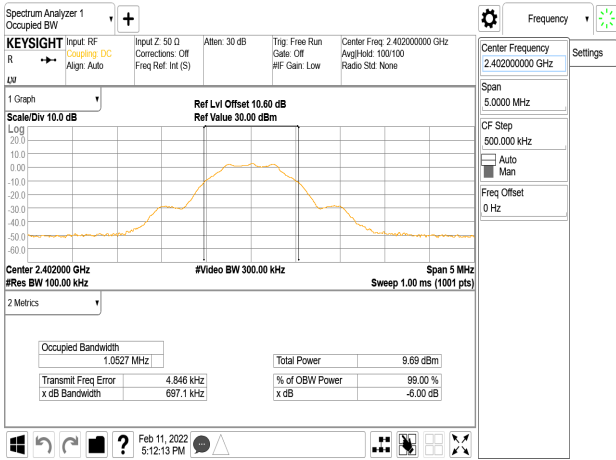
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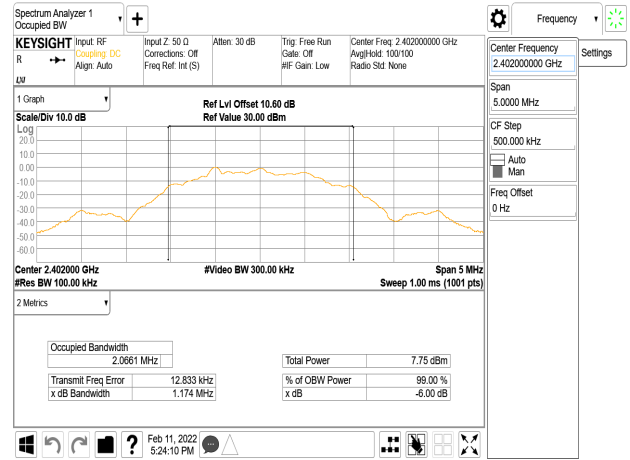


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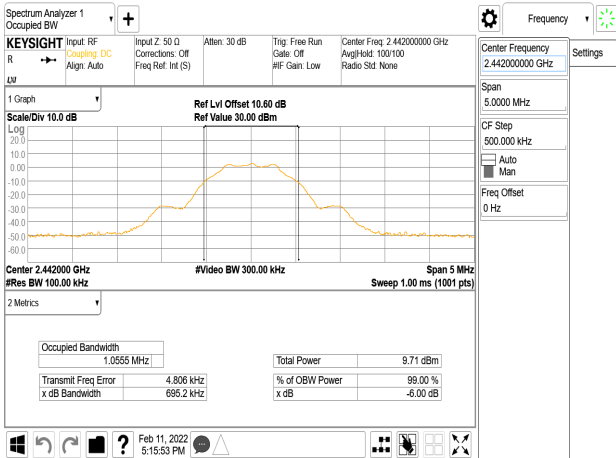
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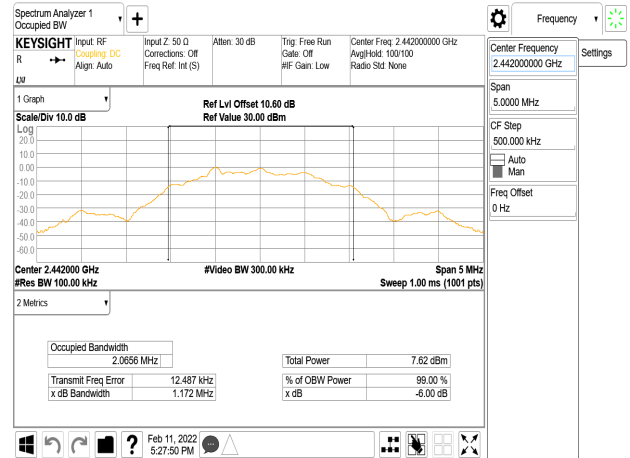
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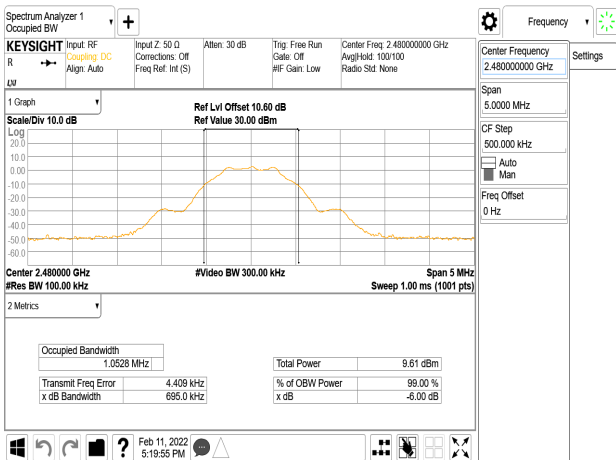
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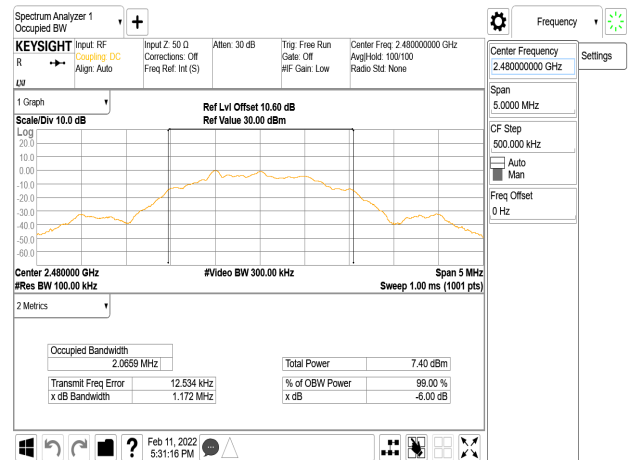
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OBW\_BLE 1M\_HighCH39-2480MHz



OBW\_BLE 2M\_HighCH39-2480MHz



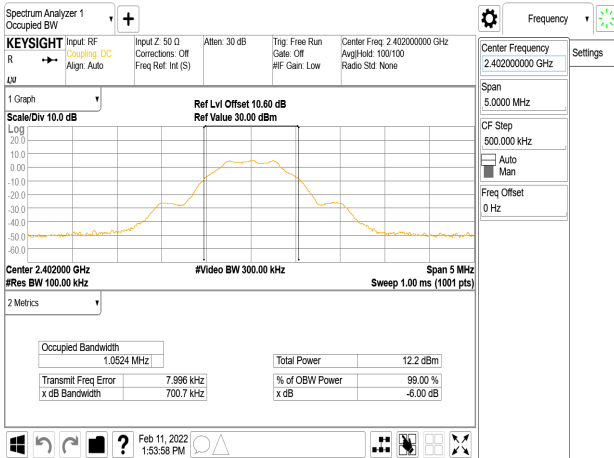
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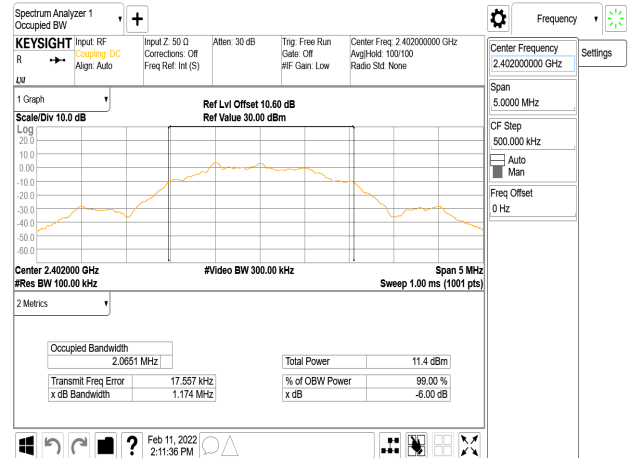
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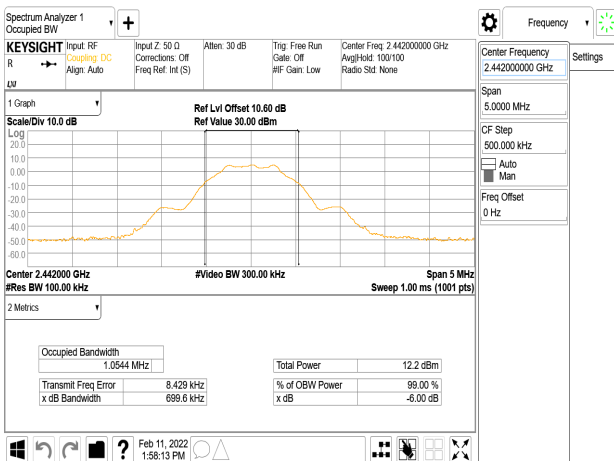
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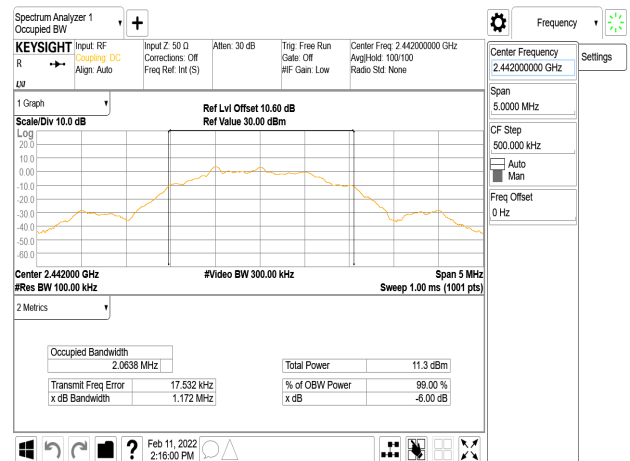
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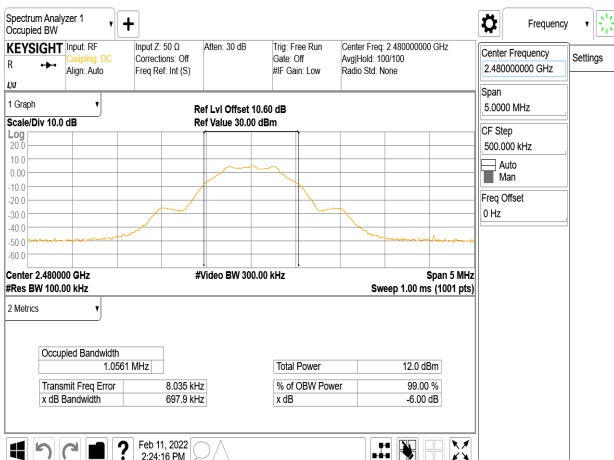
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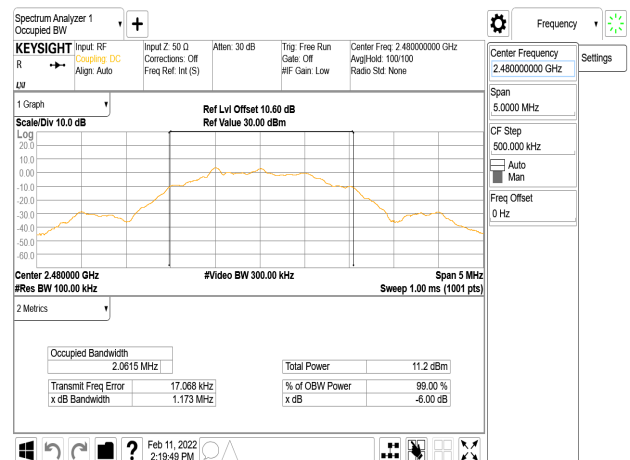
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OBW\_BLE 1M\_HighCH39-2480MHz



OBW\_BLE 2M\_HighCH39-2480MHz



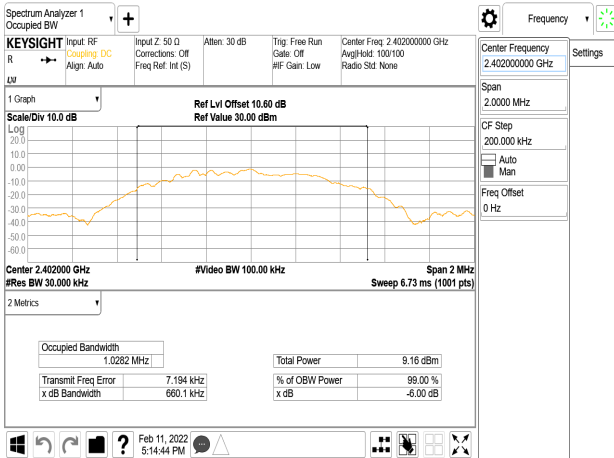
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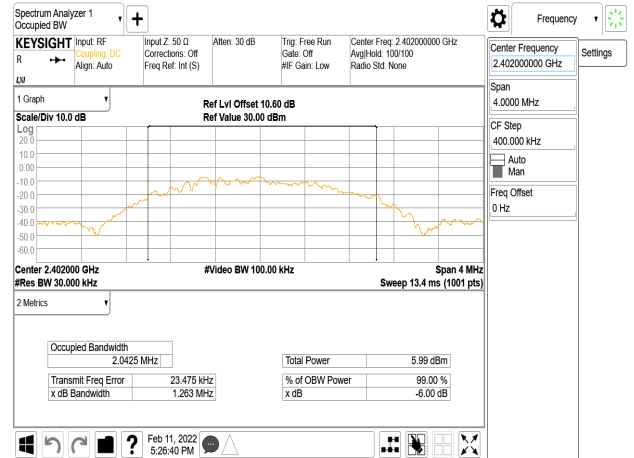
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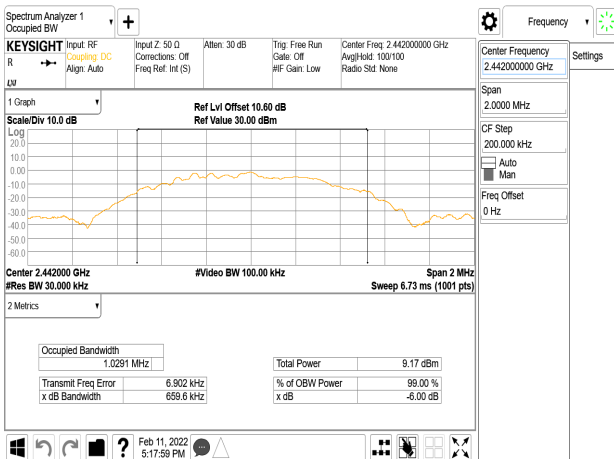
IC OBW\_BLE 1M\_LowCH00-2402MHz



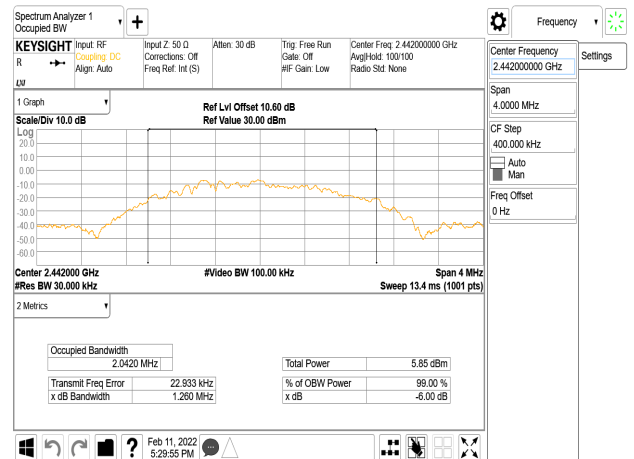
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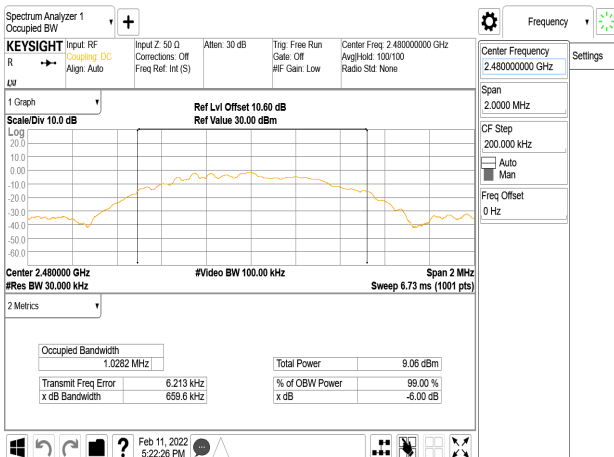
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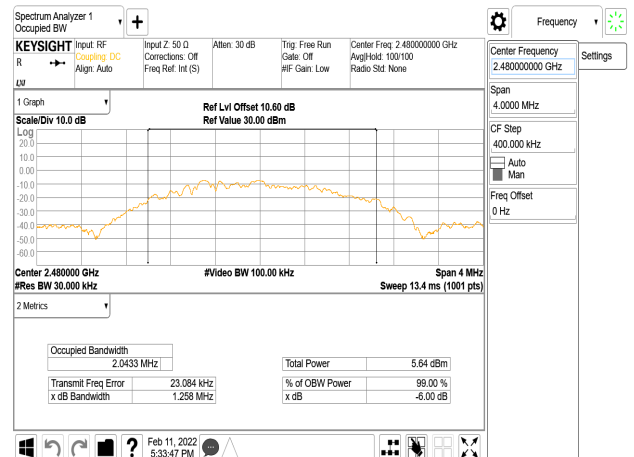
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IC OBW\_BLE 1M\_HighCH39-2480MHz



IC OBW\_BLE 2M\_HighCH39-2480MHz



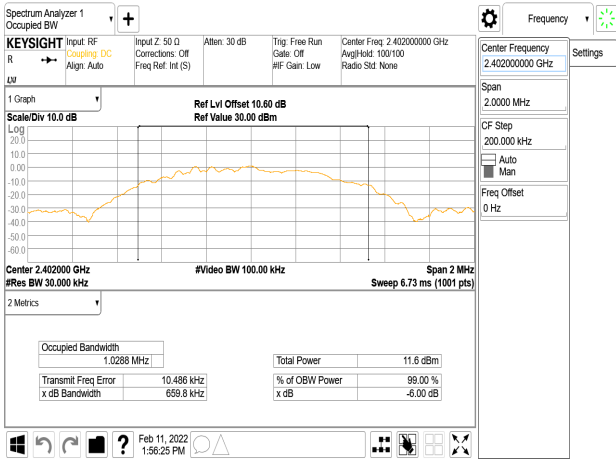
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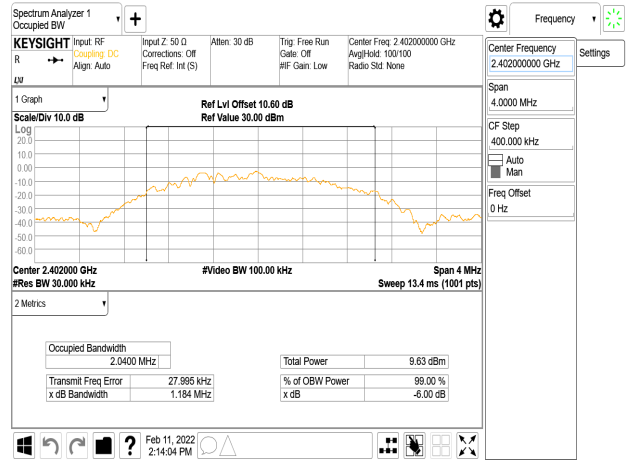
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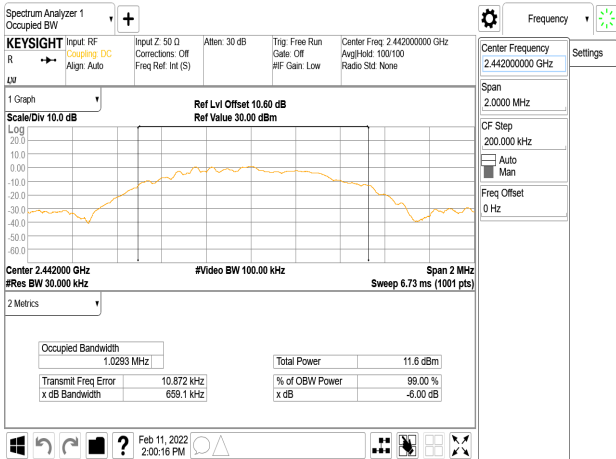
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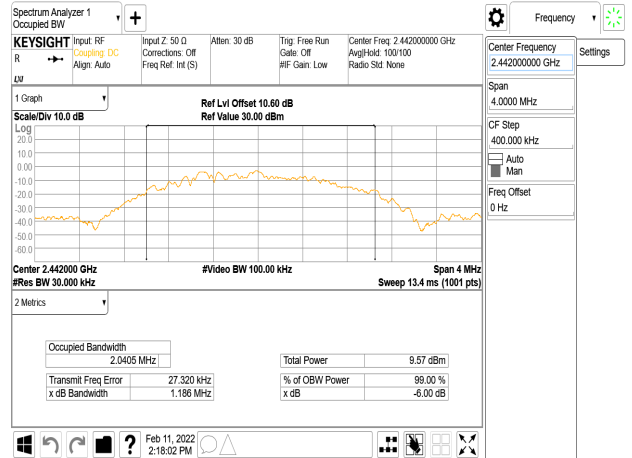
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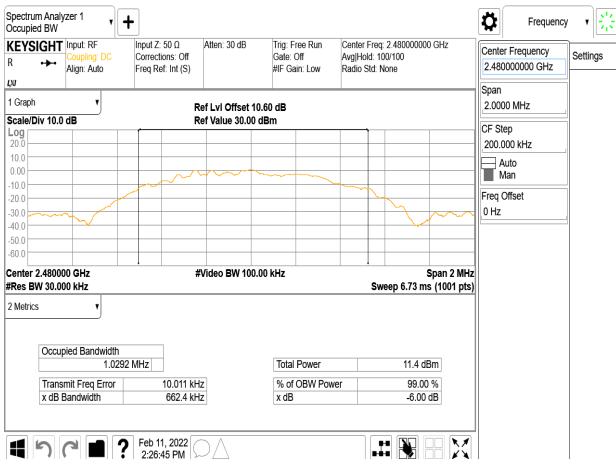
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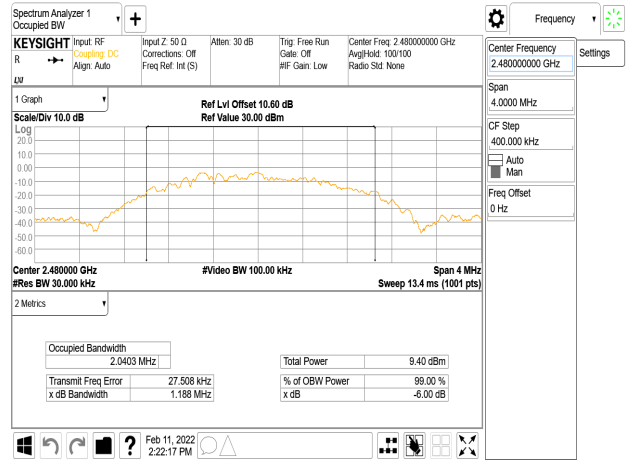
IC OBW\_BLE 2M\_MidCH20-2442MHz



IC OBW\_BLE 1M\_HighCH39-2480MHz



IC OBW\_BLE 2M\_HighCH39-2480MHz



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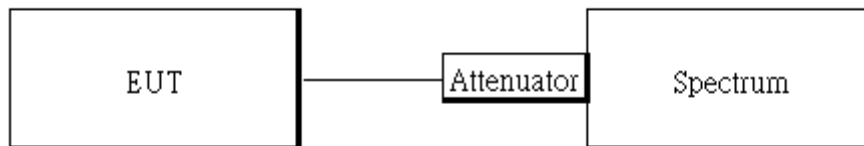
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## 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

### 10.2 Test Setup



### 10.3 Measurement Procedure

#### 10.3.1 Reference Level of Emission Limit:

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

#### 10.3.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

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

### 10.3.3 Conducted Spurious Emission:

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

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10.4 Measurement Result

1XL

**BLE 1M\_ Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	2.54	-17.46
2442	2.57	-17.43
2480	2.47	-17.53

**NOTE: cable loss as 10.6dB 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	0.00	-20.00
2442	-0.14	-20.14
2480	-0.35	-20.35

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

**NOTE: Refer to next page for plots.**

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2XS

**BLE 1M\_ Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.00	-15.00
2442	5.00	-15.00
2480	4.83	-15.17

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

**NOTE: Refer to next page for plots.**

**BLE 2M\_ Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	3.61	-16.39
2442	3.56	-16.44
2480	3.40	-16.60

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

**NOTE: Refer to next page for plots.**

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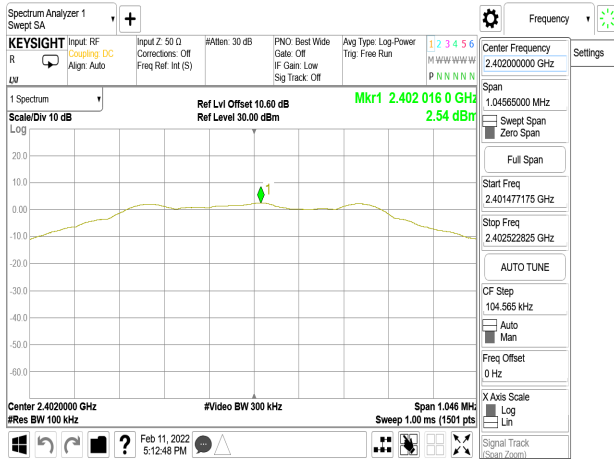
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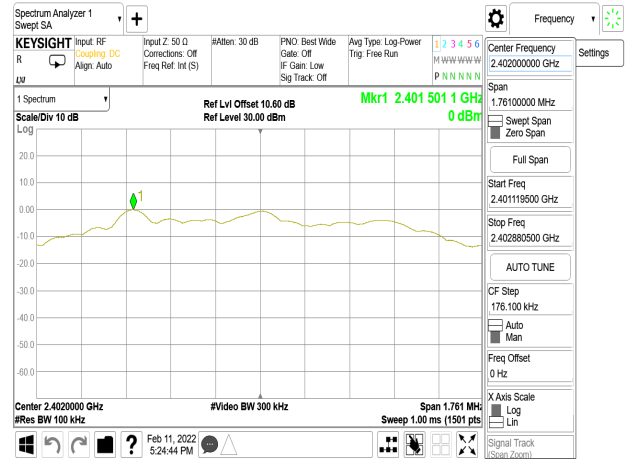


1XL

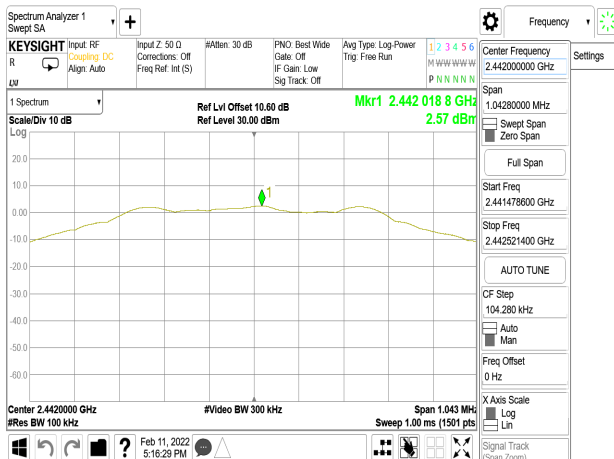
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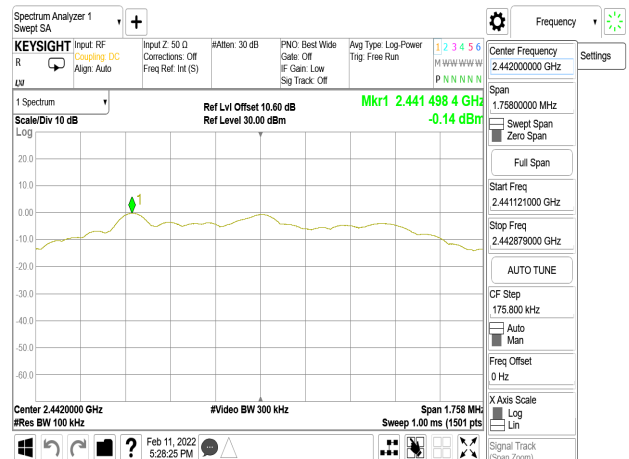
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Reference Level\_BLE 1M\_MidCH20-2442MHz



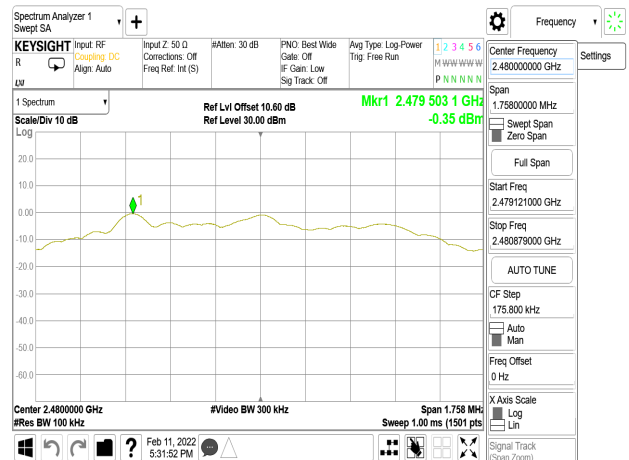
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Reference Level\_BLE 1M\_HighCH39-2480MHz



Reference Level\_BLE 2M\_HighCH39-2480MHz

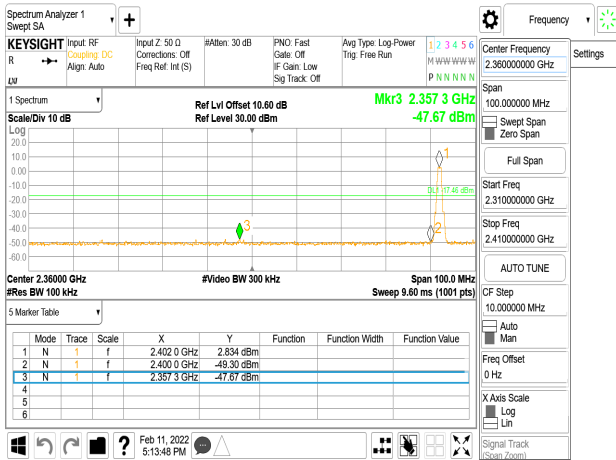


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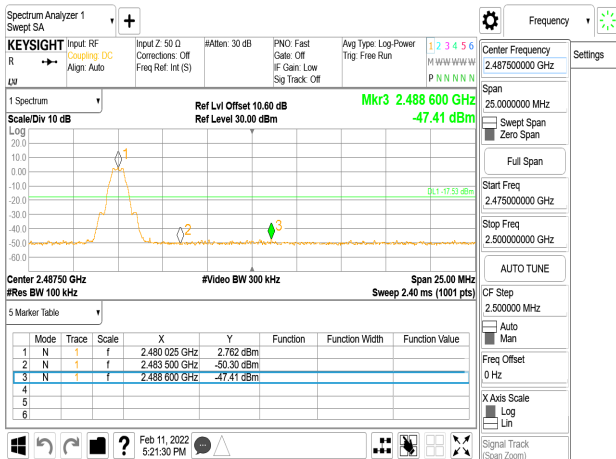
Band Edge\_BLE 1M\_LowCH00-2402MHz



Band Edge\_BLE 2M\_LowCH00-2402MHz



Band Edge\_BLE 1M\_HighCH39-2480MHz



Band Edge\_BLE 2M\_HighCH39-2480MHz

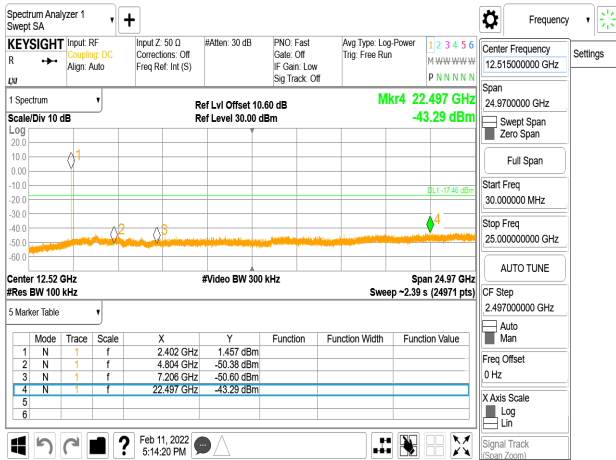


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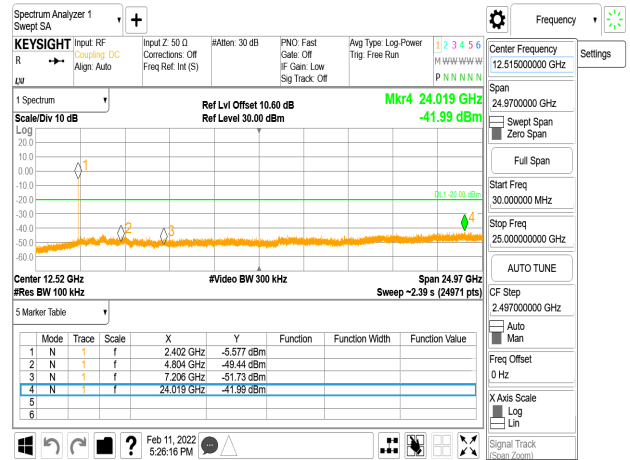
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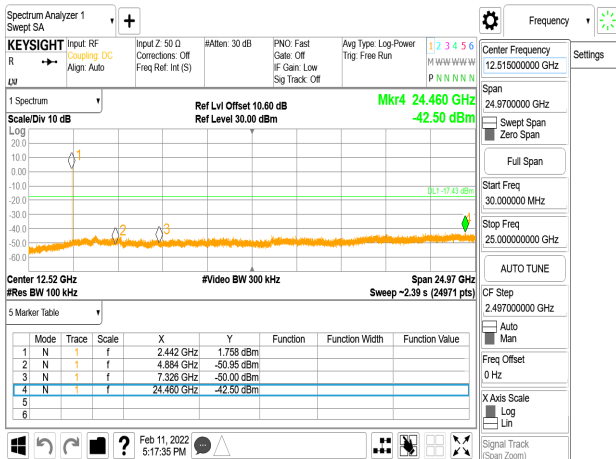
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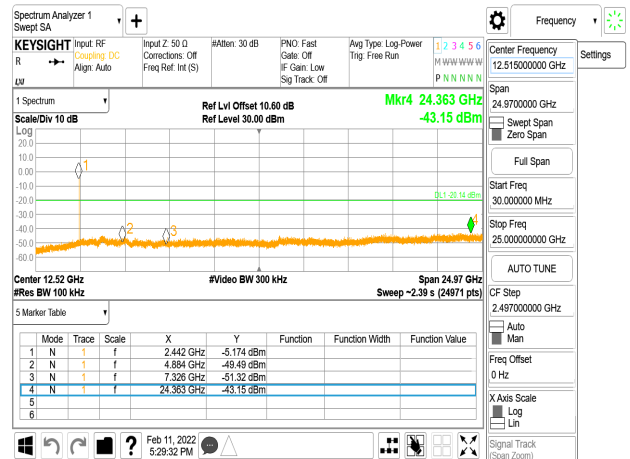
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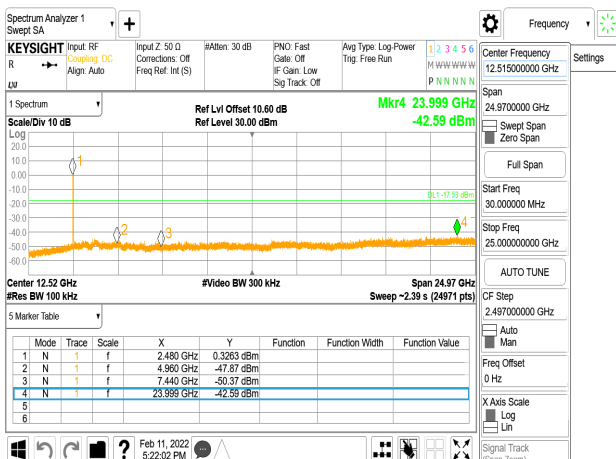
Spurious Emission\_BLE 1M\_MidCH20-2442MHz



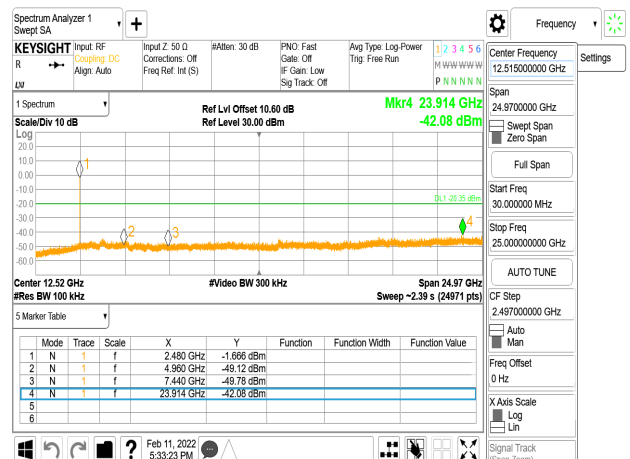
Spurious Emission\_BLE 2M\_MidCH20-2442MHz



Spurious Emission\_BLE 1M\_HighCH39-2480MHz



Spurious Emission\_BLE 2M\_HighCH39-2480MHz



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