

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.
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ISED Manufacturer: Murata Manufacturing Co., Ltd.
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Product Name: Communication Module

Brand Name: muRata

Model No.: LBEE5ZZ1XL, LBEE5ZZ2XS

Model Difference: Refer to section 1.8

Report Number: E2/2022/10036

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.

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Revision History					
Report Number	Revision	Description	Issue Date	Revised By	Remark
E2/2022/10036	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 frequency separation 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:	BT BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + $\pi/4$ DQPSK + 8DPSK
Transmit Power:	1XL: 6.05 dBm 2XS: 6.08 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	\leq 0.4s

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		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conducted 4	TW0028	
		Conducted 5		
		Conducted 6		
		Conduction C		
		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 is no special accessory 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:

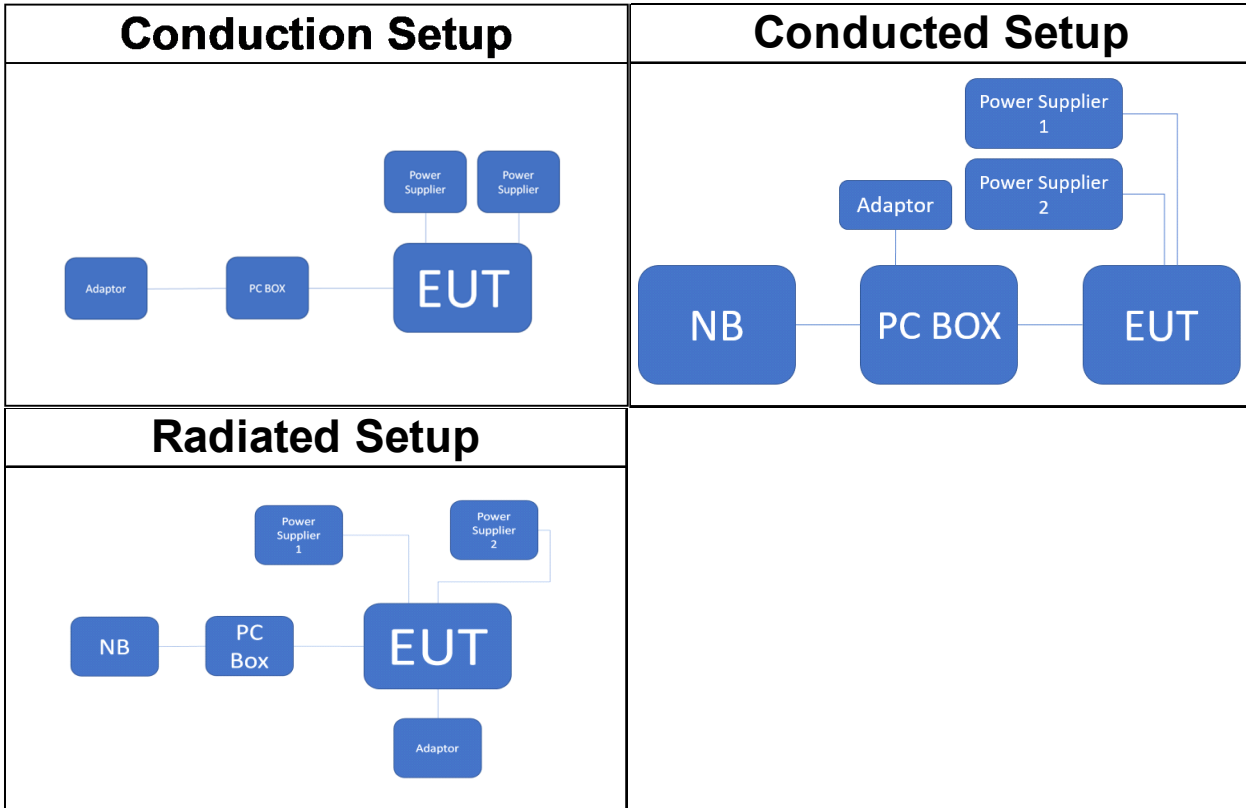
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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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)(1)	RSS-247 §5.4 b	Peak Output Power	Compliant
§15.247(a)(1)	RSS-247 §5.1 b RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Conducted & Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	RSS-247 §5.1 b	Frequency Separation	Compliant
§15.247(a)(1)(iii)	RSS-247 §5.1 d	Number of hopping frequency Time of Occupancy	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	21	2422 MHz	41	2442 MHz	71	2462 MHz
2	2403 MHz	22	2423 MHz	42	2443 MHz	72	2463 MHz
3	2404 MHz	23	2424 MHz	43	2444 MHz	73	2464 MHz
4	2405 MHz	24	2425 MHz	44	2445 MHz	74	2465 MHz
5	2406 MHz	25	2426 MHz	45	2446 MHz	75	2466 MHz
6	2407 MHz	26	2427 MHz	46	2447 MHz	76	2467 MHz
7	2408 MHz	27	2428 MHz	47	2448 MHz	77	2468 MHz
8	2409 MHz	28	2429 MHz	48	2449 MHz	78	2469 MHz
9	2410 MHz	29	2430 MHz	49	2450 MHz	79	2470 MHz
10	2411 MHz	30	2431 MHz	50	2451 MHz	70	2471 MHz
11	2412 MHz	31	2432 MHz	51	2452 MHz	71	2472 MHz
12	2413 MHz	32	2433 MHz	52	2453 MHz	72	2473 MHz
13	2414 MHz	33	2434 MHz	53	2454 MHz	73	2474 MHz
14	2415 MHz	34	2435 MHz	54	2455 MHz	74	2475 MHz
15	2416 MHz	35	2436 MHz	55	2456 MHz	75	2476 MHz
16	2417 MHz	36	2437 MHz	56	2457 MHz	76	2477 MHz
17	2418 MHz	37	2438 MHz	57	2458 MHz	77	2478 MHz
18	2419 MHz	38	2439 MHz	58	2459 MHz	78	2479 MHz
19	2420 MHz	39	2440 MHz	59	2460 MHz	79	2480 MHz
20	2421 MHz	40	2441 MHz	60	2461 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 The field strength of radiated 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.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth	0 to 78	39	GFSK	DH5
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth	0 to 78	0,39,78	GFSK/8-DPSK	DH5/3DH5
<p>Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case position was reported.</p>				

ANTNNA PORT CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE
Peak Output Power, 20dB Band Width				
Bluetooth	0 to 78	0,39,78	GFSK	DH5
	0 to 78	0,39,78	$\pi/4$ -DQPSK	2DH5
	0 to 78	0,39,78	8-DPSK	3DH5
Band Edge				
Bluetooth	0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5
Frequency Separation				
Bluetooth	0 to 78	0,1,2,38,39,40,76,77,78	GFSK $\pi/4$ -DQPSK 8-DPSK	DH5 2DH5 3DH5
Number of hopping frequency				
Bluetooth	0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5
Time of Occupancy(Dwell time)				
Bluetooth	0 to 78	39	GFSK	DH1/DH3/DH5
			$\pi/4$ -DQPSK	2DH1/2DH3/2DH5
			8-DPSK	3DH1/3DH3/3DH5

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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
Frequency Separation	+/- 1.53 Hz
Number of hopping frequency	+/- 1.53 Hz
Time of Occupancy	+/- 1.53 Hz
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	+/- 1 %

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

Note:

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

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
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

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 within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	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

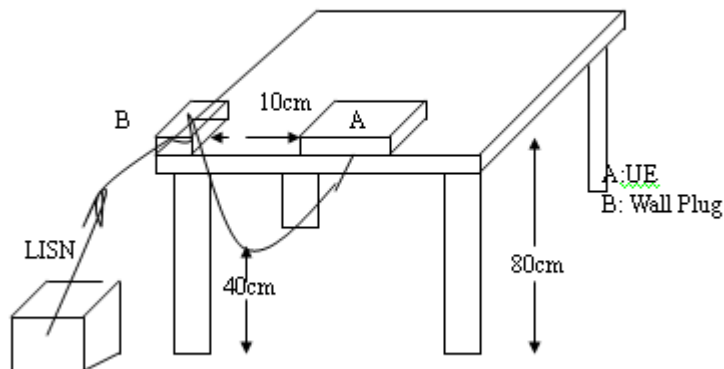
Note

- 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 63.10:2013.
- 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.
- Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- Repeat above procedures until all frequency measured were complete.

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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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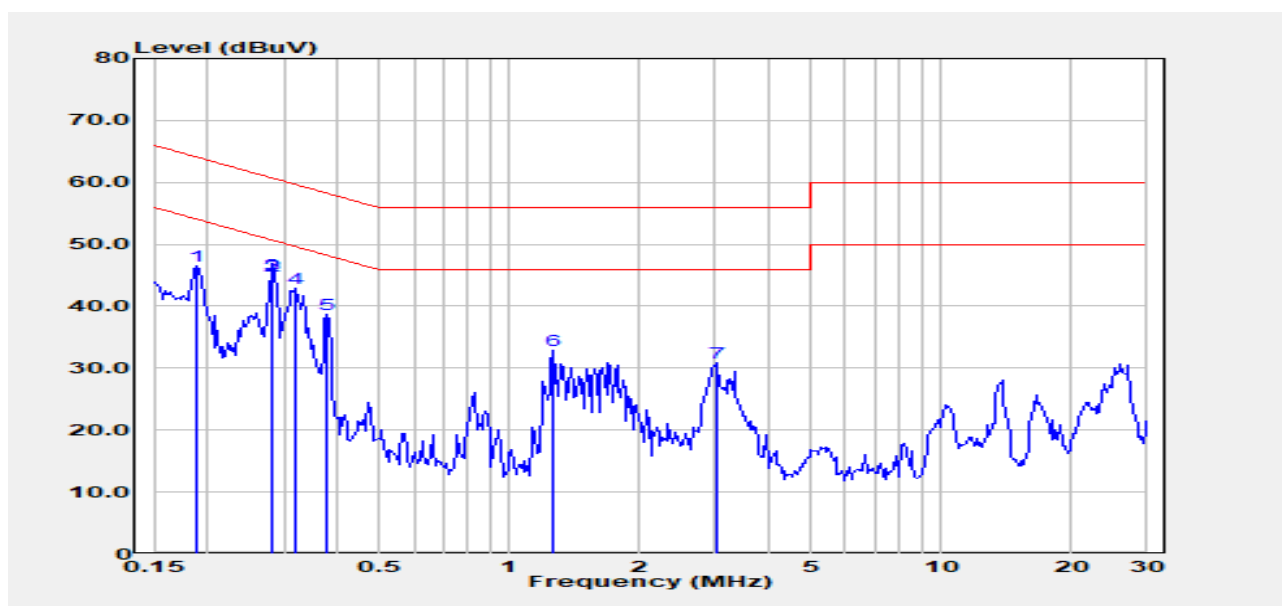
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AC POWER LINE CONDUCTED EMISSION TEST DATA

1XL

Report Number	:E2/2022/10036	Test Site	:Conduction C
Test Mode	:BT	Test Date	:2022-04-01
Power	:120V/60Hz	Temp./Humi.	:20.8/63
Probe	:L1	Engineer	:Jack Tseng
Note:	:Adapter:FSP0065-REBN2 , 1XL		



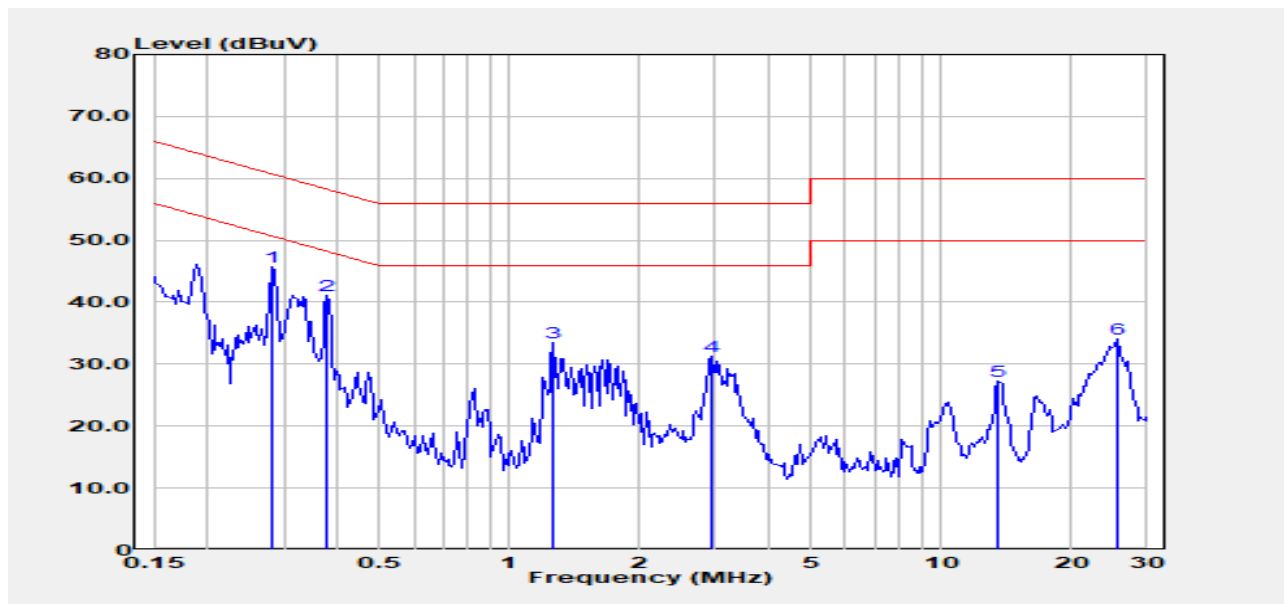
Freq. MHz	Detector Mode	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.189	Peak	36.29	10.27	46.56	64.06	-17.50
0.283	Average	34.70	10.29	44.99	50.72	-5.73
0.283	QP	34.80	10.29	45.09	60.72	-15.63
0.318	Peak	32.52	10.29	42.82	59.75	-16.93
0.377	Peak	28.44	10.30	38.74	58.34	-19.60
1.262	Peak	22.28	10.64	32.92	56.00	-23.08
3.041	Peak	20.00	10.88	30.88	56.00	-25.12

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Report Number :E2/2022/10036 Test Site :Conduction C
 Test Mode :BT 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 dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.283	Peak	35.38	10.28	45.67	60.72	-15.05
0.377	Peak	30.79	10.29	41.09	58.34	-17.26
1.262	Peak	22.83	10.61	33.44	56.00	-22.56
2.946	Peak	20.40	10.86	31.26	56.00	-24.74
13.551	Peak	16.57	10.71	27.28	60.00	-32.72
25.591	Peak	23.02	11.01	34.03	60.00	-25.97

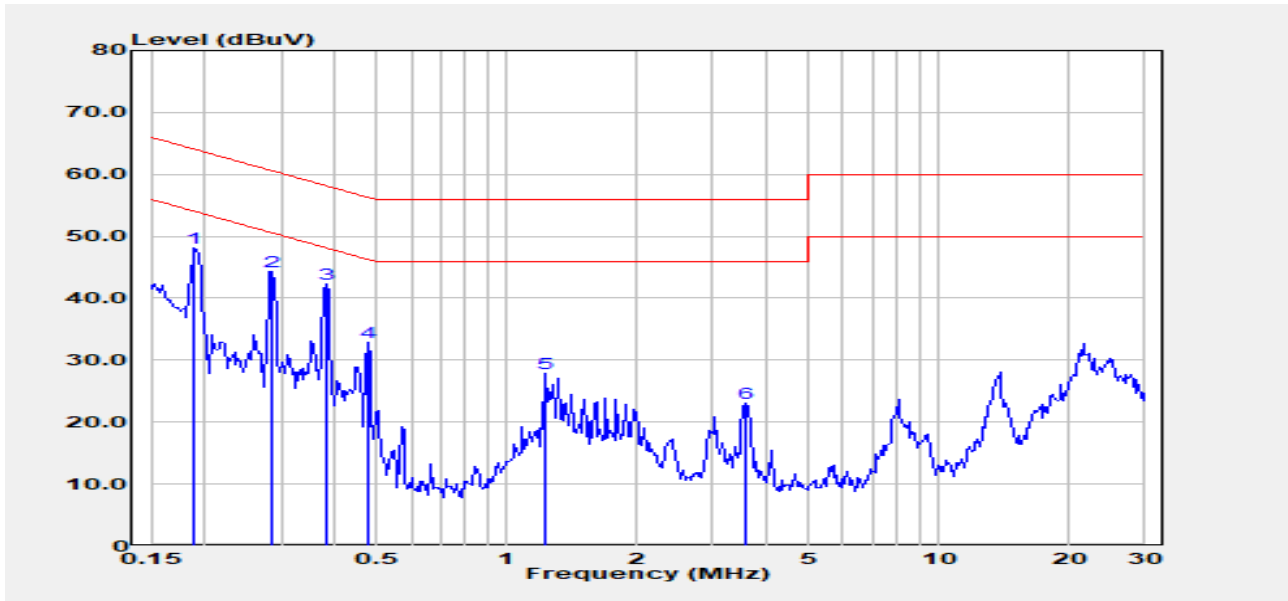
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2XS

Report Number :E2/2022/10036 Test Site :Conduction C
 Test Mode :BT Test Date :2022-04-01
 Power :120V/60Hz Temp./Humi. :20.8/63
 Probe :L1 Engineer :Jack Tseng
 Note: :Adapter:FSP0065-REBN2 , 2XS



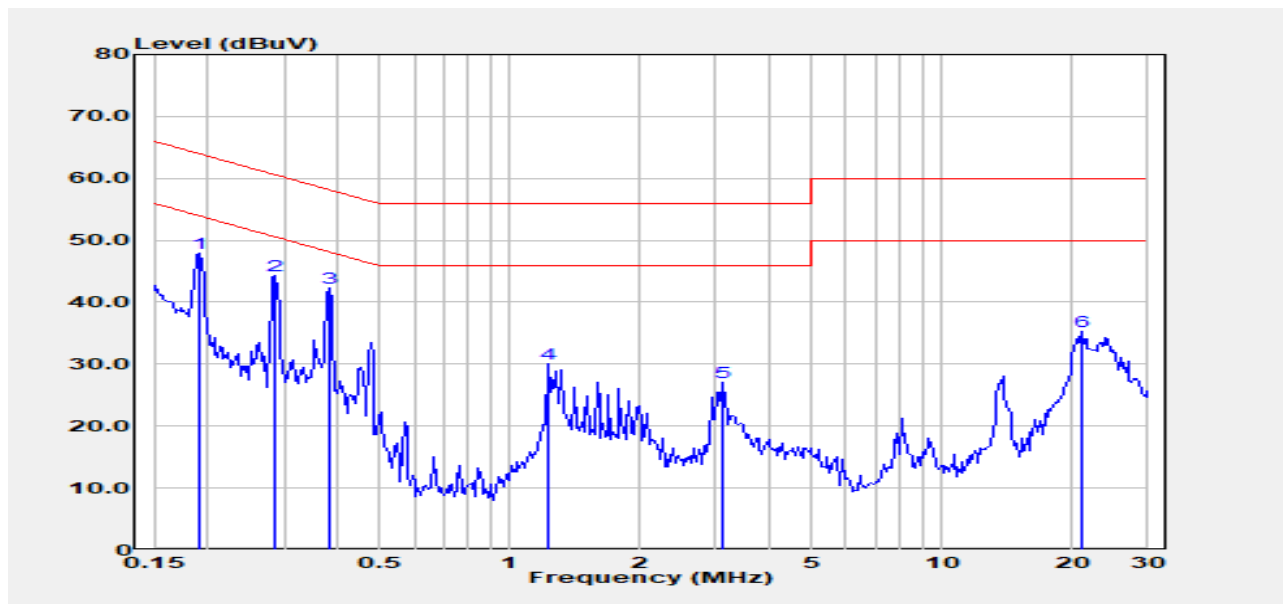
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.189	Peak	37.79	10.27	48.06	64.06	-16.00
0.286	Peak	34.05	10.29	44.34	60.63	-16.30
0.381	Peak	32.03	10.30	42.33	58.25	-15.93
0.476	Peak	22.60	10.31	32.92	56.41	-23.49
1.223	Peak	17.25	10.60	27.86	56.00	-28.14
3.565	Peak	12.39	10.76	23.15	56.00	-32.85

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Report Number :E2/2022/10036 Test Site :Conduction C
 Test Mode :BT Test Date :2022-04-01
 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
0.191	Peak	37.65	10.27	47.92	63.98	-16.06
0.286	Peak	34.08	10.28	44.37	60.63	-16.26
0.381	Peak	32.02	10.29	42.31	58.25	-15.95
1.223	Peak	19.60	10.57	30.17	56.00	-25.83
3.107	Peak	16.17	10.82	26.99	56.00	-29.01
21.147	Peak	24.43	10.88	35.31	60.00	-24.69

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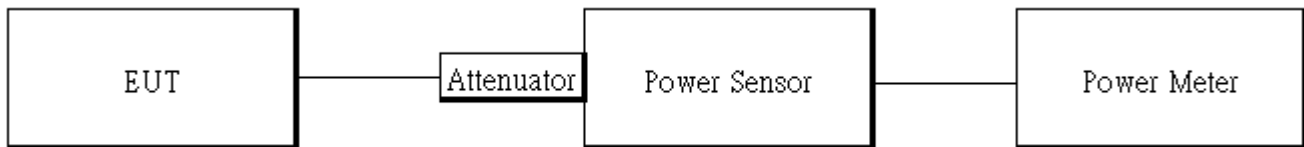
8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

The e.i.r.p. shall not exceed 4 W.

8.2 Test Setup



8.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
4. Record the max. reading.
5. Repeat above procedures until all default test channel is completed.

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8.4 Peak & Average Power Measurement Result

1XL

1M BR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	6.05	4.027	1000
Mid	2441	6	5.91	3.899	1000
High	2480	6	5.97	3.954	1000

1M BR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	5.95	3.939	1000
Mid	2441	6	5.79	3.796	1000
High	2480	6	5.88	3.876	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	5.19	3.304	125
Mid	2441	6	5.05	3.199	125
High	2480	6	5.12	3.251	125

2M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	2.88	1.943	125
Mid	2441	6	2.76	1.890	125
High	2480	6	2.83	1.920	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	5.39	3.459	125
Mid	2441	6	5.24	3.342	125
High	2480	6	5.31	3.396	125

3M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6	2.95	1.974	125
Mid	2441	6	2.81	1.912	125
High	2480	6	2.89	1.947	125

NOTE: cable loss as dB that offsets in the spectrum

*Note: Max. Output include tune up tolerance Power measured by using average detector.

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2XS

1M BR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	6.08	4.055	1000
Mid	2441	5	5.95	3.936	1000
High	2480	5	6.02	3.999	1000

1M BR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	5.96	3.941	1000
Mid	2441	5	5.86	3.852	1000
High	2480	5	5.91	3.896	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	5.31	3.396	125
Mid	2441	5	5.18	3.296	125
High	2480	5	5.25	3.350	125

2M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	2.87	1.935	125
Mid	2441	5	2.70	1.861	125
High	2480	5	2.80	1.904	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	5.58	3.614	125
Mid	2441	5	5.46	3.516	125
High	2480	5	5.51	3.556	125

3M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	2.93	1.965	125
Mid	2441	5	2.81	1.912	125
High	2480	5	2.88	1.943	125

NOTE: cable loss as dB that offsets in the spectrum

**Note: Max. Output include tune up tolerance Power measured by using average detector.*

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8.5 EIRP Measurement Result

1XL

1M BR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	6	5.95	3.20	8.230	4000
Mid	2441	6	5.79	3.20	7.932	4000
High	2480	6	5.88	3.20	8.098	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	6	2.88	3.20	4.059	4000
Mid	2441	6	2.76	3.20	3.948	4000
High	2480	6	2.83	3.20	4.012	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	6	2.95	3.20	4.125	4000
Mid	2441	6	2.81	3.20	3.994	4000
High	2480	6	2.89	3.20	4.068	4000

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

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2XS

1M BR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	5	5.96	3.20	8.235	4000
Mid	2441	5	5.86	3.20	8.047	4000
High	2480	5	5.91	3.20	8.140	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	5	2.87	3.20	4.042	4000
Mid	2441	5	2.70	3.20	3.887	4000
High	2480	5	2.80	3.20	3.978	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	5	2.93	3.20	4.106	4000
Mid	2441	5	2.81	3.20	3.994	4000
High	2480	5	2.88	3.20	4.059	4000

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

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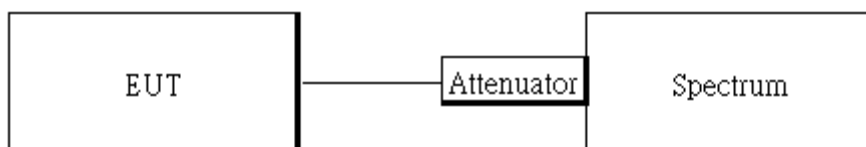
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9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

For frequency hopping systems operating in the 2400 MHz-2483.5 MHz no limit for 20dB bandwidth.

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 ANSI C63.10:2013.
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 \geq 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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9.4 20dB Bandwidth

1XL

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9645	0.64
Mid	0.9654	0.64
High	0.9663	0.64

$\pi/4$ -DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.288	0.86
Mid	1.288	0.86
High	1.289	0.86

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.305	0.87
Mid	1.306	0.87
High	1.306	0.87

2XS

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9843	0.66
Mid	0.9839	0.66
High	0.987	0.66

$\pi/4$ -DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.287	0.86
Mid	1.287	0.86
High	1.288	0.86

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.297	0.86
Mid	1.298	0.87
High	1.299	0.87

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9.5 99% Bandwidth

1XL

GFSK

CH	99% BW (MHz)
Low	0.86326
Mid	0.86581
High	0.8657

$\pi/4$ -DQPSK

CH	99% BW (MHz)
Low	1.1754
Mid	1.1768
High	1.1754

8-DPSK

CH	99% BW (MHz)
Low	1.1807
Mid	1.1818
High	1.1822

2XS

GFSK

CH	99% BW (MHz)
Low	0.87851
Mid	0.87877
High	0.88466

$\pi/4$ -DQPSK

CH	99% BW (MHz)
Low	1.1706
Mid	1.1704
High	1.1707

8-DPSK

CH	99% BW (MHz)
Low	1.1723
Mid	1.1724
High	1.1726

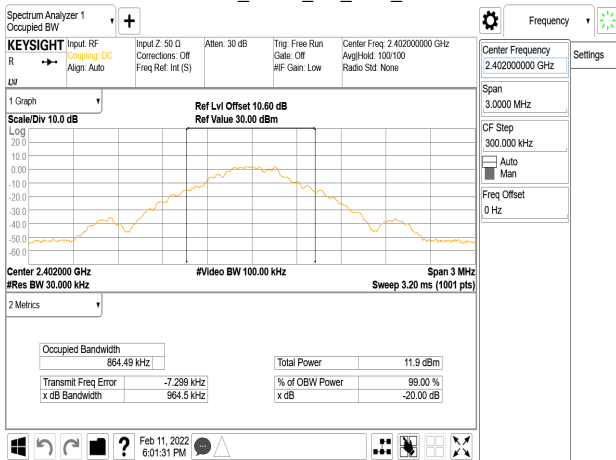
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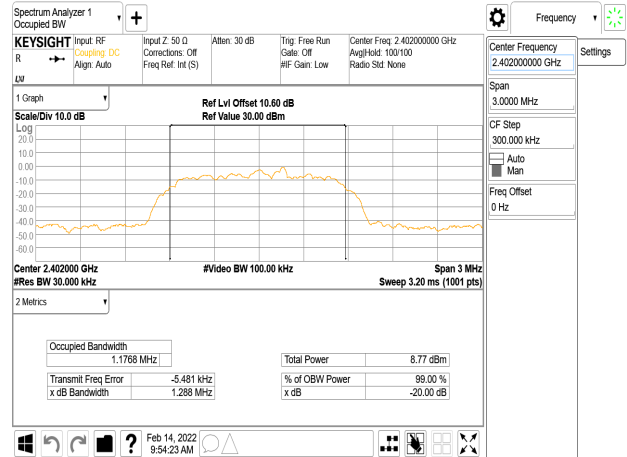
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1XL

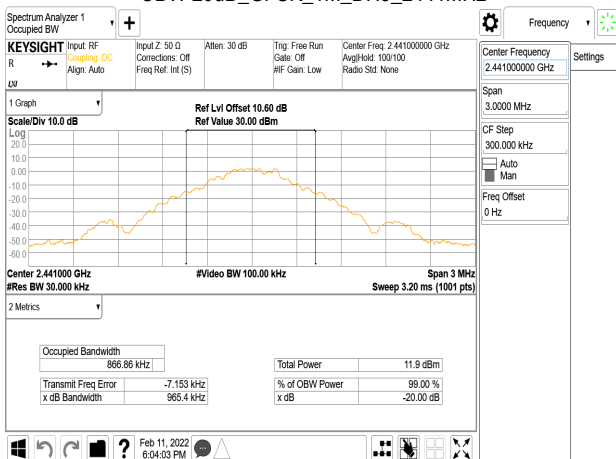
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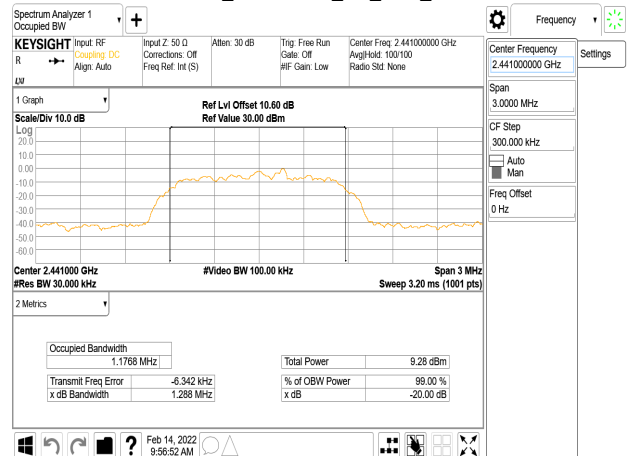
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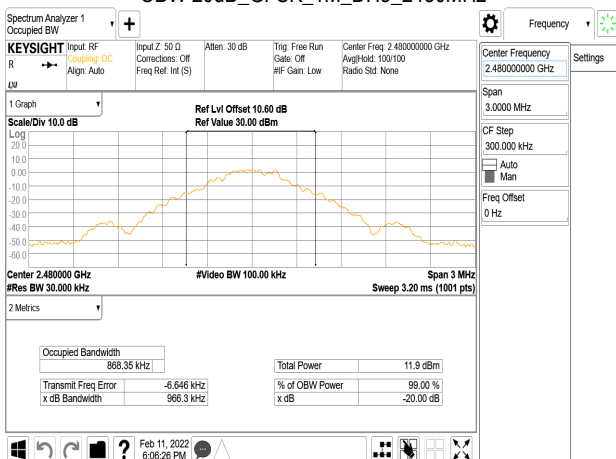
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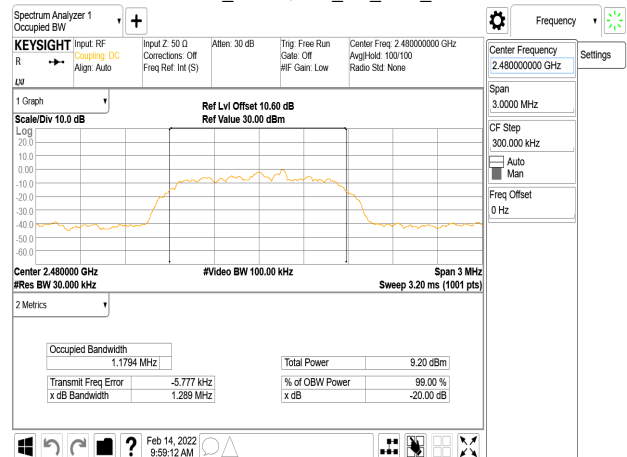
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OBW 20dB_GFSK_1M_DH5_2480MHz



OBW 20dB_pi/4QPSK_2M_DH5_2480MHz

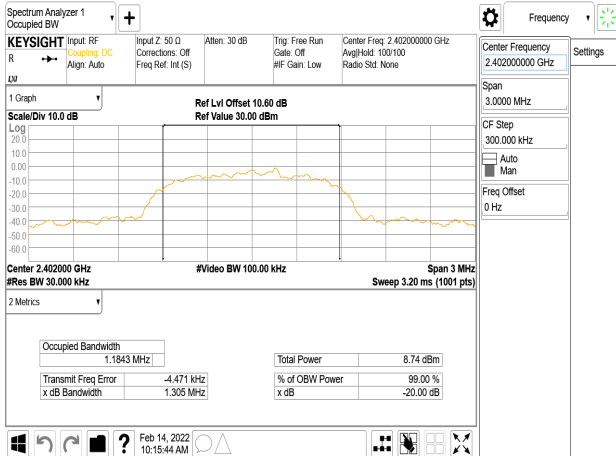


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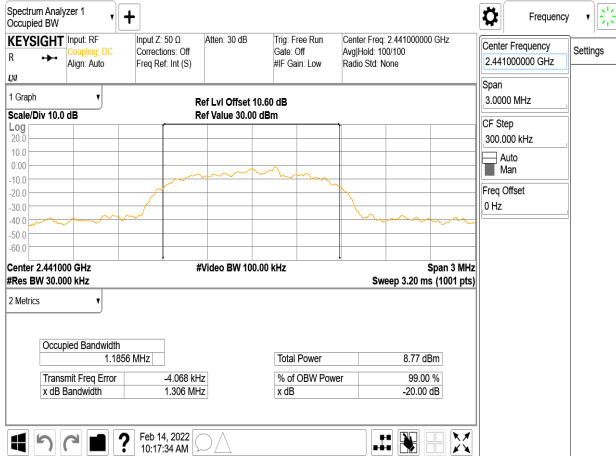
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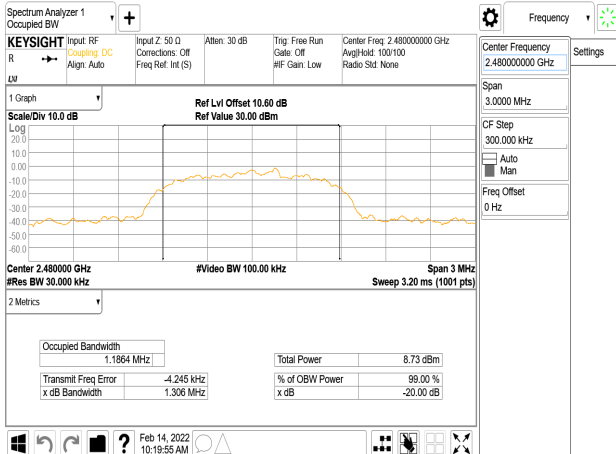
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OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz



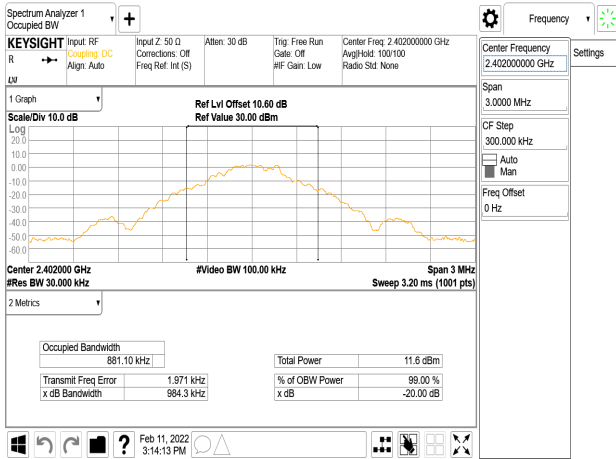
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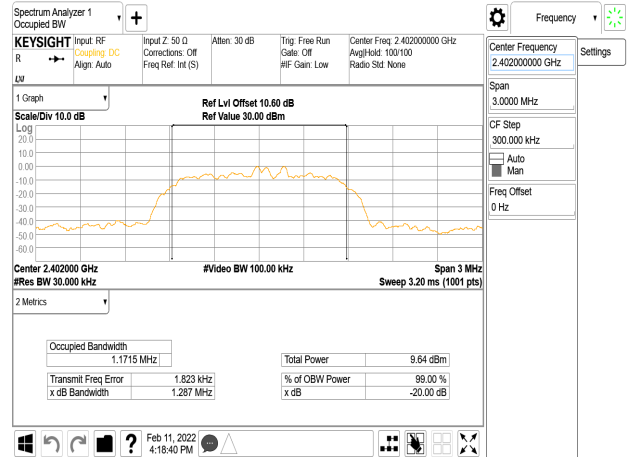
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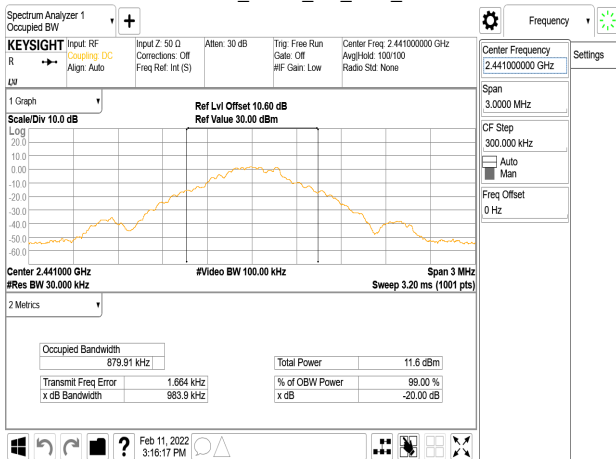
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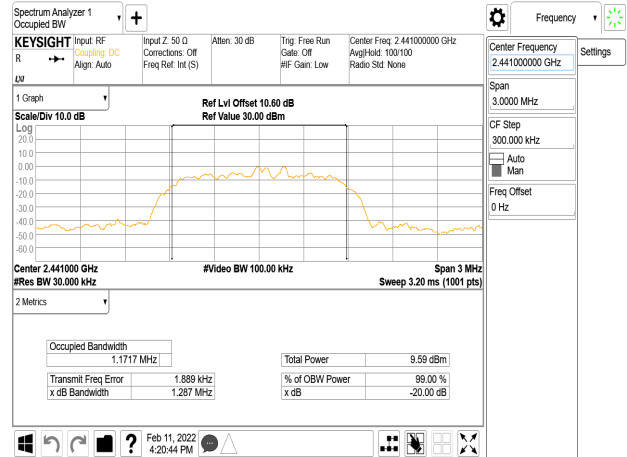
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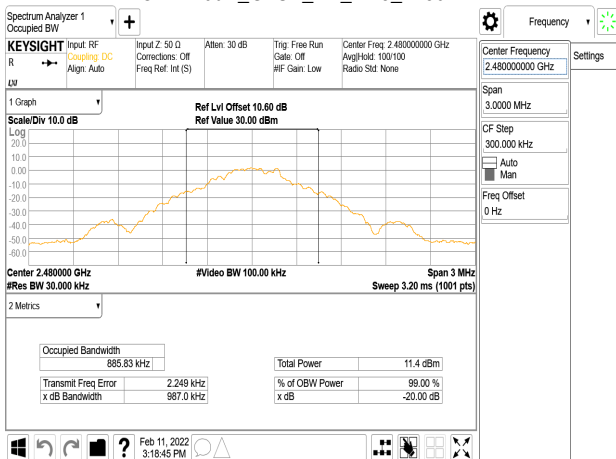
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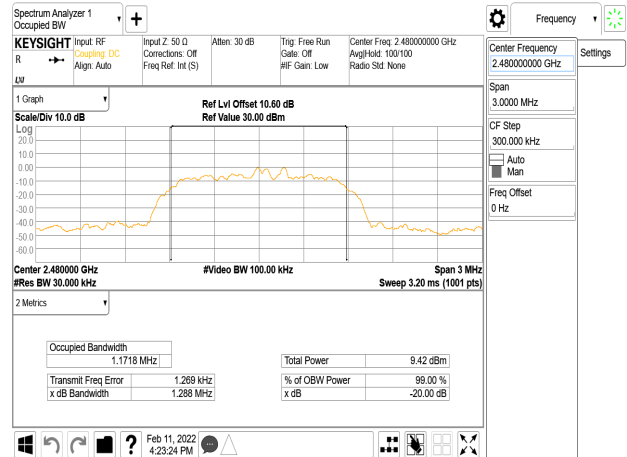
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OBW 20dB_GFSK_1M_DH5_2480MHz



OBW 20dB_π/4QPSK_2M_DH5_2480MHz

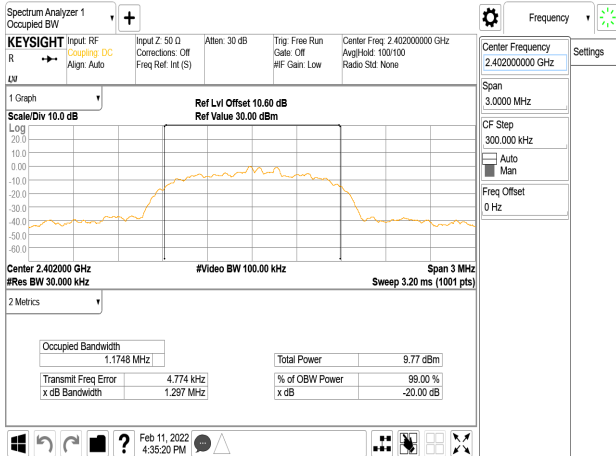


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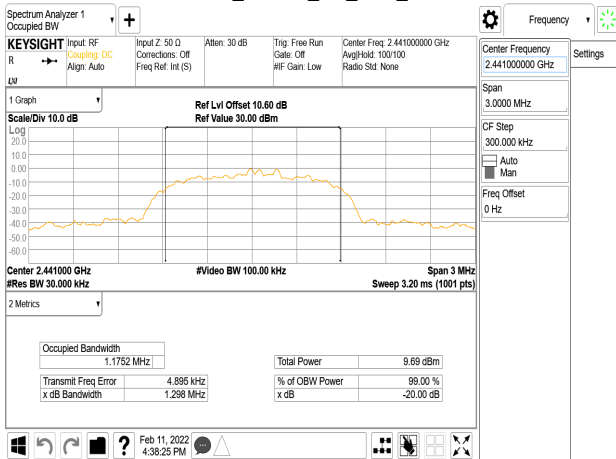
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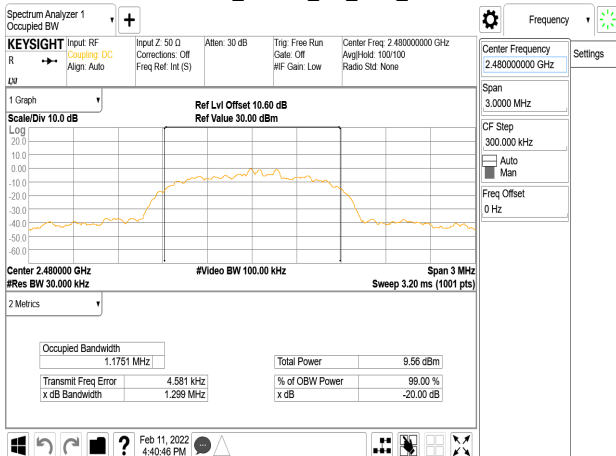
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OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz



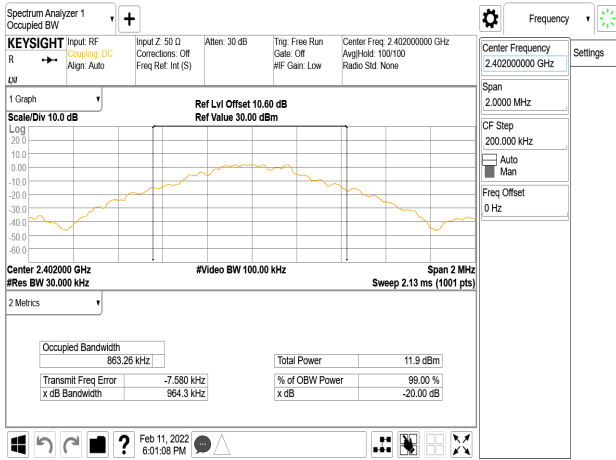
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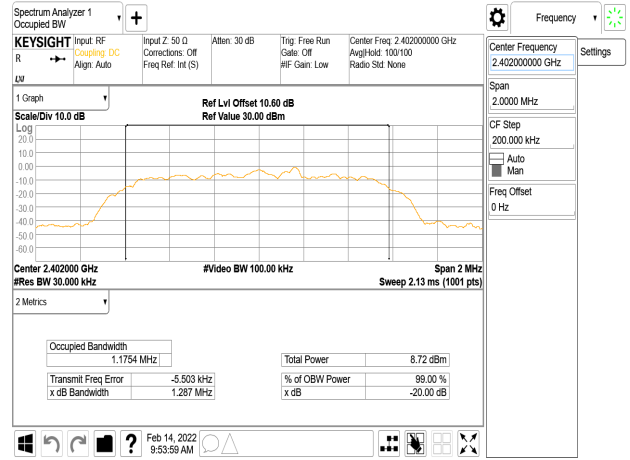
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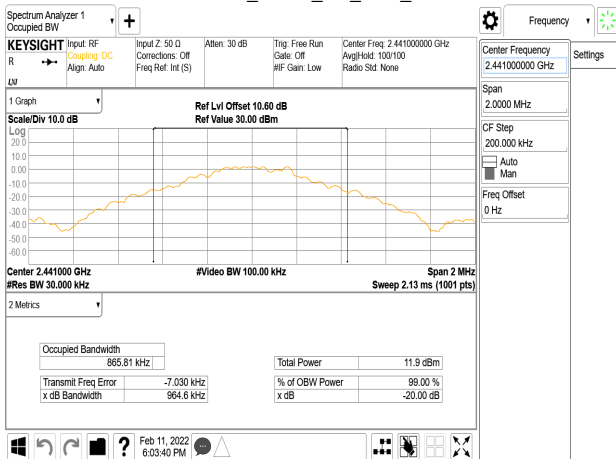
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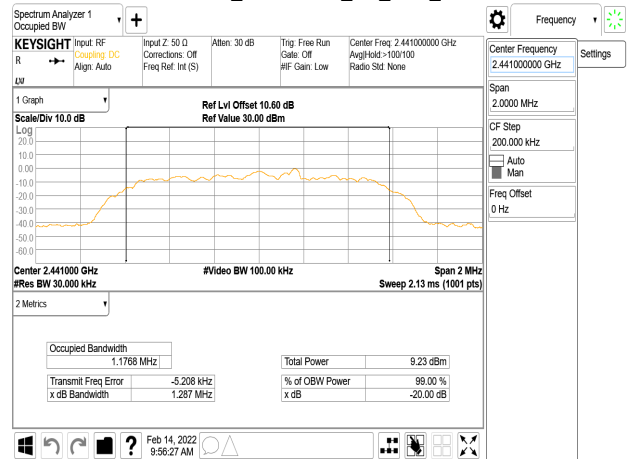
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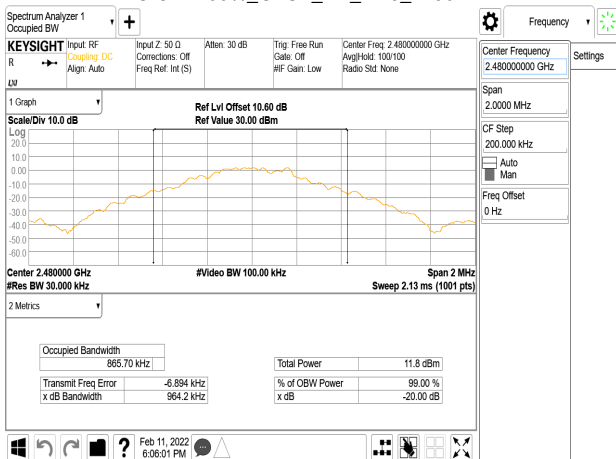
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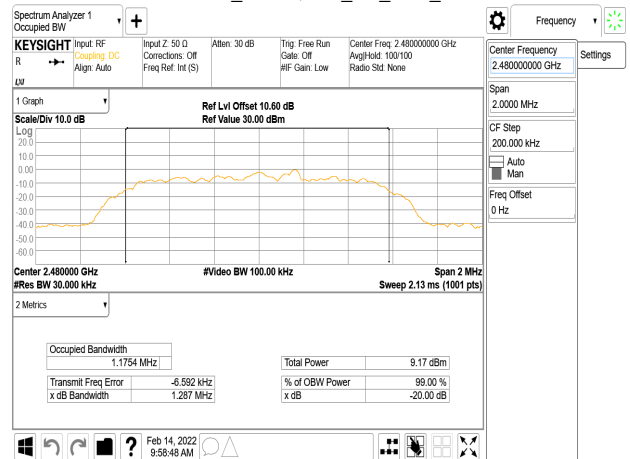
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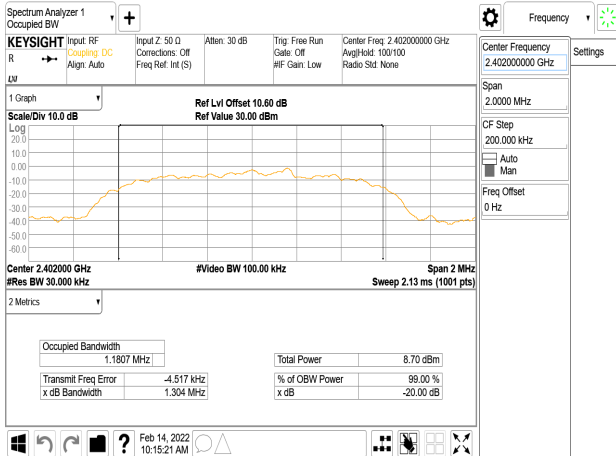
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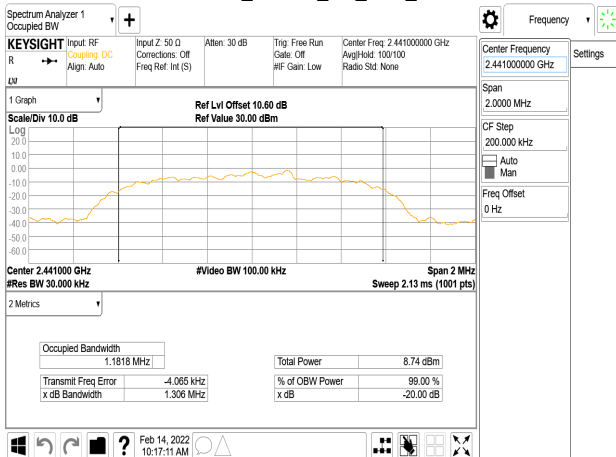
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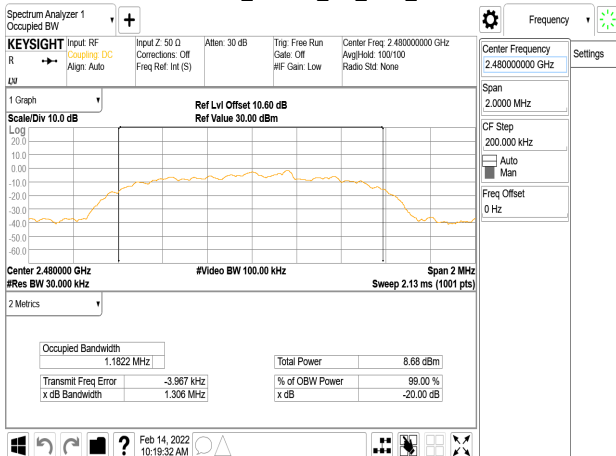
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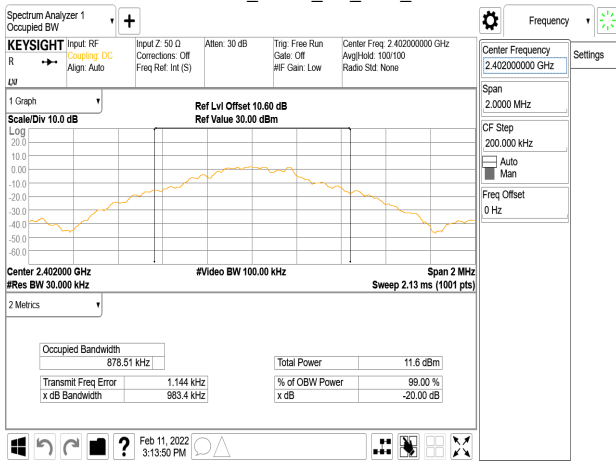
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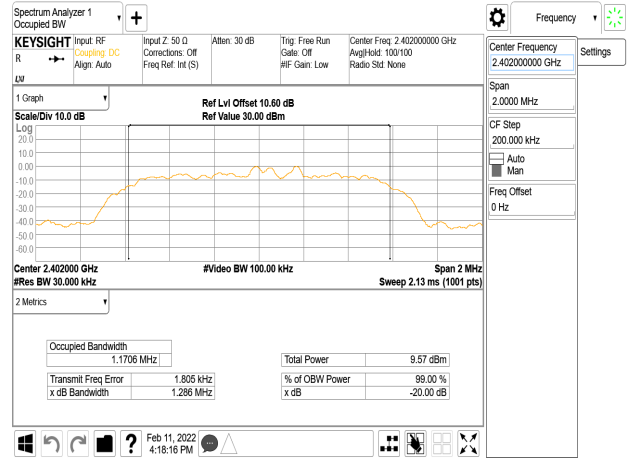
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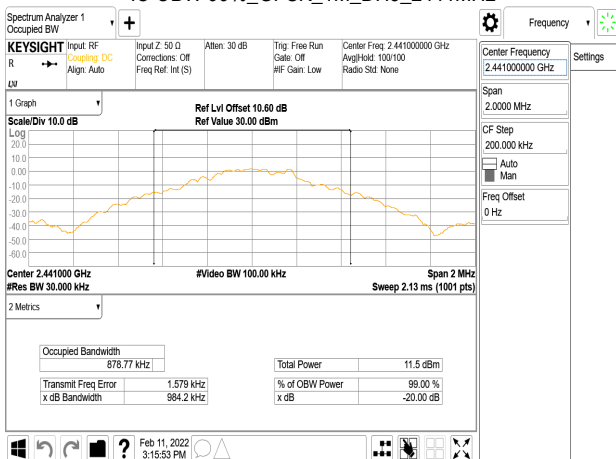
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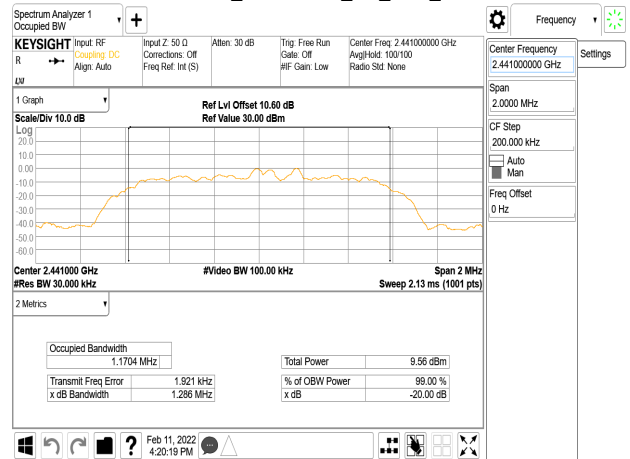
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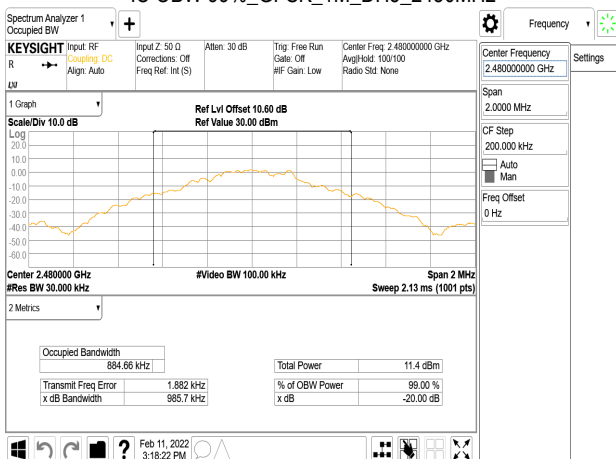
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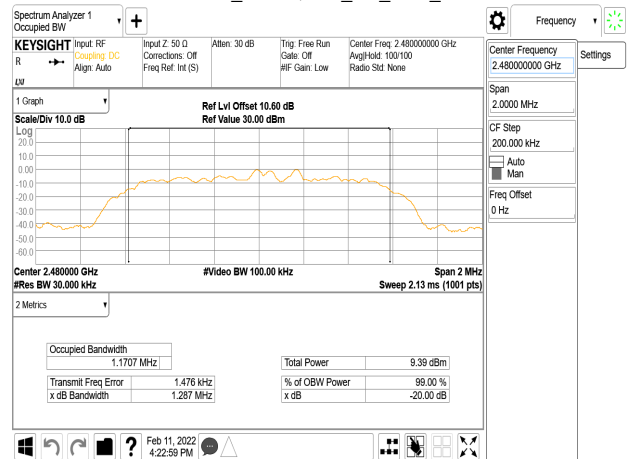
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IC OBW 99%_GFSK_1M_DH5_2480MHz



IC OBW 99%_π/4DQPSK_2M_DH5_2480MHz



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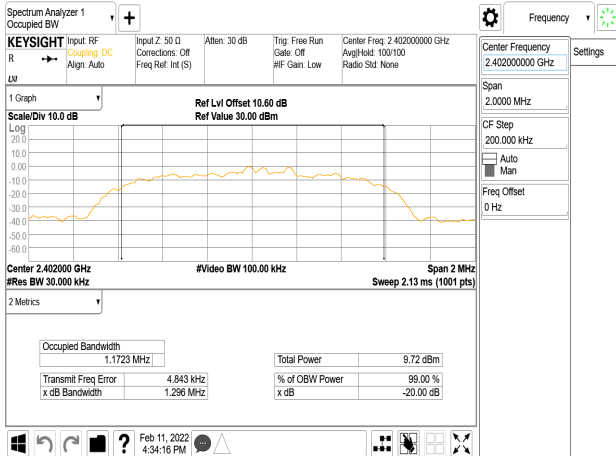
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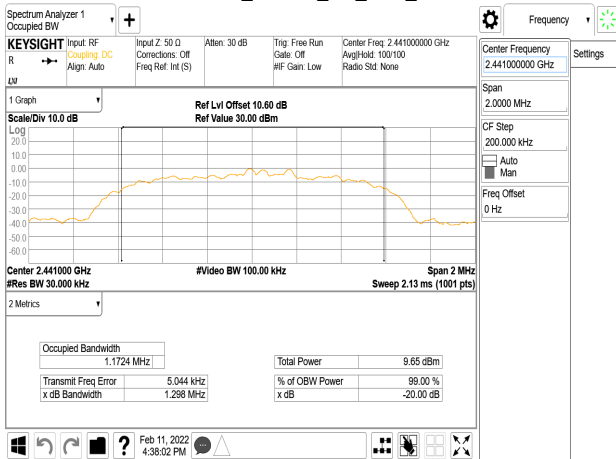
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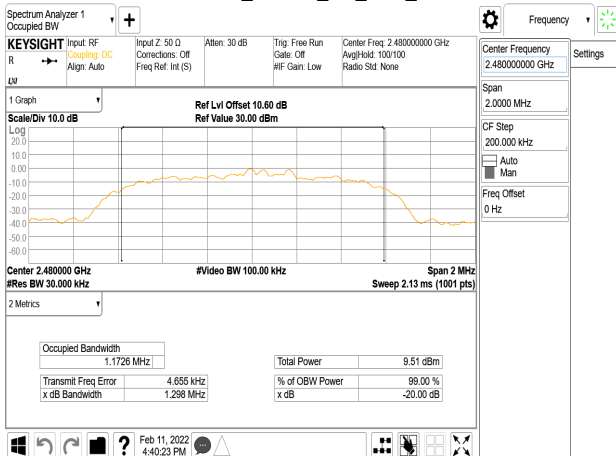
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IC OBW 99%_8DPSK_3M_DH5_2480MHz



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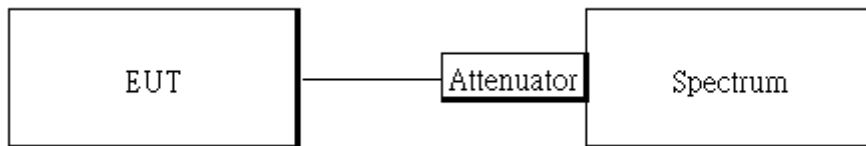
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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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 Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
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 center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
6. Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
7. Repeat above procedures until all frequency measured were complete.

10.3.2 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows ANSI C63.10:2013.
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

See next page for test plots.

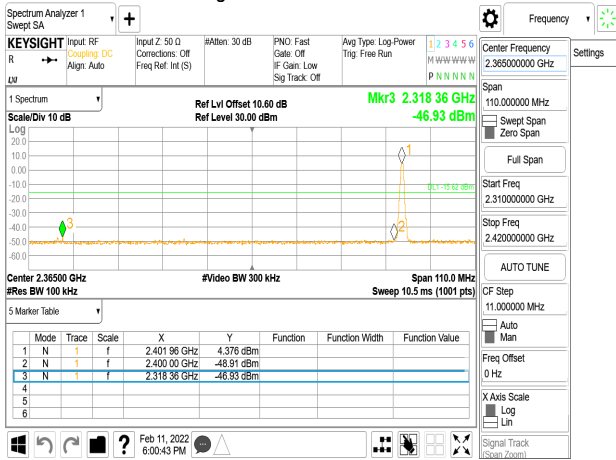
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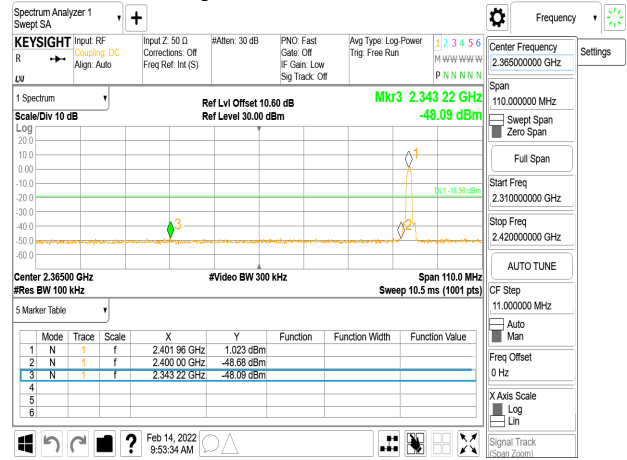
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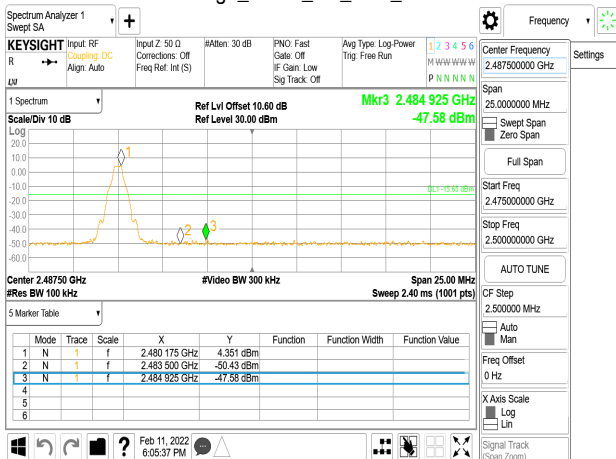
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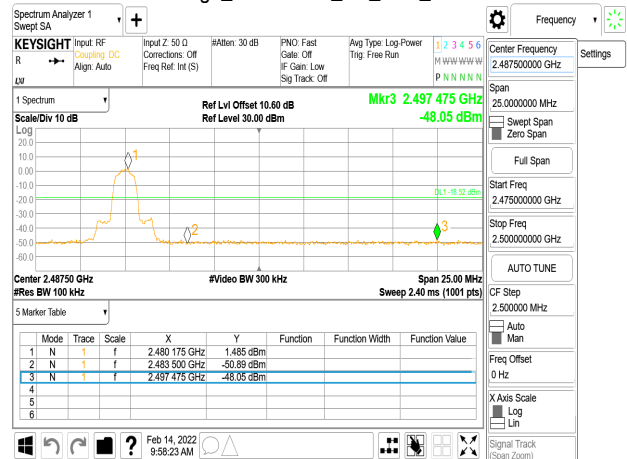
Band Edge_pi/4QPSK_2M_DH5_2402MHz



Band Edge_GFSK_1M_DH5_2480MHz



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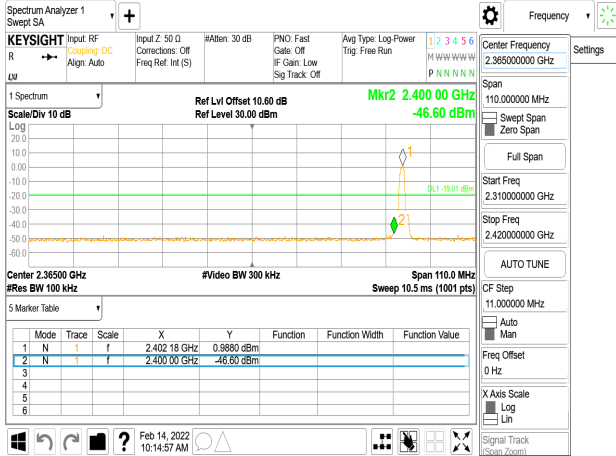


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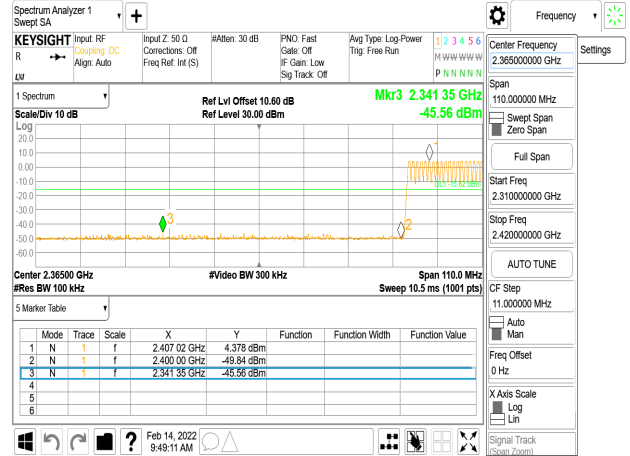
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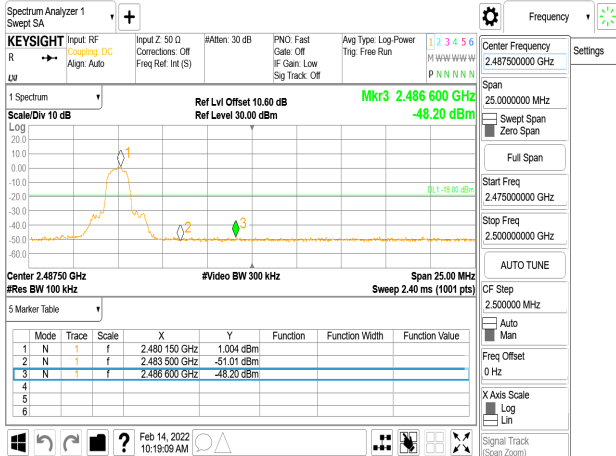
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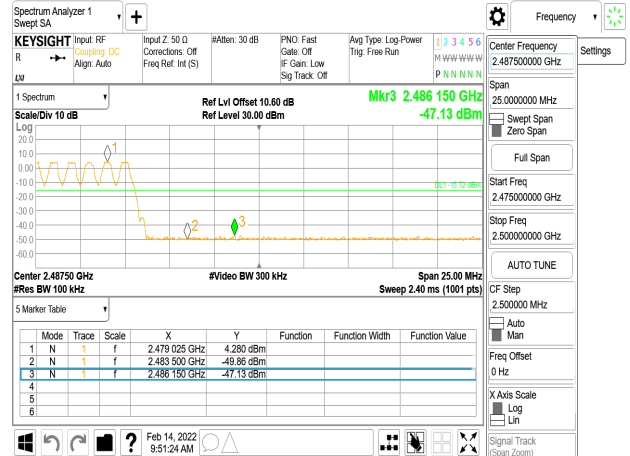
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Band Edge_8DPSK_3M_DH5_2480MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz

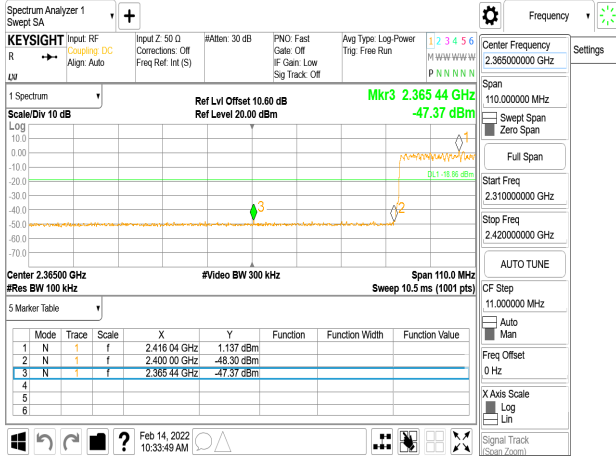


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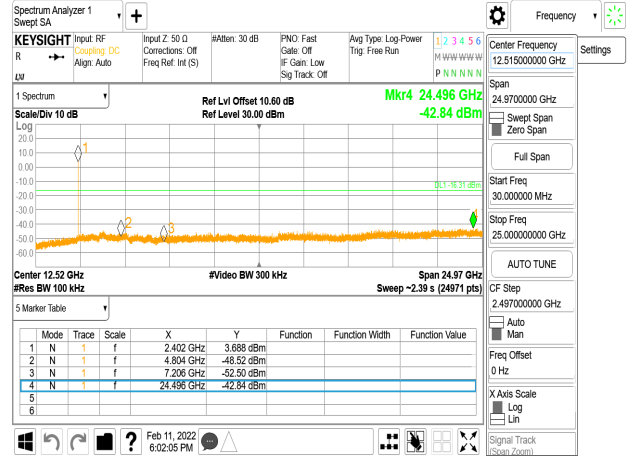
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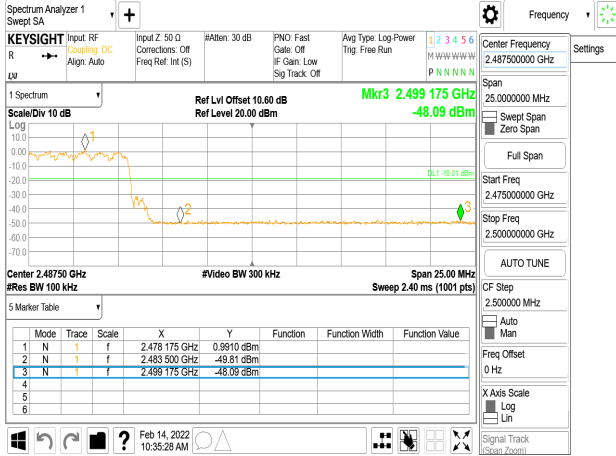
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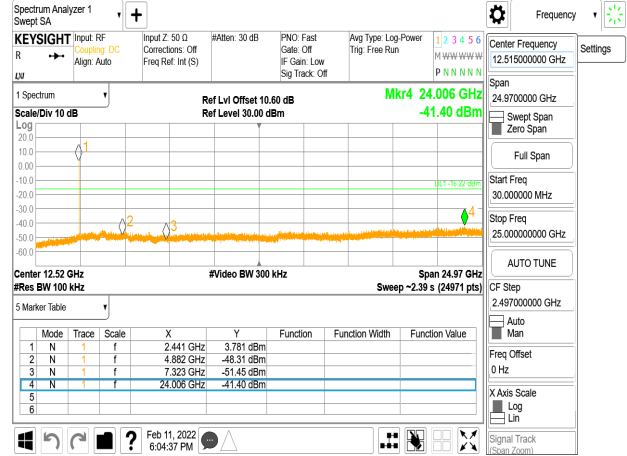
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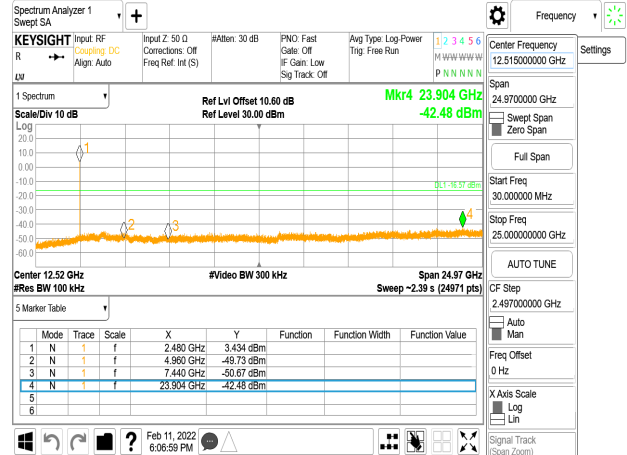
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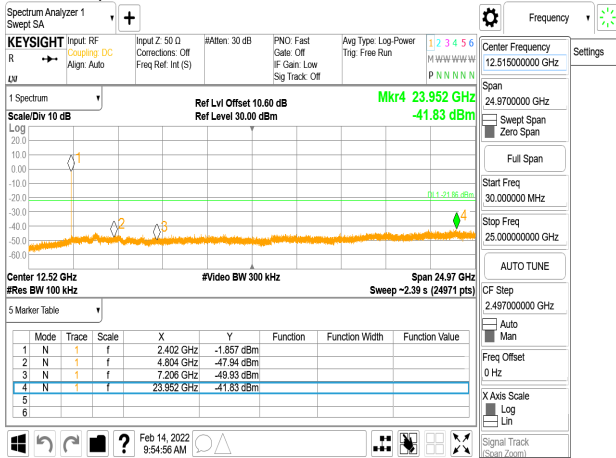


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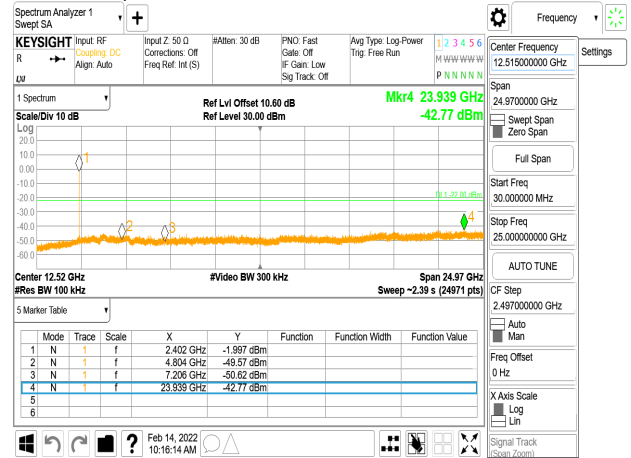
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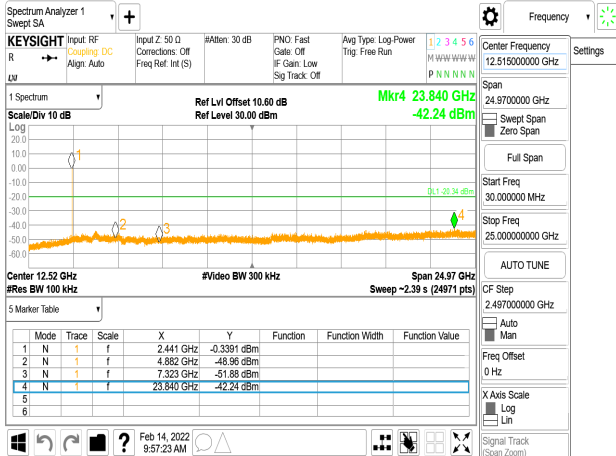
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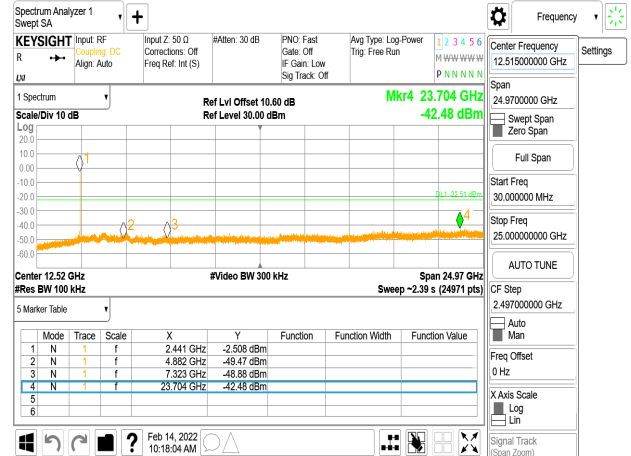
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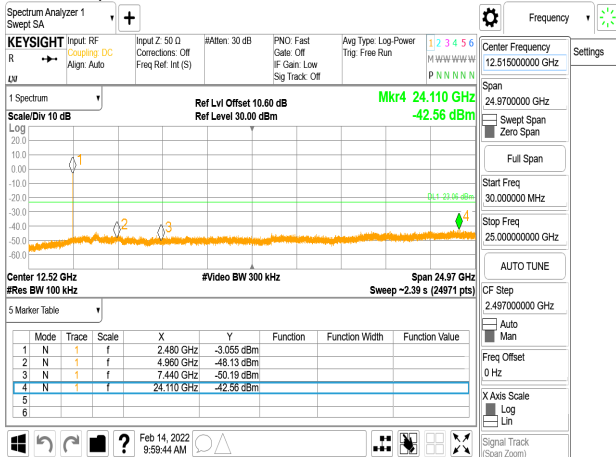
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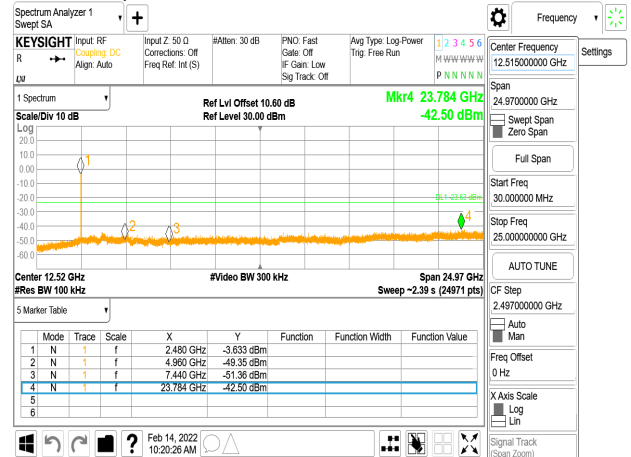
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Spurious Emission_π/4DQPSK_2M_DH5_2480MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



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