

**ELECTROMAGNETIC EMISSIONS
COMPLIANCE REPORT**

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

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

Product Name: Communication Module

Brand Name: muRata

Model No.: For FCC :
LBES5PL2EL, LBEE5PL2DL
For ISCED :
LBES5PL2EL-SANT, LBES5PL2EL-DANT,
LBEE5PL2DL-SANT, LBEE5PL2DL-DANT

Model Difference: Refer to section 1.8

Report Number: TERF2211002511E2

FCC ID VPYLBES5PL2EL

IC: 772C-LBES5PL2EL

Date of EUT Received: Nov. 25, 2022

Date of Test: Feb. 04, 2023~Feb. 15, 2023

Issue Date: Mar. 22, 2023

Approved By

Arno Hsieh

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, ISCED 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
TERF2211002511E2	00	Original	Mar. 02, 2023	Yami Kuo	
TERF2211002511E2	01	Revise applicant's address and model difference	Mar. 22, 2023	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.

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Contents

1	GENERAL INFORMATION	4
2	SYSTEM TEST CONFIGURATION	8
3	SUMMARY OF TEST RESULTS.....	11
4	DESCRIPTION OF TEST MODES	12
5	MEASUREMENT UNCERTAINTY	14
6	MEASUREMENT EQUIPMENT USED.....	15
7	CONDUCTED EMISSION TEST	16
8	PEAK OUTPUT POWER MEASUREMENT.....	20
9	EMISSION BANDWIDTH MEASUREMENT	24
10	CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT	35
11	RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT	43
12	FREQUENCY SEPARATION	146
13	NUMBER OF HOPPING FREQUENCY	151
14	TIME OF OCCUPANCY (DWELL TIME).....	154
15	ANTENNA REQUIREMENT	161

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module	
Brand Name:	muRata	
Model No.:	For FCC	LBES5PL2EL, LBEE5PL2DL
	For ISED	LBES5PL2EL-SANT, LBES5PL2EL-DANT, LBEE5PL2DL-SANT, LBEE5PL2DL-DANT
Model Difference:	Refer to section 1.8	
Hardware Version:	1	
Firmware Version:	N/A	
EUT Series No.:	ANT0: L#1 ANT1: R#1	
Power Supply:	3.3Vdc, 1.8Vdc	
Test Software (Name/Version)	Tera Term V4.106	

1.2 RF Specification

Radio Technology:	BT BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + $\pi/4$ DQPSK + 8DPSK
Transmit Power:	ANT0:16.21 dBm ANT1:15.93 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	$\leq 0.4s$

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1.3 Antenna Designation

ANT0

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	Molex	146153	2400~2500	3.2
	Molex	219611	2400~2500	2.67
	Unictron	WT32D1-KX	2400~2500	3
	Inventek	W24P-U	2400~2500	3.2
Monopole	Murata	Type2EL_Antenna	2400~2500	3.6

ANT1

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	Molex	146153	2400~2500	3.2
	Molex	219611	2400~2500	2.67
	Unictron	WT32D1-KX	2400~2500	3
	Inventek	W24P-U	2400~2500	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 April 2018

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 2		
		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 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

1. There are 4 HVINs with 2 PMNs as below

- a. The LBES5PL2EL-SANT and LBES5PL2EL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functions
LBES5PL2EL-SANT	LBES5PL2EL	IW612	WLAN 2.4GHz,5GHz, BT,BLE, IEEE802.15.4
LBES5PL2EL-DANT			

- b. The LBEE5PL2DL-SANT and LBEE5PL2DL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functions
LBEE5PL2DL-SANT	LBEE5PL2DL	IW611	WLAN 2.4GHz,5GHz, BT,BLE
LBEE5PL2DL-DANT			

2. In addition, there are 2 HMNs, the differences between the HMN(s) are

HMN	HVIN	Antenna connector(s)	WLAN	BT	BLE	IEEE802.15.4
P2ML10229-D	LBES5PL2EL-DANT	2 (ANT0, ANT1)	ANT0	ANT1	ANT1	ANT1
	LBEE5PL2DL-DANT					NA
P2ML10229-S	LBES5PL2EL-SANT	1 (ANT0)	ANT0	ANT0	ANT0	ANT0
	LBEE5PL2DL-SANT					NA

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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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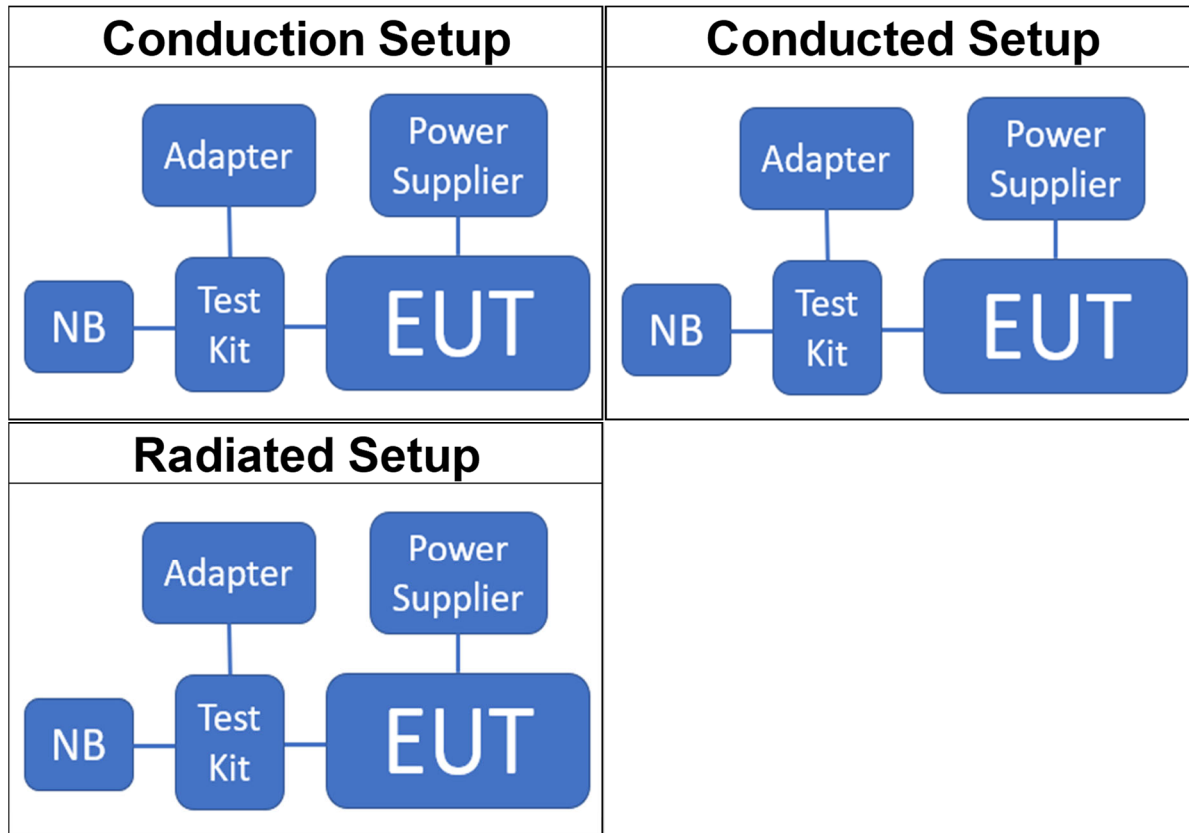
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2.5 Test Configuration



2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T440p	P0000665	N/A	N/A
USB Cable	ZHUANG SHAN CHUAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A
Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
USB Cable	ZHUANG SHAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A
Notebook	Lenovo	T420	S0012599	N/A	N/A
Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T440p	P0000665	N/A	N/A
USB Cable	ZHUANG SHAN CHUAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b)(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.

ANTENNA 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, Hopping Band edge				
Bluetooth	0 to 78	0 to 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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth	0 to 78	39	GFSK/8-DPSK	DH5/3DH5
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth	0 to 78	0,39,78	GFSK/8-DPSK	DH5/3DH5
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.				

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.32 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	+/- 0.7 °C
Humidity	+/- 3 %
DC / AC Power Source	+/- 1 %

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 2.8 dB	9kHz~30MHz
	+/- 4.82 dB	30MHz - 1000MHz
	+/- 4.37 dB	1GHz - 18GHz
	+/- 4.21 dB	18GHz - 40GHz
Polarization: Horizontal	+/- 2.8 dB	9kHz~30MHz
	+/- 4.54 dB	30MHz - 1000MHz
	+/- 4.37 dB	1GHz - 18GHz
	+/- 4.21 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	973	04/13/2022	04/12/2023
EMI Test Receiver	R&S	ESCI	101342	04/25/2022	04/24/2023
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	485	03/27/2022	03/26/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
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	MY59071573	05/16/2022	05/15/2023
Power Meter	Anritsu	ML2496A	1512003	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339378	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339379	07/26/2022	07/25/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Woken	WATT-218FS-10	RF17	11/16/2022	11/15/2023
Attenuator	Woken	WATT-218FS-10	RF18	11/16/2022	11/15/2023
Switch E-Channel	E-Channel	ETF-1801 RF Switch	EC2100175	11/16/2022	11/15/2023
DC Block	PASTERNAK	PE8210	RF158	11/16/2022	11/15/2023

6.3 Radiated Measurement

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	11/11/2022	11/10/2023
Horn Antenna	Schwarzbeck	BBHA9170	185	08/22/2022	08/21/2023
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/12/2023	01/11/2024
Loop Antenna	ETS.LINDGREN	6502	143303	05/14/2022	05/13/2023
3m Site NSA	SGS	966 chamber C	N/A	03/02/2022	03/01/2023
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	04/01/2022	03/31/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
Pre-Amplifier	EMC Instruments	EMC330	980096	11/16/2022	11/15/2023
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/16/2022	11/15/2023
Pre-Amplifier	EMC Instruments	EMC18405SEE	980881	10/25/2022	10/24/2023
Attenuator	Woken	WATT-218FS-10	RF16	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	EMC106-SM-SM-9100	150704	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/16/2022	11/15/2023

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

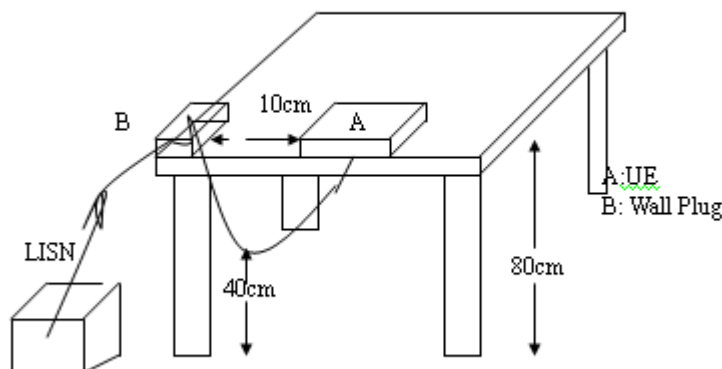
Note

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

7.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test Setup



7.4 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all 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 closest to the limit.

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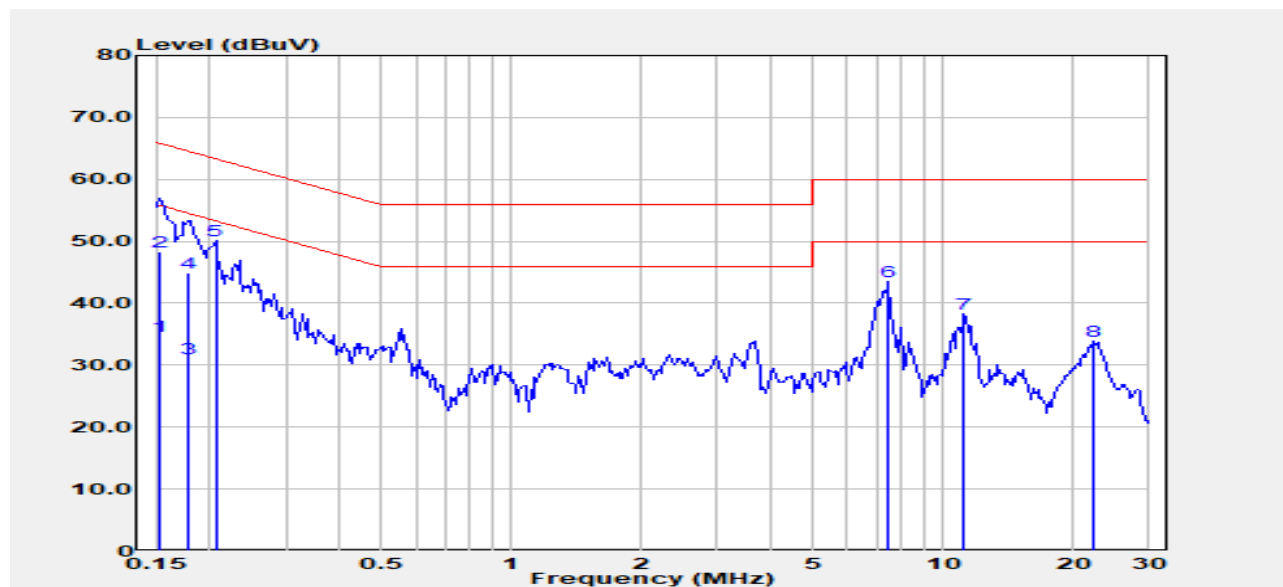
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2211002511E2	Test Site	:Conduction C
Test Mode	:BT	Test Date	:2023-02-15
Power	:120/60Hz	Temp./Humi.	:22.4/61
Probe	:L1	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.153	Average	24.50	10.27	34.77	55.82	-21.05
0.153	QP	38.10	10.27	48.37	65.82	-17.45
0.178	Average	20.80	10.27	31.07	54.59	-23.52
0.178	QP	34.60	10.27	44.87	64.59	-19.72
0.206	Peak	39.82	10.27	50.09	63.36	-13.27
7.486	Peak	32.96	10.61	43.57	60.00	-16.43
11.198	Peak	27.61	10.69	38.30	60.00	-21.70
22.298	Peak	22.96	10.93	33.90	60.00	-26.10

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Report Number :TERF2211002511E2

Test Site :Conduction C

Test Mode :BT

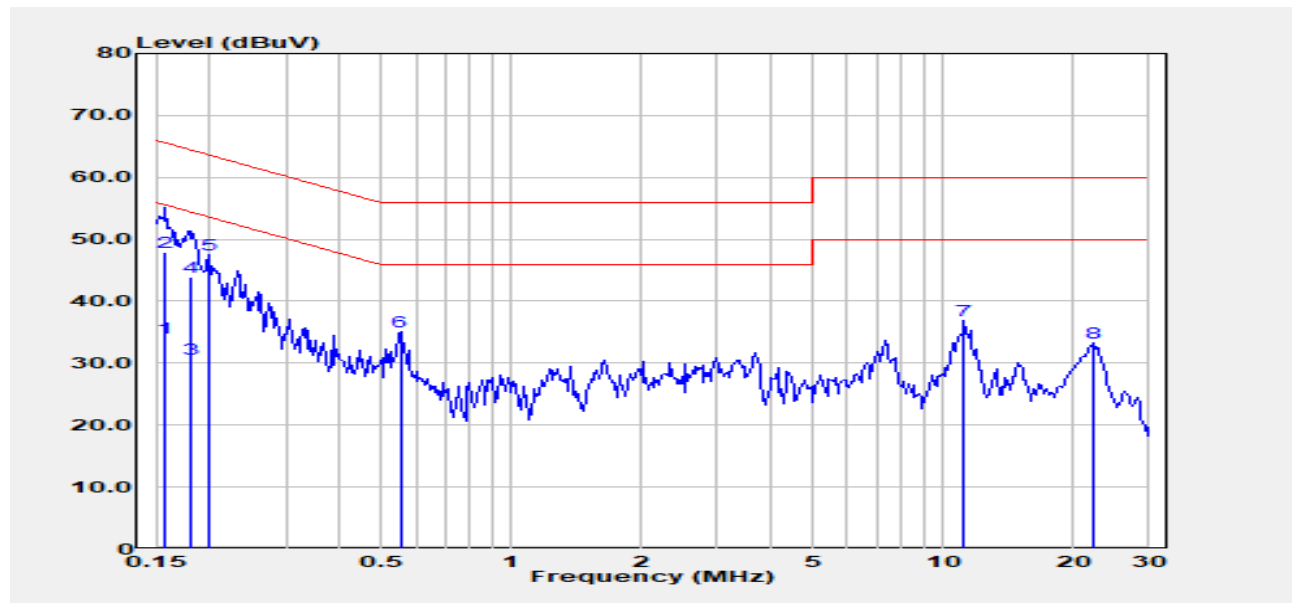
Test Date :2023-02-15

Power :120/60Hz

Temp./Humi. :22.4/61

Probe :N

Engineer :Andy Wang



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
0.158	Average	23.80	10.28	34.08	55.56	-21.48
0.158	QP	37.70	10.28	47.98	65.56	-17.58
0.180	Average	20.50	10.27	30.77	54.50	-23.73
0.180	QP	33.70	10.27	43.97	64.50	-20.53
0.200	Peak	37.20	10.27	47.47	63.62	-16.15
0.552	Peak	24.82	10.31	35.13	56.00	-20.87
11.198	Peak	26.29	10.65	36.94	60.00	-23.06
22.298	Peak	22.41	10.92	33.32	60.00	-26.68

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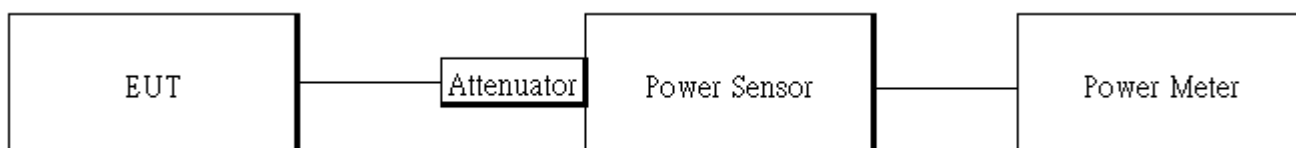
8 PEAK OUTPUT POWER MEASUREMENT

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 $\geq$ 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

Ant0

1M BR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	17	16.21	41.783	1000
Mid	2441	17	16.13	41.020	1000
High	2480	17	16.02	39.994	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	17	15.94	39.299	1000
Mid	2441	17	15.83	38.316	1000
High	2480	17	15.75	37.617	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	17	9.75	9.441	125
Mid	2441	17	9.62	9.162	125
High	2480	17	9.54	8.995	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	17	7.80	6.031	125
Mid	2441	17	7.69	5.880	125
High	2480	17	7.60	5.759	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	17	9.88	9.727	125
Mid	2441	17	9.76	9.462	125
High	2480	17	9.68	9.290	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	17	7.87	6.129	125
Mid	2441	17	7.79	6.017	125
High	2480	17	7.66	5.840	125

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

Ant1

1M BR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	17	15.93	39.174	1000
Mid	2441	17	15.82	38.194	1000
High	2480	17	15.74	37.497	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	17	15.87	38.671	1000
Mid	2441	17	15.78	37.878	1000
High	2480	17	15.66	36.845	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	16	9.72	9.376	125
Mid	2441	16	9.61	9.141	125
High	2480	16	9.53	8.974	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	16	7.83	6.062	125
Mid	2441	16	7.74	5.938	125
High	2480	16	7.64	5.803	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	16	9.89	9.750	125
Mid	2441	16	9.75	9.441	125
High	2480	16	9.64	9.204	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	16	7.91	6.175	125
Mid	2441	16	7.80	6.021	125
High	2480	16	7.68	5.857	125

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

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8.5 EIRP Measurement Result

Ant0

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	17	15.94	3.60	90.029	4000
Mid	2441	17	15.83	3.60	87.777	4000
High	2480	17	15.75	3.60	86.175	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	17	7.80	3.60	13.816	4000
Mid	2441	17	7.69	3.60	13.470	4000
High	2480	17	7.60	3.60	13.194	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	17	7.87	3.60	14.041	4000
Mid	2441	17	7.79	3.60	13.784	4000
High	2480	17	7.66	3.60	13.378	4000

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

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Ant1
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	17	15.87	3.20	80.795	4000
Mid	2441	17	15.78	3.20	79.138	4000
High	2480	17	15.66	3.20	76.981	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	16	7.83	3.20	12.666	4000
Mid	2441	16	7.74	3.20	12.406	4000
High	2480	16	7.64	3.20	12.124	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	16	7.91	3.20	12.901	4000
Mid	2441	16	7.80	3.20	12.579	4000
High	2480	16	7.68	3.20	12.236	4000

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

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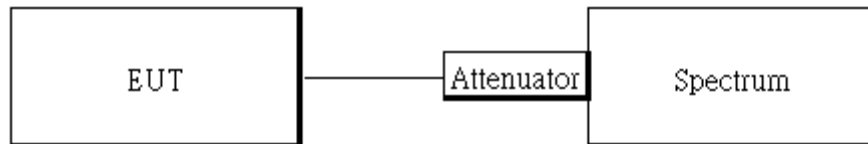
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9 EMISSION BANDWIDTH MEASUREMENT

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 Ant0

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9655	0.64
Mid	0.9648	0.64
High	0.9643	0.64

$\pi/4$ -DQPSK

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

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.307	0.87
Mid	1.311	0.87
High	1.309	0.87

Ant1

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9661	0.64
Mid	0.9647	0.64
High	0.9644	0.64

$\pi/4$ -DQPSK

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

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.309	0.87
Mid	1.309	0.87
High	1.309	0.87

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9.5 99% Bandwidth
Ant0

GFSK

CH	99% BW (MHz)
Low	0.87242
Mid	0.87249
High	0.87296

 $\pi/4$ -DQPSK

CH	99% BW (MHz)
Low	1.1738
Mid	1.1742
High	1.1732

8-DPSK

CH	99% BW (MHz)
Low	1.1816
Mid	1.1814
High	1.1809

Ant1

GFSK

CH	99% BW (MHz)
Low	0.87108
Mid	0.87347
High	0.87381

 $\pi/4$ -DQPSK

CH	99% BW (MHz)
Low	1.1750
Mid	1.1747
High	1.1748

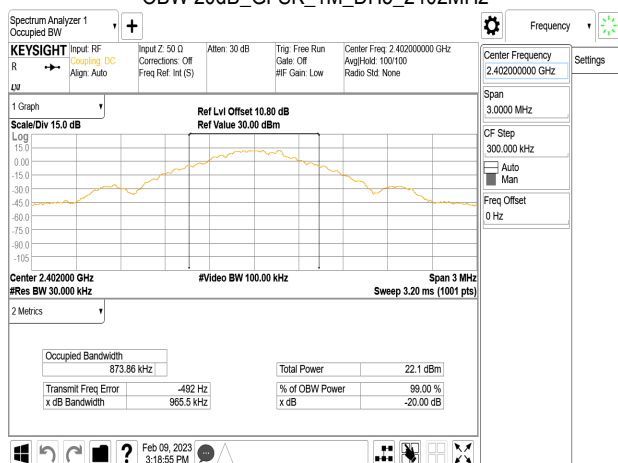
8-DPSK

CH	99% BW (MHz)
Low	1.1822
Mid	1.1820
High	1.1816

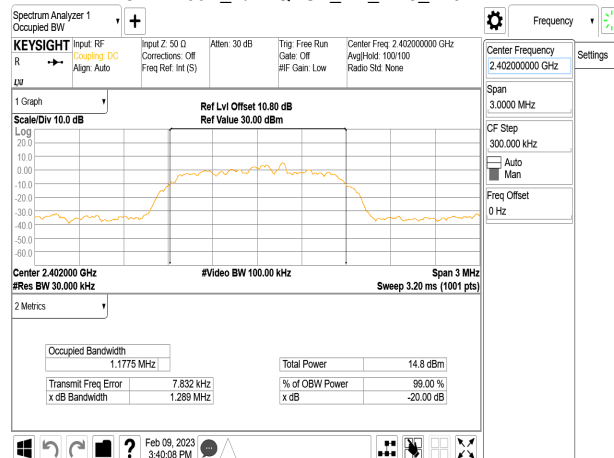
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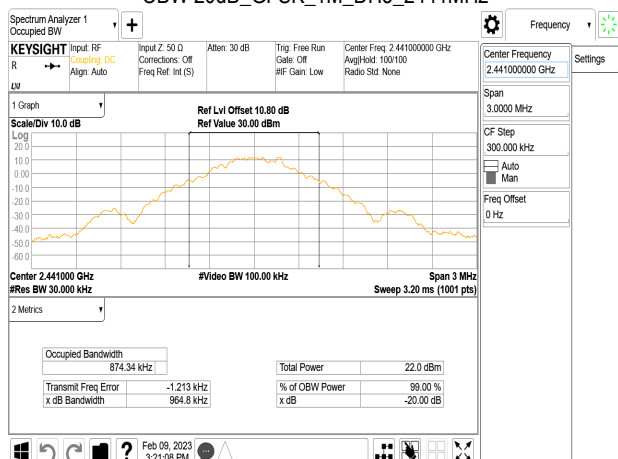
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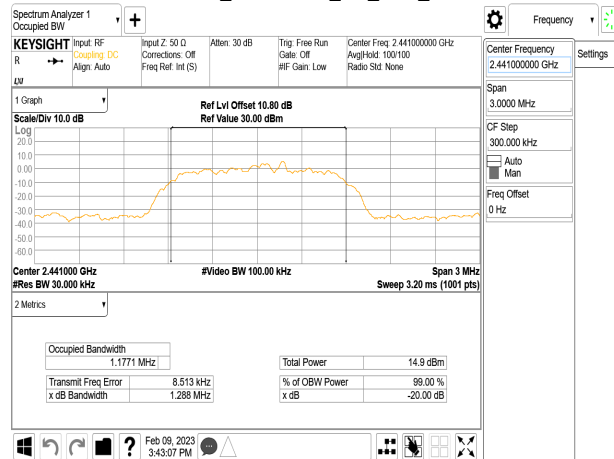
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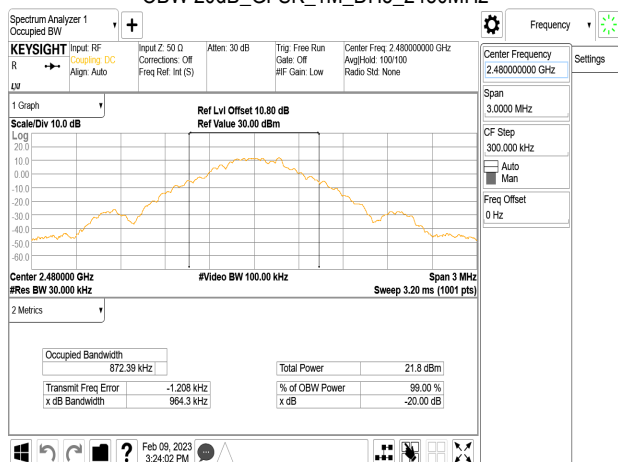
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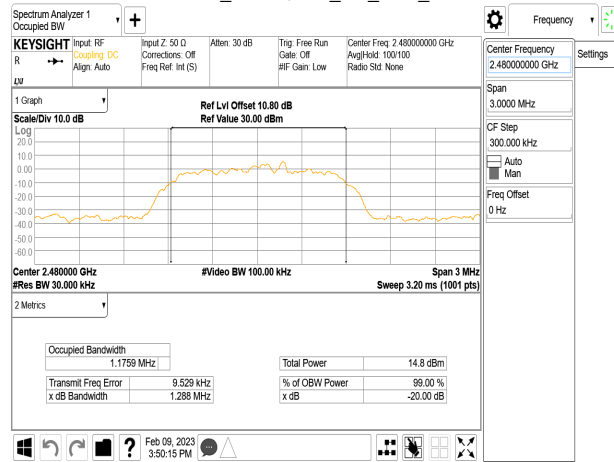
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OBW 20dB_GFSK_1M_DH5_2480MHz



OBW 20dB_π/4DQPSK_2M_DH5_2480MHz

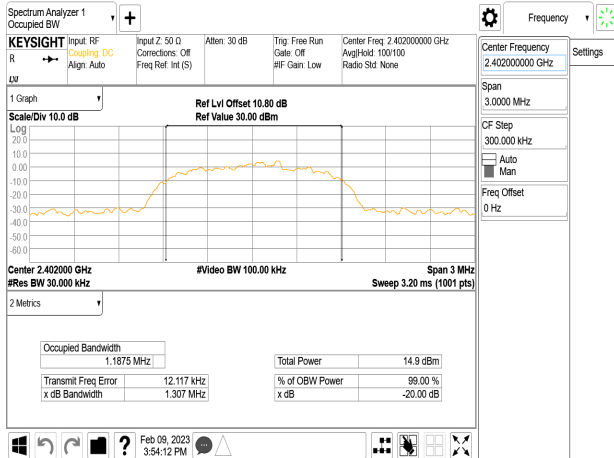


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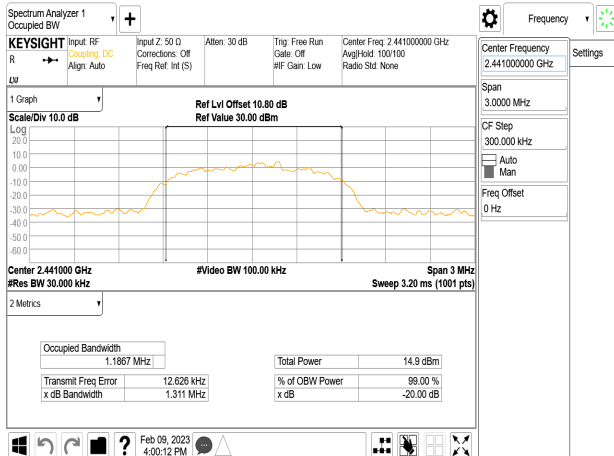
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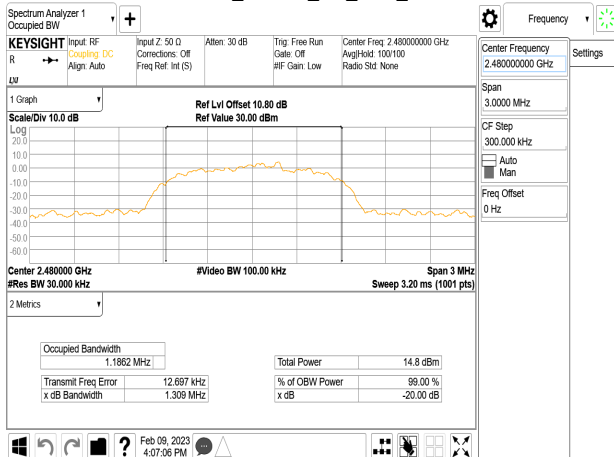
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OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz

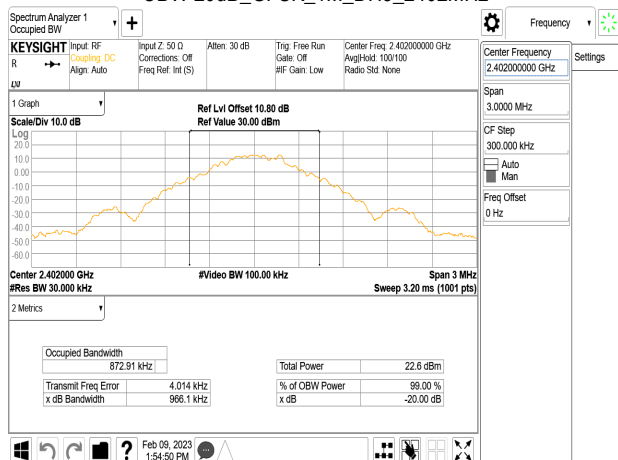


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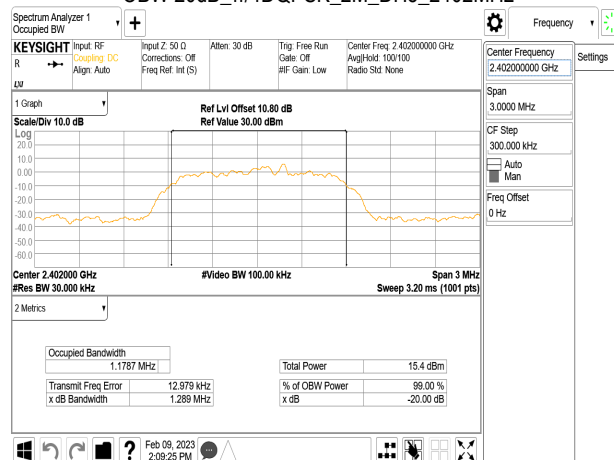
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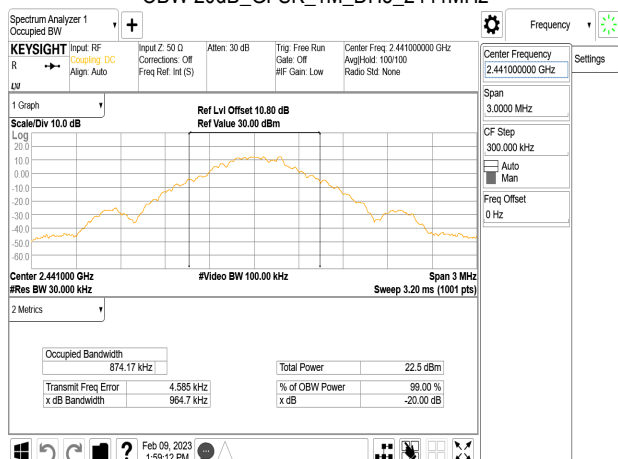
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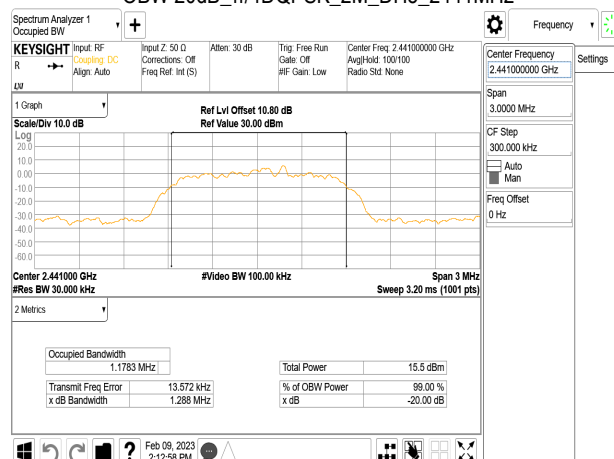
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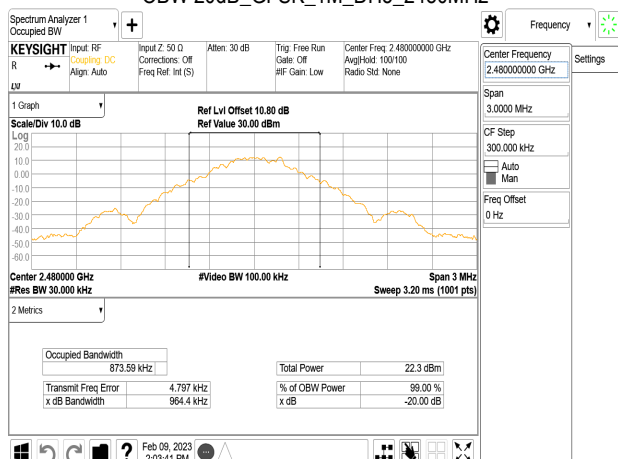
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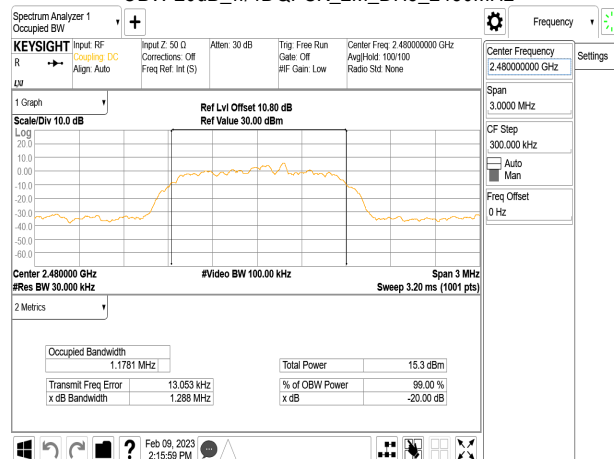
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OBW 20dB_GFSK_1M_DH5_2480MHz



OBW 20dB_π/4DQPSK_2M_DH5_2480MHz

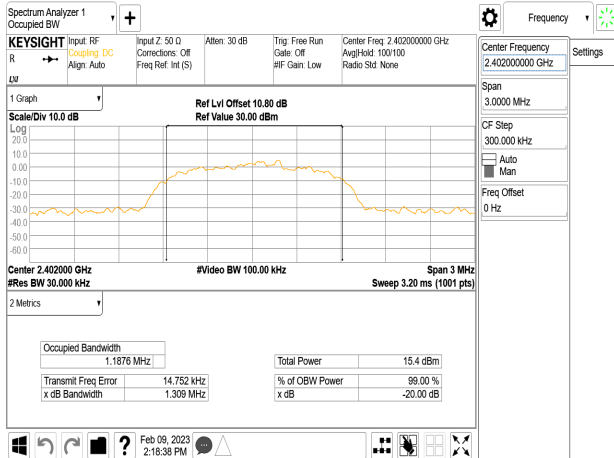


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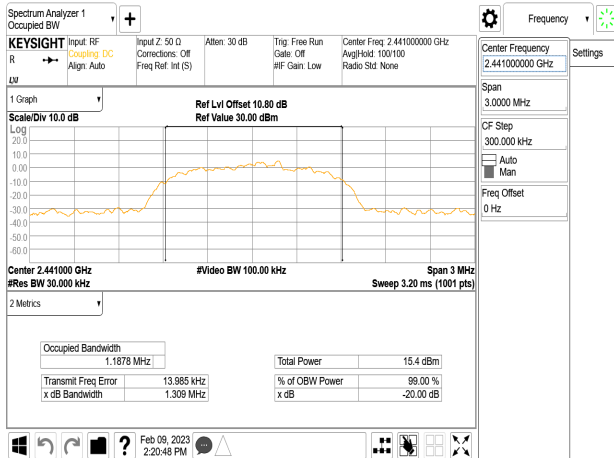
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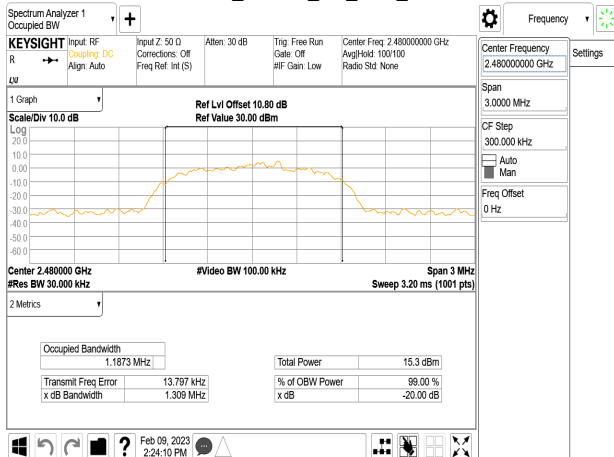
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OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz

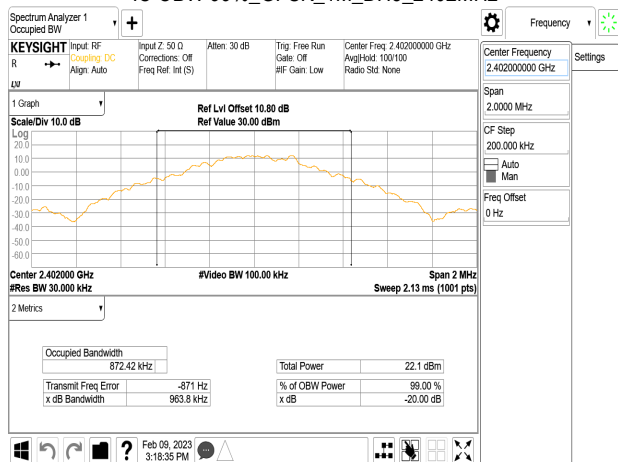


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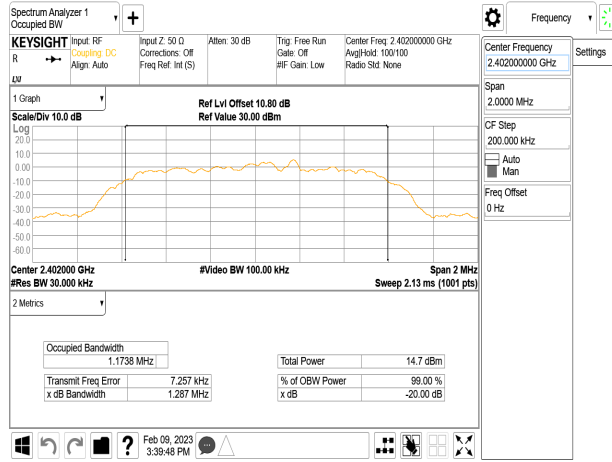
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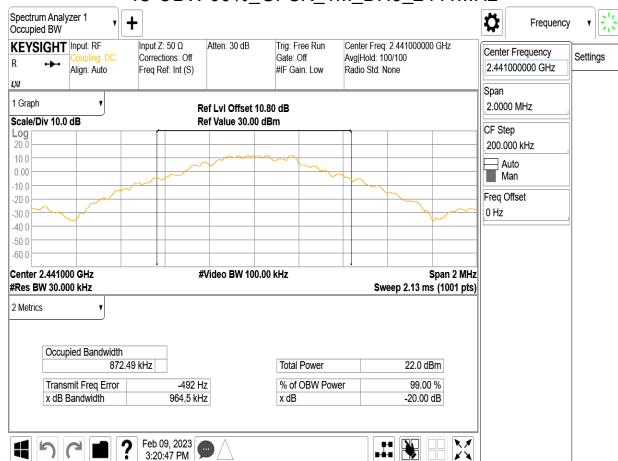
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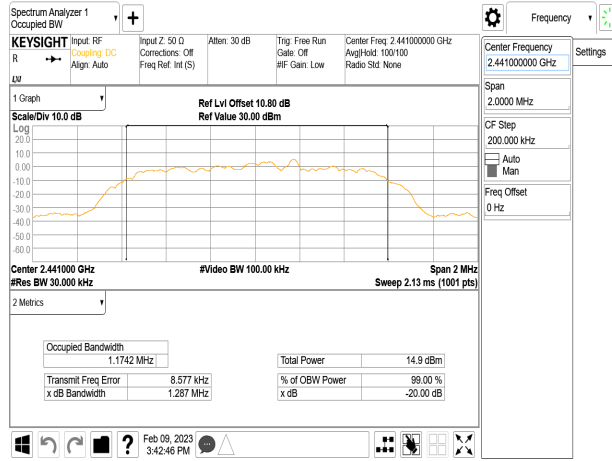
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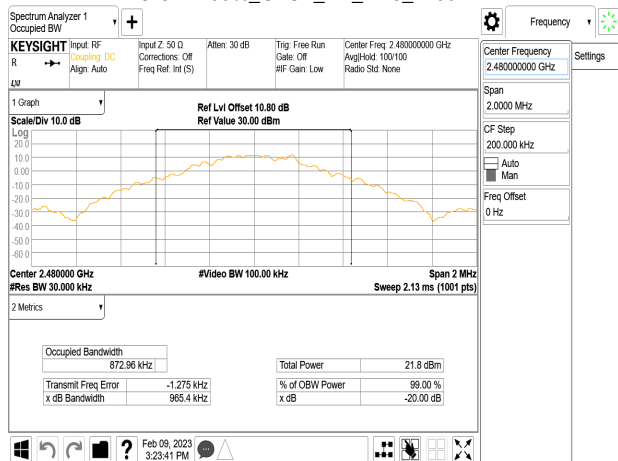
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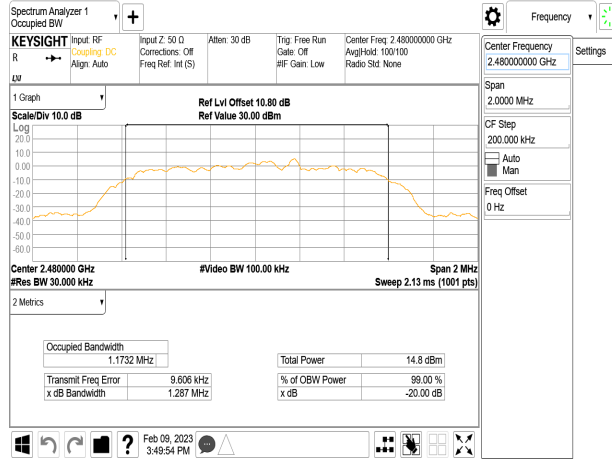
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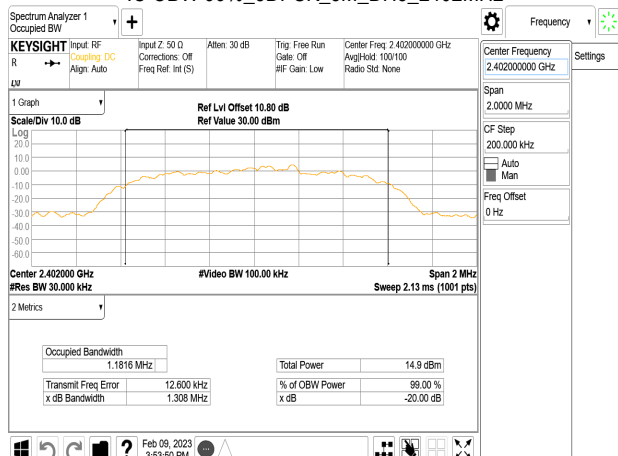


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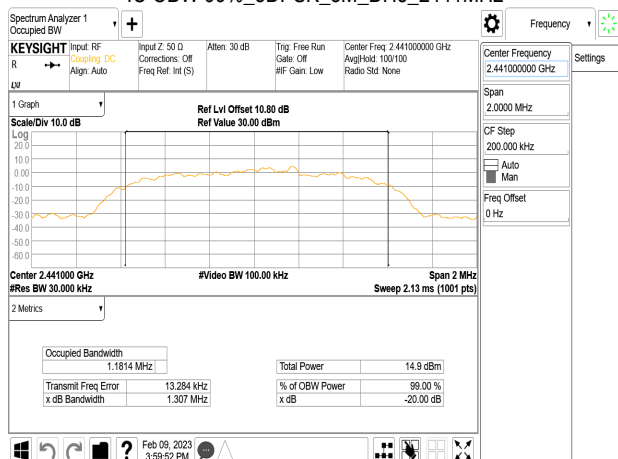
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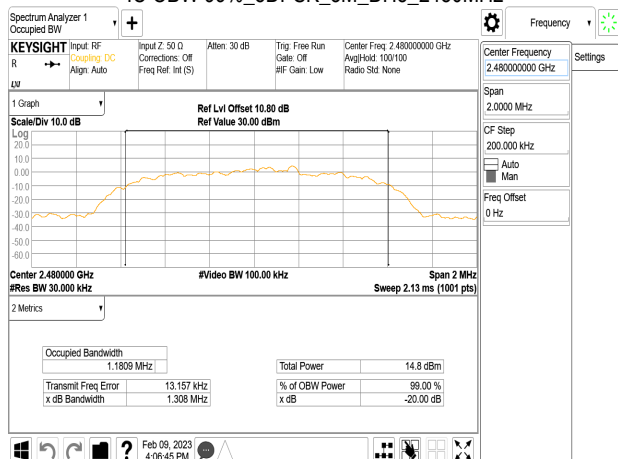
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IC OBW 99%_8DPSK_3M_DH5_2441MHz



IC OBW 99%_8DPSK_3M_DH5_2480MHz



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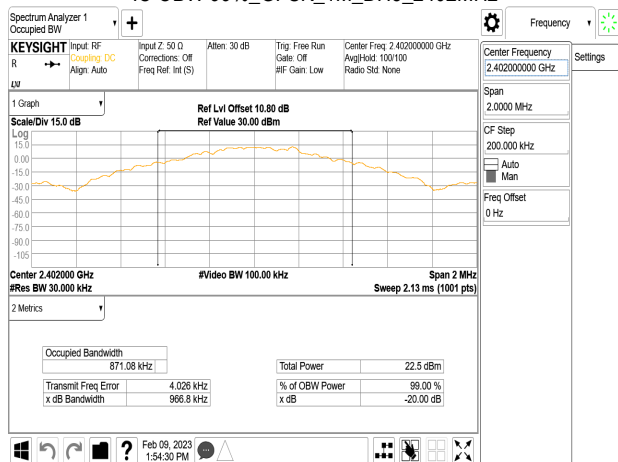
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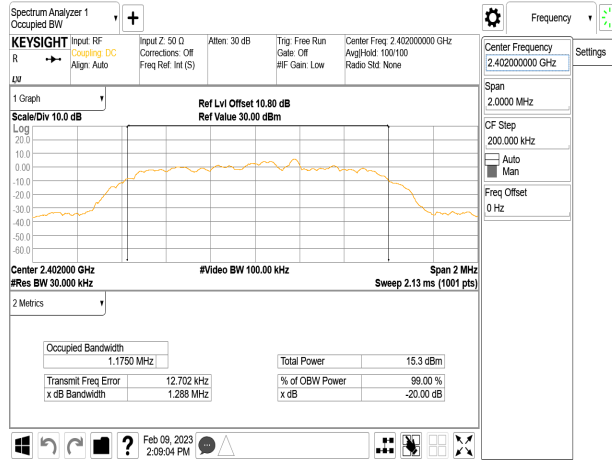
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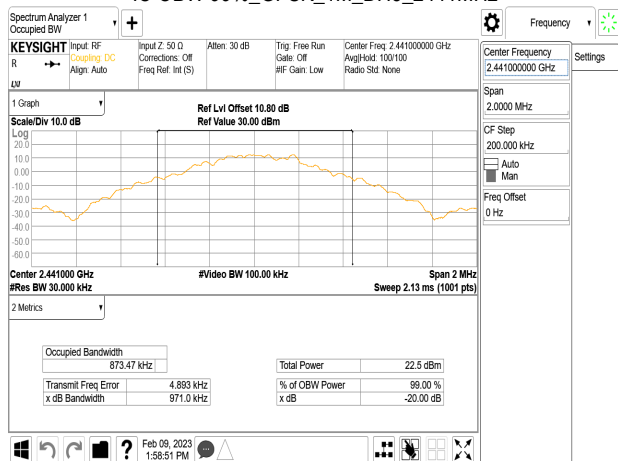
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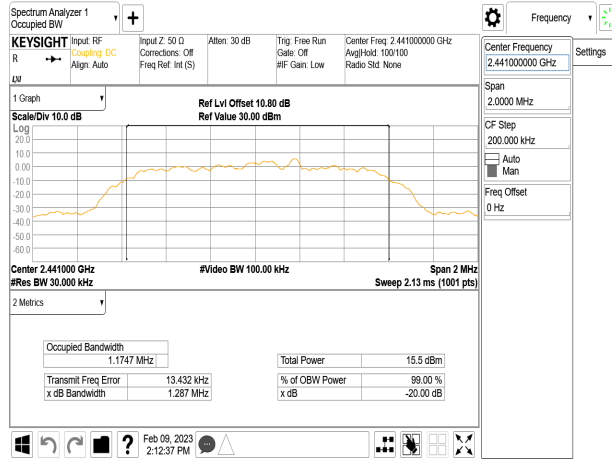
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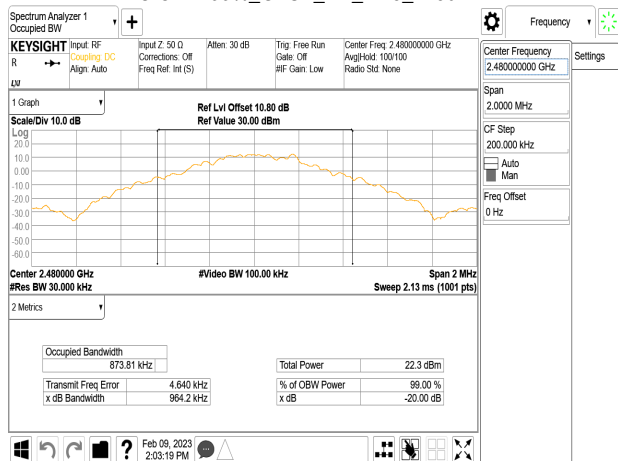
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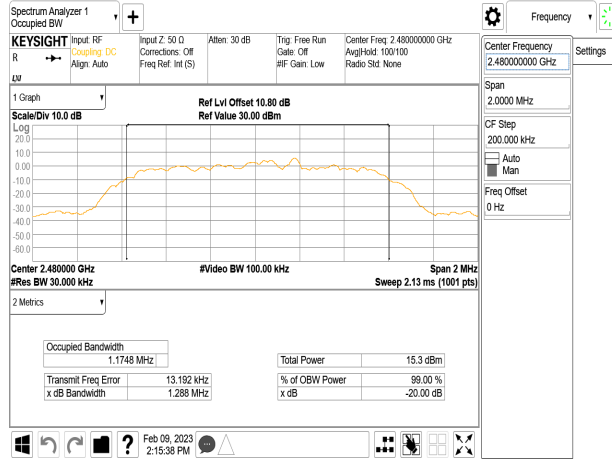
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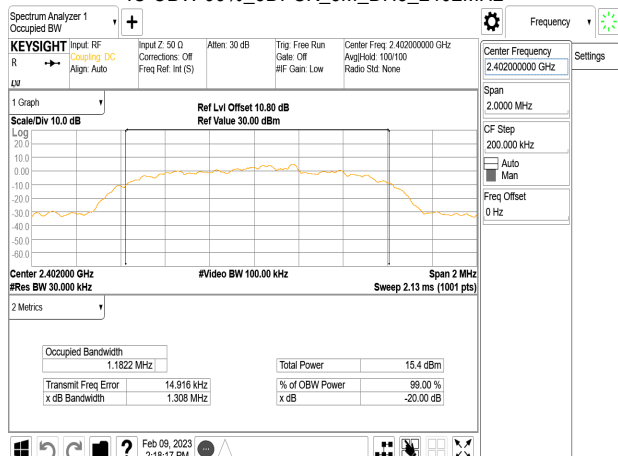


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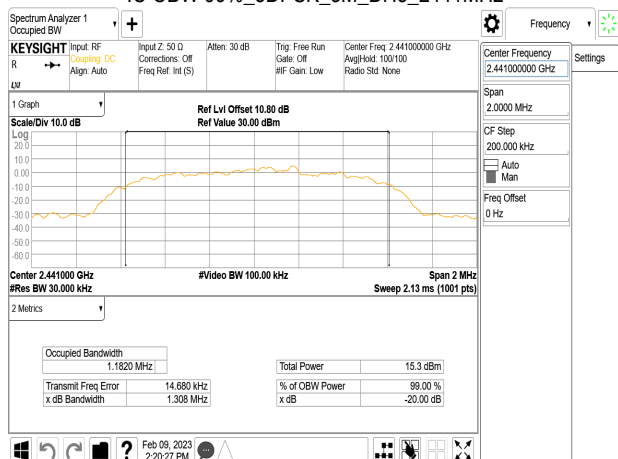
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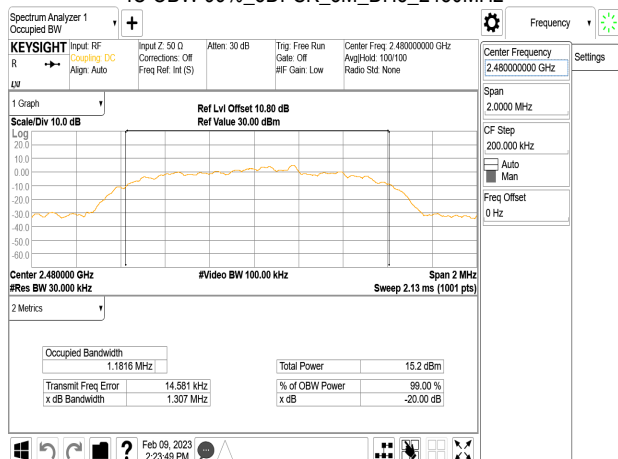
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IC OBW 99%_8DPSK_3M_DH5_2480MHz



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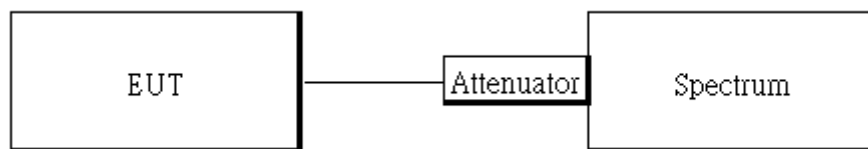
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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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, below 2.4GHz and above 2.4835GHz 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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