

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND RSS 247 REQUIREMENT

OF

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

Product Name: Communication Module

Brand Name: muRata

FCC Model No.: LBEE5XV1VA

IC Model No.: LBEE5XV1VA_3ANT, LBEE5XV1VA_2ANT

Model Difference: LBEE5XV1VA_3ANT: Connect BT_IN to BT_OUT
LBEE5XV1VA_2ANT: Connect BT_IN to 50 ohm termination
resistor

Report Number: T190506W05-RP1

FCC ID: VPYLB1VA

IC: 772C-LB1VA

FCC Rule Part: §15.247, Cat: DSS

IC Rule Part: RSS-247 issue 2 Feb 2017

Issue Date: May 31, 2019

Date of Test: May 07, 2019 ~ May 24, 2018

Date of EUT May 07, 2019

Received:

Note: The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.
The test results of this report relate only to the tested sample identified in this report.

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Peter Weng

Tested By:

Peter Weng / Engineer

Kevin Tsai

Approved By:

Kevin Tsai / Deputy Manager



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T190506W05-RP1	Rev.00	Initial creation of document	All	May 31, 2019	Elle Chang

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1 GENERAL INFORMATION

1.1 Product description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEE5XV1VA
Model Difference:	N/A
Product SW/HW Version:	1.0 / 1.0
Radio SW/HW Version:	1.0 / 1.0
Power Supply:	3.6Vdc

Radio Technology:	Bluetooth_BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + $\pi/4$ DQPSK + 8DPSK
Transmit Power:	10.86 dBm (2ANT) 11.88 dBm (3ANT)
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	$\leq 0.4s$
Antenna Designation:	Dipole Antenna, Antenna Gain: 5.68dBi

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1.2 Test Methodology of Applied Standards

Canada RSS-247 issue 2 Feb. 2017

RSS-Gen. issue 5 Apr. 2018

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas. Guidance v05r02

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,

Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)

FCC Designation number: TW1309

Canada Registration number: 2324G

1.4 Special Accessories

There is no special accessory used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

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

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 μ H/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

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

2.3.3 Radiated Emissions

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

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2.4 Measurement Results Explanation Example

For all conducted test items:

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

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2.5 Configuration of Tested System

Fig. 2-1 Radiated & Conducted Emission Configuration

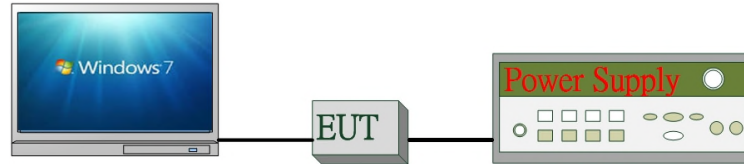


Fig.2-2 Conducted Emission (AC power line) Configuration

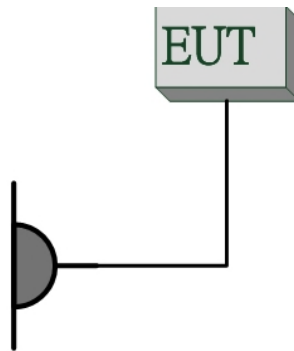


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	KR93300208	N/A	Unshielded
3.	Notebook	N/A	N/A	N/A	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC 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 (2)	Peak Output Power	Compliant
§15.247(a)(1)	RSS-247 §5.1 (1) RSS-Gen §6.7	20dB & 99% Bandwidth	Compliant
§15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	RSS-247 §5.1 (2)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	RSS-247 §5.1 (4)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii)	RSS-247 §5.1 (4)	Time of Occupancy	Compliant
§15.203 §15.247(b)	RSS- Gen §6.8	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 Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

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ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
Peak Output Power, 20dB Band Width				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK, $\pi/4$ -DQPSK, 8-DQPK	DH1/DH3/DH5 2DH1/2DH3/2DH5 3DH1/3DH3/3DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK, $\pi/4$ -DQPSK, 8-DQPK	DH1/DH3/DH5 2DH1/2DH3/2DH5 3DH1/3DH3/3DH5
Band Edge				
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Frequency Separation				
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Number of hopping frequency				
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK	DH5
Time of Occupancy (Dwell time)				
Bluetooth (2ANT)	2402 to 2480	2402, 2441, 2480	GFSK, $\pi/4$ -DQPSK, 8-DQPK	DH1/DH3/DH5 2DH1/2DH3/2DH5 3DH1/3DH3/3DH5
Bluetooth (3ANT)	2402 to 2480	2402, 2441, 2480	GFSK, $\pi/4$ -DQPSK, 8-DQPK	DH1/DH3/DH5 2DH1/2DH3/2DH5 3DH1/3DH3/3DH5

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5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575 dB
Peak Output Power	+/- 1.924 dB
20dB Bandwidth	+/- 147.256 Hz
100 kHz Bandwidth of Frequency Band Edges	+/- 1.924 dB
Frequency Separation	+/- 147.256 Hz
Number of hopping frequency	+/- 147.256 Hz
Time of Occupancy	+/- 147.256 Hz
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12 dB
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68 dB
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18 dB
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47 dB
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81 dB
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87 dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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6 CONDUCTED EMISSION TEST

6.1 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.		

6.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
CABLE	EMCI	CFD300-NL	CERF	06/29/2018	06/28/2019
EMI Test Receiver	R&S	ESCI	100064	07/24/2018	07/23/2019
LISN	SCHWARZBECK	NSLK 8127	8127-541	01/31/2019	01/30/2020
LISN	SCHAFFNER	NNB 41	03/10013	02/13/2019	02/12/2020
Software	EZ-EMC(CCS-3A1-CE)				

6.3 EUT Setup

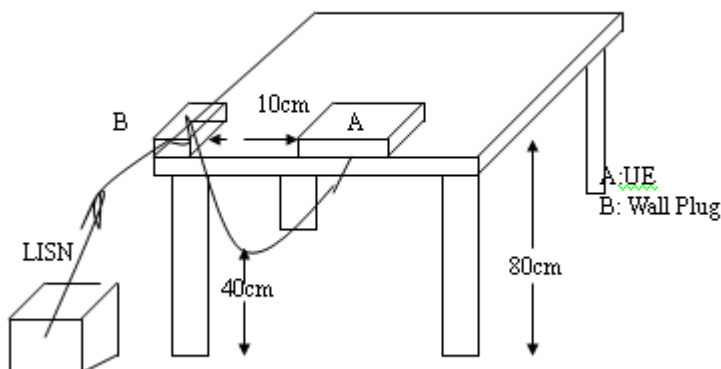
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plan.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6 Measurement Result

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

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

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Description: Operation

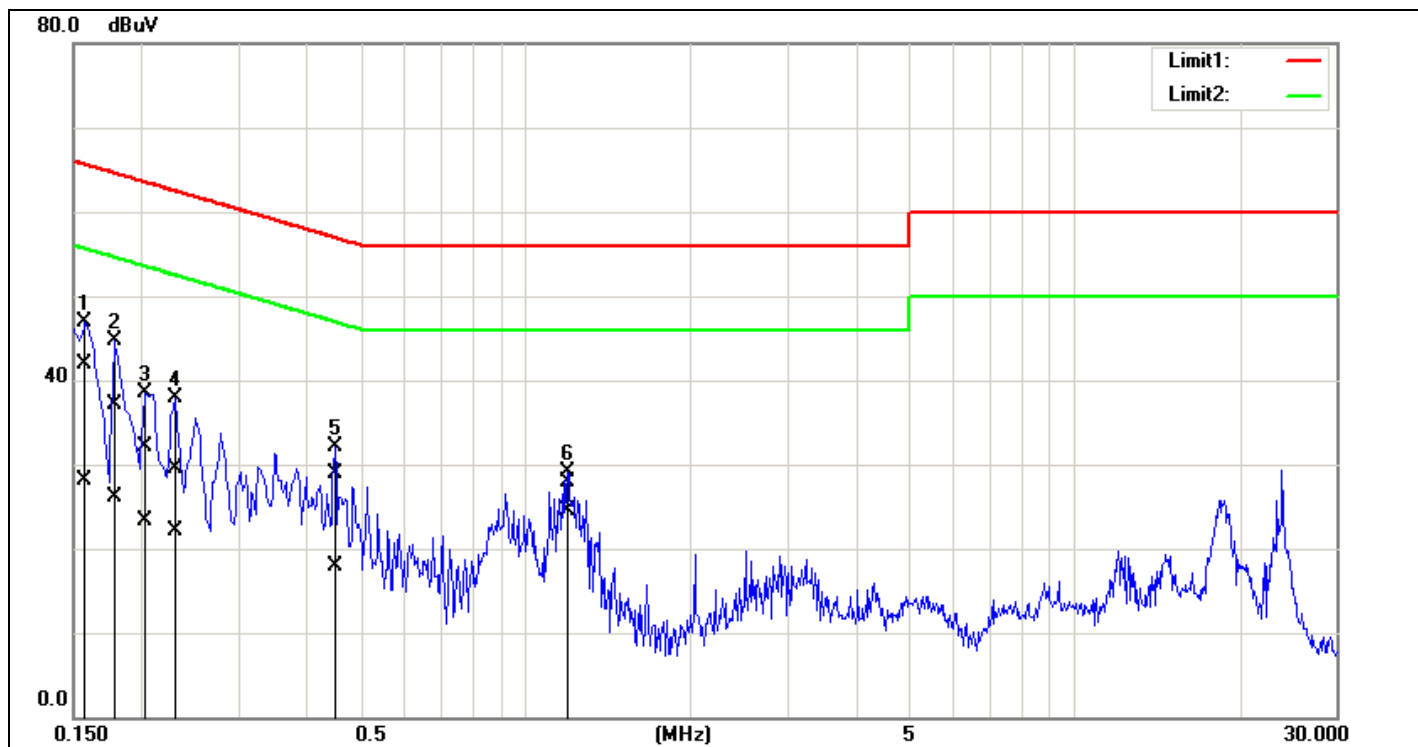
Date: 2019/5/21

Line: L1

Temp.(°C)/Hum.(%): 22.5(°C)/61%

Test Voltage: AC 120V/60Hz

Test By: Peter



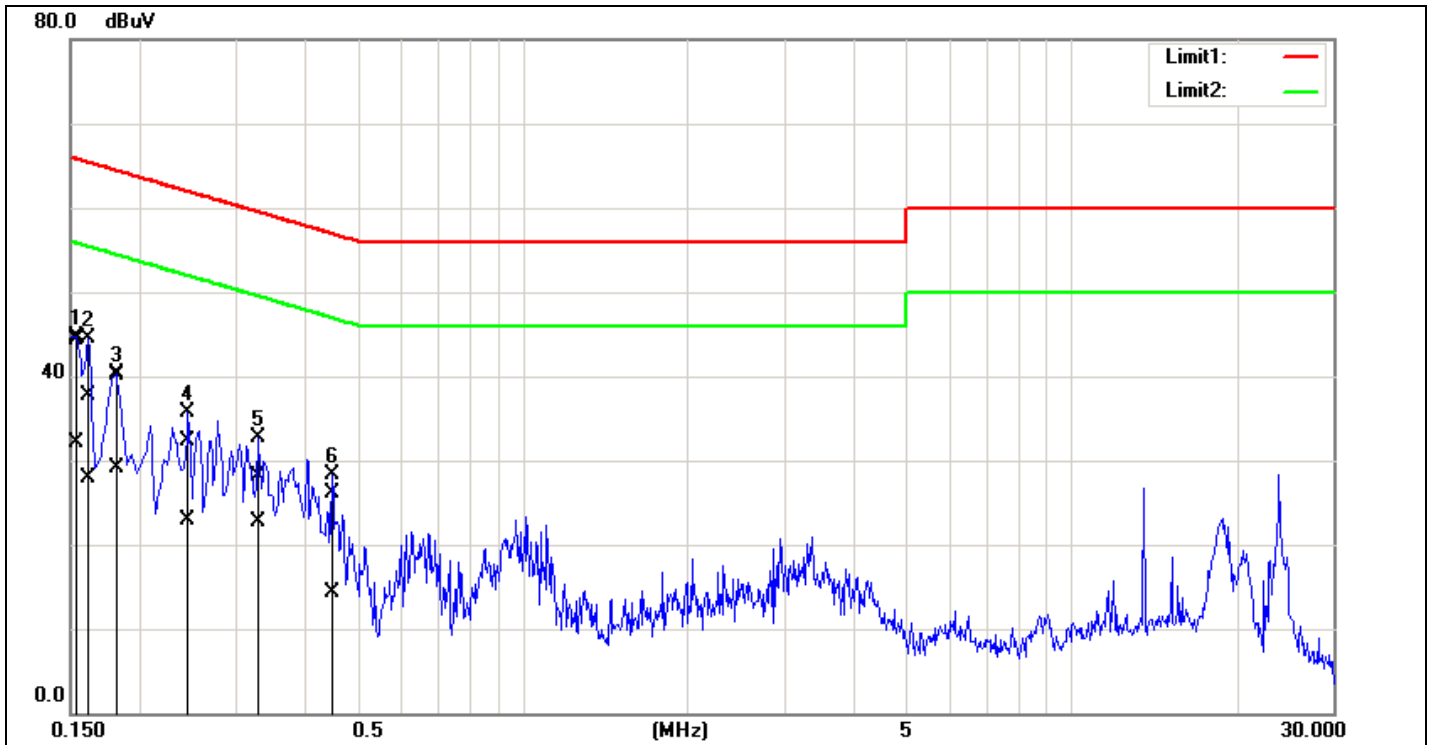
No.	Frequency	QuasiPeak	Average	Correction	QuasiPeak	Average	QuasiPeak	Average	QuasiPeak	Average	Remark
	(MHz)	reading	reading	factor	result	result	limit	limit	margin	margin	
		(dBuV)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
1	0.1580	41.75	28.03	0.16	41.91	28.19	65.56	55.57	-23.65	-27.38	Pass
2	0.1780	36.99	26.02	0.15	37.14	26.17	64.57	54.58	-27.43	-28.41	Pass
3	0.2020	31.99	23.18	0.15	32.14	23.33	63.52	53.53	-31.38	-30.20	Pass
4	0.2300	29.40	21.95	0.15	29.55	22.10	62.45	52.45	-32.90	-30.35	Pass
5	0.4500	28.78	17.84	0.16	28.94	18.00	56.87	46.88	-27.93	-28.88	Pass
6*	1.1940	27.73	24.30	0.19	27.92	24.49	56.00	46.00	-28.08	-21.51	Pass

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Description:	Operation	Date:	2019/5/21
Line:	N	Temp.(°C)/Hum.(%):	22.5(°C)/61%
Test Voltage:	AC 120V/60Hz	Test By:	Peter



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1*	0.1539	44.30	32.05	0.10	44.40	32.15	65.78	55.79	-21.38	-23.64	Pass
2	0.1620	37.55	27.72	0.10	37.65	27.82	65.36	55.36	-27.71	-27.54	Pass
3	0.1819	40.04	28.95	0.10	40.14	29.05	64.39	54.40	-24.25	-25.35	Pass
4	0.2460	32.21	22.84	0.10	32.31	22.94	61.89	51.89	-29.58	-28.95	Pass
5	0.3300	27.90	22.56	0.11	28.01	22.67	59.45	49.45	-31.44	-26.78	Pass
6	0.4500	26.06	14.13	0.11	26.17	14.24	56.87	46.88	-30.70	-32.64	Pass

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7 PEAK OUTPUT POWER MEASUREMENT

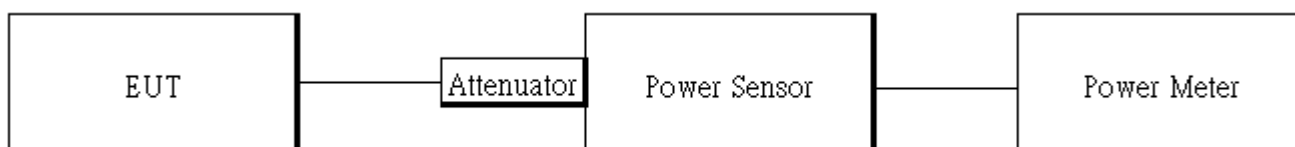
7.1 Standard Applicable

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 and the e.i.r.p. shall not exceed 0.5 W if the hop set uses less than 75 hopping channels.

7.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1242004	10/23/2018	10/22/2019
Power Sensor	Anritsu	MA2411B	1207365	10/23/2018	10/22/2019
Power Sensor	Anritsu	MA2411B	1207368	10/24/2018	10/23/2019
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
DC Power Supply	GWINSTEK	SPS-3610	GPE880163	01/14/2019	01/13/2020
Attenuator	Mini-Circuit	BW-S10W2+	1	02/26/2019	02/25/2020
Attenuator	Mini-Circuit	BW-S10W2+	3	02/26/2019	02/25/2020

7.3 Test Set-up:



7.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013. 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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7.5 Measurement Result

2ANT

1M BR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10.49	11.194	1000
Mid	2441	10.86	12.190	1000
High	2480	10.15	10.351	1000

1M BR mode (Average):

CH	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10.37	10.899	1000
Mid	2441	10.18	10.432	1000
High	2480	10.01	10.032	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	7.95	6.237	125
Mid	2441	9.07	8.072	125
High	2480	8.52	7.112	125

2M EDR mode (Average):

CH	Freq. (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5.49	3.537	125
Mid	2441	5.59	3.619	125
High	2480	6.01	3.987	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8.23	6.653	125
Mid	2441	9.28	8.472	125
High	2480	8.65	7.328	125

3M EDR mode (Average):

CH	Freq. (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5.56	3.595	125
Mid	2441	5.62	3.645	125
High	2480	6.03	4.005	125

NOTE: cable loss as 0.957dB that offsets in the sp

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

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1M BR mode EIRP

Channel	Frequency (MHz)	Max. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	10.37	5.68	40.307	4000
Mid	2441	10.18	5.68	38.582	4000
High	2480	10.01	5.68	37.101	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	5.49	5.68	13.081	4000
Mid	2441	5.59	5.68	13.386	4000
High	2480	6.01	5.68	14.745	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	5.56	5.68	13.293	4000
Mid	2441	5.62	5.68	13.478	4000
High	2480	6.03	5.68	14.813	4000

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

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3ANT

1M BR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	11.57	14.355	1000
Mid	2441	11.88	15.417	1000
High	2480	11.15	13.032	1000

1M BR mode (Average):

CH	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10.98	12.542	1000
Mid	2441	10.93	12.399	1000
High	2480	10.96	12.485	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.95	9.886	125
Mid	2441	10.53	11.298	125
High	2480	9.89	9.750	125

2M EDR mode (Average):

CH	Freq. (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	7.85	6.101	125
Mid	2441	7.81	6.045	125
High	2480	7.76	5.976	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10.04	10.093	125
Mid	2441	10.63	11.561	125
High	2480	10.02	10.046	125

3M EDR mode (Average):

CH	Freq. (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	7.83	6.073	125
Mid	2441	7.76	5.976	125
High	2480	7.76	5.976	125

NOTE: cable loss as 0.843dB that offsets in the sp

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

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1M BR mode EIRP

Channel	Frequency (MHz)	Max. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	10.98	5.68	46.386	4000
Mid	2441	10.93	5.68	45.855	4000
High	2480	10.96	5.68	46.172	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	7.85	5.68	22.562	4000
Mid	2441	7.81	5.68	22.355	4000
High	2480	7.76	5.68	22.100	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	7.83	5.68	22.459	4000
Mid	2441	7.76	5.68	22.100	4000
High	2480	7.76	5.68	22.100	4000

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

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8 20dB & 99% BANDWIDTH MEASUREMENT

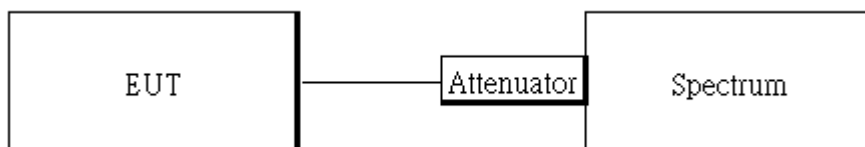
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Power Supply	GWINSTEK	SPS-3610	GPE880163	01/14/2019	01/13/2020
DC Block	Mini-Circuits	BLK-18-S+	31129(1)	02/26/2019	02/25/2020
Attenuator	Mini-Circuit	BW-S10W2+	1	02/26/2019	02/25/2020

8.3 Test Set-up



8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013. Measurement Guidelines.
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=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 3MHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and -20dB (upper and lower) frequency
6. Turn on the 99% bandwidth function, max reading.
7. Repeat above procedures until all test default channel is completed

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8.5 Measurement Result

2ANT

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9405	0.63
Mid	0.9235	0.62
High	0.9245	0.62

$\pi/4$ -DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.328	0.89
Mid	1.330	0.89
High	1.329	0.89

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.288	0.86
Mid	1.291	0.86
High	1.306	0.87

GFSK

CH	99% Bandwidth (MHz)
Low	0.88146
Mid	0.87978
High	0.88019

$\pi/4$ -DQPSK

CH	99% Bandwidth (MHz)
Low	1.2142
Mid	1.2183
High	1.2176

8-DPSK

CH	99% Bandwidth (MHz)
Low	1.2172
Mid	1.2185
High	1.2176

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3ANT

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9237	0.62
Mid	0.9243	0.62
High	0.9242	0.62

$\pi/4$ -DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.330	0.89
Mid	1.331	0.89
High	1.331	0.89

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.287	0.86
Mid	1.290	0.86
High	1.290	0.86

GFSK

CH	99% Bandwidth (MHz)
Low	0.87075
Mid	0.87134
High	0.87177

$\pi/4$ -DQPSK

CH	99% Bandwidth (MHz)
Low	1.2125
Mid	1.2169
High	1.2117

8-DPSK

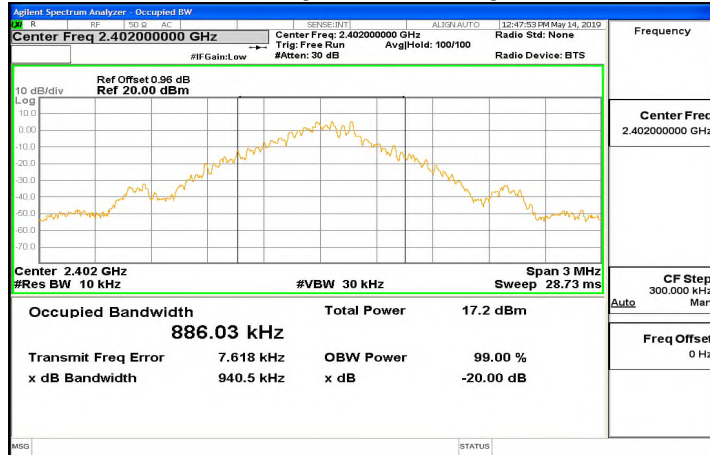
CH	99% Bandwidth (MHz)
Low	1.2176
Mid	1.2187
High	1.2160

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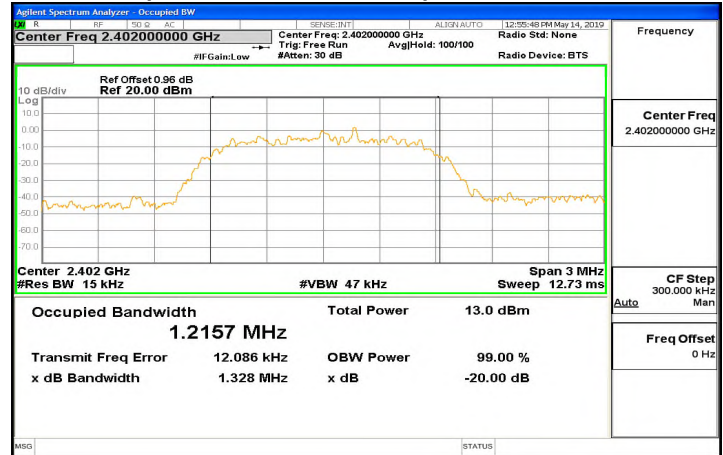
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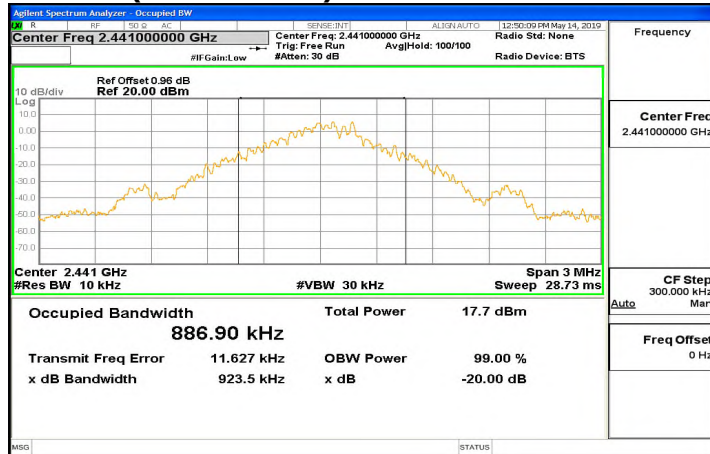
2ANT 20 dB BW CH-Low (GFSK mode)



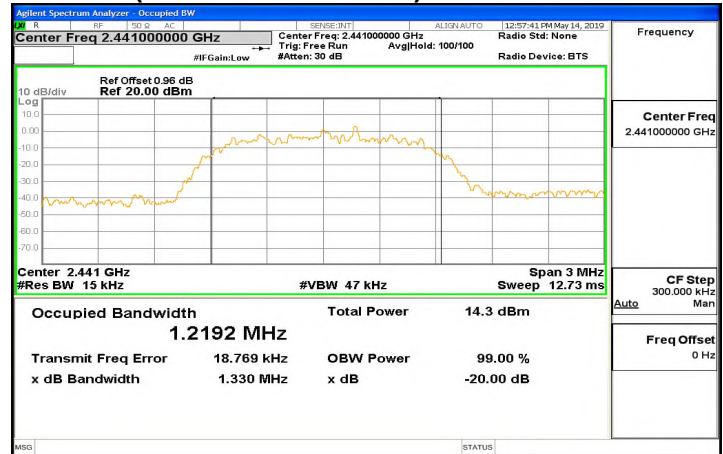
CH-Low ($\pi/4$ -DQPSK mode)



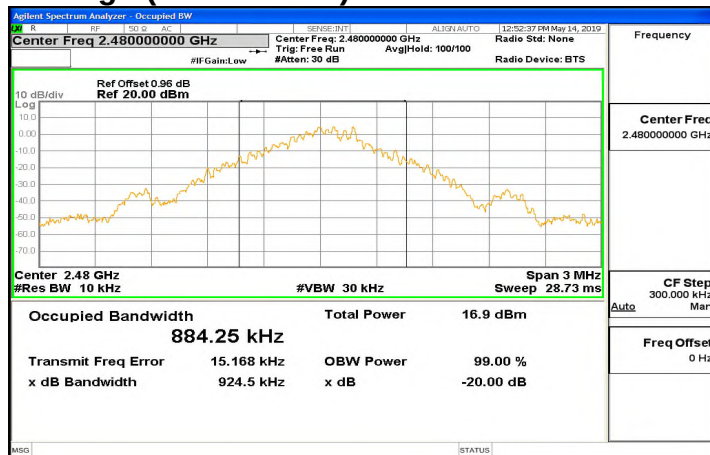
CH-Mid (GFSK mode)



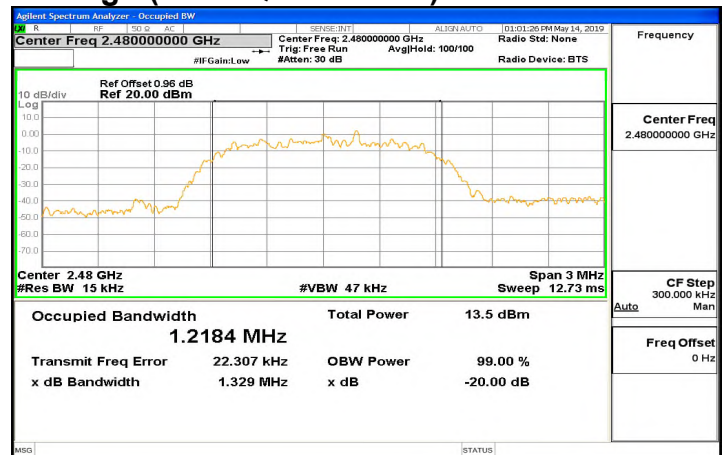
CH-Mid ($\pi/4$ -DQPSK mode)



CH-High (GFSK mode)



CH-High ($\pi/4$ -DQPSK mode)

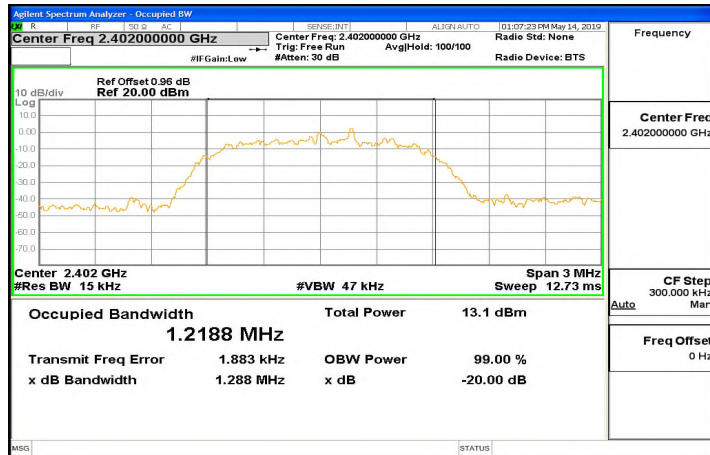


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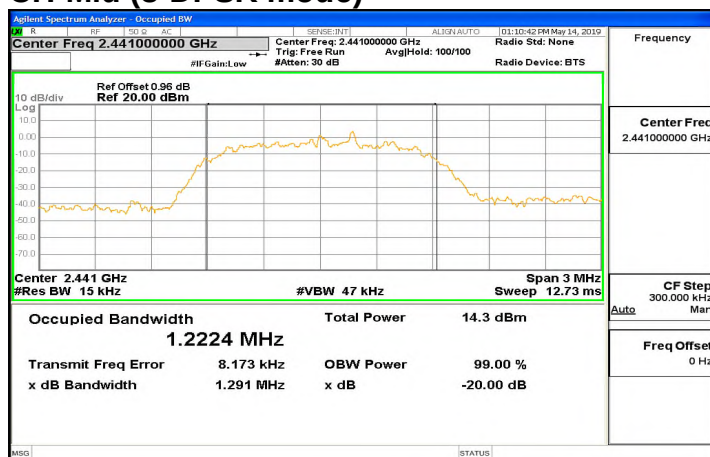
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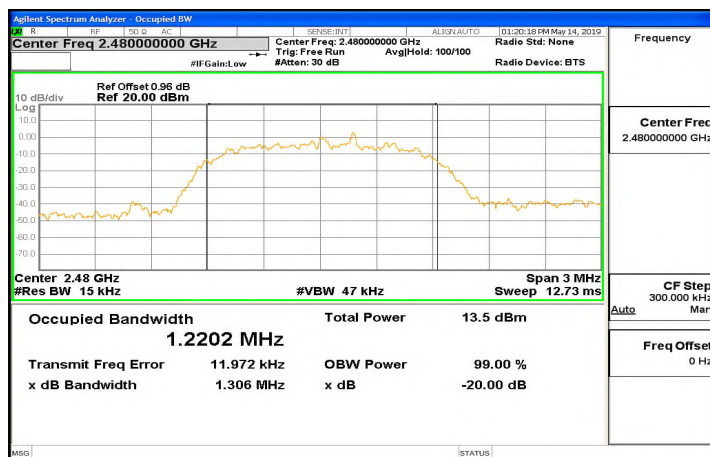
CH-Low (8-DPSK mode)



CH-Mid (8-DPSK mode)



CH-High (8-DPSK mode)

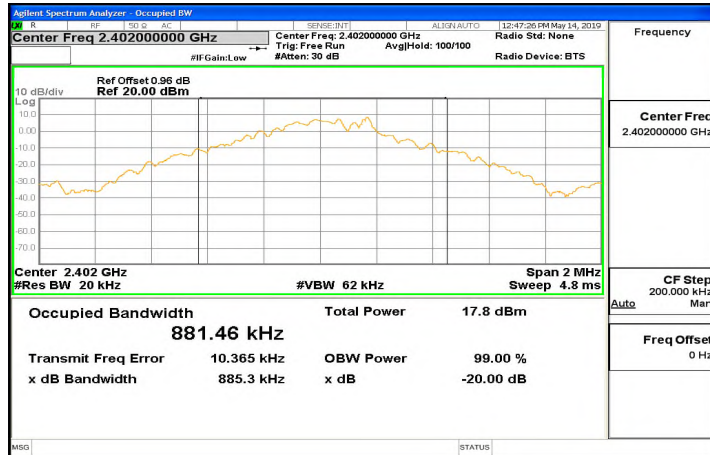


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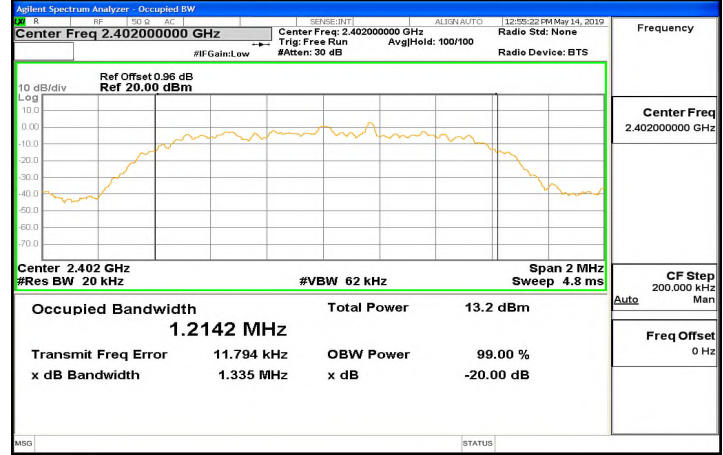
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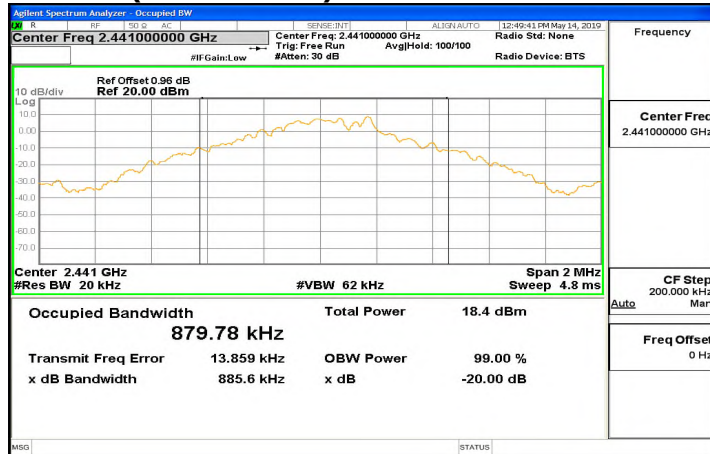
99% Bandwidth BW CH-Low (GFSK mode)



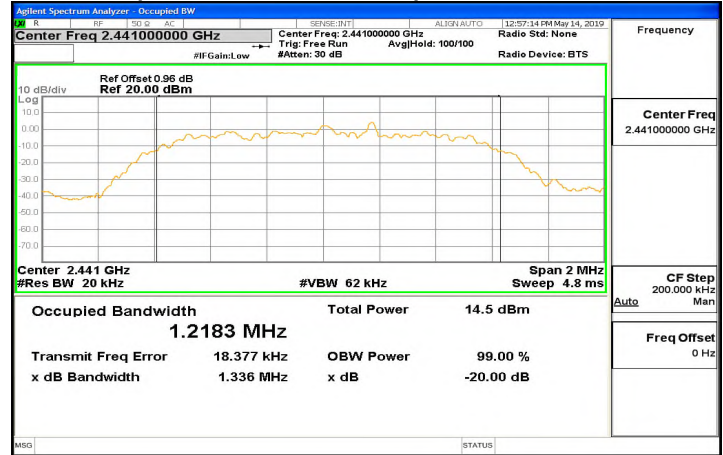
CH-Low ($\pi/4$ -DQPSK mode)



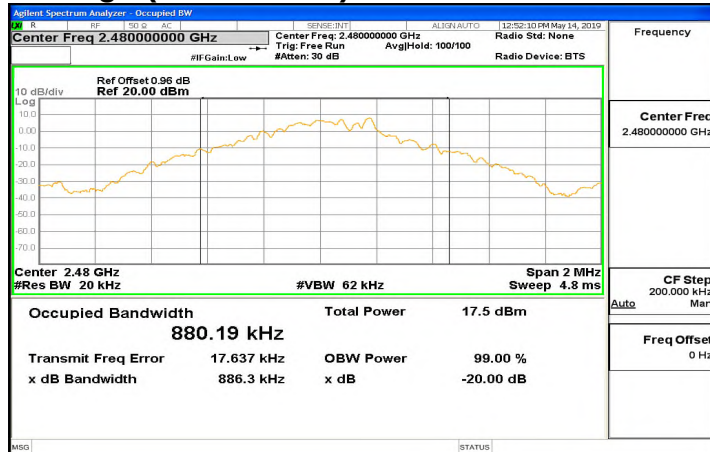
CH-Mid (GFSK mode)



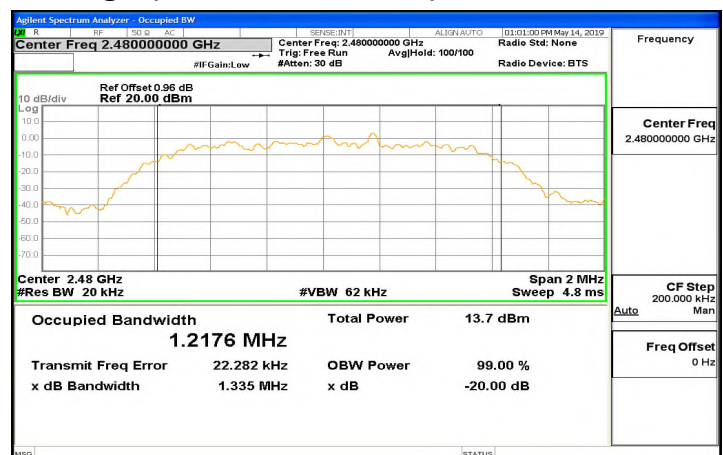
CH-Mid ($\pi/4$ -DQPSK mode)



CH-High (GFSK mode)



CH-High ($\pi/4$ -DQPSK mode)

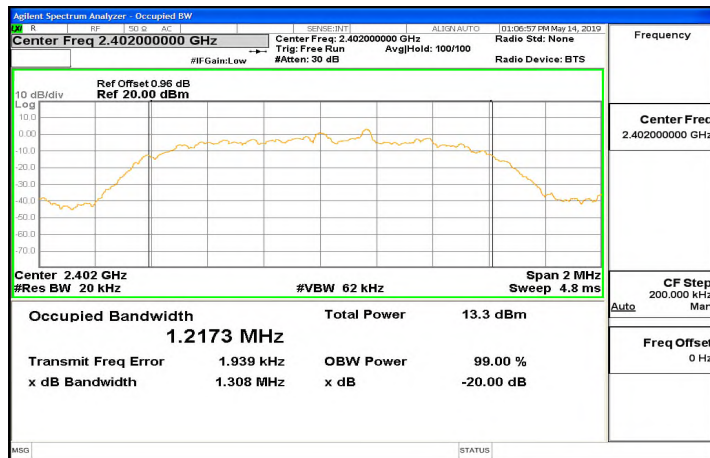


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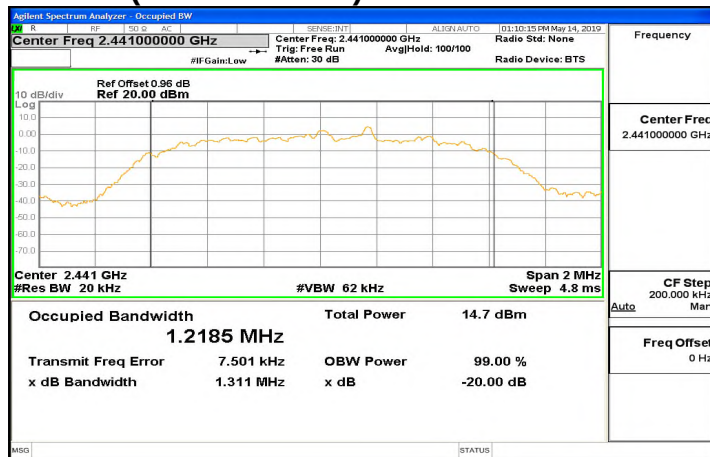
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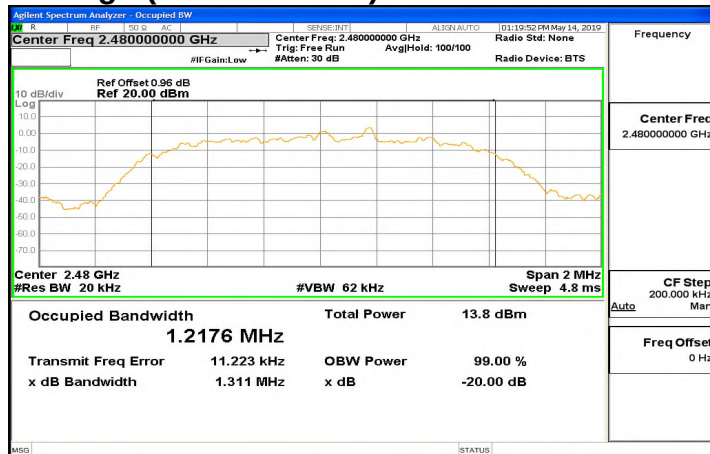
CH-Low (8-DPSK mode)



CH-Mid (8-DPSK mode)



CH-High (8-DPSK mode)



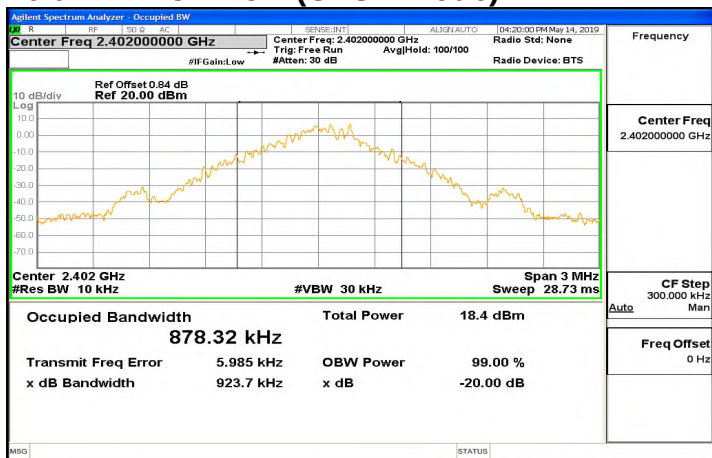
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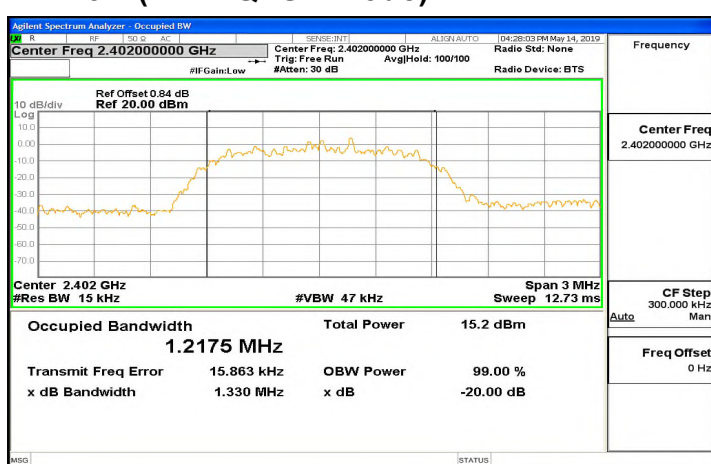
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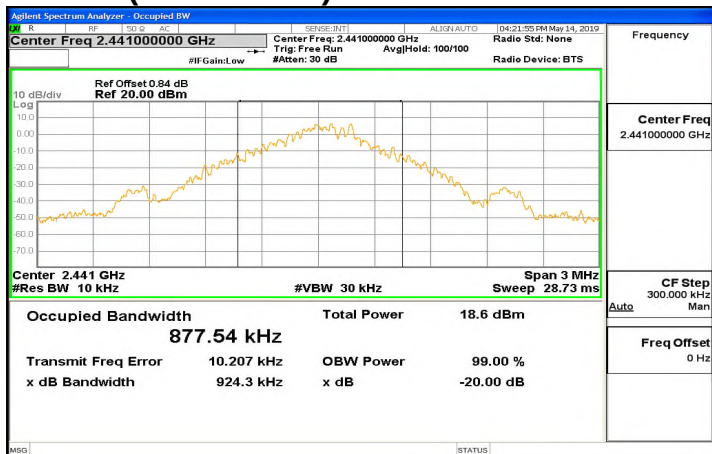
20 dB BW CH-Low (GFSK mode)



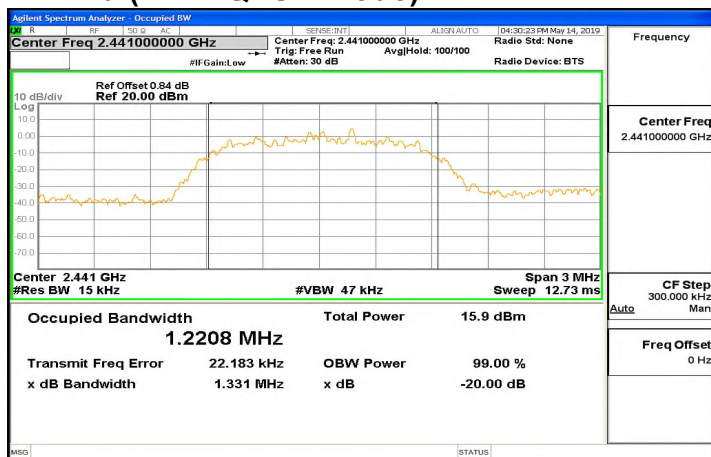
CH-Low ($\pi/4$ -DQPSK mode)



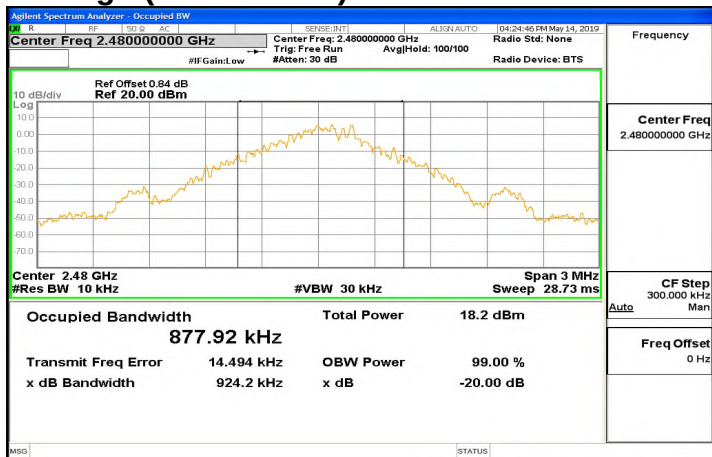
CH-Mid (GFSK mode)



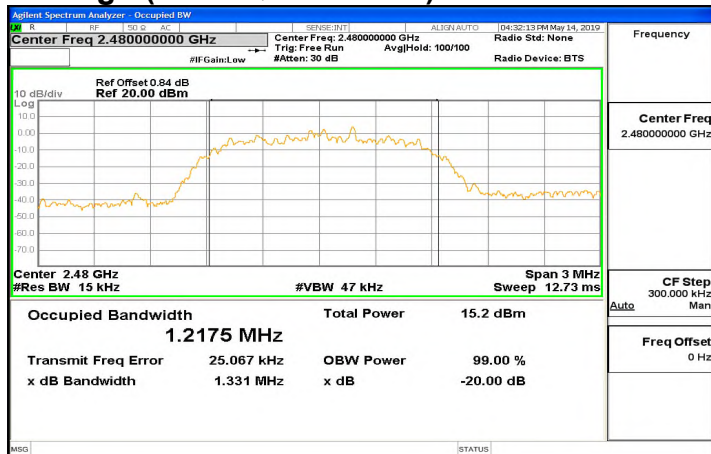
CH-Mid ($\pi/4$ -DQPSK mode)



CH-High (GFSK mode)



CH-High ($\pi/4$ -DQPSK mode)

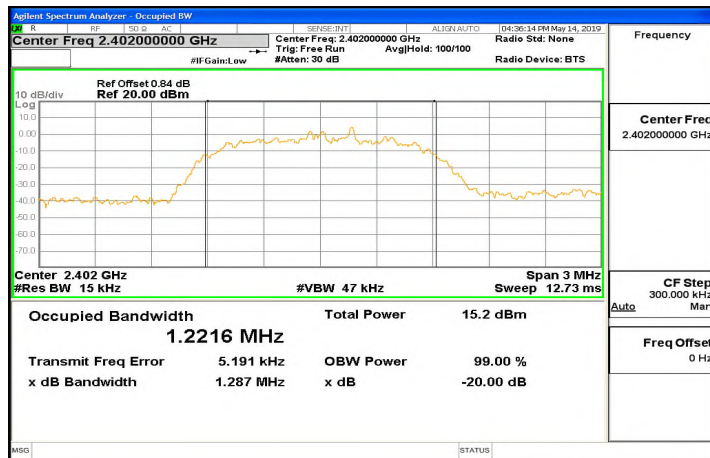


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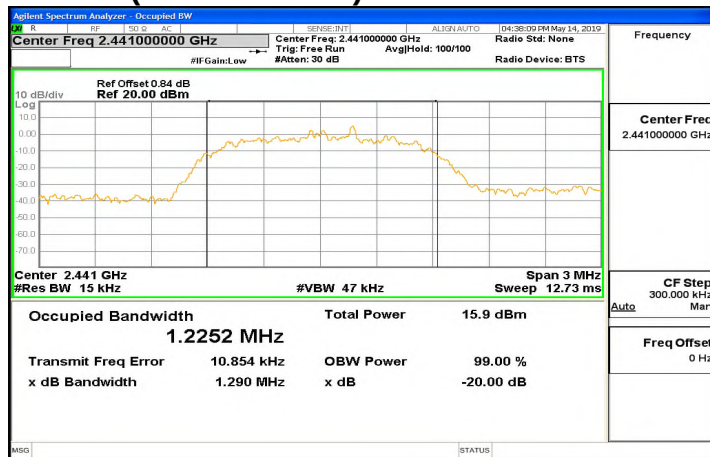
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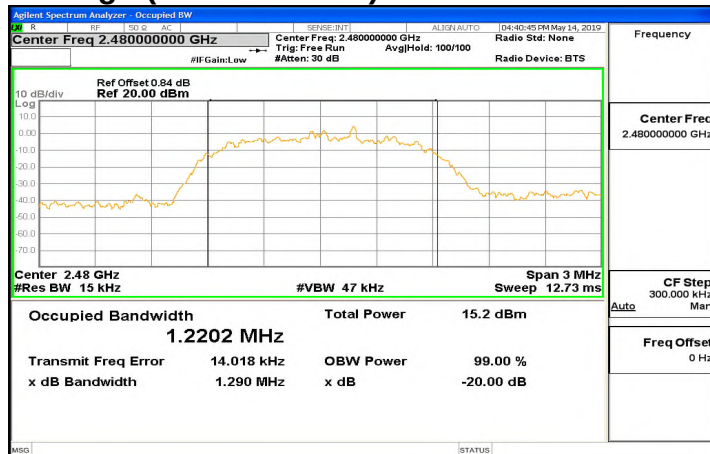
CH-Low (8-DPSK mode)



CH-Mid (8-DPSK mode)



CH-High (8-DPSK mode)

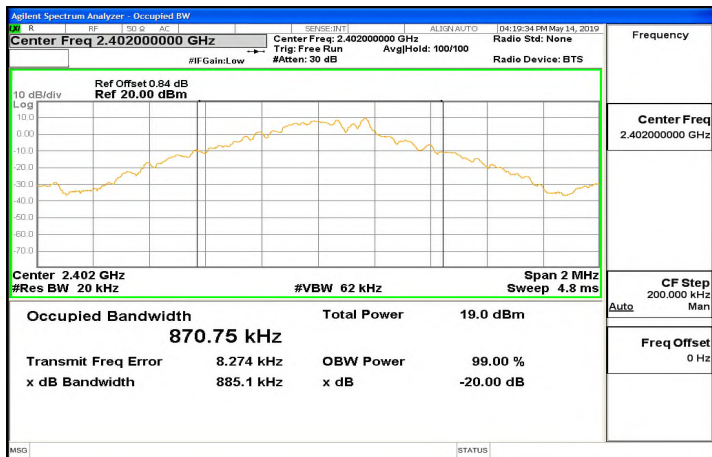


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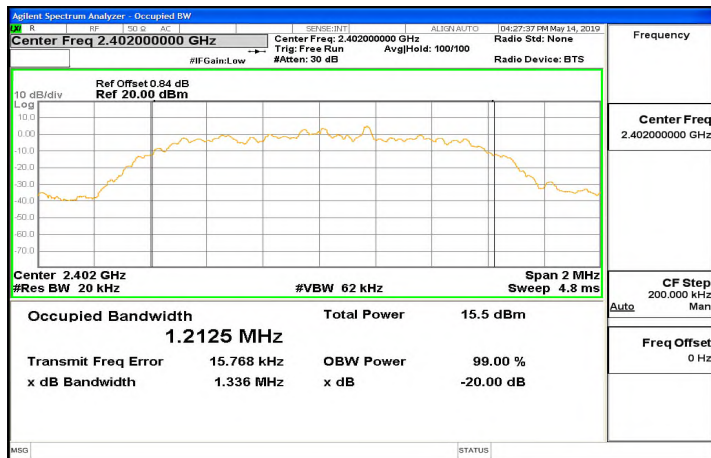
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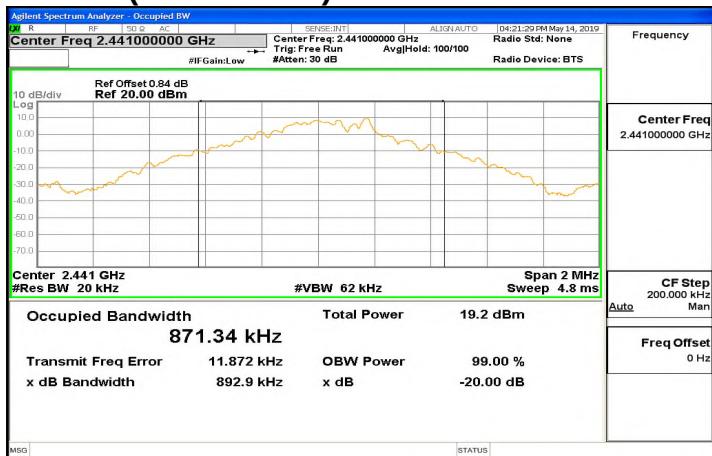
99% Bandwidth BW CH-Low (GFSK mode)



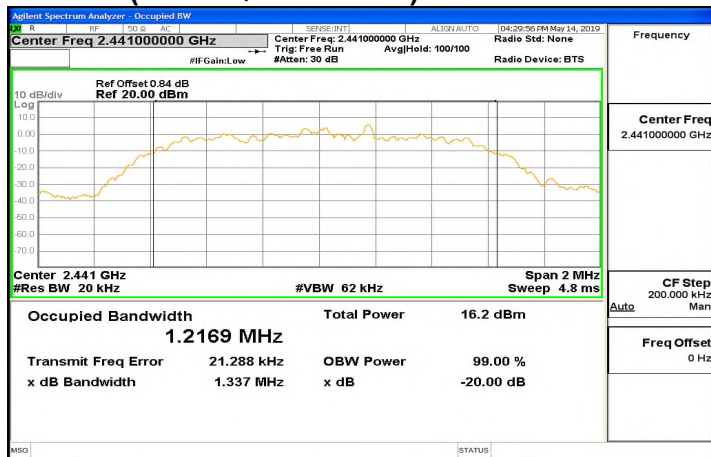
CH-Low ($\pi/4$ -DQPSK mode)



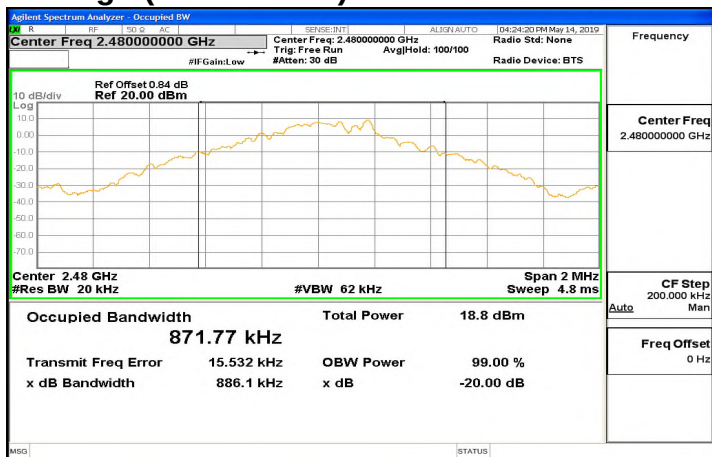
CH-Mid (GFSK mode)



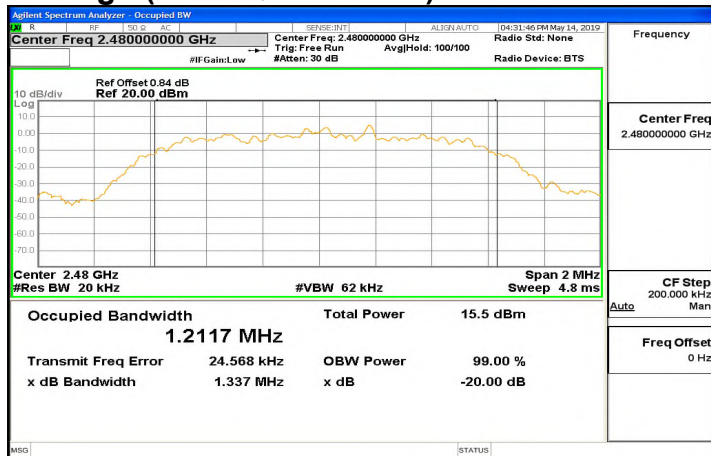
CH-Mid ($\pi/4$ -DQPSK mode)



CH-High (GFSK mode)



CH-High ($\pi/4$ -DQPSK mode)

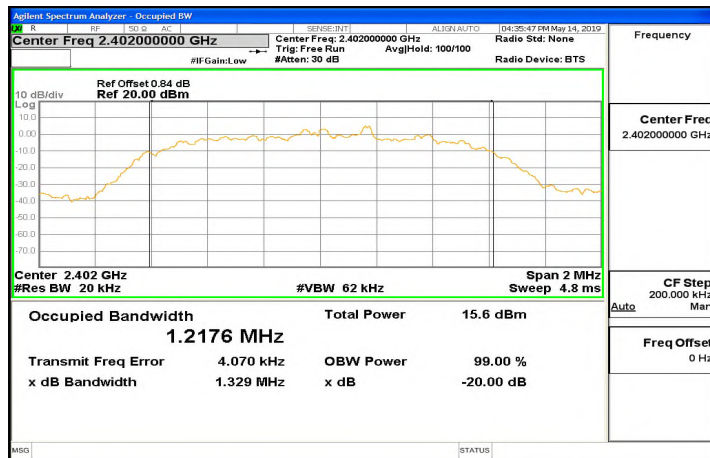


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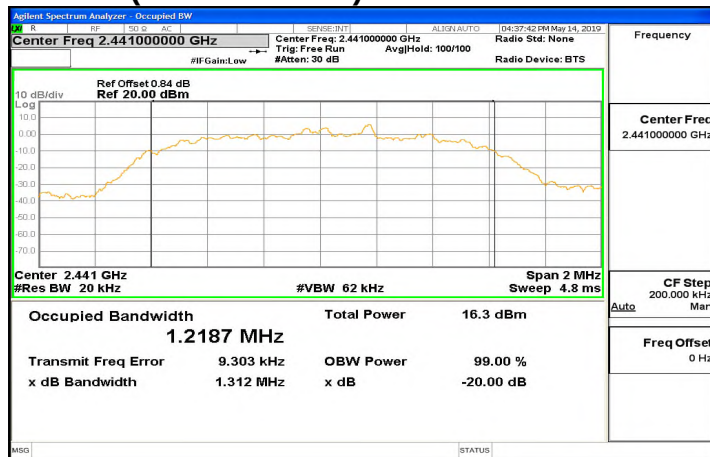
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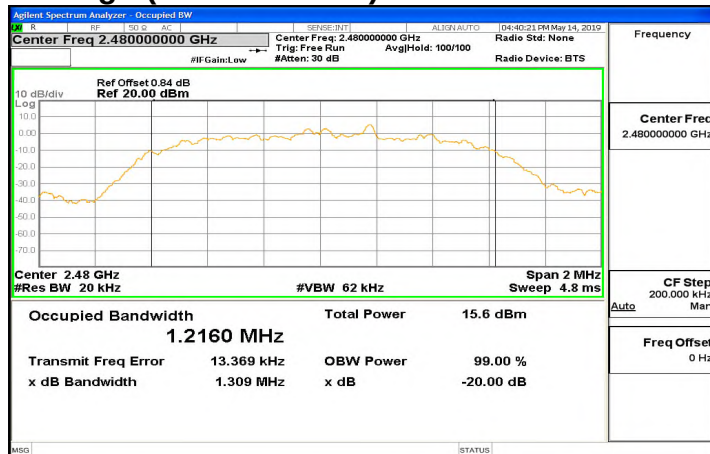
CH-Low (8-DPSK mode)



CH-Mid (8-DPSK mode)



CH-High (8-DPSK mode)



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

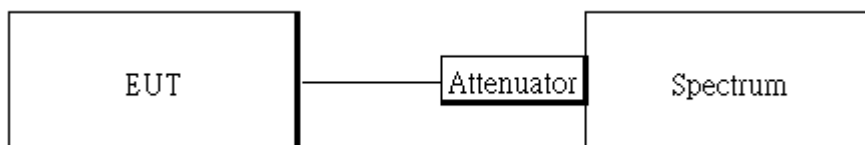
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Power Supply	GWINSTEK	SPS-3610	GPE880163	01/14/2019	01/13/2020
DC Block	Mini-Circuits	BLK-18-S+	31129(1)	02/26/2019	02/25/2020
Attenuator	Mini-Circuit	BW-S10W2+	1	02/26/2019	02/25/2020

9.3 Test SET-UP



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9.4 Measurement Procedure

Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013. Measurement Guidelines.
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.

Conducted Spurious Emission:

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

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.5 Measurement Result

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

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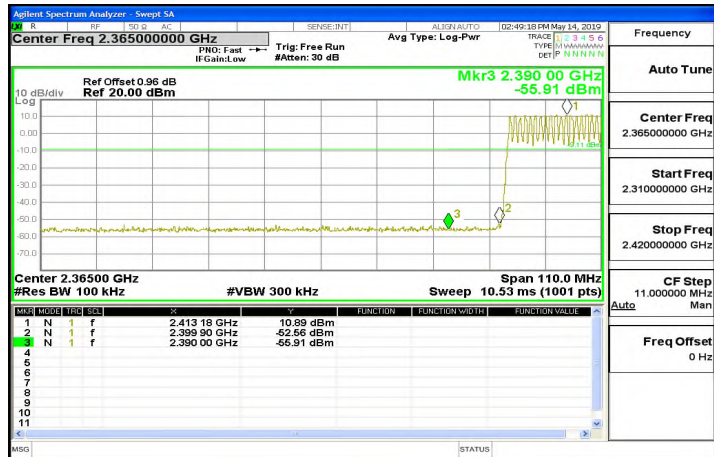
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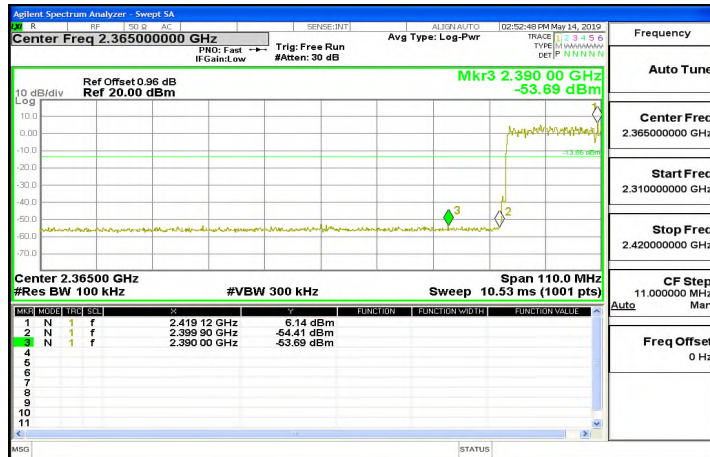
2ANT

Hopping mode

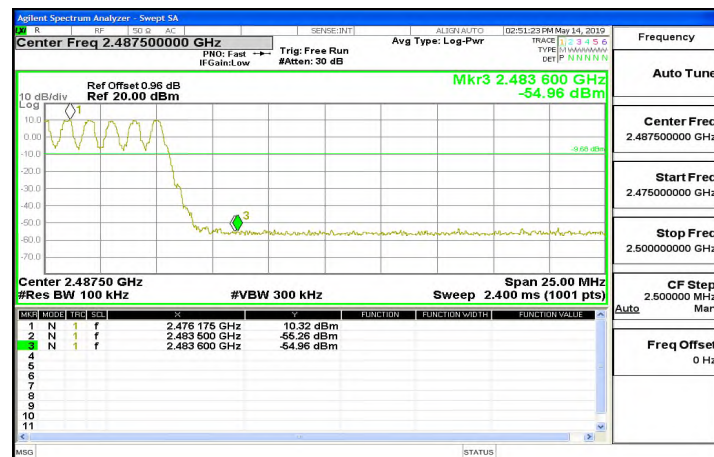
BR Band Edge CH-Low



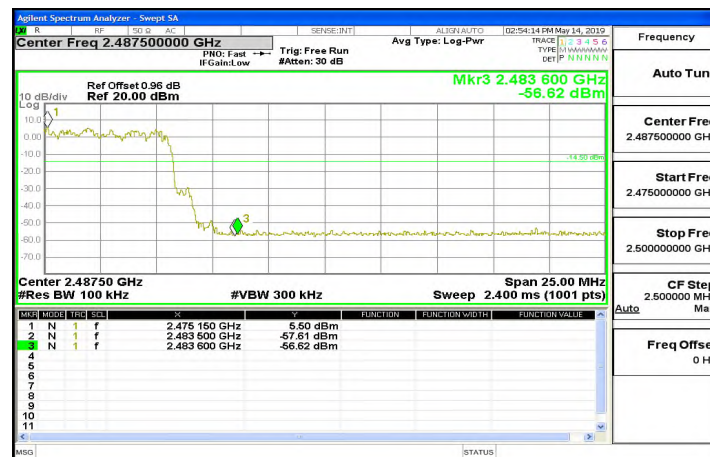
EDR Band Edge CH-Low



BR Band Edge CH-High



EDR Band Edge CH-High



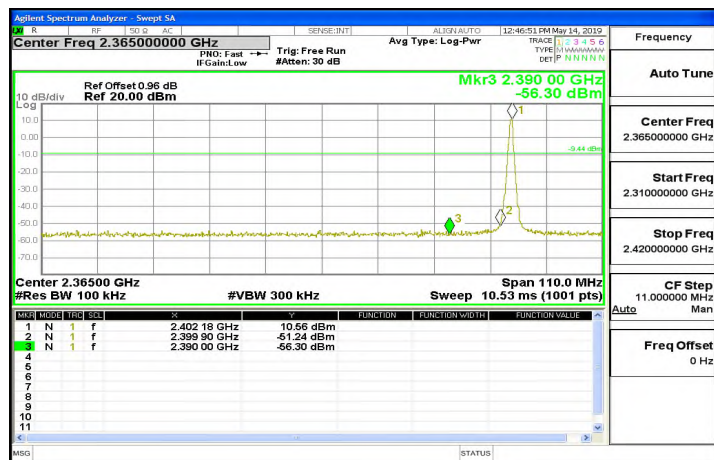
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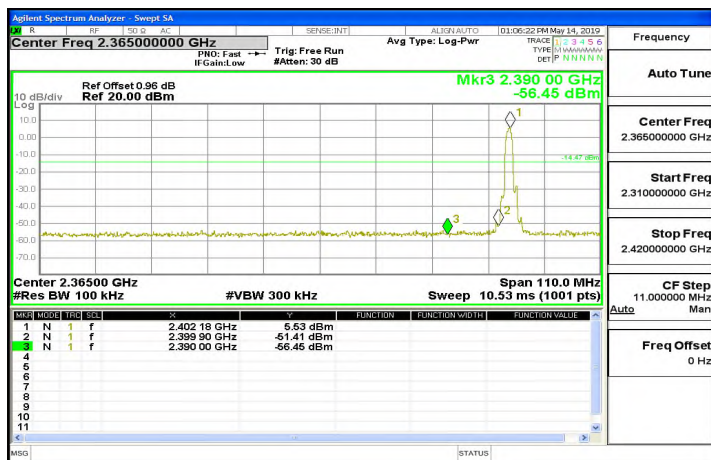
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Non-Hopping

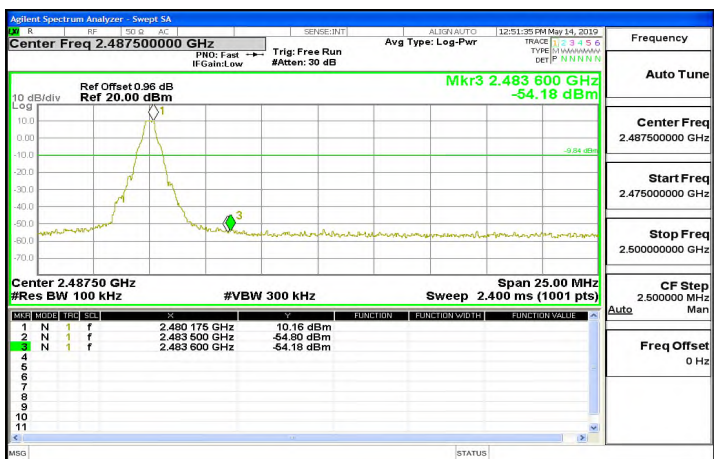
BR Band Edge CH-Low



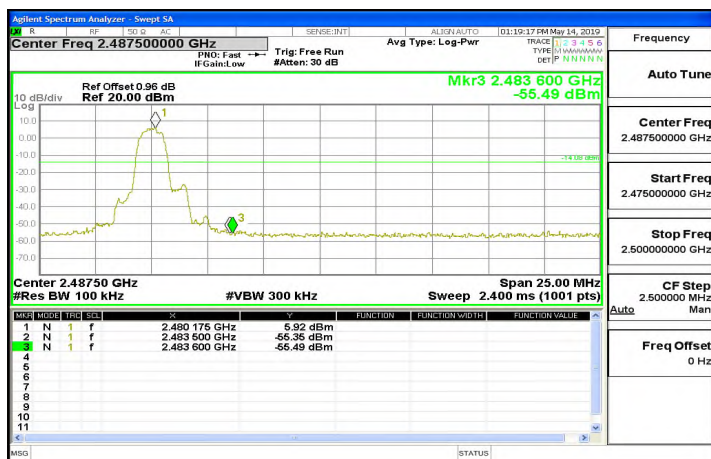
EDR Band Edge CH-Low



BR Band Edge CH-High



EDR Band Edge CH-High

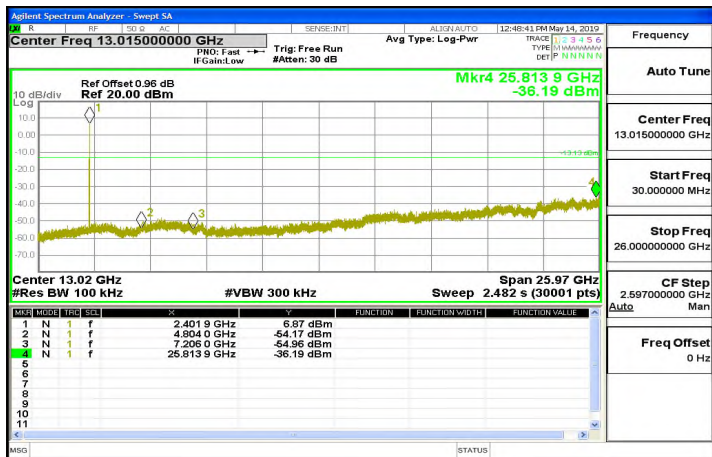


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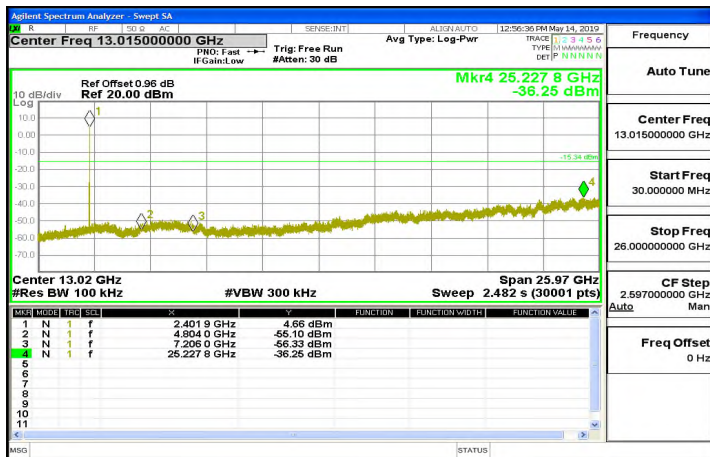
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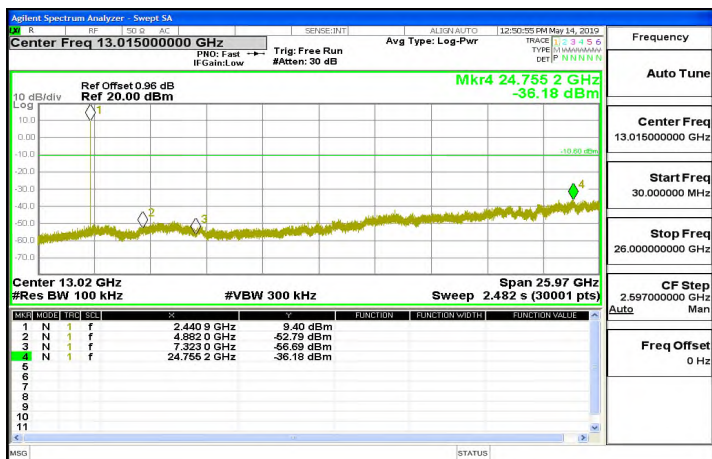
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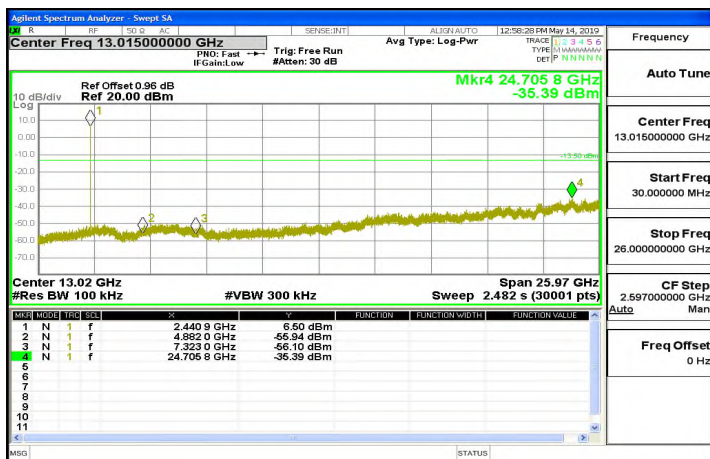
Spurious Emission_π4DQPSK_2M_DH5_2402MHz



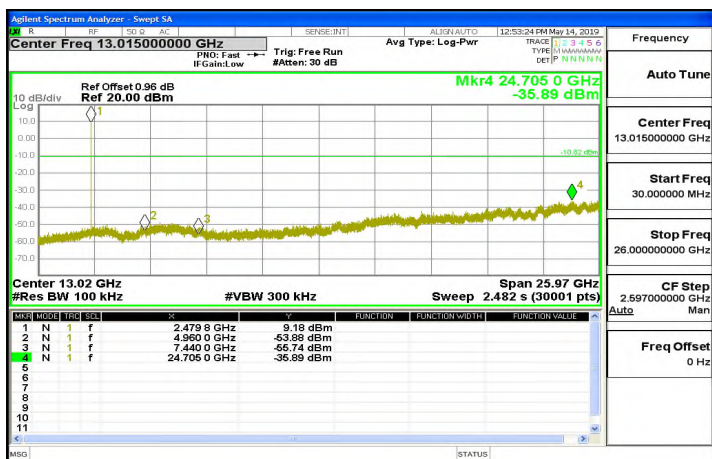
Spurious Emission_GFSK_1M_DH5_2441MHz



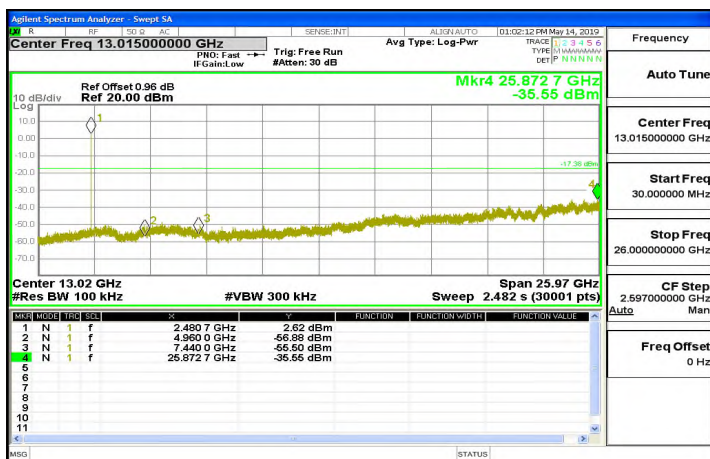
Spurious Emission_π4DQPSK_2M_DH5_2441MHz



Spurious Emission_GFSK_1M_DH5_2480MHz



Spurious Emission_π4DQPSK_2M_DH5_2480MHz

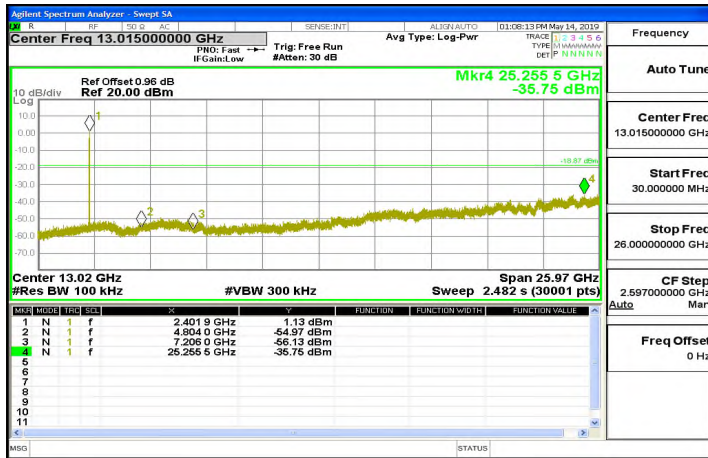


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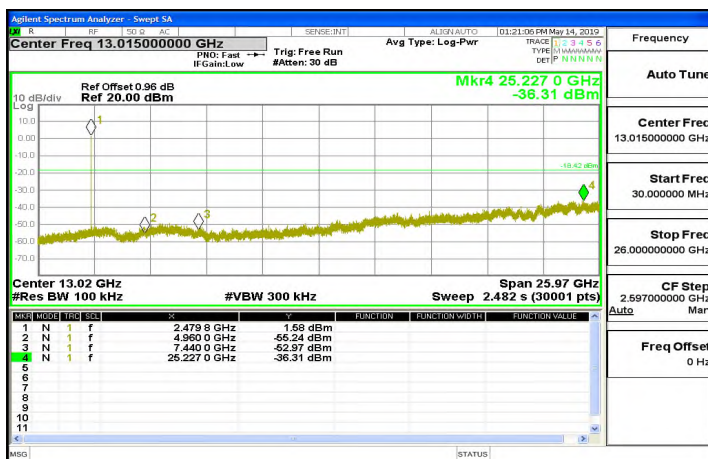
Spurious Emission_8DPSK_3M_DH5_2402MHz



Spurious Emission_8DPSK_3M_DH5_2441MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



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