



Shenzhen GUOREN Certification Technology Service Co., Ltd.

101#, Building K & Building T, The Second Industrial Zone, Jiazitang Community,
Fenghuang Street, Guangming District, Shenzhen, China

FCC PART 15 SUBPART C TEST REPORT
FCC PART 15.247

Report Reference No...... : GRCTR231202012-01

FCC ID..... : 2BF67-PZPA055

Compiled by

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Date of issue.....: Jan. 05, 2024

Testing Laboratory Name.....: **Shenzhen GUOREN Certification Technology Service Co., Ltd.**

Address.....: 101#, Building K & Building T, The Second Industrial Zone, Jiazitang Community, Fenghuang Street, Guangming District, Shenzhen, China

Applicant's name.....: **Puzhen Life LLC**

Address.....: 420 E Main St, 2nd Fl, Middletown, NY10940

Test specification.....:

Standard.....: **FCC Part 15.247**

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Test item description.....: **Gemini Diffuser**

Trade Mark.....: /

Manufacturer.....: Puzhen Life Co., Ltd.

Model/Type reference.....: PZ-PA055

Listed Models: /

Firmware Version.....: V1.0

Hardware Version.....: V1.0

Modulation: GFSK, $\pi/4$ DQPSK, 8DPSK

Frequency.....: From 2402MHz to 2480MHz

Rating.....: 5.0V $\overline{\text{---}}$, 2.0A(charged by Power Adapter) or
3.6V $\overline{\text{---}}$, 5200mAh (By Li-ion rechargeable battery)

Result.....: **PASS**

TEST REPORT

Equipment under Test : Gemini Diffuser

Model /Type : PZ-PA055

Listed Models : /

Applicant : **Puzhen Life LLC**

Address : 420 E Main St, 2nd Fl, Middletown, NY10940

Manufacturer : **Puzhen Life Co., Ltd.**

Address : Unit S7,2/F., W LUXE,5 On Yiu Street, Shatin, NT, Hong Kong

Test Result:	PASS
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Dec. 12, 2023
Testing commenced on	:	Dec. 12, 2023
Testing concluded on	:	Jan. 05, 2024

2.2 Product Description

Product Name:	Gemini Diffuser
Model/Type reference:	PZ-PA055
Listed Models:	/
Power supply:	5.0V $\overline{\text{---}}$,2.0A(charged by Power Adapter) or 3.6V $\overline{\text{---}}$,5200mAh (By Li-ion rechargeable battery)
Adapter 1 Information:	Model:NBS10B050200VUU Input:AC100-240V 50/60Hz, 0.3A Output:DC 5V,2A
Adapter 2 Information:	Model:NBS10B050200VCU Input:AC100-240V 50/60Hz, 0.3A Output:DC 5V,2A
Testing sample ID:	GRCTR231202012-1# (Engineer sample), GRCTR231202012-2# (Normal sample)
Bluetooth	
Supported Type:	Bluetooth BR/EDR
Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB antenna
Antenna gain*(Supplied by the customer):	1.7 dBi
Remark:*When the information provided by the customer was used to calculate test results, if the information provided by the customer is not accurate, shenzhen GUOREN Certification Technology Service Co., Ltd. does not assume any responsibility.	

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	☐ 230V / 50 Hz	☐ 120V / 60Hz
		☐ 12 V DC	☐ 24 V DC
		☒ Other (specified in blank below)	

DC 5.0V From external circuit

2.4 Short description of the Equipment under Test (EUT)

This is a Gemini Diffuser.

For more details, refer to the user's manual of the EUT.

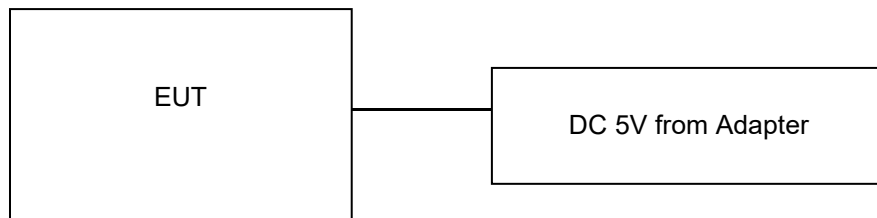
2.5 EUT operation mode

The Applicant provides communication tools software(SecureCRT) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

Operation Frequency:

Channel	Frequency (MHz)
00	2402
01	2403
⋮	⋮
38	2440
39	2441
40	2442
⋮	⋮
77	2479
78	2480

2.6 Block Diagram of Test Setup



2.7 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen GUOREN Certification Technology Service Co., Ltd.

101#, Building K & Building T, The Second Industrial Zone, Jiazitang Community, Fenghuang Street, Guangming District, Shenzhen, China

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 920798 Designation Number: CN1304

Shenzhen GUOREN Certification Technology Service Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6202.01

Shenzhen GUOREN Certification Technology Service Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

ISED#: 27264 CAB identifier: CN0115

Shenzhen GUOREN Certification Technology Service Co., Ltd. has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

CNAS-Lab Code: L15631

Shenzhen GUOREN Certification Technology Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories for the Competence of Testing and Calibration Laboratories.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature	15-35 °C
Relative Humidity	30-60 %
Air Pressure	950-1050mbar

3.4 Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Test result
§15.247(a)(1)	Carrier Frequency separation	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Number of Hopping channels	GFSK Π/4DQPSK 8DPSK	☒ Full	GFSK	☒ Full	Compliant
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Spectrum bandwidth of aFHSS system 20dB bandwidth	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(b)(1)	Maximum output peak power	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	Band edge compliance conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.205	Band edge compliance radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.247(d)	TX spurious emissions conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	TX spurious emissions radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.209(a)	TX spurious Emissions radiated Below 1GHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant
§15.107(a) §15.207	Conducted Emissions 9KHz-30 MHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant

Remark:

1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report.
3. N/A means “not applicable”.

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1” and TR-100028-02 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2” and is documented in the Shenzhen GUOREN Certification Technology Service Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GUOREN Certification Technology Service Co., Ltd.:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Max output power	30MHz~18GHz	0.54 dB	(1)
Spectrum bandwidth	/	1.2%	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

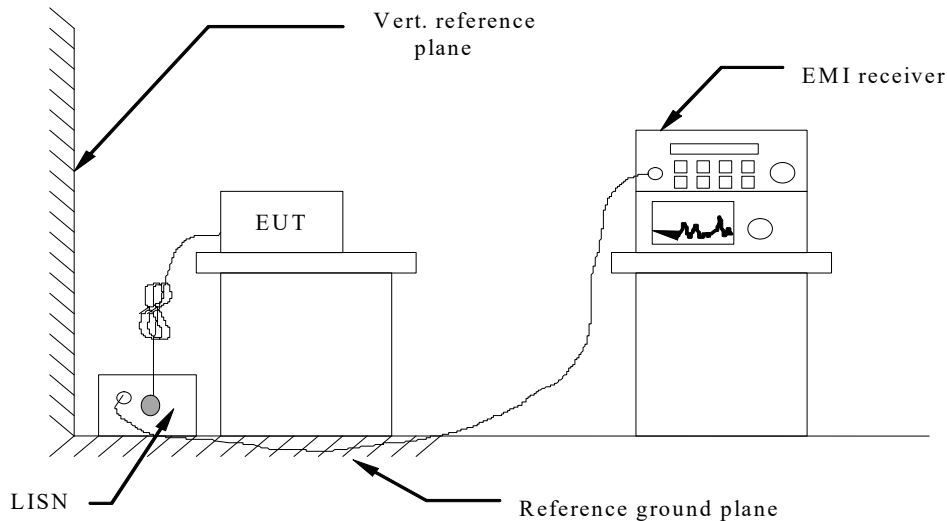
3.6 Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	GRCTEE009	2023/09/27	2024/09/26
LISN	R&S	ENV216	GRCTEE010	2023/09/27	2024/09/26
EMI Test Receiver	R&S	ESPI	GRCTEE017	2023/09/28	2024/09/27
EMI Test Receiver	R&S	ESCI	GRCTEE008	2023/09/27	2024/09/26
Spectrum Analyzer	Agilent	N9020A	GRCTEE002	2023/09/27	2024/09/26
Spectrum Analyzer	R&S	FSP	GRCTEE003	2023/09/28	2024/09/27
Vector Signal generator	Agilent	N5181A	GRCTEE007	2023/09/27	2024/09/26
Analog Signal Generator	R&S	SML03	GRCTEE006	2023/09/27	2024/09/26
Climate Chamber	QIYA	LCD-9530	GRCTES016	2023/09/27	2024/09/26
Ultra-Broadband Antenna	Schwarzbeck	VULB9163	GRCTEE018	2023/09/28	2026/09/27
Horn Antenna	Schwarzbeck	BBHA 9120D	GRCTEE019	2023/09/28	2026/09/27
Loop Antenna	Zhinan	ZN30900C	GRCTEE020	2023/10/15	2026/10/14
Horn Antenna	Beijing Hangwei Dayang	OBH100400	GRCTEE049	2023/09/28	2026/09/27
Amplifier	Schwarzbeck	BBV 9745	GRCTEE021	2023/09/27	2024/09/26
Amplifier	Taiwan chengyi	EMC051845B	GRCTEE022	2023/09/28	2024/09/27
Temperature/Humidity Meter	Huaguan	HG-308	GRCTES037	2023/09/27	2024/09/26
Directional coupler	NARDA	4226-10	GRCTEE004	2023/09/27	2024/09/26
High-Pass Filter	XingBo	XBLBQ-GTA18	GRCTEE053	2023/09/27	2024/09/26
High-Pass Filter	XingBo	XBLBQ-GTA27	GRCTEE054	2023/09/27	2024/09/26
Automated filter bank	Tonscend	JS0806-F	GRCTEE055	2023/09/27	2024/09/26
Power Sensor	Agilent	U2021XA	GRCTEE070	2023/09/27	2024/09/26
EMI Test Software	ROHDE & SCHWARZ	ESK1-V1.71	GRCTEE060	N/A	N/A
EMI Test Software	Fera	EZ-EMC	GRCTEE061	N/A	N/A

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received power from variable frequency power supply, the AC 120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

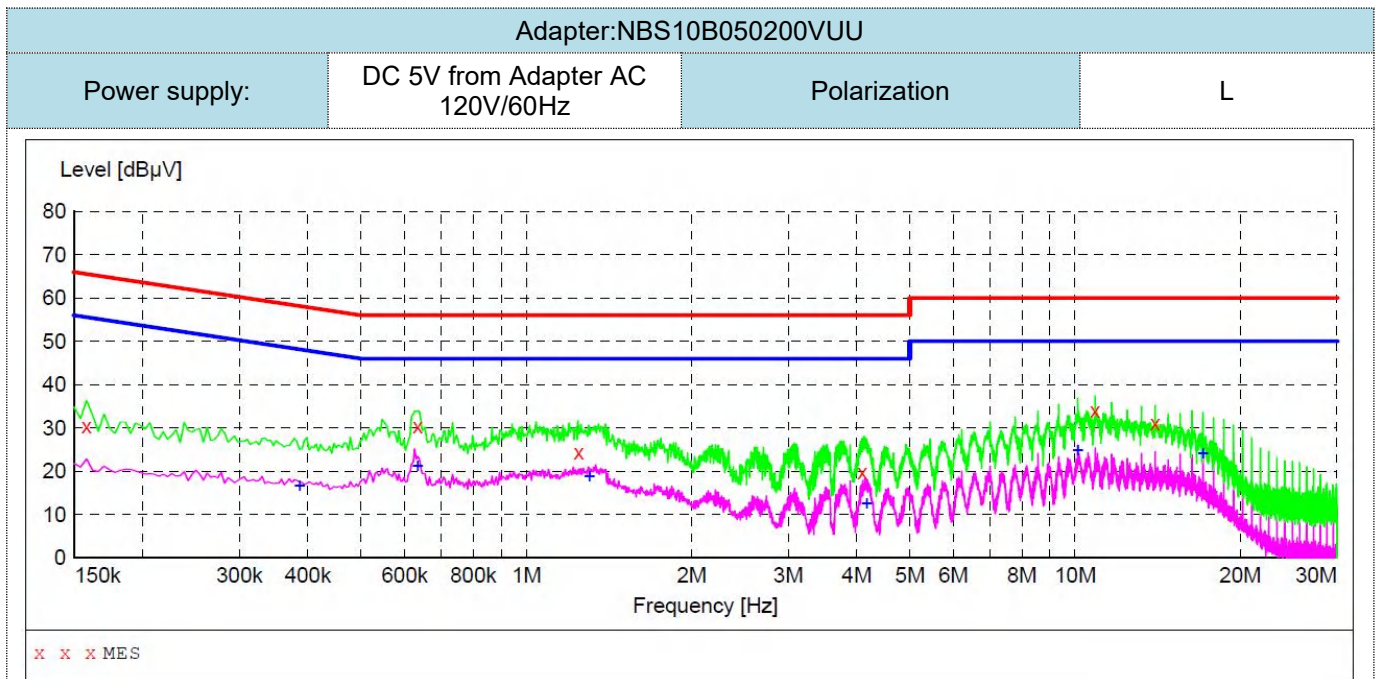
* Decreases with the logarithm of the frequency.

TEST RESULTS

Remark:

1. All modes of GFSK, $\pi/4$ DQPSK and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:

2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:



MEASUREMENT RESULT:

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.158000	30.50	9.5	66	35.1	QP	L1	GND
0.634000	30.40	9.6	56	25.6	QP	L1	GND
1.246000	24.50	10.0	56	31.5	QP	L1	GND
4.098000	19.90	9.9	56	36.1	QP	L1	GND
10.882000	34.00	10.0	60	26.0	QP	L1	GND
13.990000	31.10	10.0	60	28.9	QP	L1	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.386000	16.60	9.7	48	31.5	AV	L1	GND
0.634000	21.20	9.6	46	24.8	AV	L1	GND
1.302000	18.80	10.0	46	27.2	AV	L1	GND
4.170000	12.60	9.9	46	33.4	AV	L1	GND
10.106000	25.00	10.0	50	25.0	AV	L1	GND
17.102000	24.20	10.1	50	25.8	AV	L1	GND

Note:1).Level (dBμV)= Reading (dBμV)+ Transducer (dB)

2). Transducer (dB)=insertion loss of LISN (dB) + Cable loss (dB)

3). Margin(dB) = Limit (dBμV) - Level (dBμV)

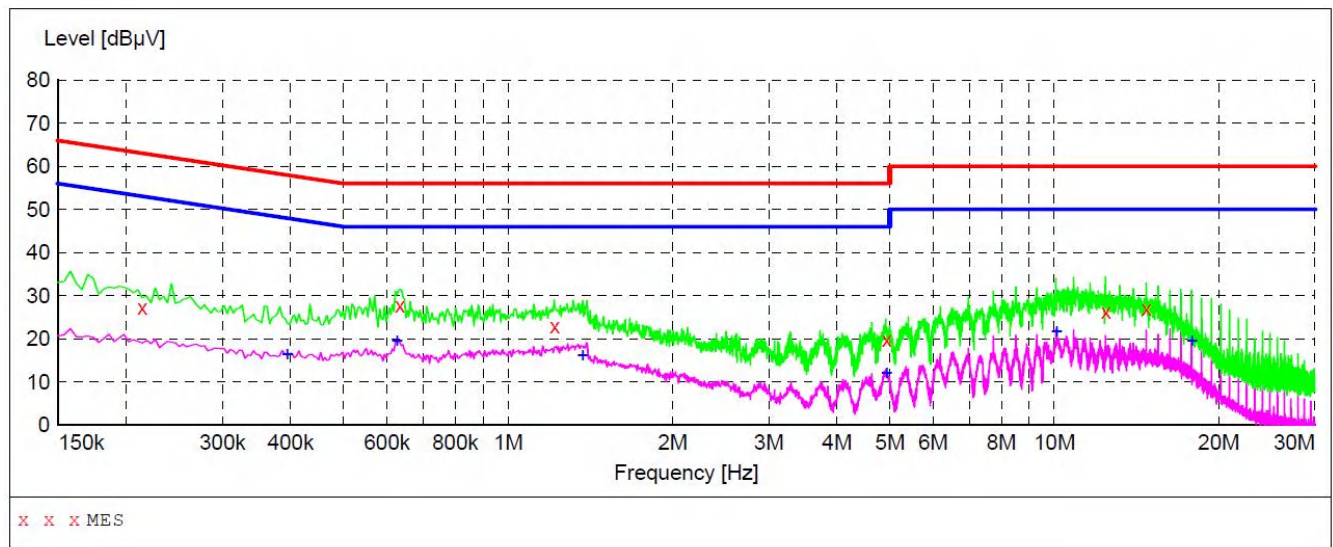
Adapter:NBS10B050200VUU

Power supply:

DC 5V from Adapter AC
120V/60Hz

Polarization

N

**MEASUREMENT RESULT:**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.214000	27.30	9.6	63	35.7	QP	N	GND
0.634000	27.80	9.6	56	28.2	QP	N	GND
1.218000	22.90	10.0	56	33.1	QP	N	GND
4.938000	19.80	10.0	56	36.2	QP	N	GND
12.434000	26.40	10.0	60	33.6	QP	N	GND
14.758000	27.00	10.0	60	33.0	QP	N	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.394000	16.40	9.8	48	31.6	AV	N	GND
0.626000	19.60	9.6	46	26.4	AV	N	GND
1.370000	16.30	10.0	46	29.7	AV	N	GND
4.930000	12.10	10.0	46	33.9	AV	N	GND
10.098000	21.70	10.0	50	28.3	AV	N	GND
17.866000	19.60	10.1	50	30.4	AV	N	GND

Note:1).Level (dBμV)= Reading (dBμV)+ Transducer (dB)

2). Transducer (dB)=insertion loss of LISN (dB) + Cable loss (dB)

3). Margin(dB) = Limit (dBμV) - Level (dBμV)

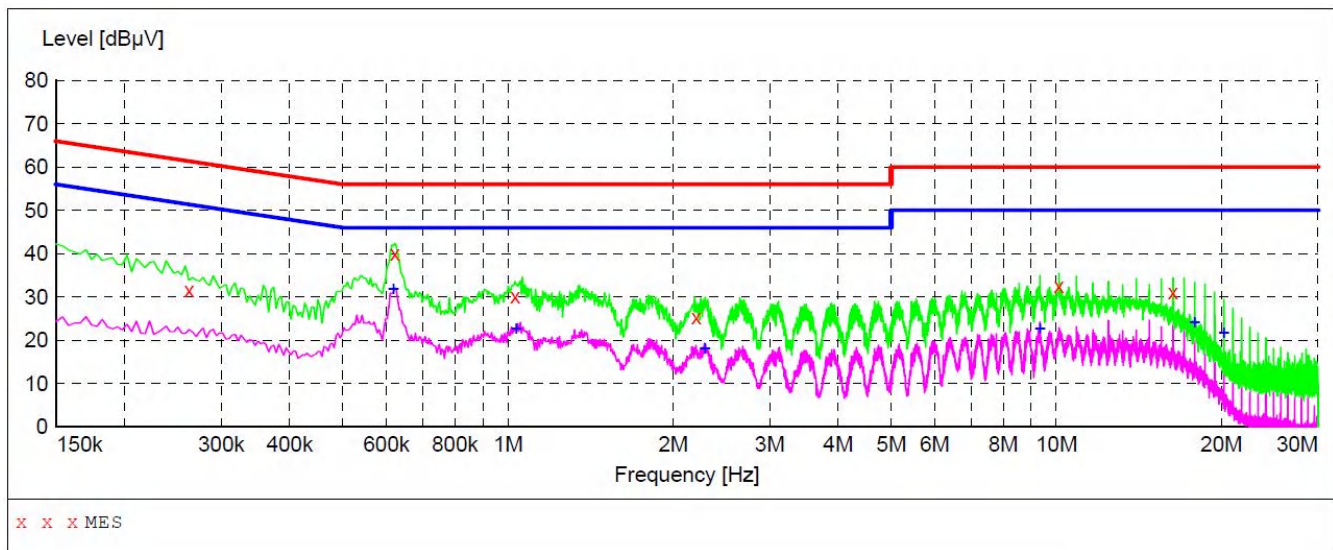
Adapter:NBS10B050200VCU

Power supply:

DC 5V from Adapter AC
120V/60Hz

Polarization

L

**MEASUREMENT RESULT:**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.262000	31.70	9.6	61	29.7	QP	L1	GND
0.622000	40.00	9.6	56	16.0	QP	L1	GND
1.030000	30.10	10.0	56	25.9	QP	L1	GND
2.206000	25.40	10.0	56	30.6	QP	L1	GND
10.106000	32.50	10.0	60	27.5	QP	L1	GND
16.322000	31.10	10.1	60	28.9	QP	L1	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.618000	31.80	9.6	46	14.2	AV	L1	GND
1.034000	22.70	10.0	46	23.3	AV	L1	GND
2.286000	18.20	10.0	46	27.8	AV	L1	GND
9.326000	22.80	10.0	50	27.2	AV	L1	GND
17.878000	24.20	10.1	50	25.8	AV	L1	GND
20.210000	21.70	10.2	50	28.3	AV	L1	GND

Note:1).Level (dBμV)= Reading (dBμV)+ Transducer (dB)

2). Transducer (dB)=insertion loss of LISN (dB) + Cable loss (dB)

3). Margin(dB) = Limit (dBμV) - Level (dBμV)

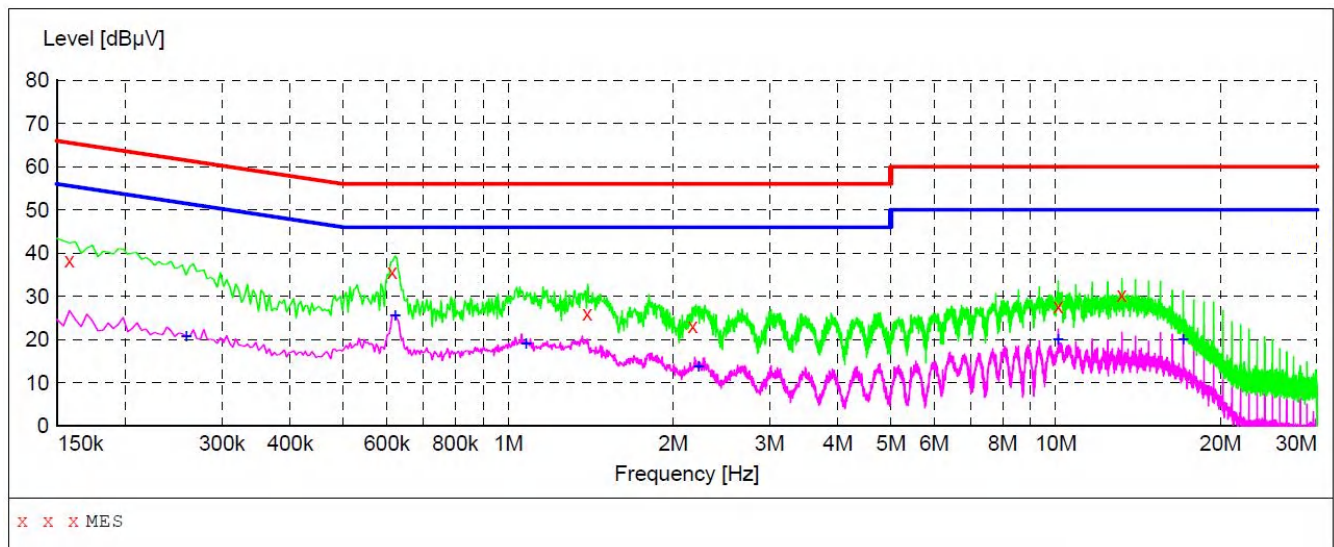
Adapter:NBS10B050200VCU

Power supply:

DC 5V from Adapter AC
120V/60Hz

Polarization

N

**MEASUREMENT RESULT:**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.158000	38.40	9.5	66	27.2	QP	N	GND
0.614000	35.70	9.6	56	20.3	QP	N	GND
1.394000	26.10	10.0	56	29.9	QP	N	GND
2.174000	23.20	10.0	56	32.8	QP	N	GND
10.110000	27.70	10.0	60	32.3	QP	N	GND
13.214000	30.50	10.0	60	29.5	QP	N	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.258000	20.80	9.7	52	30.7	AV	N	GND
0.622000	25.60	9.6	46	20.4	AV	N	GND
1.078000	19.10	10.0	46	26.9	AV	N	GND
2.226000	13.80	10.0	46	32.2	AV	N	GND
10.102000	20.00	10.0	50	30.0	AV	N	GND
17.098000	20.10	10.1	50	29.9	AV	N	GND

Note:1).Level (dBμV)= Reading (dBμV)+ Transducer (dB)

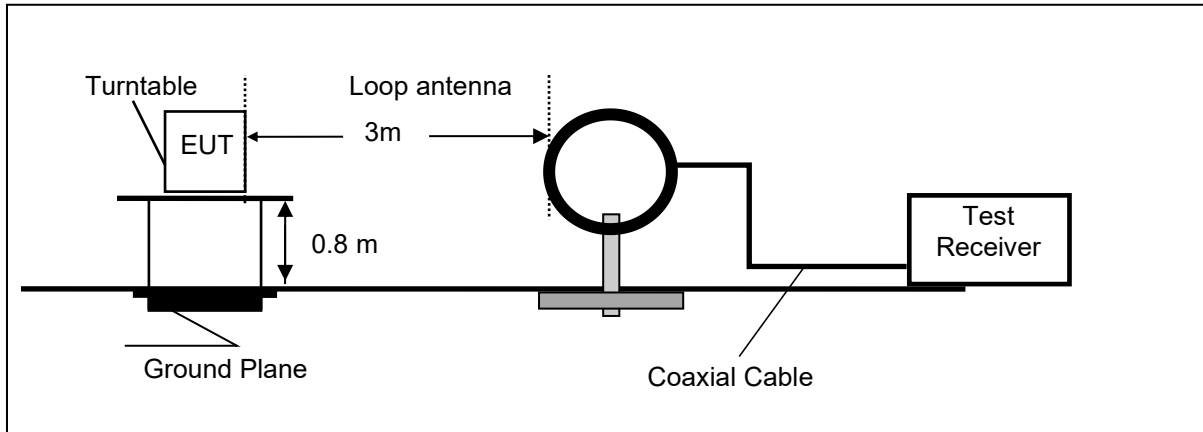
2). Transducer (dB)=insertion loss of LISN (dB) + Cable loss (dB)

3). Margin(dB) = Limit (dBμV) - Level (dBμV)

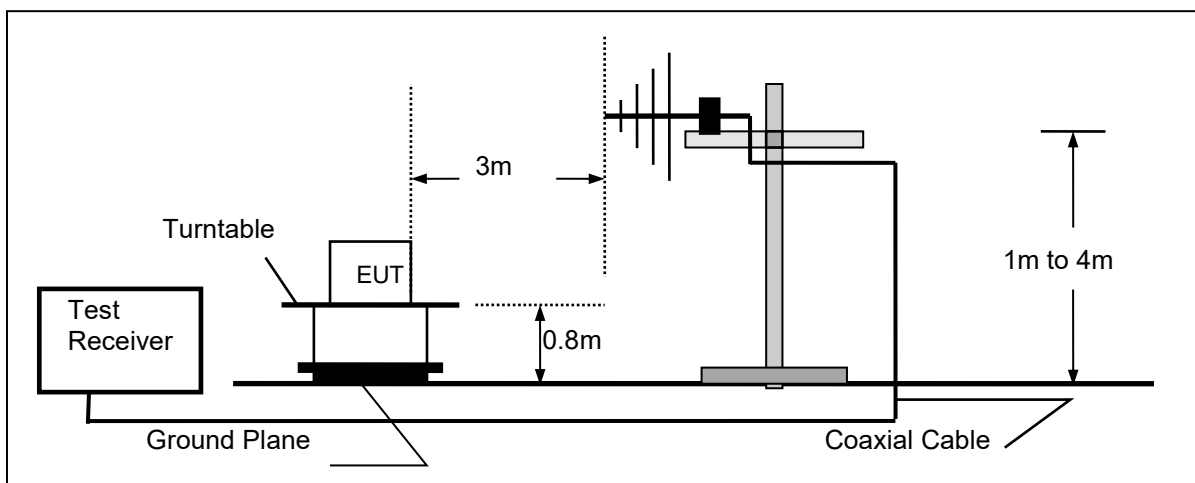
4.2 Radiated Emission

TEST CONFIGURATION

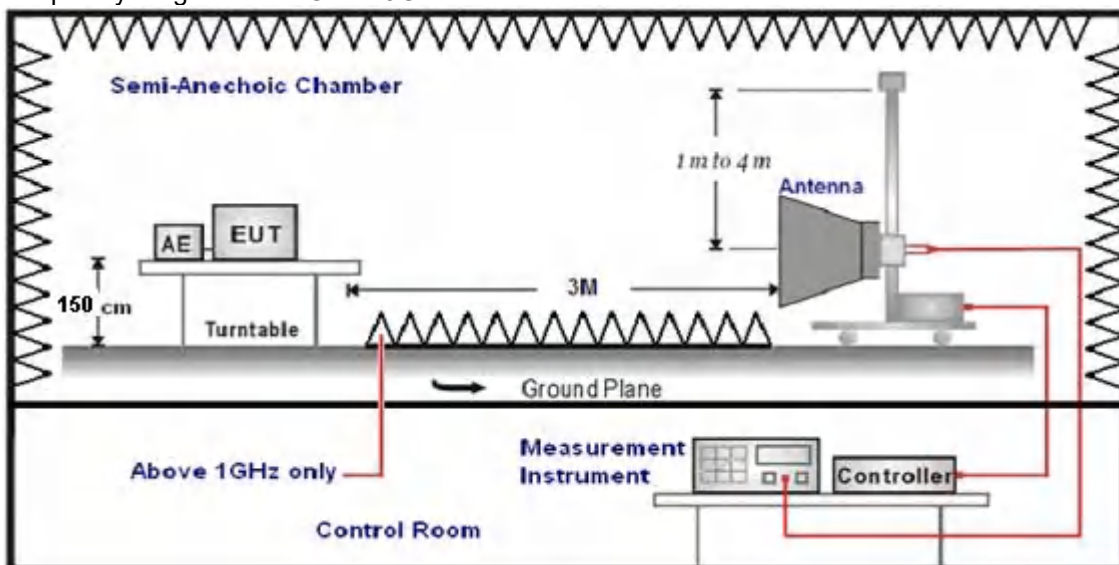
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz, the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

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	

$$\text{Transd} = \text{AF} + \text{CL} - \text{AG}$$

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz})) + 40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz})) + 40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30) + 40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

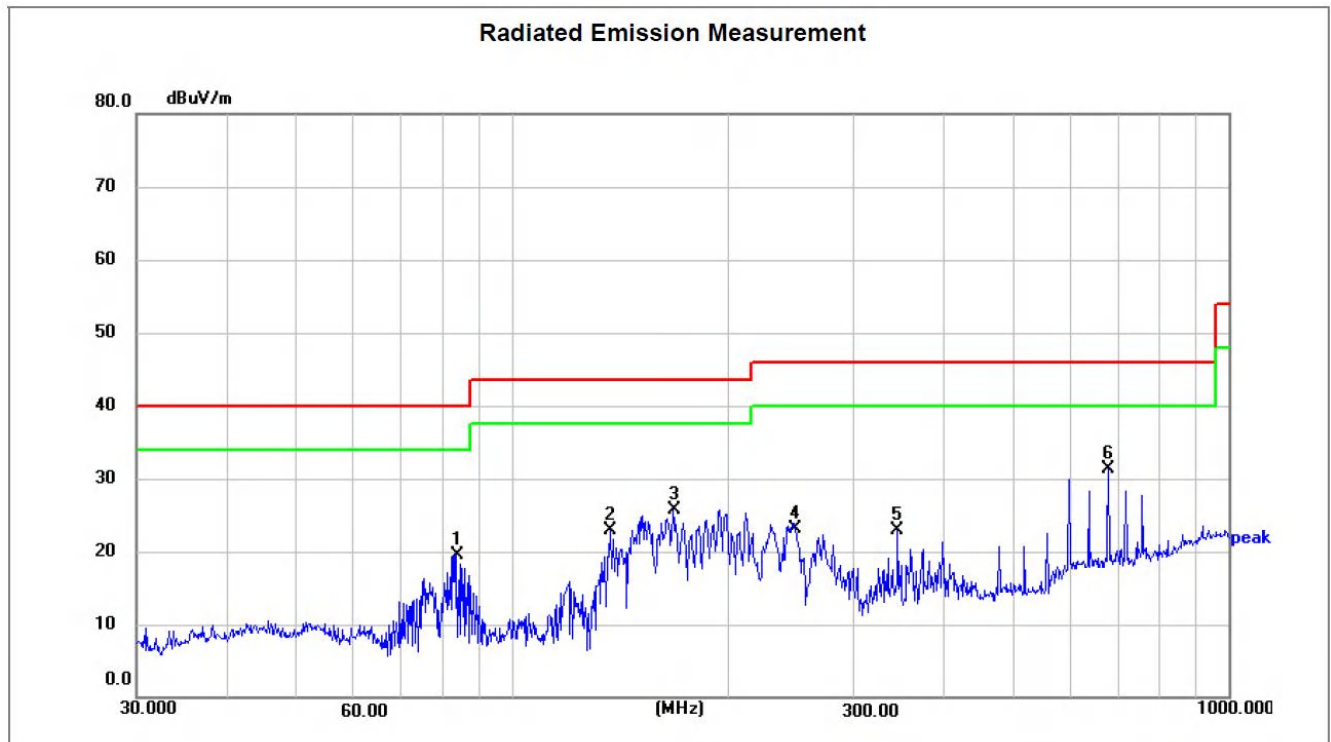
TEST RESULTS

Remark:

1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. We measured Radiated Emission at GFSK, $\pi/4$ DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
3. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Adapter: NBS10B050200VUU
Horizontal



Site LAB
Limit: FCC Part15 RE-Class B_30-1000MHz
EUT: Gemini Diffuser
M/N: PZ-PA055
Mode: GFSK DH5 CH 39
Note: NBS10B050200VUU

Polarization: **Horizontal**
Power: AC120V/60Hz
Distance: 3m

Temperature: 24(C)
Humidity: 51 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	83.8156	41.56	-21.97	19.59	40.00	-20.41	peak	199	209	P	
2	137.4202	44.97	-22.14	22.83	43.50	-20.67	peak	199	147	P	
3	167.8243	47.18	-21.40	25.78	43.50	-17.72	peak	199	351	P	
4	248.5519	41.40	-18.32	23.08	46.00	-22.92	peak	100	90	P	
5	345.5952	39.59	-16.59	23.00	46.00	-23.00	peak	100	277	P	
6 *	679.9600	42.04	-10.64	31.40	46.00	-14.60	peak	100	360	P	

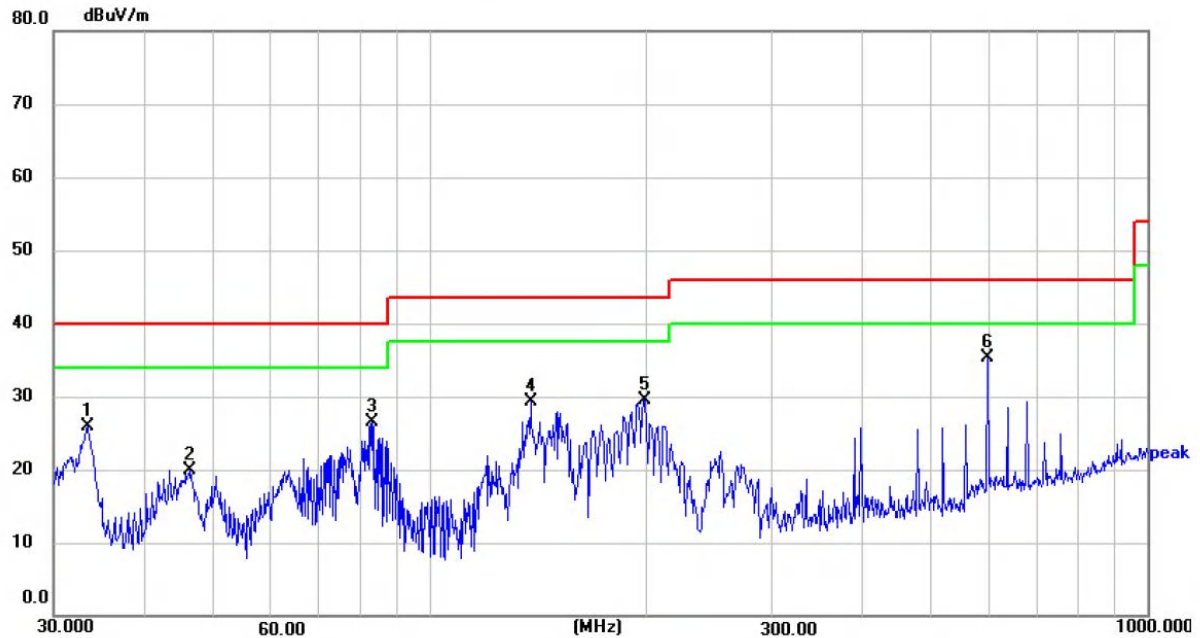
Note: 1). Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

2). Factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin (dB) = Level (dBuV/m) - Limit (dBuV/m)

Adapter:NBS10B050200VUU
Vertical

Radiated Emission Measurement



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT: Gemini Diffuser

M/N: PZ-PA055

Mode: GFSK DH5 CH 39

Note: NBS10B050200VUU

Polarization: **Vertical**

Power: AC120V/60Hz

Distance: 3m

Temperature: 24(C)

Humidity: 51 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	33.4449	45.68	-19.68	26.00	40.00	-14.00	peak	100	288	P	
2	46.5030	37.50	-17.53	19.97	40.00	-20.03	peak	100	117	P	
3	83.2298	48.58	-22.08	26.50	40.00	-13.50	peak	100	261	P	
4	138.3873	51.47	-22.07	29.40	43.50	-14.10	peak	100	46	P	
5	199.2855	48.66	-19.08	29.58	43.50	-13.92	peak	100	316	P	
6 *	599.3212	46.52	-11.14	35.38	46.00	-10.62	peak	100	73	P	

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Level (dBμV/m) - Limit (dBμV/m)

Adapter: NBS10B050200VCU

Horizontal

Radiated Emission Measurement



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT: Gemini Diffuser

M/N: PZ-PA055

Mode: GFSK DH5 CH 39

Note: NBS10B050200VCU

Polarization: **Horizontal**

Power: AC120V/60Hz

Distance: 3m

Temperature: 24(C)

Humidity: 51%

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	134.0882	47.19	-22.39	24.80	43.50	-18.70	peak	200	350	P	
2	162.7532	46.06	-21.72	24.34	43.50	-19.16	peak	200	178	P	
3	222.1698	42.85	-18.69	24.16	46.00	-21.84	peak	100	87	P	
4	399.0302	37.26	-15.72	21.54	46.00	-24.46	peak	100	183	P	
5	599.3212	41.93	-11.14	30.79	46.00	-15.21	peak	200	350	P	
6 *	679.9600	43.30	-10.64	32.66	46.00	-13.34	peak	200	350	P	

Note: 1). Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

2). Factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin (dB) = Level (dBuV/m) - Limit (dBuV/m)

Adapter:NBS10B050200VCU

Vertical

Radiated Emission Measurement



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT: Gemini Diffuser

M/N: PZ-PA055

Mode:GFSK DH5 CH 39

Note:NBS10B050200VCU

Polarization: **Vertical**

Power: AC120V/60Hz

Distance: 3m

Temperature: 24(C)

Humidity: 51 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	46.1779	39.78	-17.54	22.24	40.00	-17.76	peak	100	70	P	
2	63.9828	42.01	-19.74	22.27	40.00	-17.73	peak	100	9	P	
3	164.9075	51.59	-21.63	29.96	43.50	-13.54	peak	100	61	P	
4	207.8501	45.88	-18.91	26.97	43.50	-16.53	peak	100	256	P	
5	478.8456	42.67	-14.69	27.98	46.00	-18.02	peak	100	211	P	
6 *	599.3212	45.32	-11.14	34.18	46.00	-11.82	peak	100	96	P	

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Level (dBμV/m) - Limit (dBμV/m)

For 1GHz to 25GHz

Note: GFSK , $\pi/4$ DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	53.02	PK	74	20.98	74.18	28.42	5.14	54.72	-21.16
4804.00	41.99	AV	54	12.01	63.15	28.42	5.14	54.72	-21.16
7206.00	48.21	PK	74	25.79	62.63	34.15	6.46	55.03	-14.42
7206.00	37.39	AV	54	16.61	51.81	34.15	6.46	55.03	-14.42

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	53.44	PK	74	20.56	74.60	28.42	5.14	54.72	-21.16
4804.00	41.80	AV	54	12.20	62.96	28.42	5.14	54.72	-21.16
7206.00	47.27	PK	74	26.73	61.69	34.15	6.46	55.03	-14.42
7206.00	38.12	AV	54	15.88	52.54	34.15	6.46	55.03	-14.42

Frequency(MHz):			2441		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4882.00	54.74	PK	74	19.26	74.98	28.76	5.34	54.34	-20.24
4882.00	43.03	AV	54	10.97	63.27	28.76	5.34	54.34	-20.24
7323.00	49.22	PK	74	24.78	62.85	34.41	6.83	54.87	-13.63
7323.00	37.34	AV	54	16.66	50.97	34.41	6.83	54.87	-13.63

Frequency(MHz):			2441		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4882.00	54.08	PK	74	19.92	74.32	28.76	5.34	54.34	-20.24
4882.00	43.66	AV	54	10.34	63.90	28.76	5.34	54.34	-20.24
7323.00	49.29	PK	74	24.71	62.92	34.41	6.83	54.87	-13.63
7323.00	38.59	AV	54	15.41	52.22	34.41	6.83	54.87	-13.63

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	54.02	PK	74	19.98	73.55	29.52	5.63	54.68	-19.53
4960.00	43.83	AV	54	10.17	63.36	29.52	5.63	54.68	-19.53
7440.00	49.70	PK	74	24.30	62.90	34.49	7.23	54.92	-13.2
7440.00	38.00	PK	54	16.00	51.20	34.49	7.23	54.92	-13.2

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	54.96	PK	74	19.04	74.49	29.52	5.63	54.68	-19.53
4960.00	44.86	AV	54	9.14	64.39	29.52	5.63	54.68	-19.53
7440.00	50.35	PK	74	23.65	63.55	34.49	7.23	54.92	-13.2
7440.00	38.45	PK	54	15.55	51.65	34.49	7.23	54.92	-13.2

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

Results of Band Edges Test (Radiated)

Note: GFSK, $\pi/4$ DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.

GFSK

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	57.35	PK	74	16.65	82.07	25.72	4.32	54.76	-24.72
2390.00	41.26	AV	54	12.74	65.98	25.72	4.32	54.76	-24.72
2400.00	56.63	PK	74	17.37	80.89	25.73	4.33	54.75	-24.26
2400.00	41.34	AV	54	12.66	65.60	25.73	4.33	54.75	-24.26
Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	58.26	PK	74	15.74	82.98	25.72	4.32	54.76	-24.72
2390.00	41.06	AV	54	12.94	65.78	25.72	4.32	54.76	-24.72
2400.00	58.03	PK	74	15.97	82.29	25.73	4.33	54.75	-24.26
2400.00	41.17	AV	54	12.83	65.43	25.73	4.33	54.75	-24.26
Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	57.79	PK	74	16.21	82.36	25.78	4.48	54.83	-24.57
2483.50	41.06	AV	54	12.94	65.63	25.78	4.48	54.83	-24.57
Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	57.07	PK	74	16.93	81.64	25.78	4.48	54.83	-24.57
2483.50	39.93	AV	54	14.07	64.50	25.78	4.48	54.83	-24.57

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3 Maximum Peak Output Power

Limit

The Maximum Peak Output Power Measurement is 125mW (20.97).

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	14.26	20.97	Pass
	39	15.19		
	78	15.21		
$\pi/4$ DQPSK	00	14.35	20.97	Pass
	39	15.04		
	78	14.95		
8DPSK	00	14.03	20.97	Pass
	39	15.06		
	78	15.09		

Note: 1.The test results including the cable lose.

4.4 20dB Bandwidth

Limit

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

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Configuration

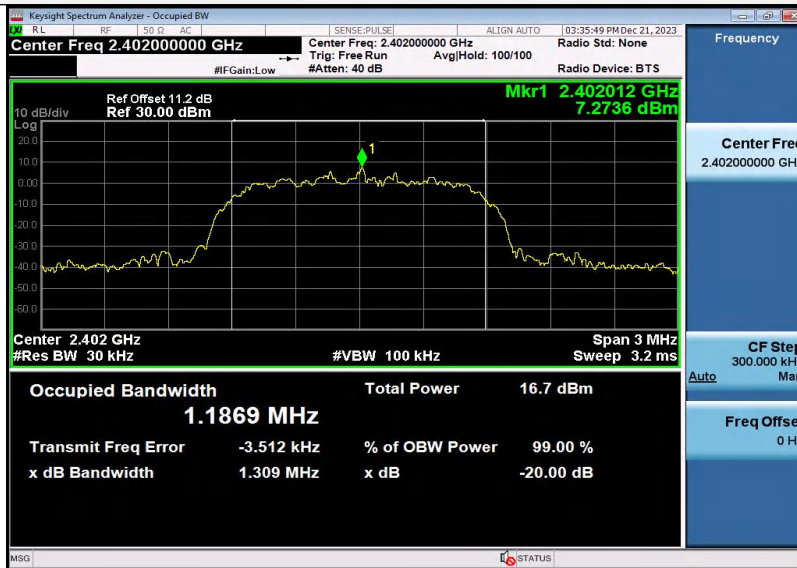


Test Results

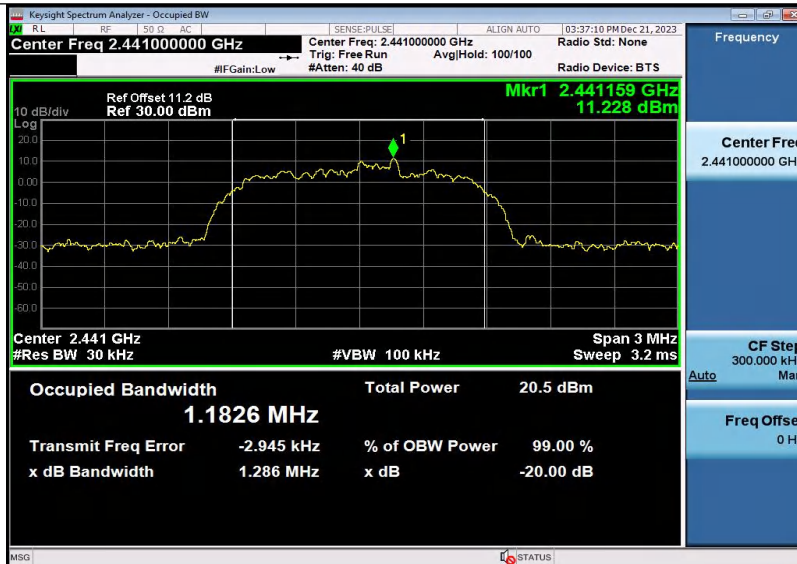
Modulation	Channel	20dB bandwidth (MHz)	Result
GFSK	00	0.9551	Pass
	39	1.046	
	78	1.034	
$\pi/4$ DQPSK	00	1.309	
	39	1.286	
	78	1.321	
8DPSK	00	1.311	
	39	1.314	
	78	1.317	

Test plot as follows:

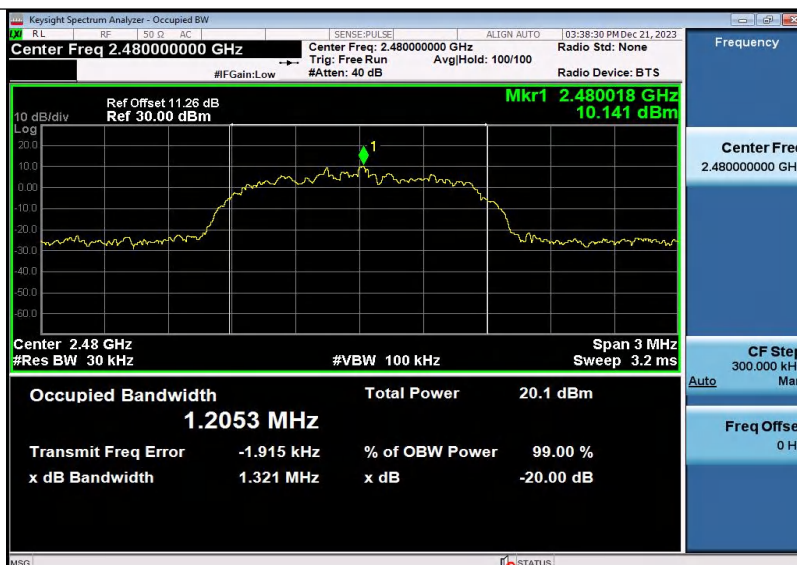


$\pi/4$ DQPSK Modulation

CH00

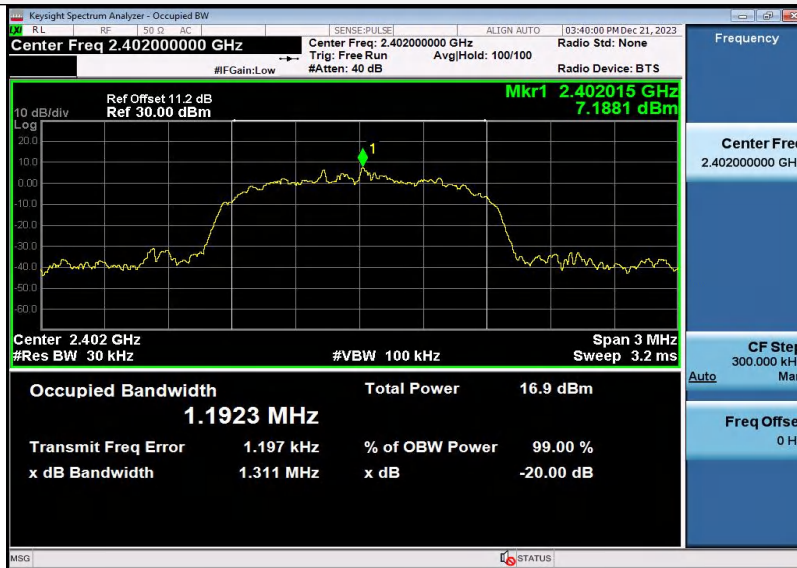


CH39

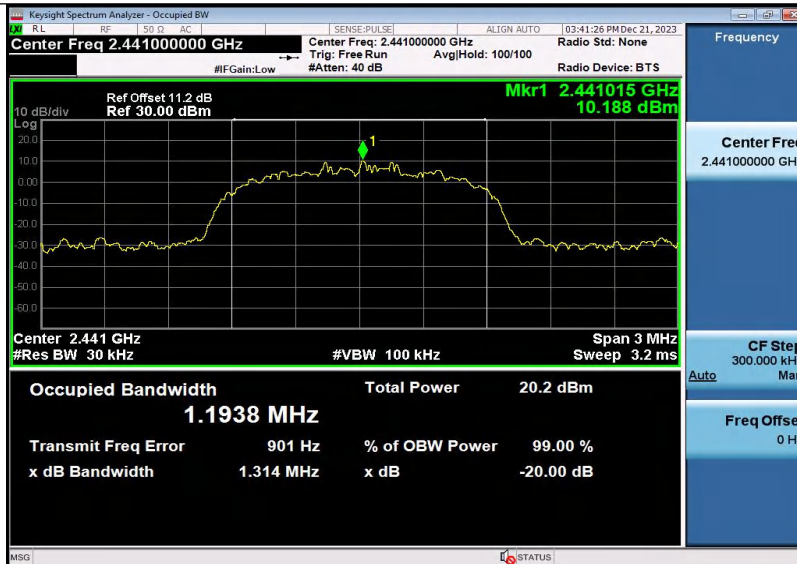


CH78

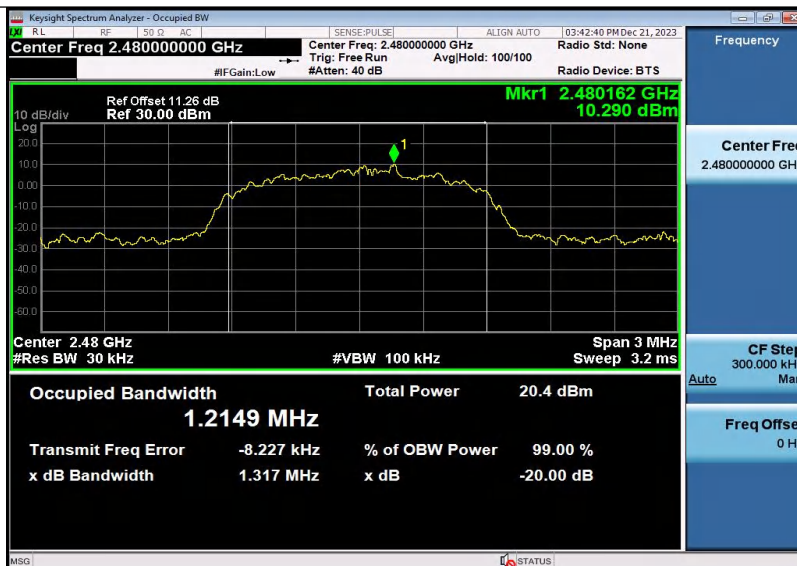
8DPSK Modulation



CH00



CH39



CH78

4.5 Frequency Separation

LIMIT

According to 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the $2/3 \times 20\text{dB}$ bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. CH39 and CH40 was measured by spectrum analyzer with 300 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION

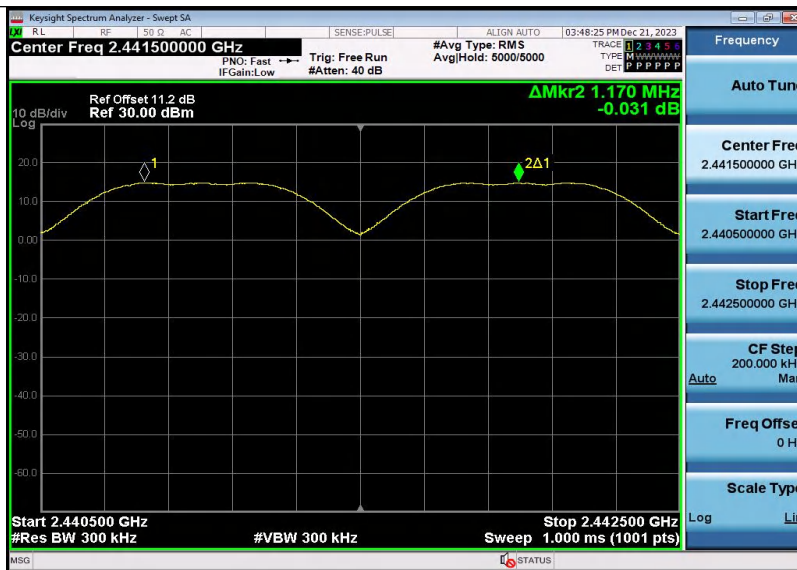


TEST RESULTS

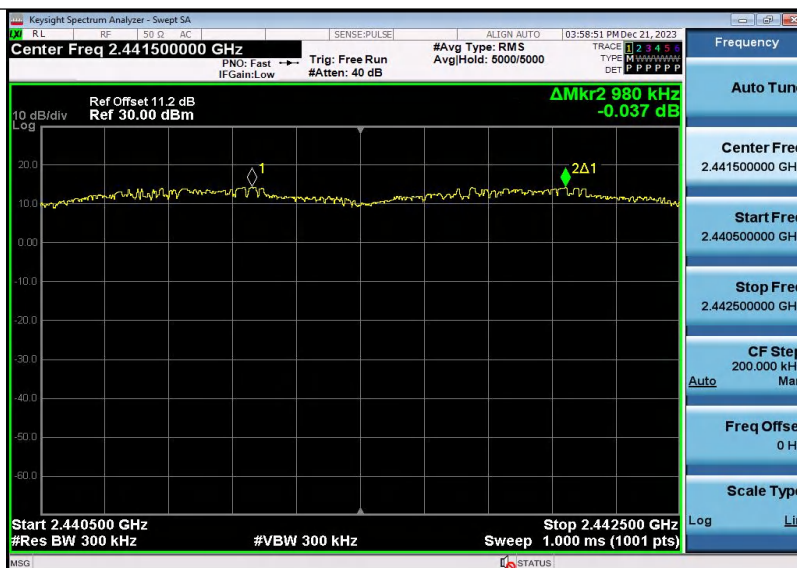
Modulation	Channel	Channel Separation (MHz)	Limit	Result
GFSK	CH39	1.17	0.637MHz	Pass
	CH40			
$\pi/4$ DQPSK	CH39	0.982	0.857MHz	Pass
	CH40			
8DPSK	CH39	0.980	0.874MHz	Pass
	CH40			

Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle.

Test plot as follows:

GFSK

 $\pi/4$ DQPSK

8DPSK

4.6 Number of hopping frequency

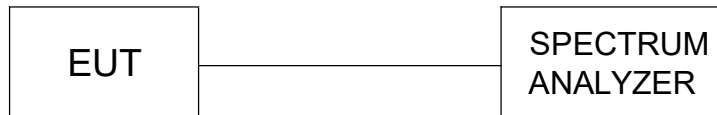
Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

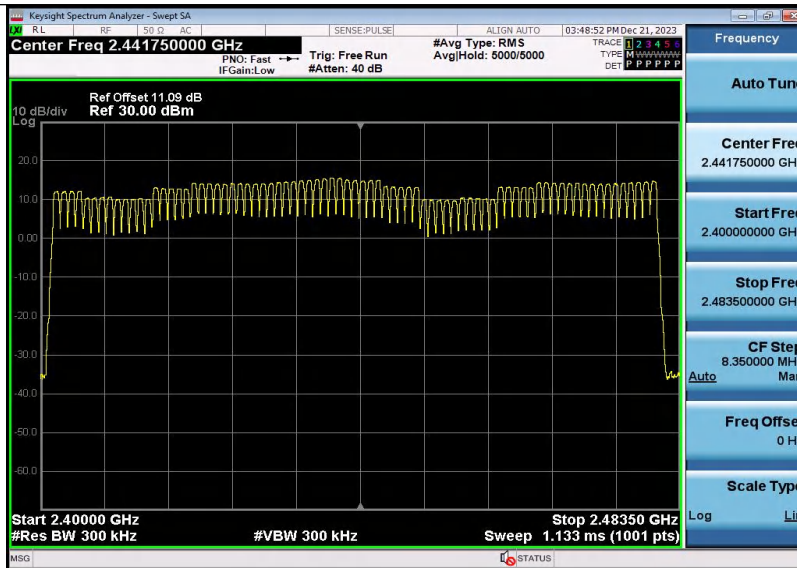
Test Configuration



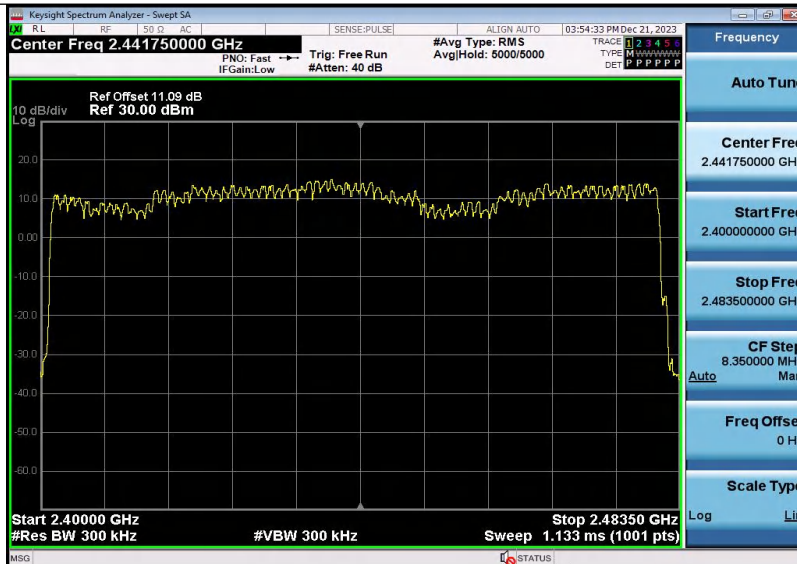
Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
$\pi/4$ DQPSK	79		
8DPSK	79		

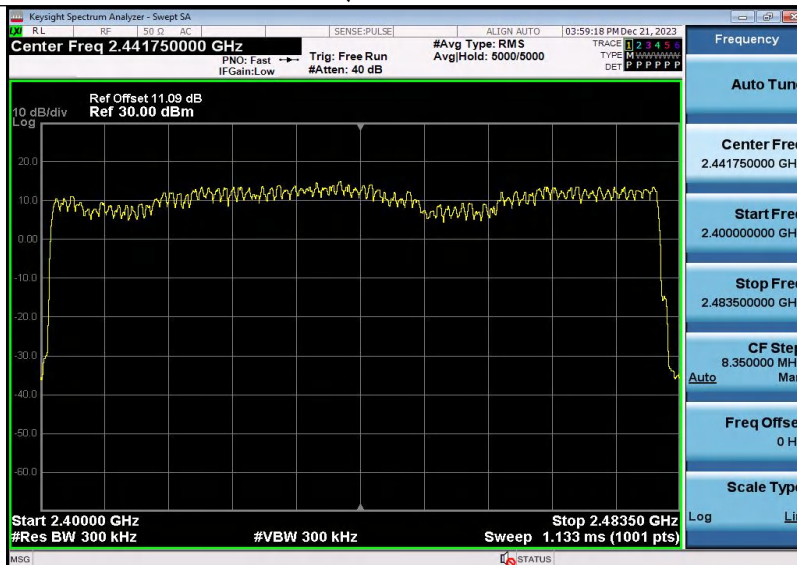
Test plot as follows:



GFSK Modulation



$\pi/4$ DQPSK Modulation



8DPSK Modulation

4.7 Time of Occupancy (Dwell Time)

Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

Test Configuration



Test Results

Modulation	Packet	Burst time (ms)	Dwell time (s)	Limit (s)	Result
GFSK	DH1	0.376	0.120	0.40	Pass
	DH3	1.633	0.261		
	DH5	2.880	0.307		
π/4DQPSK	2-DH1	0.384	0.123	0.40	Pass
	2-DH3	1.635	0.262		
	2-DH5	2.884	0.308		
8DPSK	3-DH1	0.384	0.123	0.40	Pass
	3-DH3	1.635	0.262		
	3-DH5	2.885	0.308		

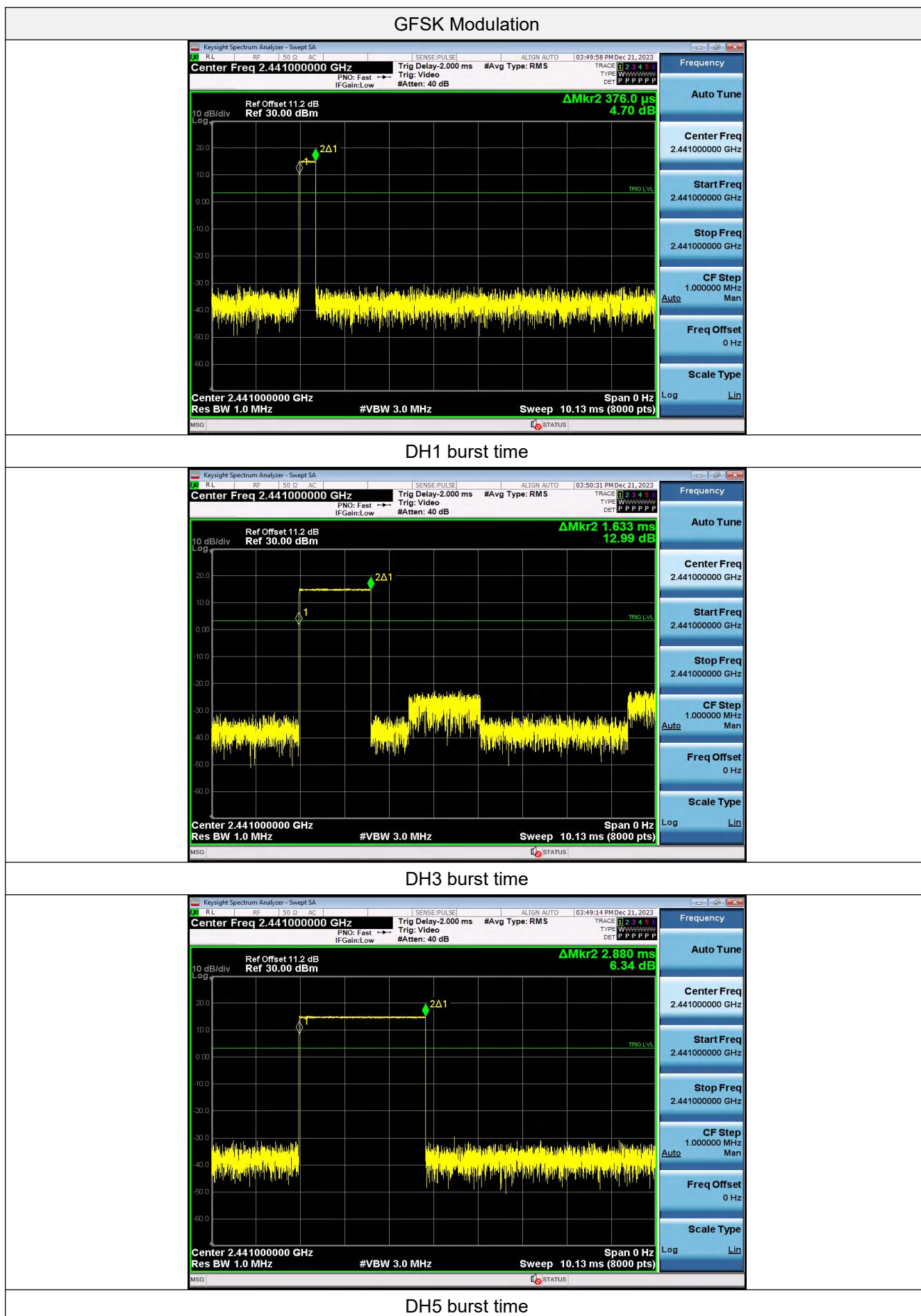
Note: We have tested all mode at high, middle and low channel, and recorded worst case at middle channel.

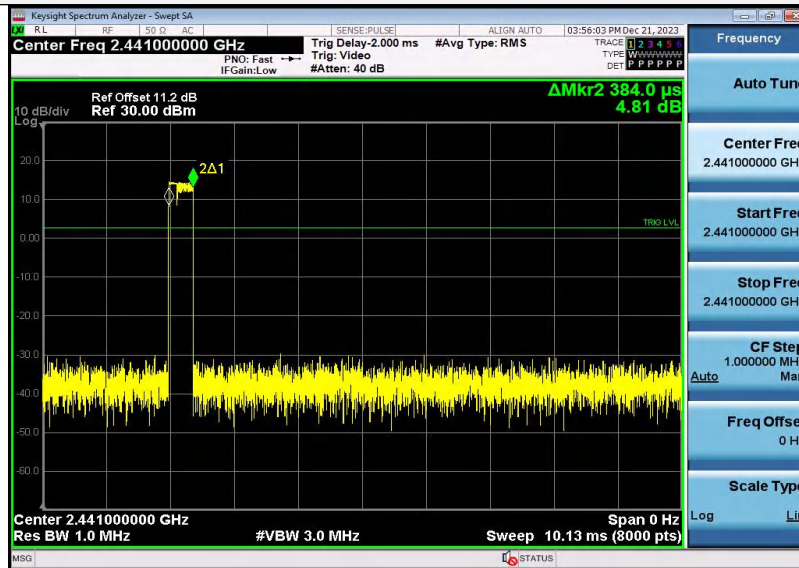
Dwell time = Pulse time (ms) × (1600 ÷ 2 ÷ 79) × 31.6 Second for DH1, 2-DH1, 3-DH1

Dwell time = Pulse time (ms) × (1600 ÷ 4 ÷ 79) × 31.6 Second for DH3, 2-DH3, 3-DH3

Dwell time = Pulse time (ms) × (1600 ÷ 6 ÷ 79) × 31.6 Second for DH5, 2-DH5, 3-DH5

Test plot as follows:

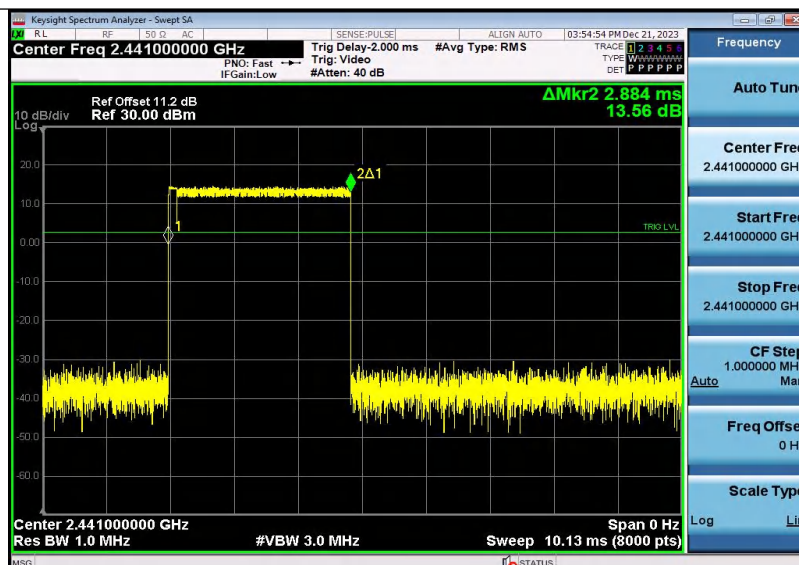


$\pi/4$ DQPSK Modulation

2-DH1 burst time

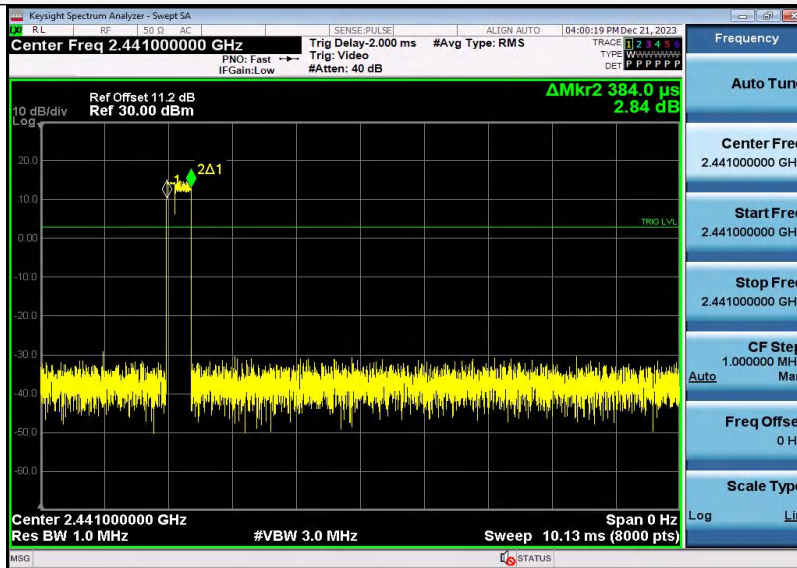


2-DH3 burst time



2-DH5 burst time

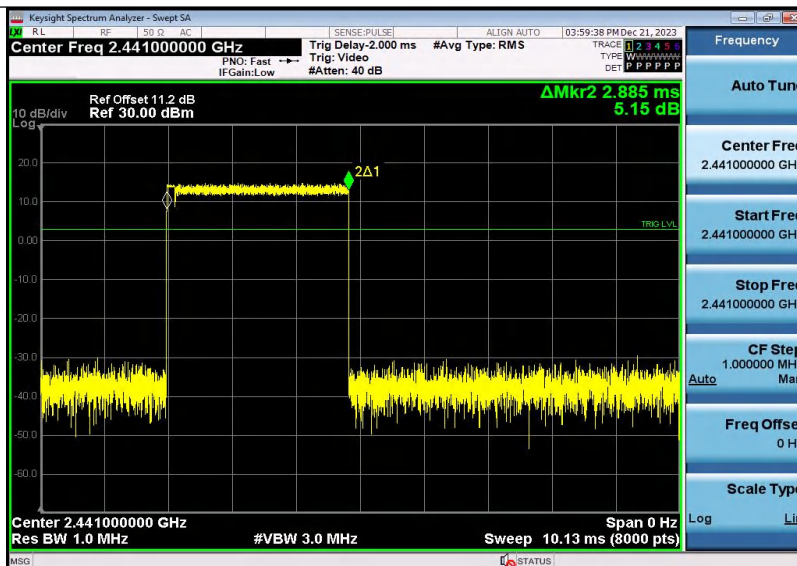
8DPSK Modulation



3-DH1 burst time



3-DH3 burst time



3-DH5 burst time

4.8 Out-of-band Emissions

Limit

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge and out-of-band emissions.

Test Configuration



Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandedge measurement data.

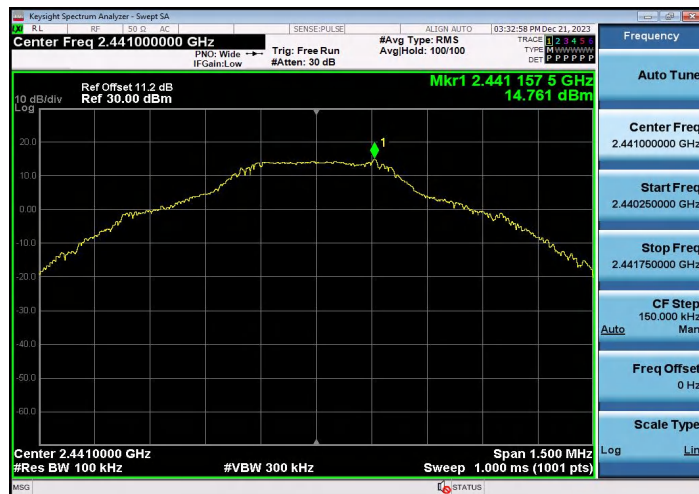
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5.

Test plot as follows:

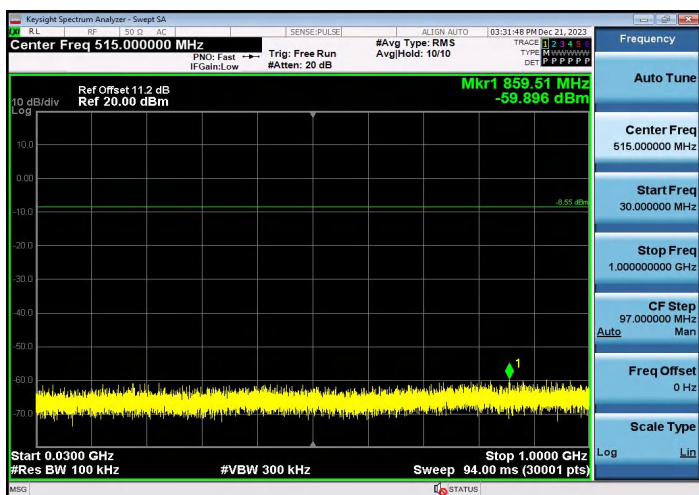
GFSK(CH00)



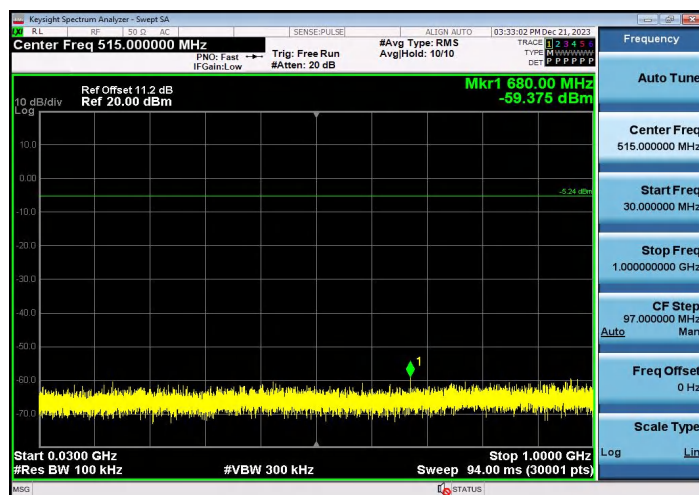
GFSK(CH39)



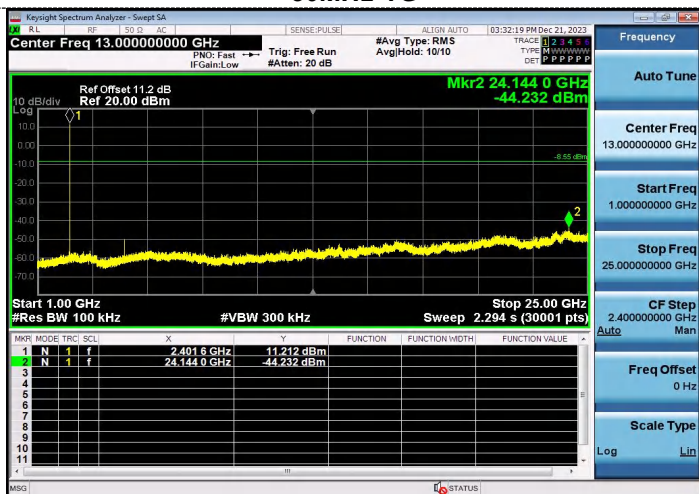
reference



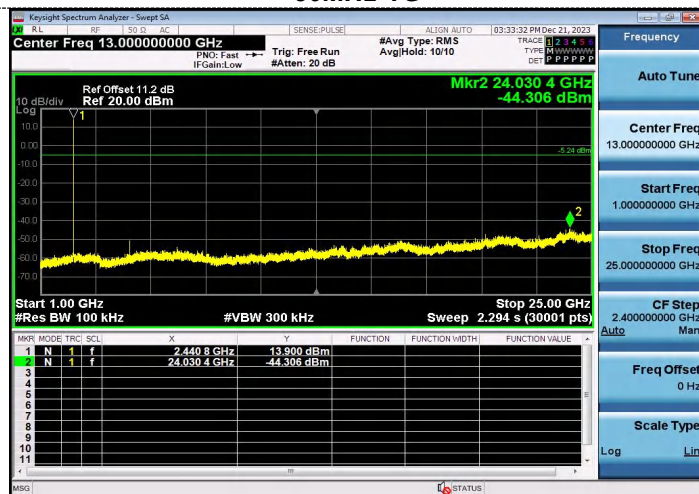
reference



30MHz-1G



30MHz-1G



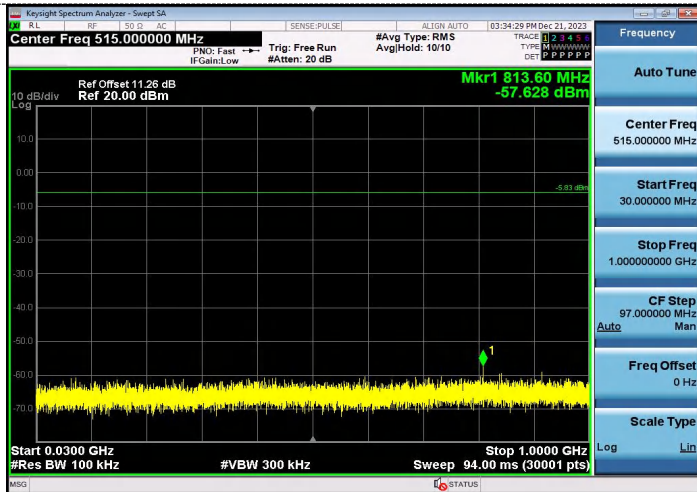
1G-25G

1G-25G

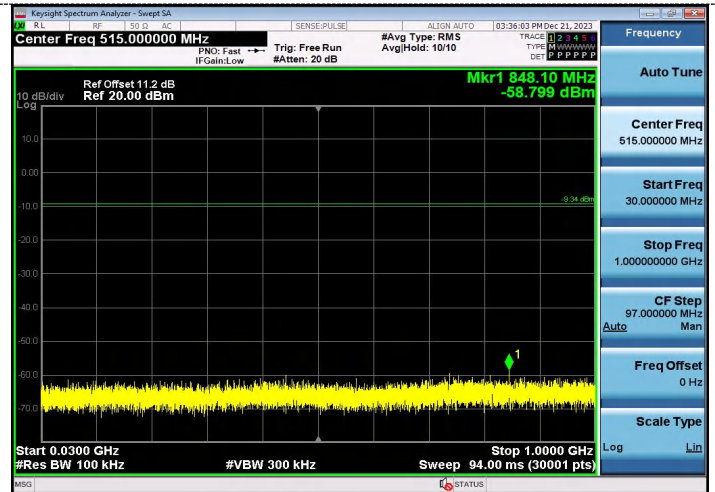
GFSK(CH78)

 $\pi/4$ DQPSK (CH00)

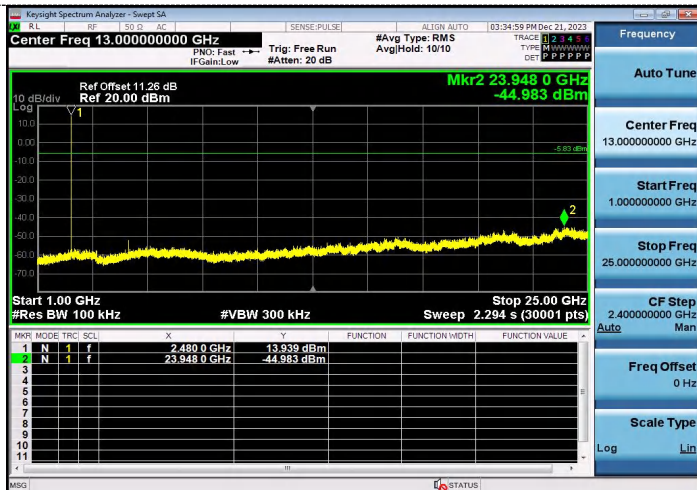
reference



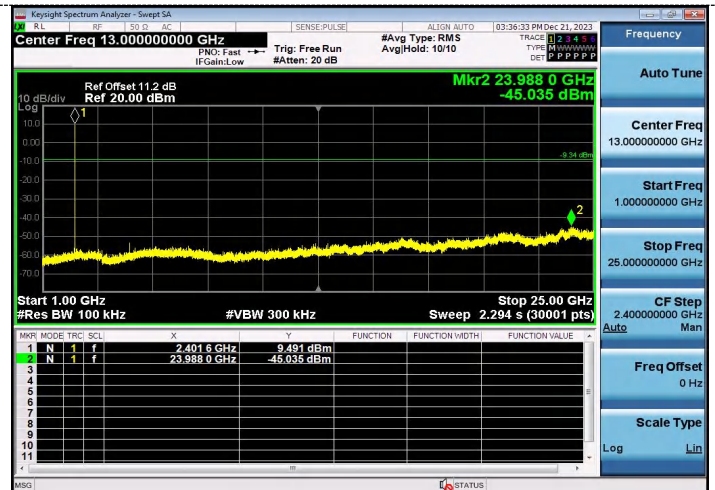
reference



30MHz-1G



30MHz-1G

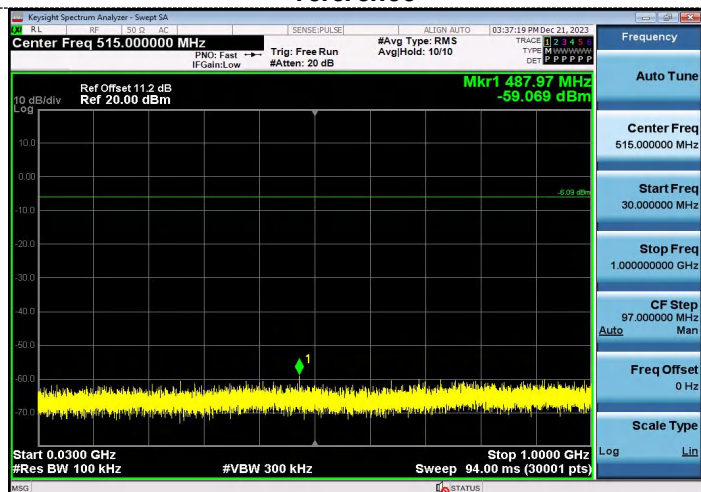


1G-25G

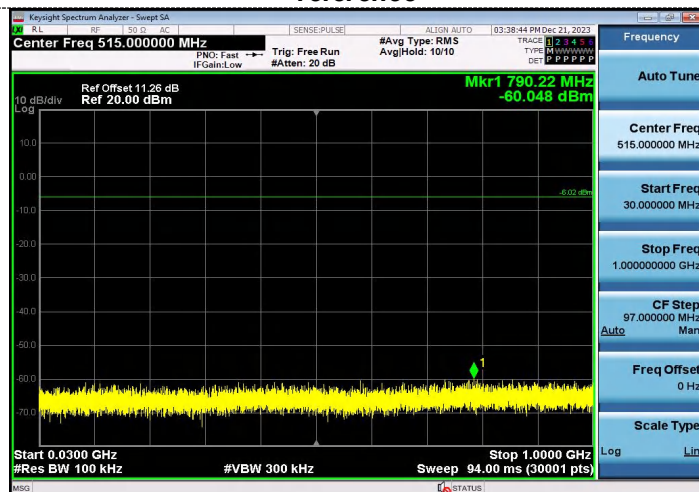
1G-25G

$\pi/4$ DQPSK (CH39) $\pi/4$ DQPSK (CH78)

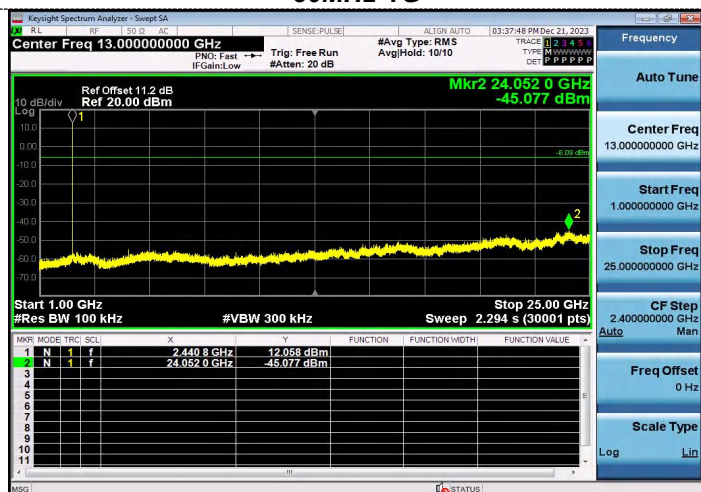
reference



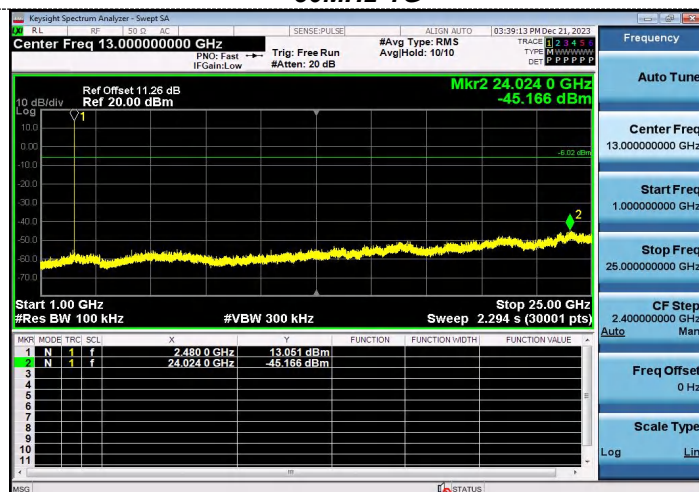
reference



30MHz-1G



30MHz-1G



1G-25G

1G-25G