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.....:	**GRCTR231202014-01**
FCC ID..... :	**2BF67-PZPA196**
Compiled by (position+printed name+signature)..:	Testing Engineer Jimmy Wang
Supervised by (position+printed name+signature)..:	Project Engineer Kelley Zhang
Approved by (position+printed name+signature)..:	Manager Sam Wang
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.....:	**North Star Diffuser**
Trade Mark.....:	/
Manufacturer.....:	Puzhen Life Co., ltd.
Model/Type reference.....:	PZ-PA196
Listed Models .....:	/
Firmware Version.....:	V1.0
Hardware Version.....:	V1.0
Modulation .....:	GFSK, Π/4DQPSK,8DPSK
Frequency.....	From 2402MHz to 2480MHz
Rating.....:	5.0V⎓1.0A(charged by Power Adapter) or 3.7V⎓3000mAh (By Li-ion rechargeable battery)
Result.....:	**PASS**

TEST REPORT

Equipment under Test	:	North Star Diffuser
Model /Type	:	PZ-PA196
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**

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:	North Star Diffuser
Model/Type reference:	PZ-PA196
Listed Models:	/
Power supply:	5.0V⎓1.0A(charged by Power Adapter) or 3.7V⎓3000mAh (By Li-ion rechargeable battery)
Adapter 1 Information:	Model:NBS05B050100VUU Input:AC100-240V 50/60Hz Output:DC 5V,1A
Adapter 2 Information:	Model:K05V050100U Input:AC100-240V 50/60Hz Output:DC 5V,1A
Testing sample ID:	GRCTR231202014-1# (Engineer sample), GRCTR231202014-2# (Normal sample)
Bluetooth	
Supported Type:	Bluetooth BR/EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB antenna
Antenna gain*(Supplied by the customer):	-7.16 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 North Star Diffuser.
For more details, refer to the user's manual of the EUT.

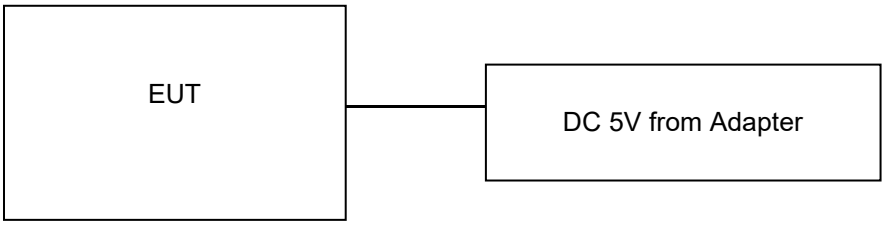
2.5 EUT operation mode

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 ℃
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)	Spectrumbandwidth of aFHSS system20dB 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.

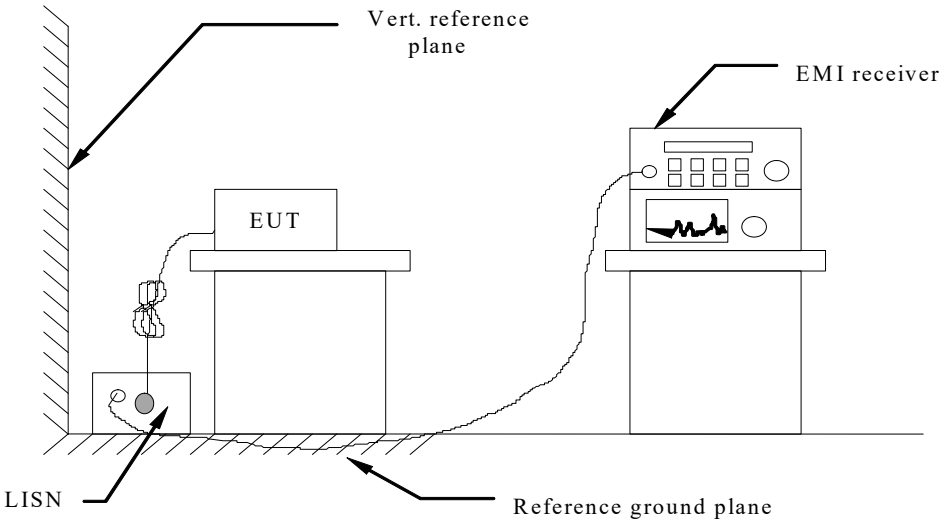
3.6 Equipments Used during the Test

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：

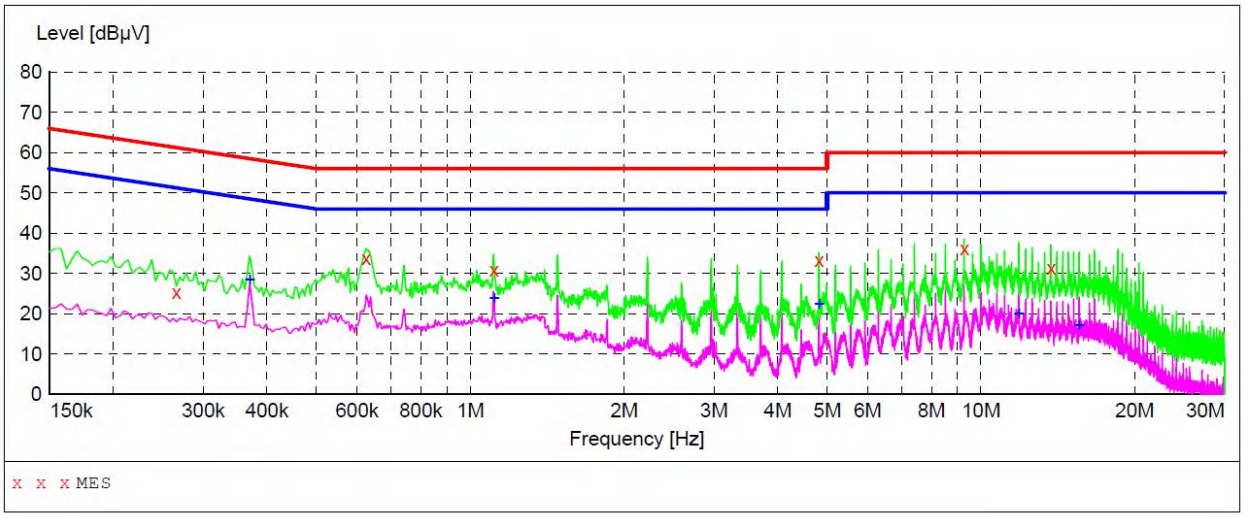
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

TEST RESULTS

Remark:
1. All modes of GFSK, Π/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:

Adapter:K05V050100U			
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
0.266000	25.30	9.6	61	35.9	QP	L1	GND
0.626000	33.70	9.6	56	22.3	QP	L1	GND
1.114000	31.00	10.0	56	25.0	QP	L1	GND
4.826000	33.40	9.9	56	22.6	QP	L1	GND
9.278000	36.30	10.0	60	23.7	QP	L1	GND
13.726000	31.50	10.0	60	28.5	QP	L1	GND

MEASUREMENT RESULT:

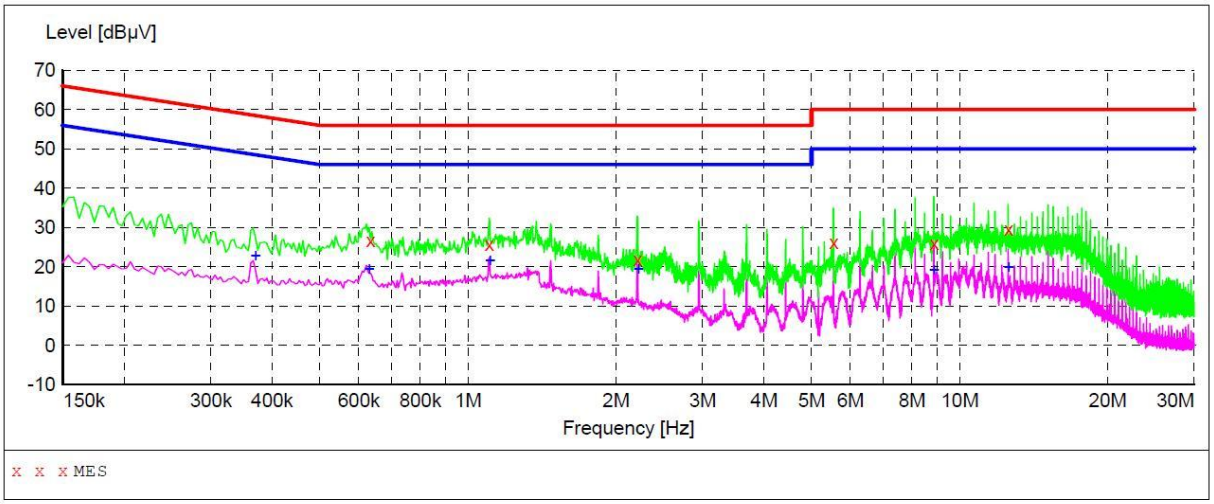
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.370000	28.50	9.6	49	20.0	AV	L1	GND
1.114000	23.90	10.0	46	22.1	AV	L1	GND
4.826000	22.40	9.9	46	23.6	AV	L1	GND
11.866000	20.00	10.0	50	30.0	AV	L1	GND
15.566000	17.10	10.1	50	32.9	AV	L1	GND

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:K05V050100U			
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
0.634000	26.70	9.6	56	29.3	QP	N	GND
1.106000	25.70	10.0	56	30.3	QP	N	GND
2.214000	21.80	10.0	56	34.2	QP	N	GND
5.546000	26.10	10.0	60	33.9	QP	N	GND
8.874000	25.90	10.0	60	34.1	QP	N	GND
12.578000	29.60	10.0	60	30.4	QP	N	GND

MEASUREMENT RESULT:

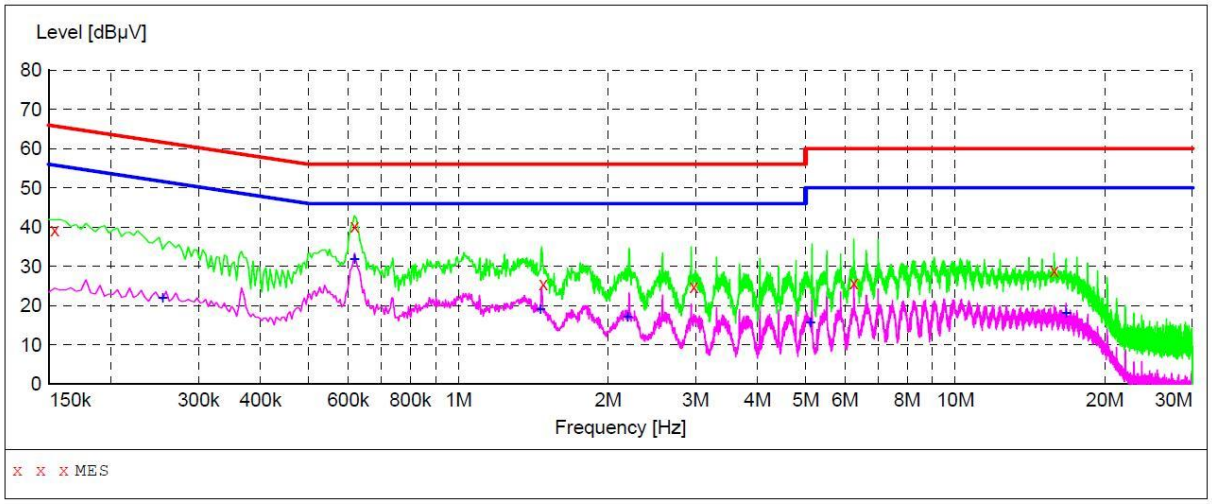
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.370000	22.90	9.6	49	25.6	AV	N	GND
0.630000	19.40	9.6	46	26.6	AV	N	GND
1.110000	21.60	10.0	46	24.4	AV	N	GND
2.222000	19.50	10.0	46	26.5	AV	N	GND
8.878000	19.30	10.0	50	30.7	AV	N	GND
12.578000	19.90	10.0	50	30.1	AV	N	GND

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:NBS05B050100VUU			
Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	L



MEASUREMENT RESULT:

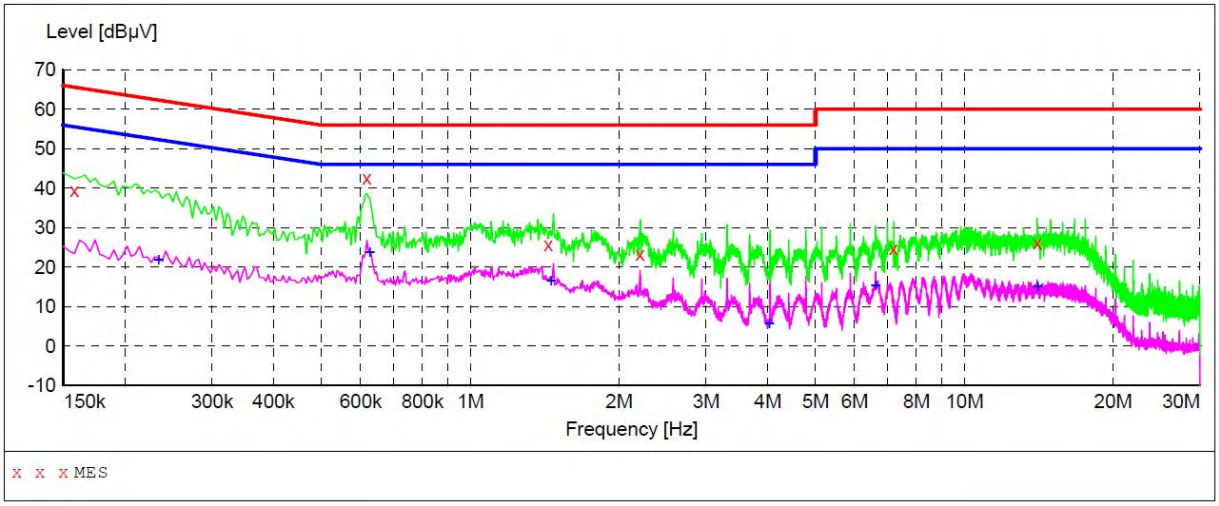
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.154000	39.40	9.6	66	26.4	QP	L1	GND
0.618000	40.40	9.6	56	15.6	QP	L1	GND
1.482000	25.60	10.0	56	30.4	QP	L1	GND
2.978000	25.00	10.0	56	31.0	QP	L1	GND
6.254000	25.90	10.0	60	34.1	QP	L1	GND
15.826000	28.90	10.1	60	31.1	QP	L1	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.254000	22.00	9.7	52	29.6	AV	L1	GND
0.618000	31.90	9.6	46	14.1	AV	L1	GND
1.462000	19.00	10.0	46	27.0	AV	L1	GND
2.190000	17.30	10.0	46	28.7	AV	L1	GND
5.106000	15.70	10.0	50	34.3	AV	L1	GND
16.718000	18.20	10.1	50	31.8	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:NBS05B050100VUU			
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	39.50	9.5	66	26.1	QP	N	GND
0.618000	42.60	9.6	56	13.4	QP	N	GND
1.438000	25.70	10.0	56	30.3	QP	N	GND
2.206000	23.40	10.0	56	32.6	QP	N	GND
7.190000	24.80	10.0	60	35.2	QP	N	GND
14.058000	26.10	10.0	60	33.9	QP	N	GND

MEASUREMENT RESULT:

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.234000	21.80	9.6	52	30.5	AV	N	GND
0.626000	23.90	9.6	46	22.1	AV	N	GND
1.458000	16.70	10.0	46	29.3	AV	N	GND
4.034000	5.70	9.8	46	40.3	AV	N	GND
6.618000	15.40	10.0	50	34.6	AV	N	GND
14.082000	15.10	10.0	50	34.9	AV	N	GND

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

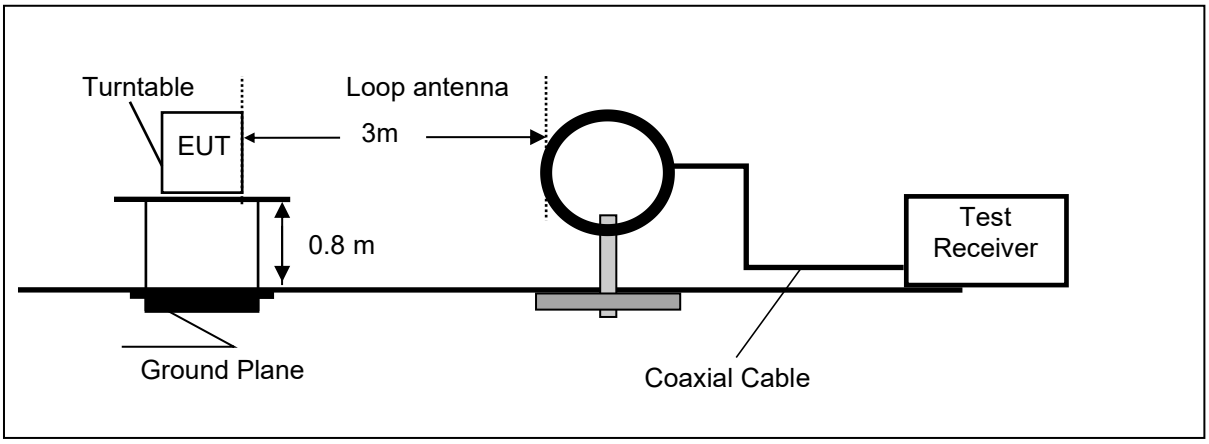
2). Transducer (dB)=insertion loss of LISN (dB) + Cable loss (dB)

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

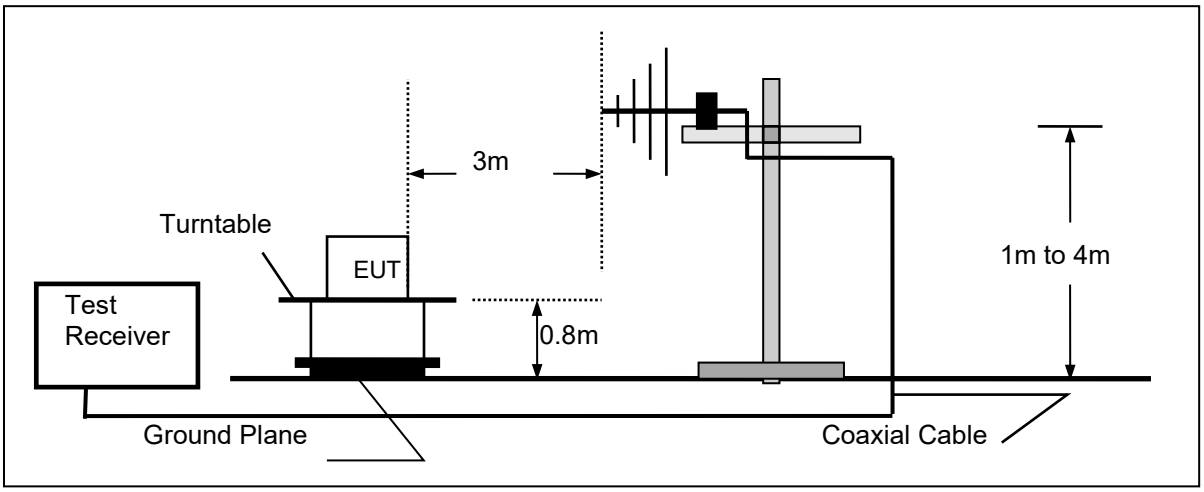
4.2 Radiated Emission

TEST CONFIGURATION

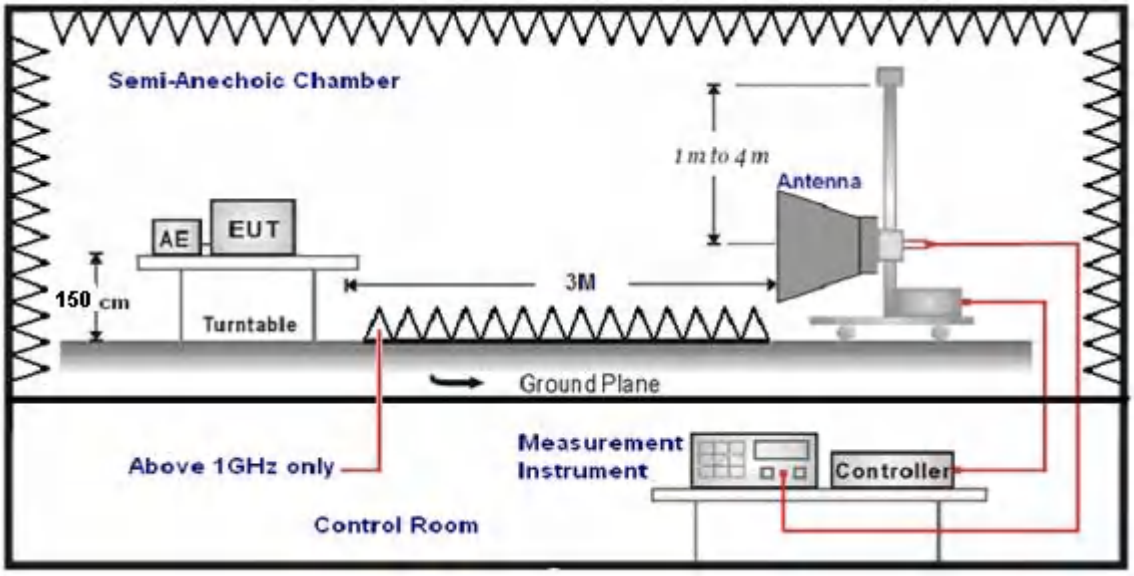
Frequency range 9 KHz – 30MHz



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 Anternna	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	

Transd=AF +CL-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 the100kHz 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	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(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,π/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:K05V050100U

Horizontal

Site LAB
Limit: FCC Part15 RE-Class B_30-1000MHz
EUT: North Star Diffuser
M/N: PZ-PA196
Mode: GFSK DH5 CH 19
Note:K05V050100U

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

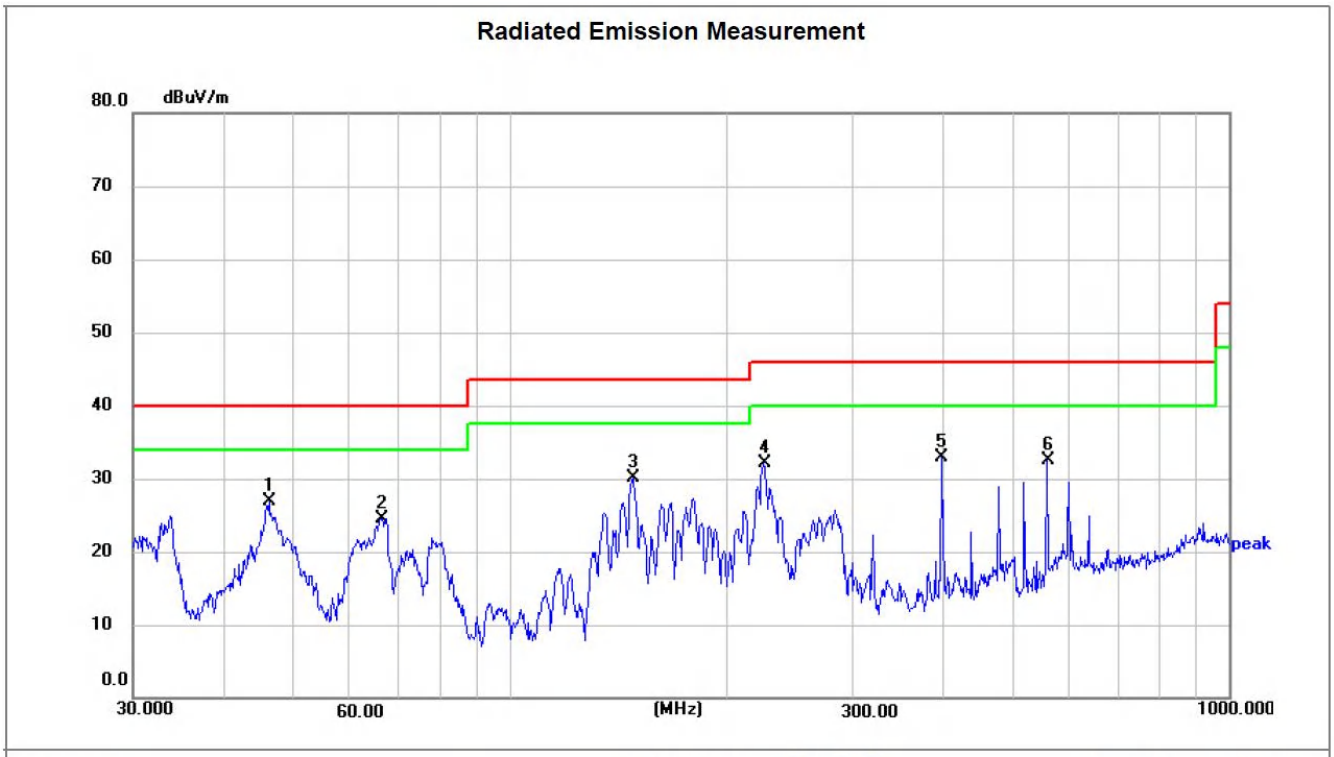
Temperature: 24(C)
Humidity: 51 %

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	78.1389	37.75	-22.37	15.38	40.00	-24.62	peak	199	186	P	
2	149.4857	42.65	-21.64	21.01	43.50	-22.49	peak	199	64	P	
3 *	207.3042	46.64	-18.91	27.73	43.50	-15.77	peak	199	0	P	
4	319.9370	42.09	-16.81	25.28	46.00	-20.72	peak	199	194	P	
5	399.0302	43.74	-15.72	28.02	46.00	-17.98	peak	199	134	P	
6	599.3212	40.79	-11.14	29.65	46.00	-16.35	peak	199	116	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:K05V050100U

Vertical



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT: North Star Diffuser

M/N: PZ-PA196

Mode: GFSK DH5 CH 19

Note: K05V050100U

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	46.3402	44.41	-17.53	26.88	40.00	-13.12	peak	100	343	P	
2	66.4989	44.70	-20.11	24.59	40.00	-15.41	peak	100	336	P	
3	148.4410	51.85	-21.68	30.17	43.50	-13.33	peak	100	71	P	
4	225.3080	50.83	-18.66	32.17	46.00	-13.83	peak	100	124	P	
5 *	399.0302	48.65	-15.72	32.93	46.00	-13.07	peak	100	301	P	
6	558.7302	46.03	-13.59	32.44	46.00	-13.56	peak	100	274	P	

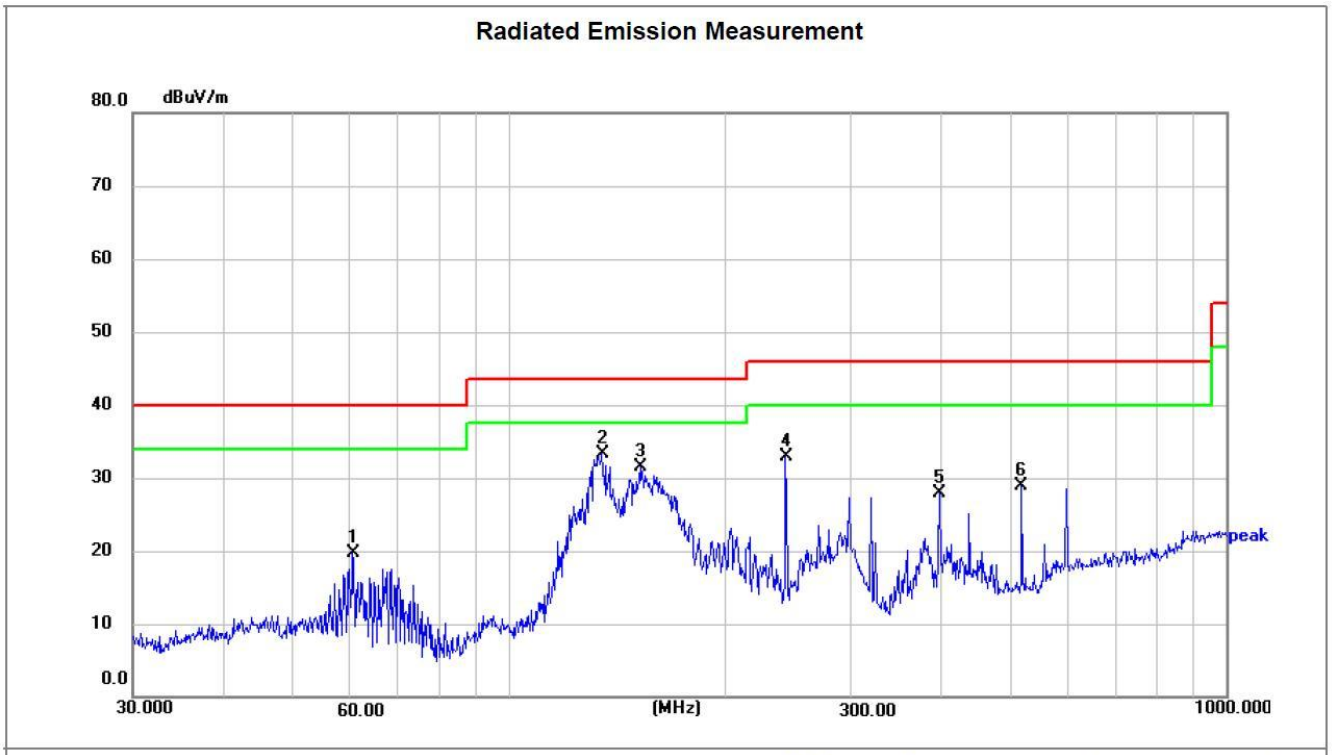
Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

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:NBS05B050100VUU

Horizontal



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT:North Star Diffuser

M/N: PZ-PA196

Mode: GFSK DH5 CH 19

Note: NBS05B050100VUU

Polarization: ***Horizontal***

Power: AC120V/60Hz

Distance: 3m

Temperature: 24.5(C)

Humidity: 52 %

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	60.7044	38.80	-19.06	19.74	40.00	-20.26	peak	199	315	P	
2 *	135.0319	55.68	-22.34	33.34	43.50	-10.16	peak	199	12	P	
3	152.6641	53.38	-21.80	31.58	43.50	-11.92	peak	199	176	P	
4	243.3772	51.21	-18.39	32.82	46.00	-13.18	peak	199	27	P	
5	399.0302	43.58	-15.72	27.86	46.00	-18.14	peak	100	202	P	
6	519.0649	43.17	-14.25	28.92	46.00	-17.08	peak	100	17	P	

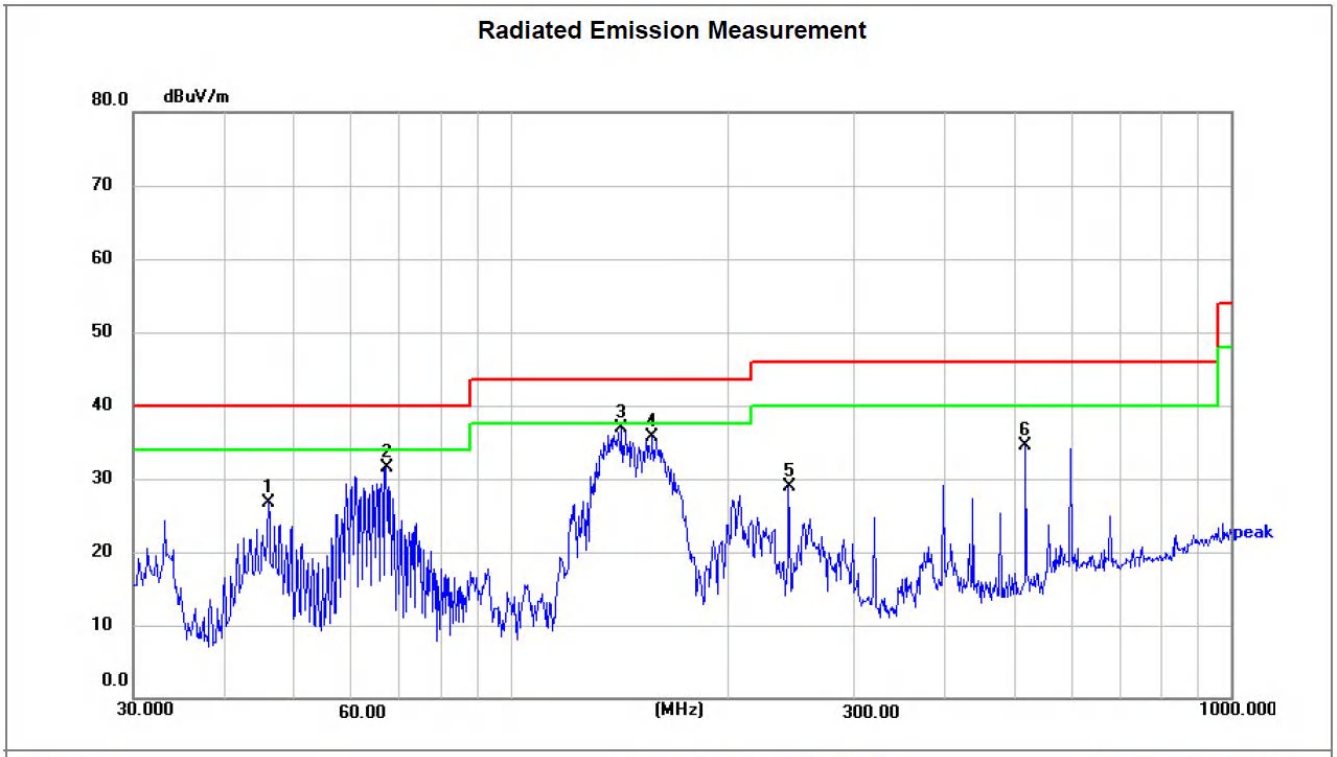
Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

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:NBS05B050100VUU

Vertical



Site LAB

Limit: FCC Part15 RE-Class B_30-1000MHz

EUT: North Star Diffuser

M/N: PZ-PA196

Mode: GFSK DH5 CH 19

Note: NBS05B050100VUU

Polarization: ***Vertical***

Power: AC120V/60Hz

Distance: 3m

Temperature: 24.5(C)

Humidity: 52 %

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	46.2996	44.33	-17.53	26.80	40.00	-13.20	peak	100	273	P	
2	67.2022	51.68	-20.17	31.51	40.00	-8.49	peak	100	359	P	
3 *	142.8243	58.70	-21.82	36.88	43.50	-6.62	peak	100	70	P	
4	157.5588	57.50	-21.88	35.62	43.50	-7.88	peak	100	88	P	
5	243.3772	47.20	-18.39	28.81	46.00	-17.19	peak	100	309	P	
6	519.0649	48.83	-14.25	34.58	46.00	-11.42	peak	100	336	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 , π/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	52.91	PK	74	21.09	74.07	28.42	5.14	54.72	-21.16
4804.00	41.81	AV	54	12.19	62.97	28.42	5.14	54.72	-21.16
7206.00	46.89	PK	74	27.11	61.31	34.15	6.46	55.03	-14.42
7206.00	37.86	AV	54	16.14	52.28	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	52.83	PK	74	21.17	73.99	28.42	5.14	54.72	-21.16
4804.00	42.80	AV	54	11.20	63.96	28.42	5.14	54.72	-21.16
7206.00	48.53	PK	74	25.47	62.95	34.15	6.46	55.03	-14.42
7206.00	36.70	AV	54	17.30	51.12	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	54.45	PK	74	19.55	74.69	28.76	5.34	54.34	-20.24
4882.00	42.06	AV	54	11.94	62.30	28.76	5.34	54.34	-20.24
7323.00	48.92	PK	74	25.08	62.55	34.41	6.83	54.87	-13.63
7323.00	38.07	AV	54	15.93	51.70	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	53.69	PK	74	20.31	73.93	28.76	5.34	54.34	-20.24
4882.00	43.91	AV	54	10.09	64.15	28.76	5.34	54.34	-20.24
7323.00	50.48	PK	74	23.52	64.11	34.41	6.83	54.87	-13.63
7323.00	38.94	AV	54	15.06	52.57	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	55.37	PK	74	18.63	74.90	29.52	5.63	54.68	-19.53
4960.00	43.35	AV	54	10.65	62.88	29.52	5.63	54.68	-19.53
7440.00	49.63	PK	74	24.37	62.83	34.49	7.23	54.92	-13.2
7440.00	37.86	PK	54	16.14	51.06	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	55.77	PK	74	18.23	75.30	29.52	5.63	54.68	-19.53
4960.00	42.52	AV	54	11.48	62.05	29.52	5.63	54.68	-19.53
7440.00	49.92	PK	74	24.08	63.12	34.49	7.23	54.92	-13.2
7440.00	38.49	PK	54	15.51	51.69	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, π/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	56.40	PK	74	17.60	81.12	25.72	4.32	54.76	-24.72
2390.00	40.21	AV	54	13.79	64.93	25.72	4.32	54.76	-24.72
2400.00	57.36	PK	74	16.64	81.62	25.73	4.33	54.75	-24.26
2400.00	42.01	AV	54	11.99	66.27	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	56.57	PK	74	17.43	81.29	25.72	4.32	54.76	-24.72
2390.00	41.91	AV	54	12.09	66.63	25.72	4.32	54.76	-24.72
2400.00	57.80	PK	74	16.20	82.06	25.73	4.33	54.75	-24.26
2400.00	41.80	AV	54	12.20	66.06	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	56.03	PK	74	17.97	80.60	25.78	4.48	54.83	-24.57
2483.50	40.31	AV	54	13.69	64.88	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	56.20	PK	74	17.80	80.77	25.78	4.48	54.83	-24.57
2483.50	40.11	AV	54	13.89	64.68	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

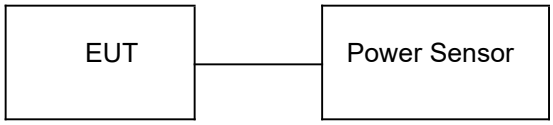
Limit

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	13.36	20.97	Pass
	39	13.23		
	78	13.91		
π/4DQPSK	00	13.33	20.97	Pass
	39	13.28		
	78	13.85		
8DPSK	00	13.13	20.97	Pass
	39	12.99		
	78	13.69		

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.

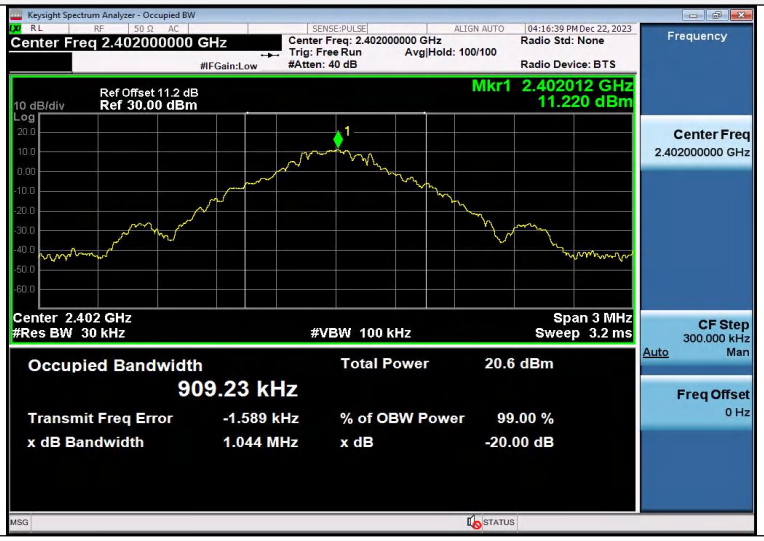
Test Configuration

Test Results

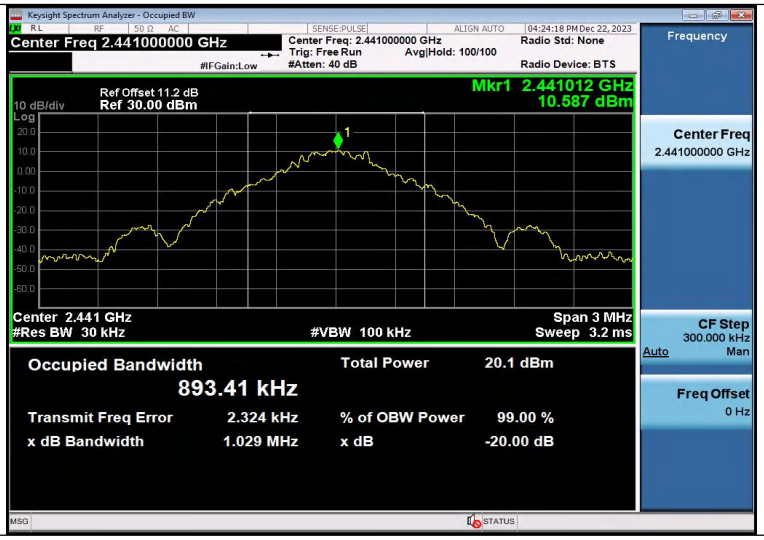
Modulation	Channel	20dB bandwidth (MHz)	Result
GFSK	00	1.044	Pass
	39	1.029	
	78	1.040	
π/4DQPSK	00	1.321	
	39	1.311	
	78	1.317	
8DPSK	00	1.300	
	39	1.283	
	78	1.311	

Test plot as follows:

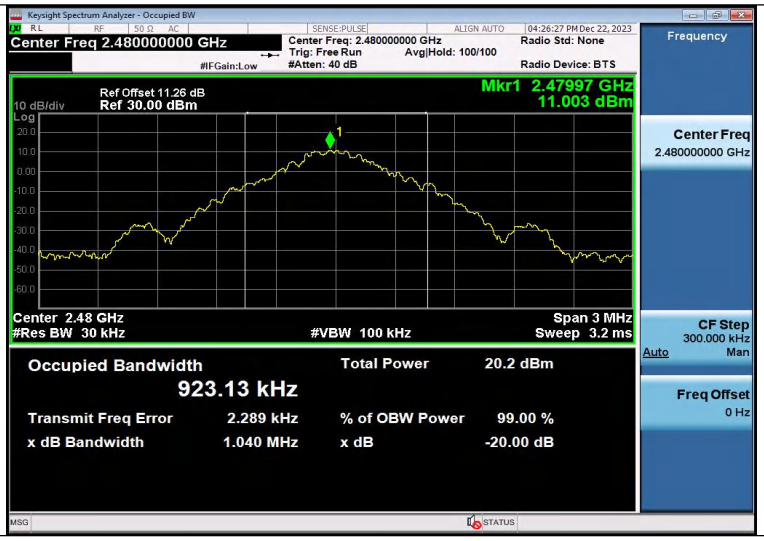
GFSK Modulation



CH00

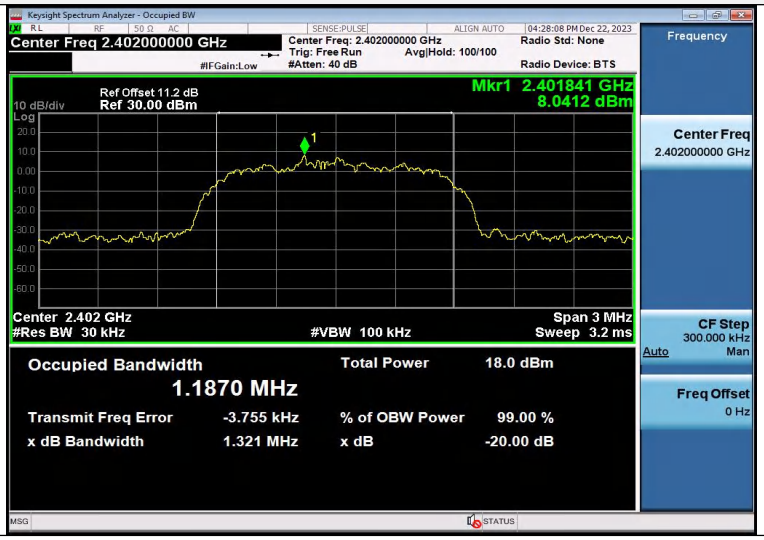


CH39



CH78

π/4DQPSK Modulation



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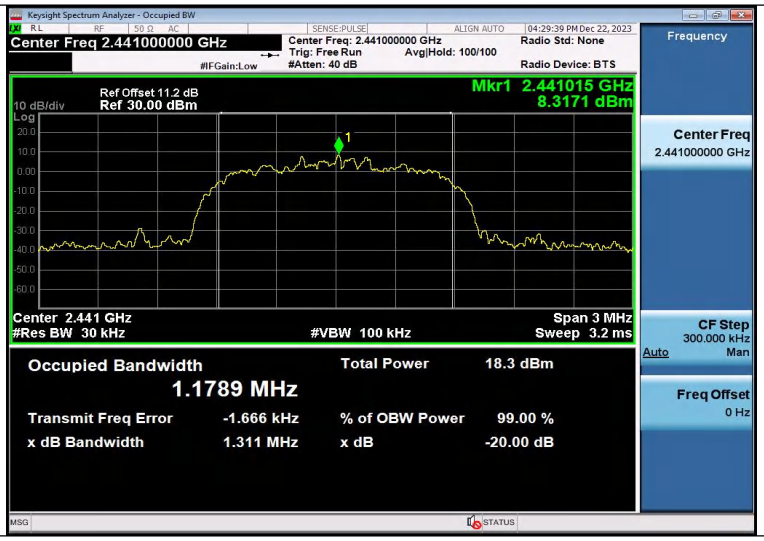

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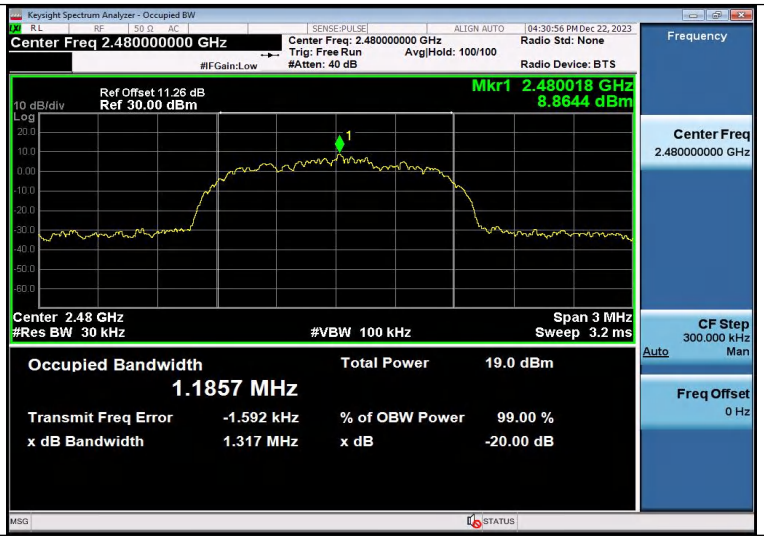
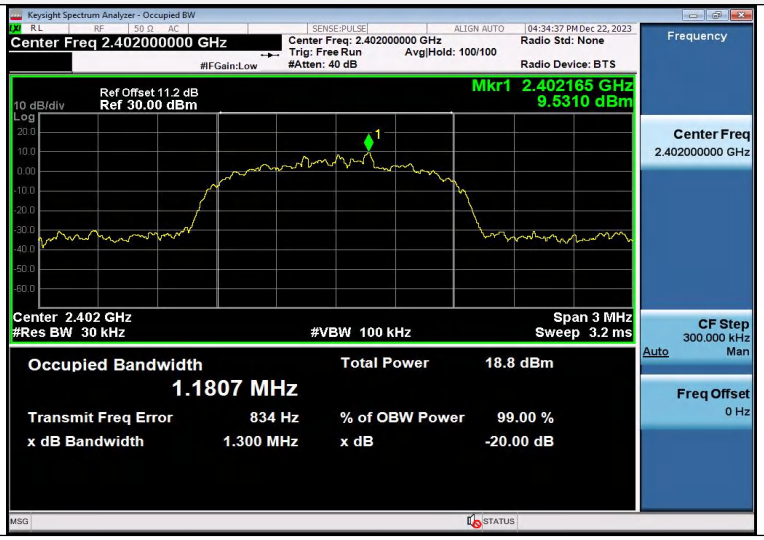
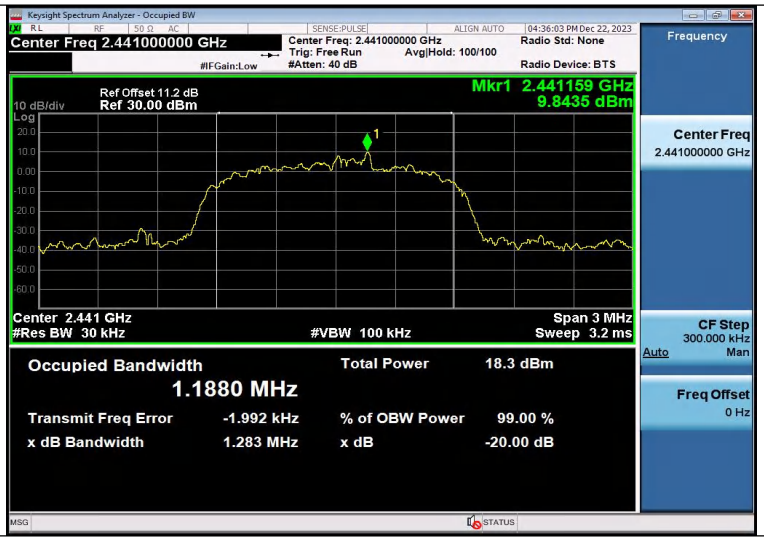


CH78

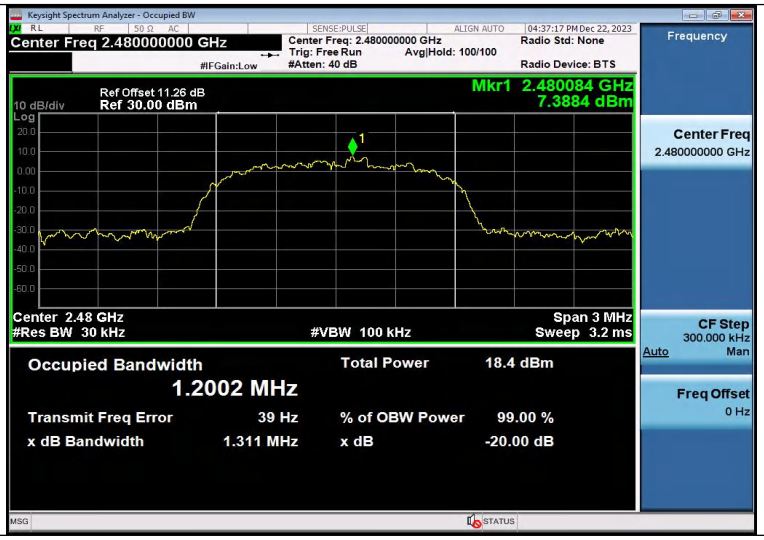
8DPSK Modulation



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*20dB 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 with300 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION

TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit	Result
GFSK	CH39	1.018	0.686MHz	Pass
	CH40			
π/4DQPSK	CH39	1.004	0.874MHz	Pass
	CH40			
8DPSK	CH39	1.350	0.855MHz	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

π/4DQPSK

8DPSK

4.6 Number of hopping frequency

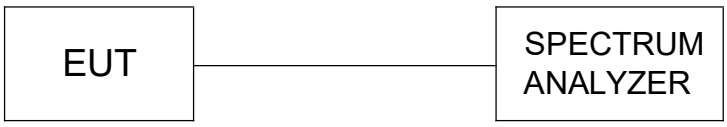
Limit

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.

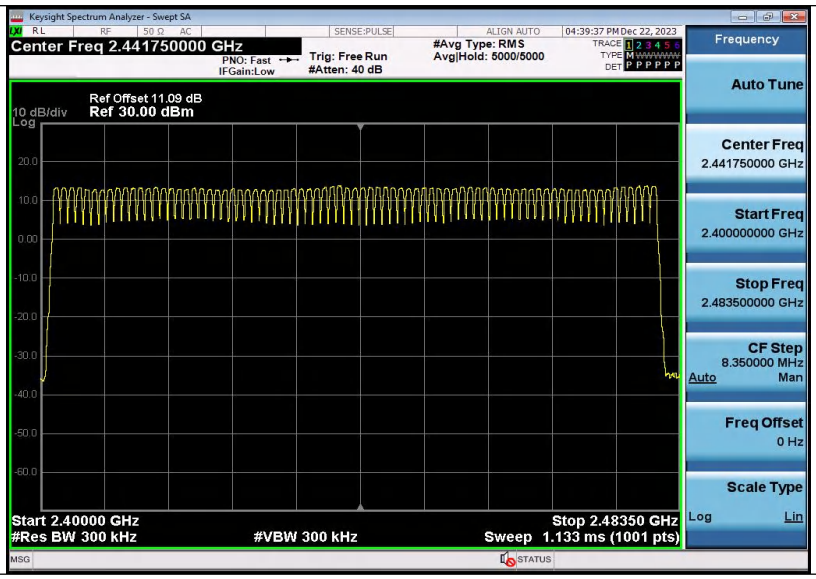
Test Configuration



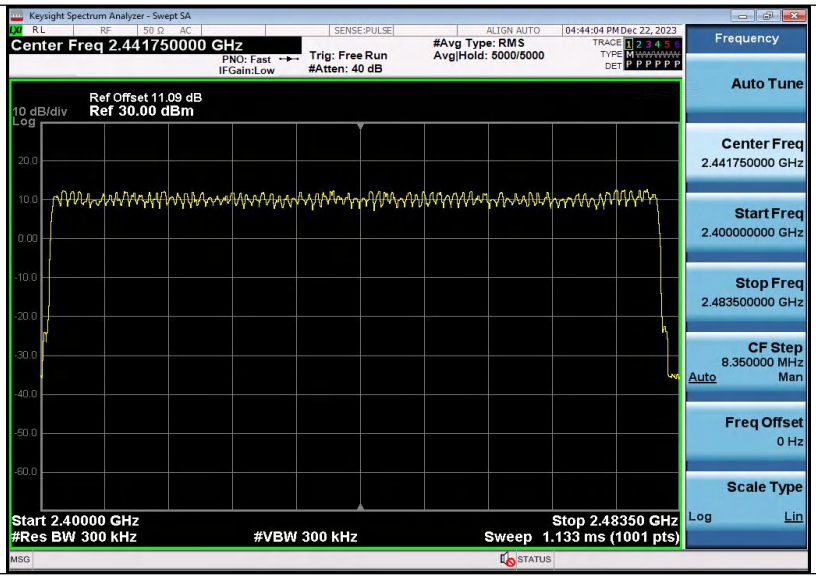
Test Results

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

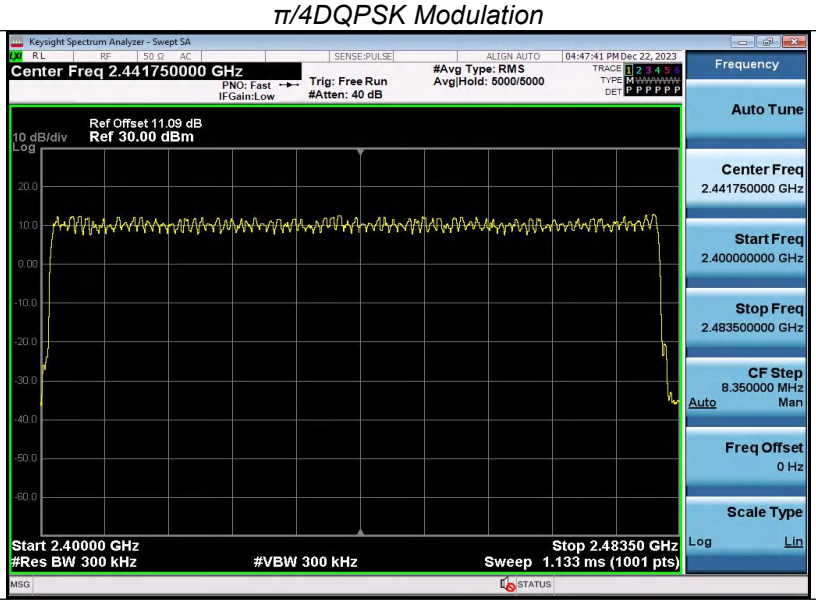
Test plot as follows:



GFSK Modulation



π/4DQPSK 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	0.385	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.

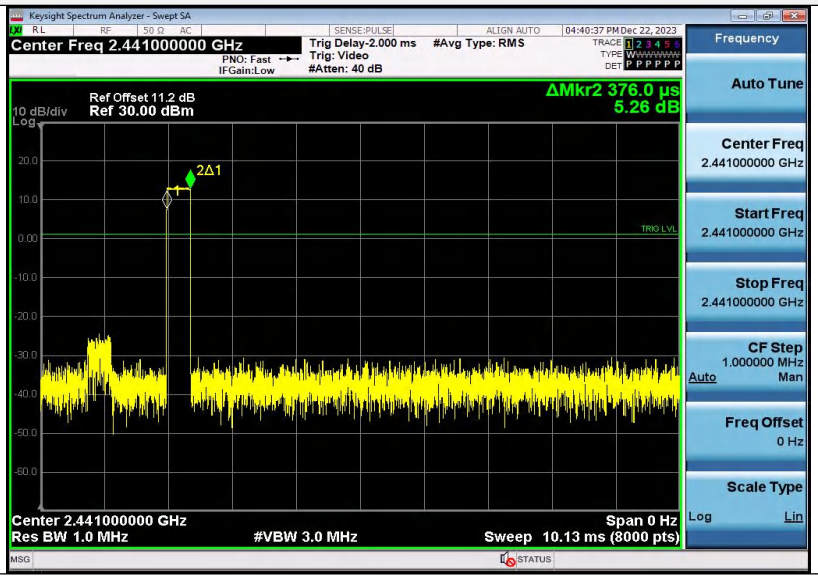
Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1

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:

GFSK Modulation

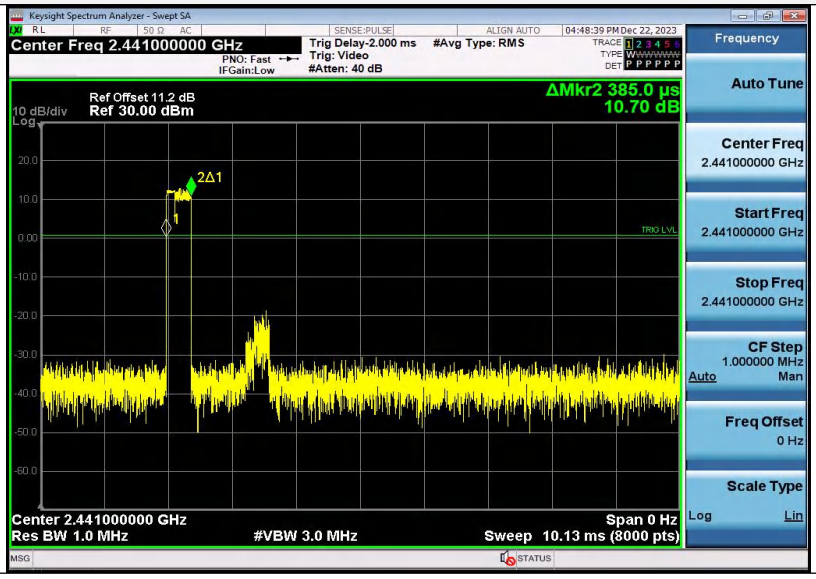


DH1 burst time

DH3 burst time

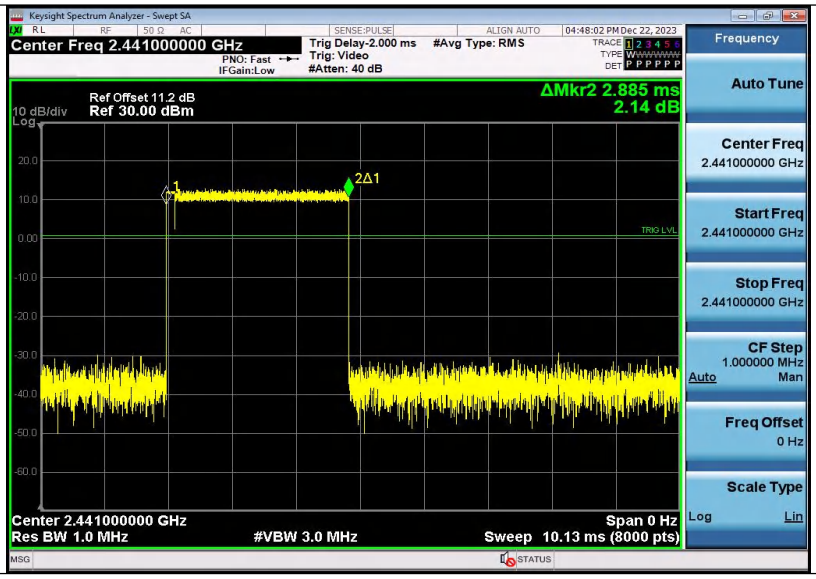
DH5 burst time

π/4DQPSK Modulation



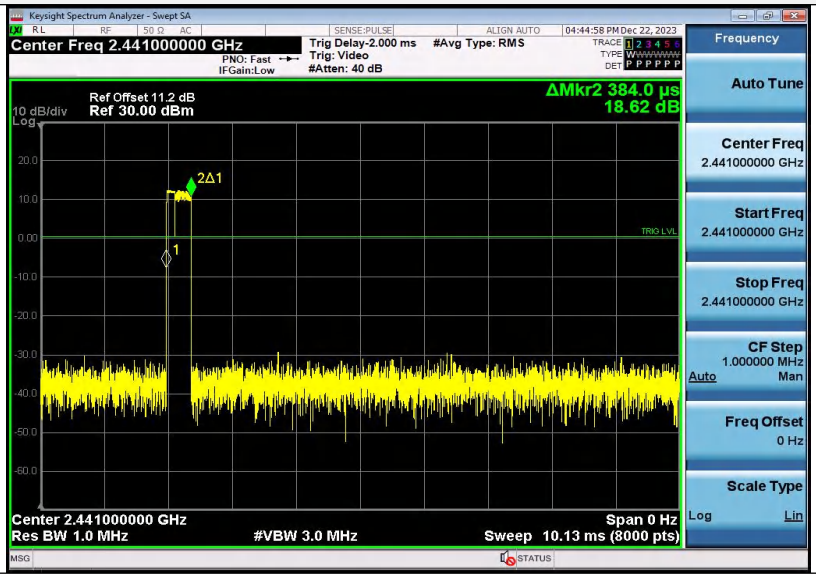
2-DH1 burst time

2-DH3 burst time



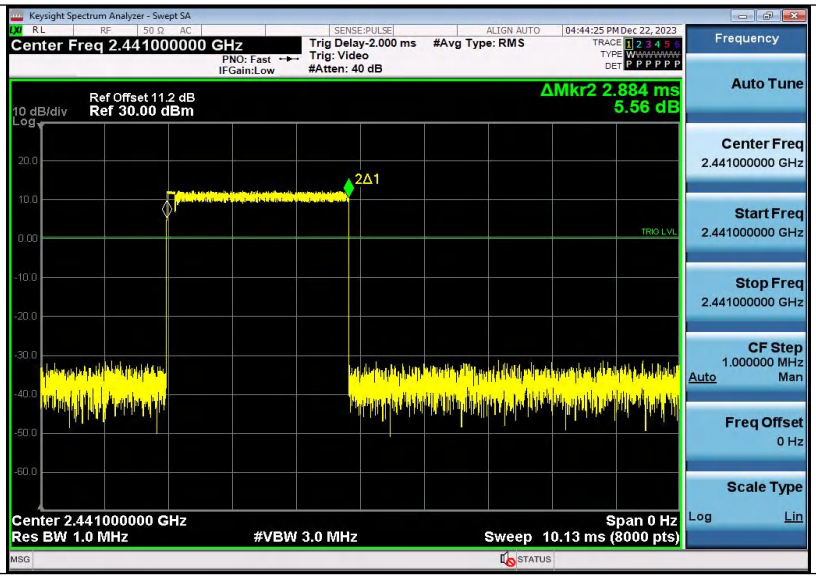
2-DH5 burst time

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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

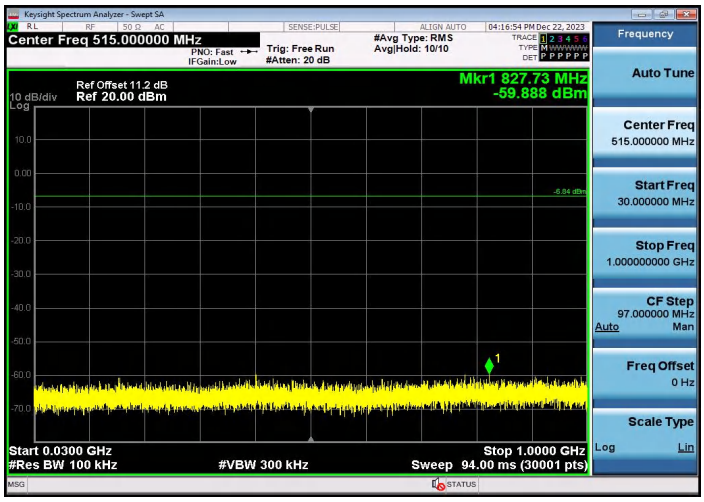
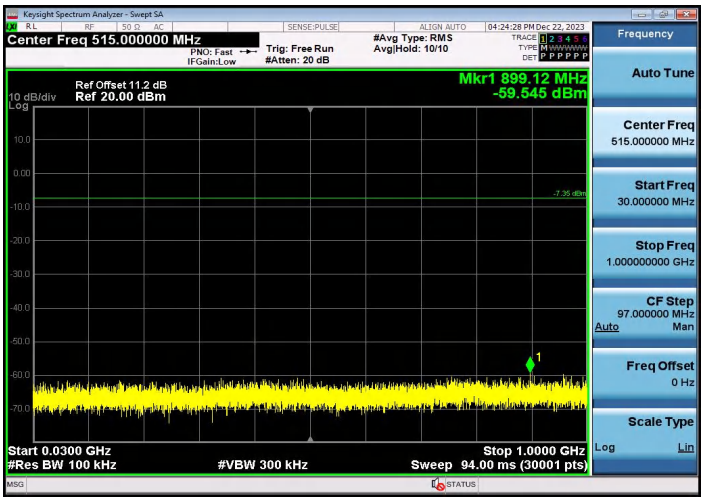
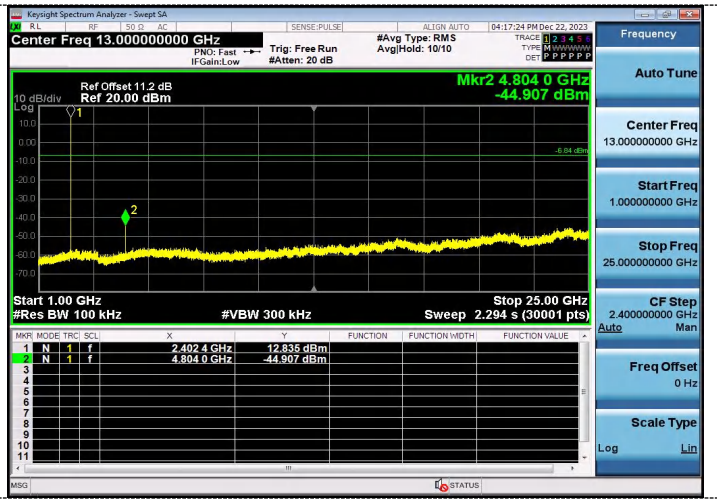
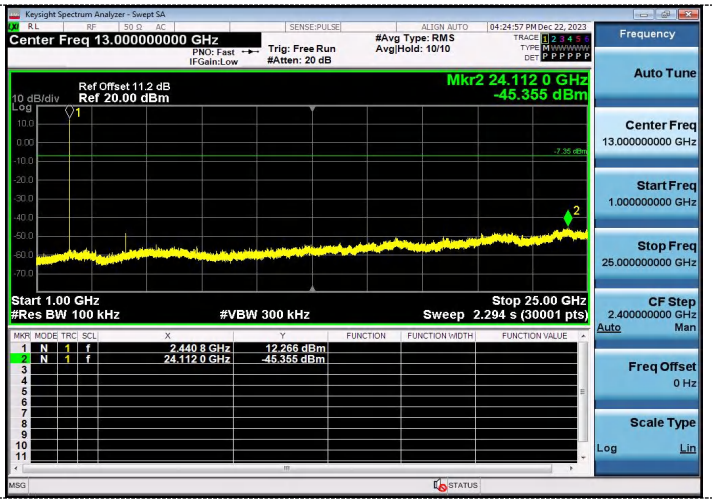
Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

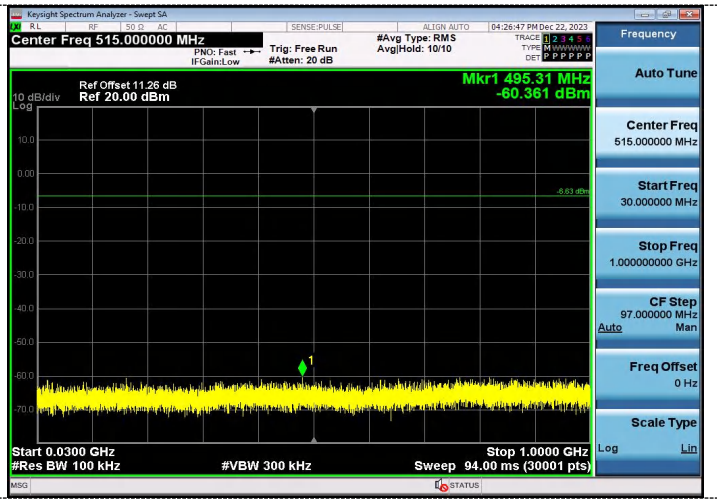
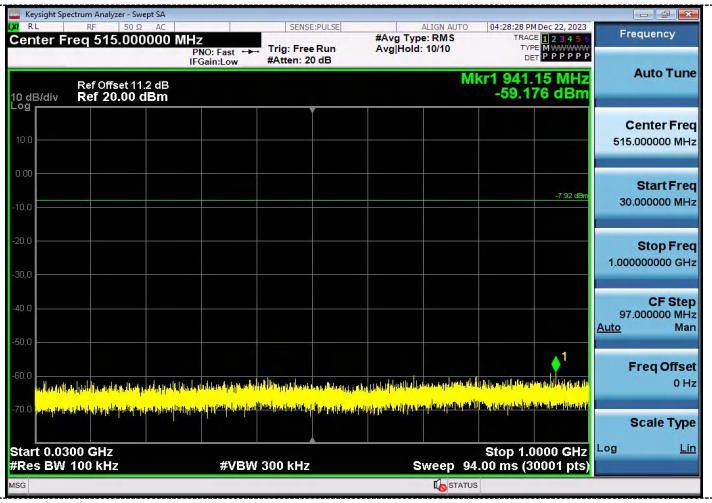
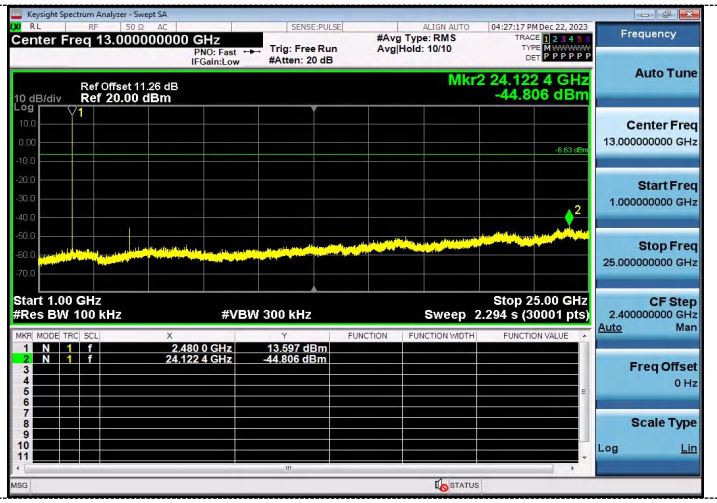
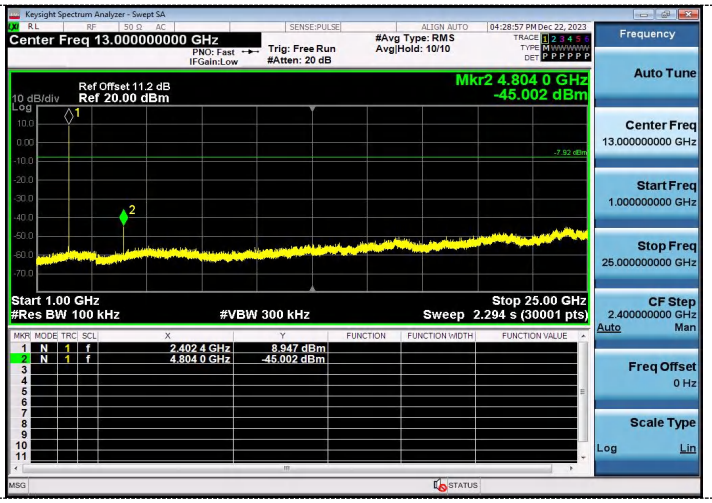
Test Configuration

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 bandage 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)	π/4DQPSK (CH00)
reference	reference
	
30MHz-1G	30MHz-1G
	
1G-25G	1G-25G