Shenzhen Most Technology Service Co., Ltd.
No.5, 2nd Langshan Road, North District, Hi-tech Industrial Park, Nanshan, Shenzhen, Guangdong, China.

TEST REPORT

FCC Rules Part 15.247

Report Reference No.....:	**MTEB24030282-R1**
FCC ID..... :	**2AUTE-HDR3D2331**
Compiled by (position+printed name+signature)..:	File administrators Alisa Luo
Supervised by (position+printed name+signature)..:	Test Engineer Sunny Deng
Approved by (position+printed name+signature)..:	Manager Yvette Zhou
Date of issue.....:	March 27,2024
Representative Laboratory Name.:	**Shenzhen Most Technology Service Co., Ltd.**
Address.....:	No.5, 2nd Langshan Road, North District, Hi-tech Industrial Park, Nanshan, Shenzhen, Guangdong, China.
Applicant's name.....:	**Xiamen Hanin Co.,Ltd.**
Address.....:	Room 305A, Angye Buildling, Pioneering Park,Torch High-tech Zone, Xiamen, china
Test specification/ Standard.....:	**FCC Rules Part 15.247**
TRF Originator.....:	Shenzhen Most Technology Service Co., Ltd.

Test item description.....:	Thermal Receipt Printer
Trade Mark.....:	N/A
Model/Type reference.....:	TP900
Listed Models .....:	TP900-i, TP901-i, TP902-i, TP903-i, TP904-i, FFSP9000+,FFSP9U00+, FFSP9U01+, FFSP9U02+, FFSP9U03+, FFSP8U04+,FFSP9X00+, FFSP9X01+, FFSP9X02+, FFSP9X03+, FFSP9X04+,POS90D, POS90H,HDR3D2331
Modulation Type.....:	GFSK, π/4DQPSK, 8DPSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Hardware Version.....	TP900-MBA
Software Version.....	V.TP900.1.x
Rating.....:	DC 24V by Adapter
Result.....:	**PASS**

T E S T R E P O R T

Equipment under Test	:	Thermal Receipt Printer
Model /Type	:	TP900
Listed Models	:	TP900-i, TP901-i, TP902-i, TP903-i, TP904-i, FFSP9000+,FFSP9U00+, FFSP9U01+, FFSP9U02+, FFSP9U03+, FFSP8U04+,FFSP9X00+, FFSP9X01+, FFSP9X02+, FFSP9X03+, FFSP9X04+,POS90D, POS90H,HDR3D2331
Remark		It's just that the product models are called differently
Applicant	:	Xiamen Hanin Co.,Ltd.
Address	:	Room 305A, Angye Buildling, Pioneering Park,Torch High-tech Zone, Xiamen, china
Manufacturer	:	Xiamen Hanin Co.,Ltd.
Address	:	Room 305A, Angye Buildling, Pioneering Park,Torch High-tech Zone, Xiamen, china

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.

Contents

1 Revision History

Revision	Issue Date	Revisions	Revised By
00	2024.03.27	Initial Issue	Alisa Luo

2 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

3 SUMMARY

3.1 General Remarks

Date of receipt of test sample	:	2024.03.22
Testing commenced on	:	2024.03.22
Testing concluded on	:	2024.03.27

3.2 Product Description

Product Name:	Thermal Receipt Printer
Model/Type reference:	TP900
Power Supply：	DC 24V by Adapter
Testing sample ID：	MTYP04553
Bluetooth :	
Supported Type:	Bluetooth BR/EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	FPC Antenna
Antenna gain:	3.02dBi

3.3 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 24V by Adapter

3.4 Short description of the Equipment under Test (EUT)

This is a Thermal Receipt Printer For more details, refer to the user's manual of the EUT.

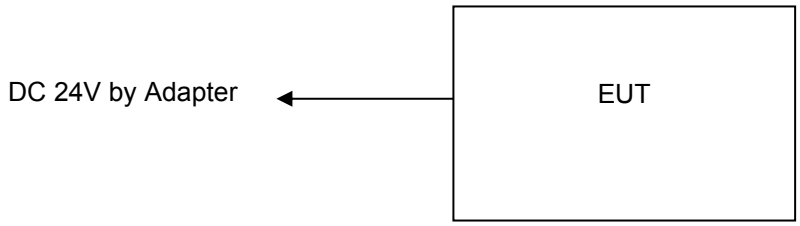
3.5 EUT operation mode

The Applicant provides communication tools software(Engineer mode) 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

3.6 Block Diagram of Test Setup



3.7 Test Item (Equipment Under Test) Description*

Short designation	EUT Name	EUT Description	Serial number	Hardware status	Software status
EUT A	Adapter	GM60-240250-F			
EUT B					

*: declared by the applicant. According to customers information EUTs A and B are the same devices.

3.8 Auxiliary Equipment (AE) Description

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1			/	
AE 2	-			

3.9 Antenna Information*

Short designation	Antenna Name	Antenna Type	Frequency Range	Serial number	Antenna Peak Gain
Antenna 1	---	FPC Antenna	2.4 – 2.5 GHz	---	3.02dBi
Antenna 2					

*: declared by the applicant.

3.10 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.

3.11 Modifications

No modifications were implemented to meet testing criteria.

3.12 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - Supplied by the lab

●	ADAPTER	M/N:	GM60-240250-F
		Manufacturer:	FOSHAN SHUNDE GUANYUDA POWER CO., LTD.

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

Shenzhen Most Technology Service Co., Ltd.
No.5, 2nd Langshan Road, North District, Hi-tech Industrial Park, Nanshan, Shenzhen, Guangdong, China.
The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

Test Facility

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

FCC-Designation No.: CN1315

Shenzhen Most Technology Service Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

A2LA-Lab Cert. No.: 6343.01

Shenzhen Most Technology Service Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

4.2 Environmental conditions

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

Radiated Emission:

Temperature:	23 ° C
Humidity:	48 %
Atmospheric pressure:	950-1050mbar

AC Main Conducted testing：

Temperature:	24 ° C
Humidity:	45 %
Atmospheric pressure:	950-1050mbar

Conducted testing：

Temperature:	24 ° C
Humidity:	45 %
Atmospheric pressure:	950-1050mbar

4.3 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 8DPSK	☒ 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 outputpower	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	Band edgecompliance conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.205	Band edgecompliance radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions 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

4.4 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 CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Most 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 Most Technology Service Co., Ltd. is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)
20dB Bandwidth	/	5%	(1)
Maximum Conducted Output Power	/	0.80dB	(1)
Spurious RF Conducted Emission	/	1.6dB	(1)

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

4.5 Equipments Used during the Test

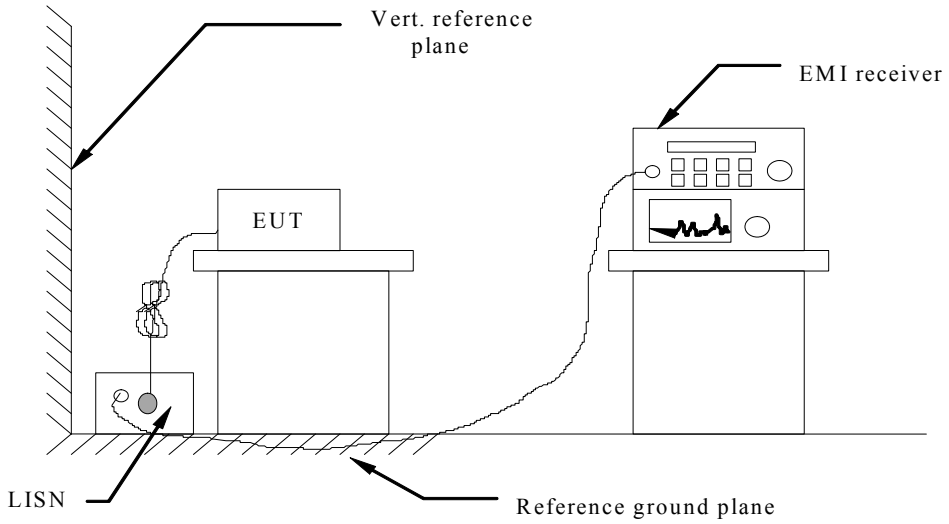
Item	Equipment	Manufacturer	Model No.	Serial No.	Firmware versions	Last Cal.
1.	L.I.S.N.	R&S	ENV216	100093	/	2024/03/15
2	Three-phase artificial power network	Schwarzback Mess	NNLK8129	8129178	/	2024/03/15
3.	Receiver	R&S	ESCI	100492	V3.0-10-2	2024/03/15
4	Receiver	R&S	ESPI	101202	V3.0-10-2	2024/03/15
5	Spectrum analyzer	Agilent	9020A	MT-E306	A14.16	2024/03/15
6	Bilong Antenna	Sunol Sciences	JB3	A121206	/	2023/08/15
7	Horn antenna	HF Antenna	HF Antenna	MT-E158	/	2024/03/15
8	Loop antenna	Beijing Daze	ZN30900B	/	/	2024/03/15
9	Horn antenna	R&S	OBH100400	26999002	/	2024/03/15
10	Wireless Communication Test Set	R&S	CMW500	/	CMW-BASE-3.7.21	2024/03/15
11	Spectrum analyzer	R&S	FSP	100019	V4.40 SP2	2024/03/15
12	High gain antenna	Schwarzbeck	LB-180400KF	MT-E389	/	2024/03/15
13	Preamplifier	Schwarzbeck	BBV 9743	MT-E390	/	2024/03/15
14	Pre-amplifier	EMCI	EMC051845SE	MT-E391	/	2024/03/15
15	Pre-amplifier	Agilent	83051A	MT-E392	/	2024/03/15
16	High pass filter unit	Tonscend	JS0806-F	MT-E393	/	2024/03/15
17	RF Cable(below1GHz)	Times	9kHz-1GHz	MT-E394	/	2024/03/15
18	RF Cable(above 1GHz)	Times	1-40G	MT-E395	/	2024/03/15
19	RF Cable (9KHz-40GHz)	Tonscend	170660	N/A	/	2024/03/15
20	Power meter	R&S	NRVS	100444	/	2024/03/15

Note: The Cal.Interval was one year.

5 TEST CONDITIONS AND RESULTS

5.1 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 DC 24V power from adapter, the adapter received AC120V/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：

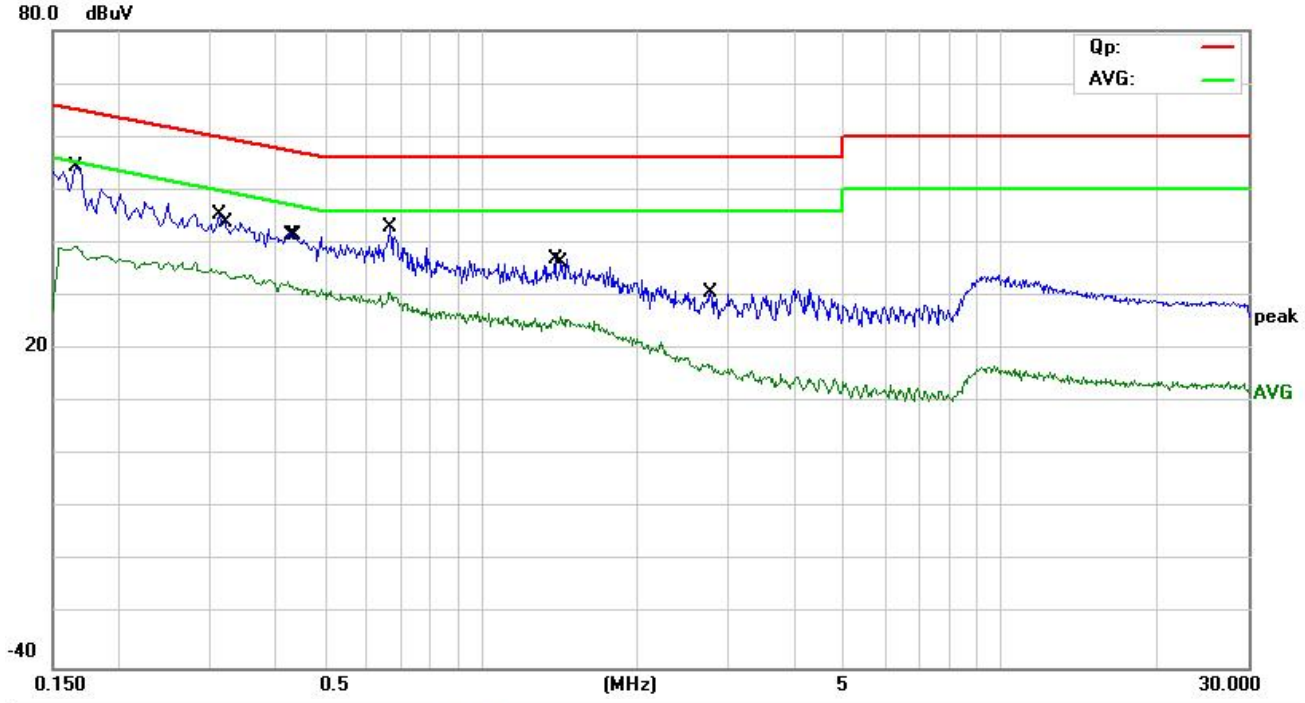
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

TEST RESULTS

Remark:

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

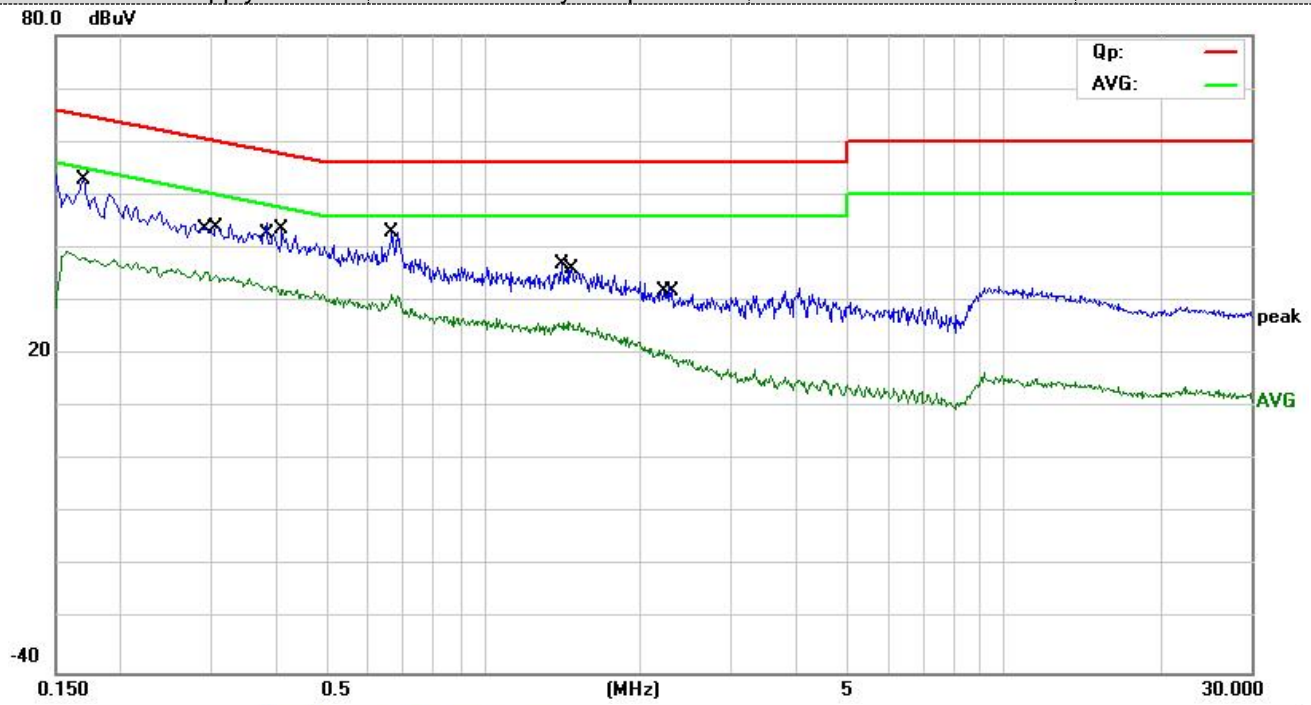
Power supply:	DC 24V by Adapter	Polarization	L



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1660	44.69	9.61	54.30	65.16	-10.86	QP	
2		0.1660	29.88	9.61	39.49	55.16	-15.67	AVG	
3		0.3100	25.28	9.59	34.87	49.97	-15.10	AVG	
4		0.3220	34.41	9.59	44.00	59.66	-15.66	QP	
5		0.4351	22.00	9.59	31.59	47.15	-15.56	AVG	
6		0.4380	31.85	9.59	41.44	57.10	-15.66	QP	
7		0.6700	33.42	9.60	43.02	56.00	-12.98	QP	
8		0.6700	20.96	9.60	30.56	46.00	-15.44	AVG	
9		1.3900	27.46	9.60	37.06	56.00	-18.94	QP	
10		1.4260	16.42	9.60	26.02	46.00	-19.98	AVG	
11		2.7220	7.54	9.61	17.15	46.00	-28.85	AVG	
12		2.7700	21.11	9.61	30.72	56.00	-25.28	QP	

*:Maximum data x:Over limit !:over margin

Power supply:	DC 24V by Adapter	Polarization	N



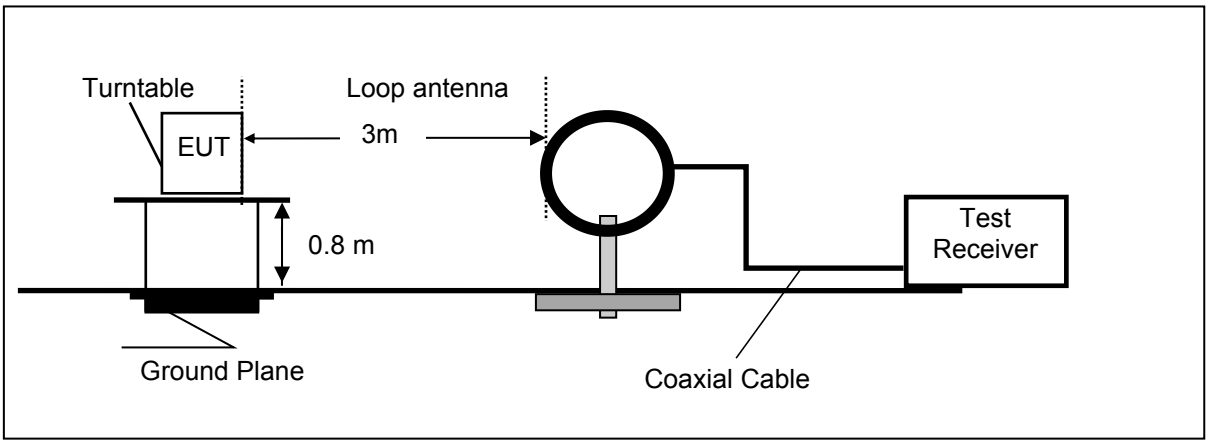
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1700	43.24	9.61	52.85	64.96	-12.11	QP	
2		0.1700	28.54	9.61	38.15	54.96	-16.81	AVG	
3		0.2940	25.96	9.59	35.55	50.41	-14.86	AVG	
4		0.3060	34.34	9.59	43.93	60.08	-16.15	QP	
5		0.3860	23.29	9.59	32.88	48.15	-15.27	AVG	
6		0.4100	34.09	9.59	43.68	57.65	-13.97	QP	
7		0.6660	33.43	9.60	43.03	56.00	-12.97	QP	
8		0.6660	21.57	9.60	31.17	46.00	-14.83	AVG	
9		1.4180	27.44	9.60	37.04	56.00	-18.96	QP	
10		1.4500	16.41	9.60	26.01	46.00	-19.99	AVG	
11		2.2220	11.05	9.60	20.65	46.00	-25.35	AVG	
12		2.2980	22.30	9.61	31.91	56.00	-24.09	QP	

*:Maximum data x:Over limit !:over margin

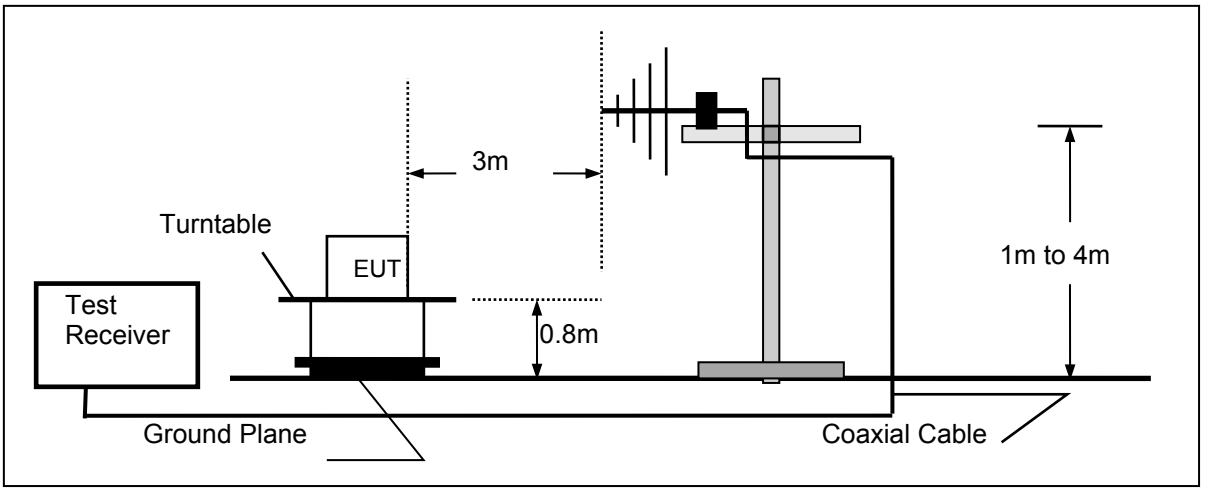
5.2 Radiated Emission

TEST CONFIGURATION

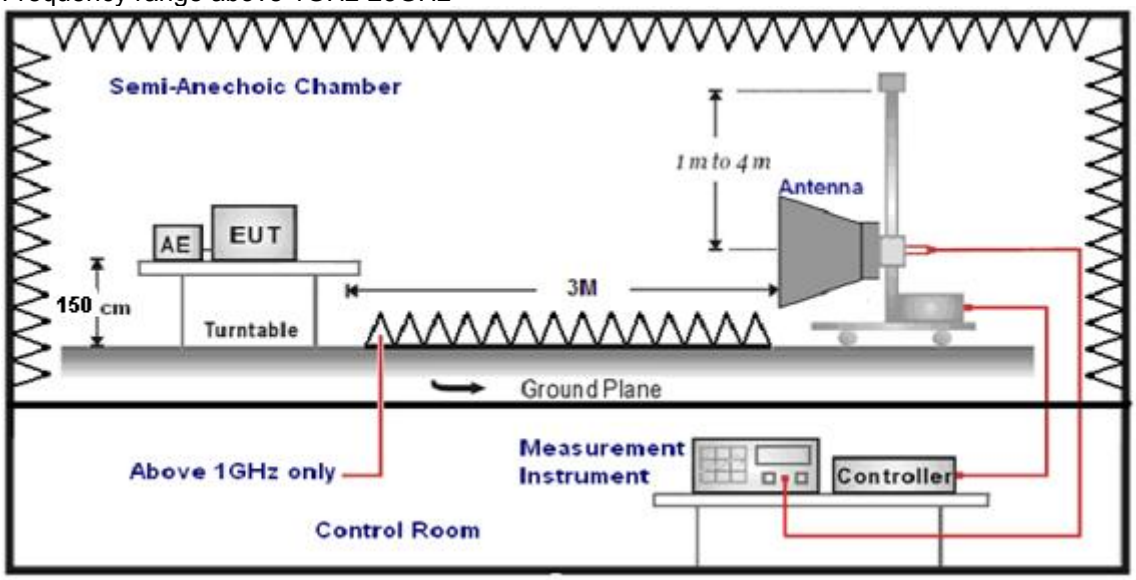
Frequency range 9 KHz – 30MHz



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.
5. Remark: Result=Reading value+Factor

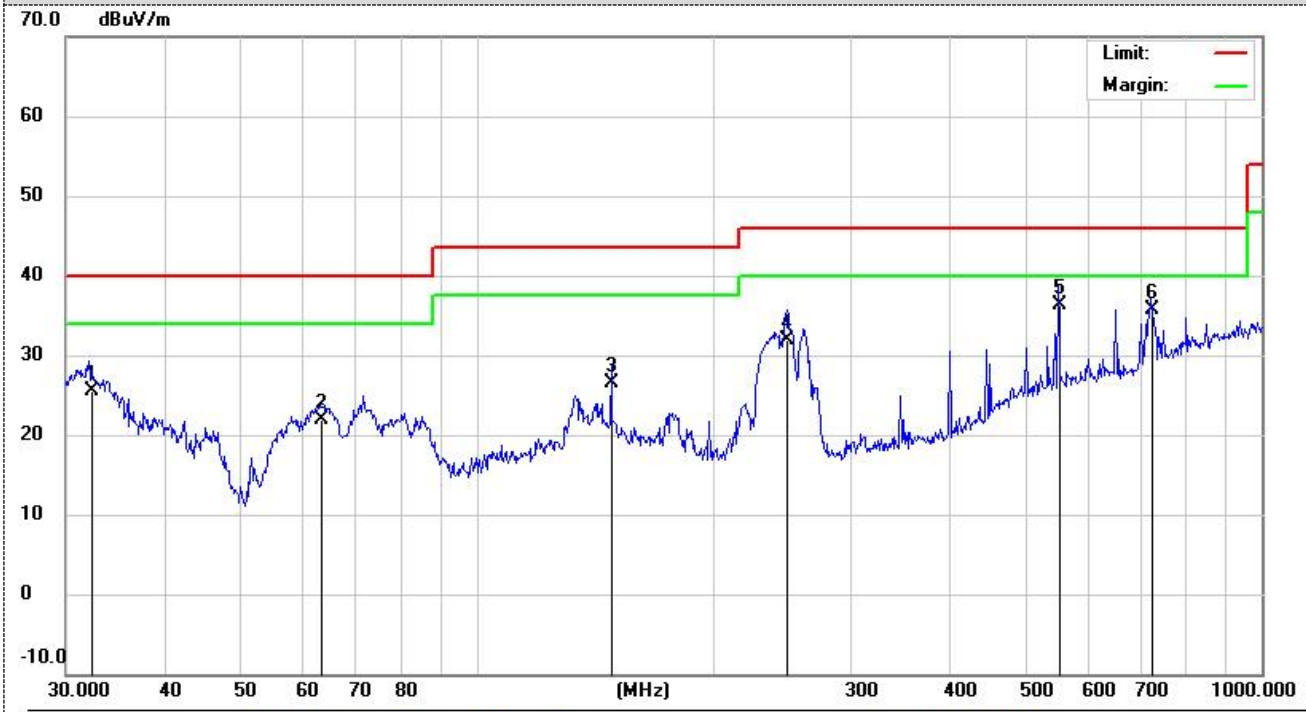
For 30MHz-1GHz

Horizontal

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		31.8427	2.10	19.65	21.75	40.00	-18.25	QP	200	23	
2		69.6005	7.20	9.27	16.47	40.00	-23.53	QP	200	88	
3	*	142.3243	15.00	16.70	31.70	43.50	-11.80	QP	200	139	
4		249.4250	17.60	13.82	31.42	46.00	-14.58	QP	200	188	
5		346.8092	10.00	16.39	26.39	46.00	-19.61	QP	200	238	
6		533.8321	7.30	23.07	30.37	46.00	-15.63	QP	200	299	
7		726.8052	5.30	25.85	31.15	46.00	-14.85	QP	200	321	

*:Maximum data x:Over limit !:over margin

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		32.4059	6.30	19.26	25.56	40.00	-14.44	QP	100	35	
2		63.5356	13.00	8.85	21.85	40.00	-18.15	QP	100	88	
3		148.4410	9.00	17.50	26.50	43.50	-17.00	QP	100	157	
4		248.5519	18.00	13.84	31.84	46.00	-14.16	QP	100	199	
5	*	550.9480	13.00	23.26	36.26	46.00	-9.74	QP	100	254	
6		721.7259	10.00	25.71	35.71	46.00	-10.29	QP	100	306	

*:Maximum data x:Over limit !:over margin

For 1GHz to 25GHz

Note: GFSK, π/4DQPSK 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	54.57	PK	74	19.43	52.67	31.42	6.98	36.5	1.9
4804	45.24	AV	54	8.76	43.34	31.42	6.98	36.5	1.9
7206	52.99	PK	74	21.01	42.39	37.03	8.87	35.3	10.6
7206	41.53	AV	54	12.47	30.93	37.03	8.87	35.3	10.6

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	56.75	PK	74	17.25	54.85	31.42	6.98	36.5	1.9
4804	42.75	AV	54	11.25	40.85	31.42	6.98	36.5	1.9
7206	54.77	PK	74	19.23	44.17	37.03	8.87	35.3	10.6
7206	41.2	AV	54	12.8	30.6	37.03	8.87	35.3	10.6

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	54.55	PK	74	19.45	52.49	30.98	7.58	36.5	2.06
4882	43.43	AV	54	10.57	41.37	30.98	7.58	36.5	2.06
7323	51.24	PK	74	22.76	40.32	37.66	8.56	35.3	10.92
7323	41.7	AV	54	12.3	30.78	37.66	8.56	35.3	10.92

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	57.65	PK	74	16.35	55.59	30.98	7.58	36.5	2.06
4882	43.19	AV	54	10.81	41.13	30.98	7.58	36.5	2.06
7323	51.78	PK	74	22.22	40.86	37.66	8.56	35.3	10.92
7323	43.35	AV	54	10.65	32.43	37.66	8.56	35.3	10.92

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	58.79	PK	74	15.21	55.72	31.47	7.8	36.2	3.07
4960	46.38	AV	54	7.62	43.31	31.47	7.8	36.2	3.07
7440	54.98	PK	74	19.02	43.24	38.32	8.72	35.3	11.74
7440	42.35	AV	54	11.65	30.61	38.32	8.72	35.3	11.74

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	58.14	PK	74	15.86	55.07	31.47	7.8	36.2	3.07
4960	47.47	AV	54	6.53	44.4	31.47	7.8	36.2	3.07
7440	54.65	PK	74	19.35	42.91	38.32	8.72	35.3	11.74
7440	42.48	AV	54	11.52	30.74	38.32	8.72	35.3	11.74

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/4DQPSK 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	54.77	PK	74	19.23	60.18	27.49	3.32	36.22	-5.41
2390	42.07	AV	54	11.93	47.48	27.49	3.32	36.22	-5.41
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	58.29	PK	74	15.71	63.7	27.49	3.32	36.22	-5.41
2390	39.81	AV	54	14.19	45.22	27.49	3.32	36.22	-5.41
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)
2483.5	58.76	PK	74	15.24	64.27	27.45	3.38	36.34	-5.51
2483.5	39.49	AV	54	14.51	45	27.45	3.38	36.34	-5.51
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)
2483.5	58.32	PK	74	15.68	63.83	27.45	3.38	36.34	-5.51
2483.5	42.23	AV	54	11.77	47.74	27.45	3.38	36.34	-5.51

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.

5.3 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 powersensor.

Test Configuration

Test Results

See Appendix I

5.4 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

See Appendix III

5.5 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. The bandwidth of the fundamental frequency was measured by spectrum analyzer with100 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION

TEST RESULTS

See Appendix IV

5.6 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

See Appendix VIII

5.7 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.

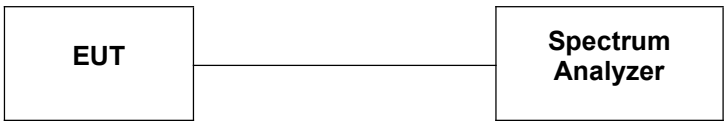
Test Configuration

Test Results

See Appendix VII

5.8 Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 25GHz.

LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

Test Results

See Appendix V

5.9 Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

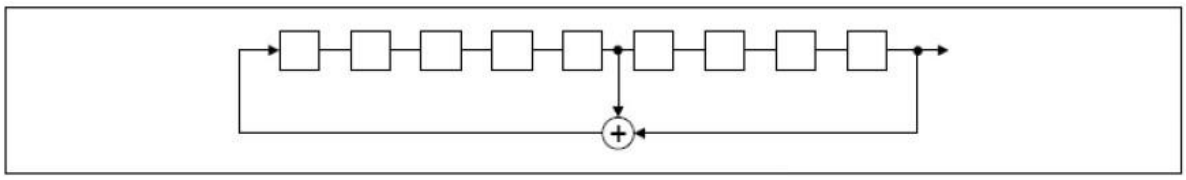
For 47 CFR Part 15C section 15.247 (a) (1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

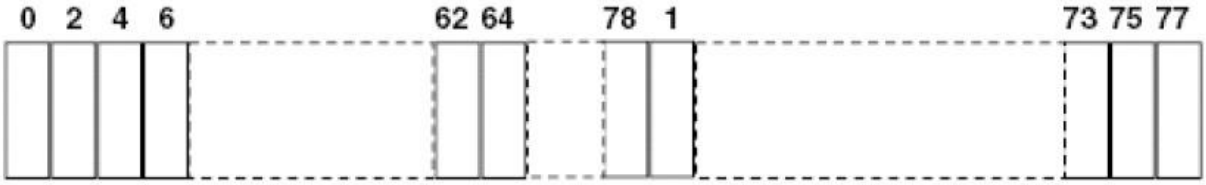
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

5.10 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

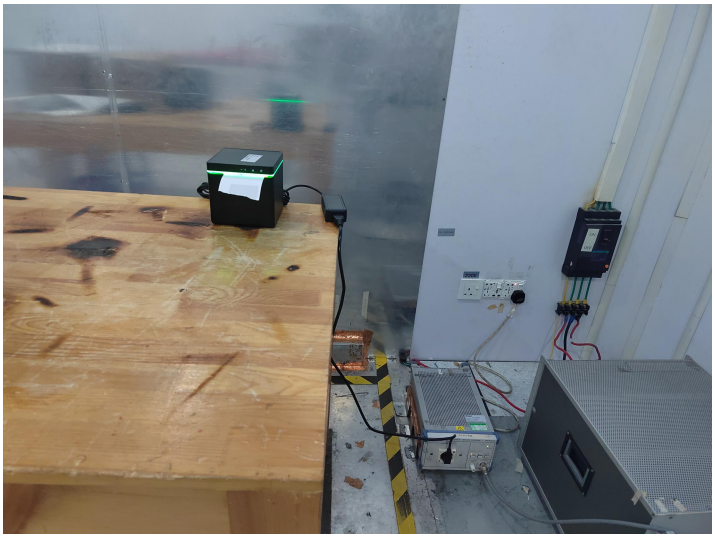
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

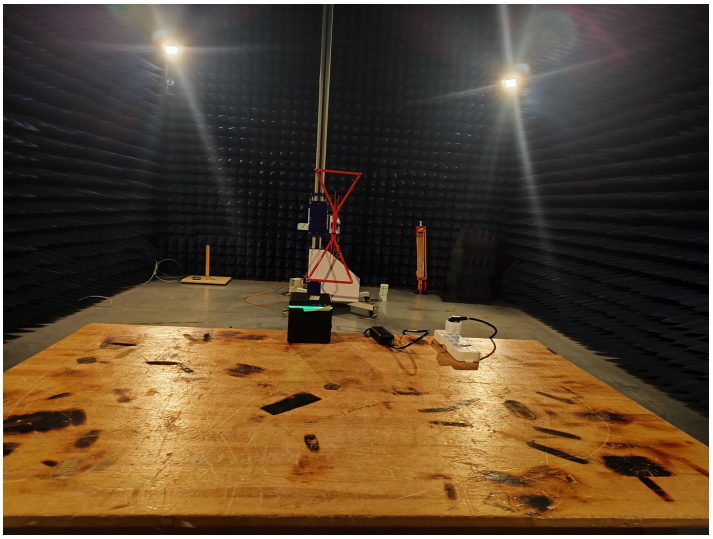
Antenna Connected Construction

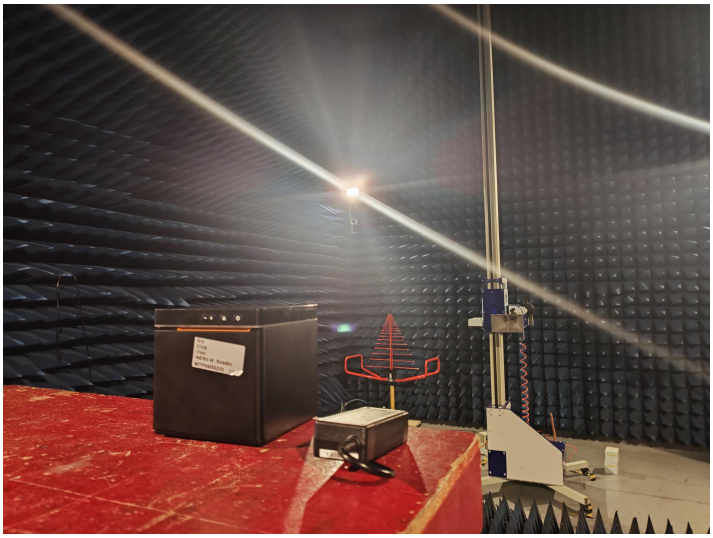
The directional gains of antenna used for transmitting is 3.02dBi, and the antenna is an FPC Antennaconnect to PCB board and no consideration of replacement. Please see EUT photo for details.

Results: Compliance.

6 Test Setup Photos of the EUT







7 Photos of the EUT

See related photo report.

APPENDIX I.Conducted Peak Output Power

Test Result

Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Max. Avg. Power (dBm)	Limit (dBm)	Result
GFSK	DH5	0	2.259	1.682	None	30	PASS
		39	2.673	1.851	None		PASS
		78	2.635	1.834	None		PASS
π/4DQPSK	2-DH5	0	3.142	2.062	None	20.97	PASS
		39	3.469	2.223	None		PASS
		78	3.511	2.244	None		PASS
8DPSK	3-DH5	0	3.328	2.152	None		PASS
		39	3.795	2.396	None		PASS
		78	3.774	2.385	None		PASS

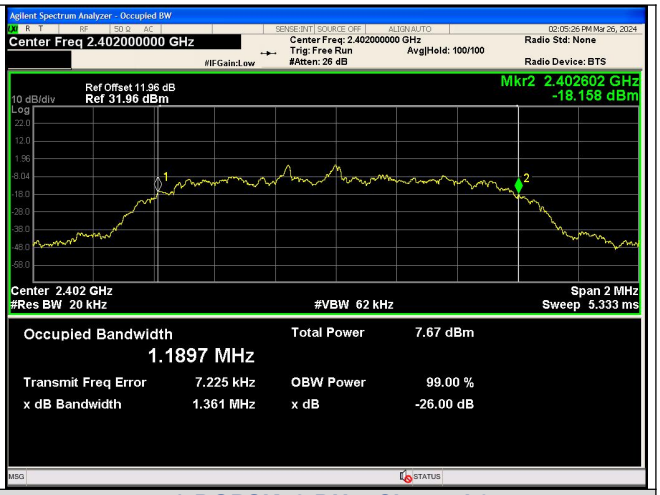
APPENDIX II.99% Bandwidth

Test Result

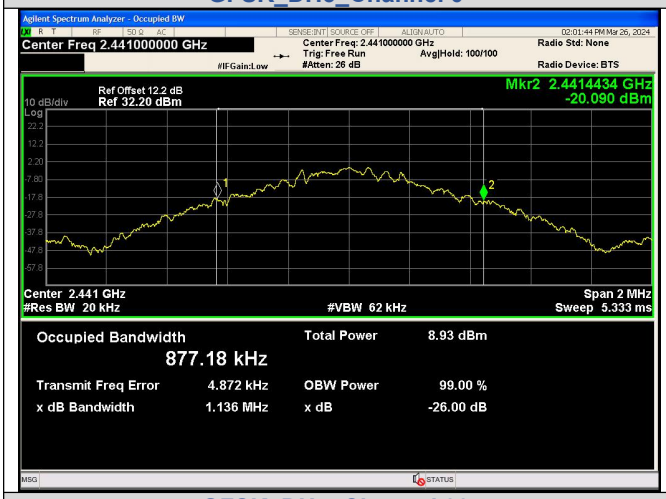
Modulation	Channel	99% BW (MHz)
GFSK	0	0.87684
	39	0.87718
	78	0.89522
π/4DQPSK	0	1.1897
	39	1.1860
	78	1.1874
8DPSK	0	1.1742
	39	1.1826
	78	1.1777

Test Graphs

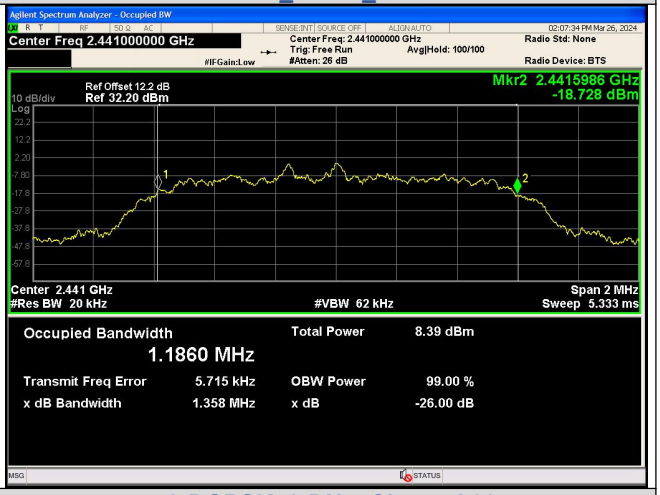
GFSK_DH5_Channel 0



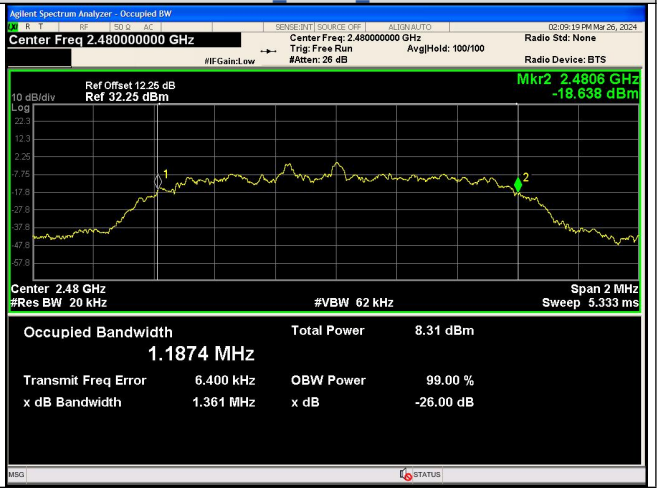
π/4DQPSK_2-DH5_Channel 0

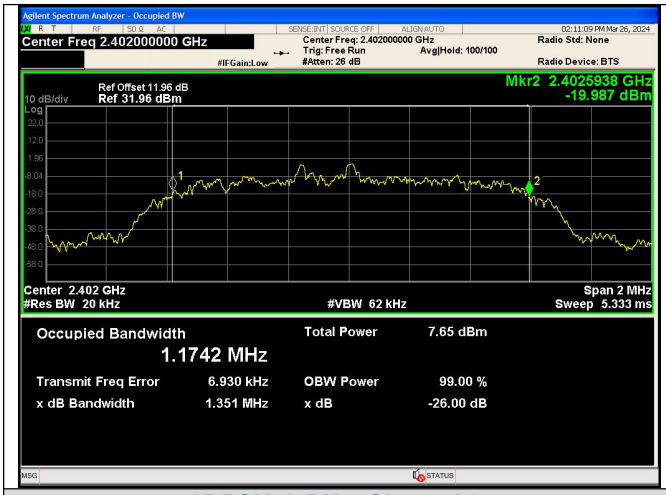
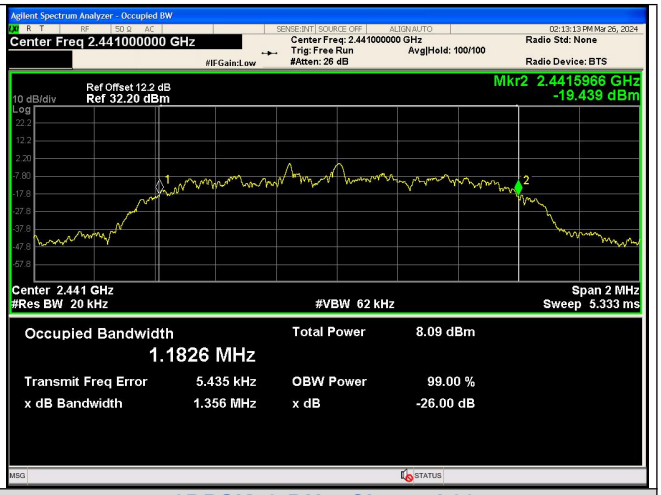


GFSK_DH5_Channel 39



π/4DQPSK_2-DH5_Channel 39



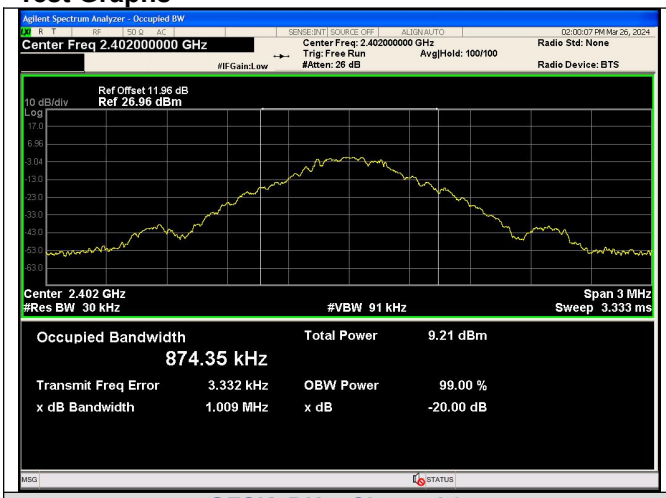
GFSK_DH5_Channel 78	π/4DQPSK_2-DH5_Channel 78
	
8DPSK_3-DH5_Channel 0	8DPSK_3-DH5_Channel 39
	
8DPSK_3-DH5_Channel 78	

APPENDIX III.20dB Bandwidth

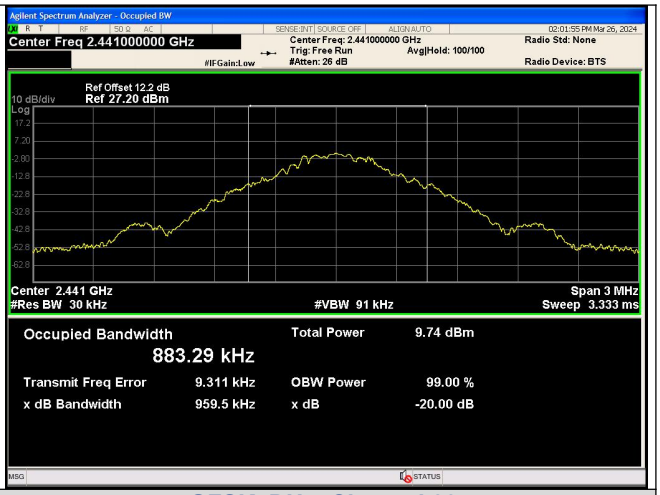
Test Result

Modulation	Channel	Center Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	0	2402 MHz	1.009
	39	2441 MHz	0.9595
	78	2480 MHz	1.016
π/4DQPSK	0	2402 MHz	1.307
	39	2441 MHz	1.285
	78	2480 MHz	1.304
8DPSK	0	2402 MHz	1.277
	39	2441 MHz	1.271
	78	2480 MHz	1.292

Test Graphs

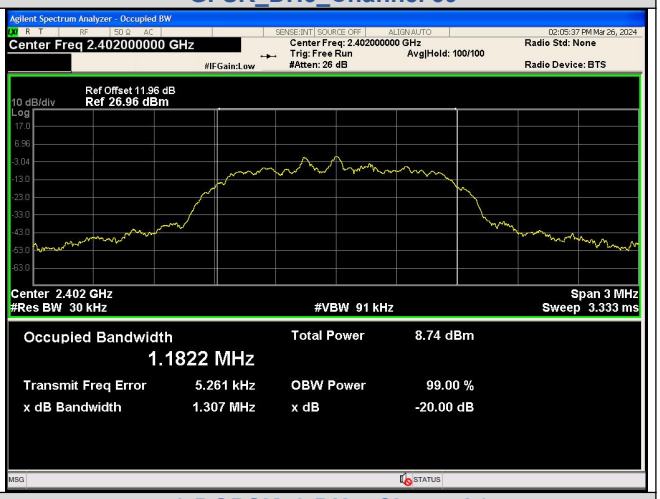


GFSK_DH5_Channel 0

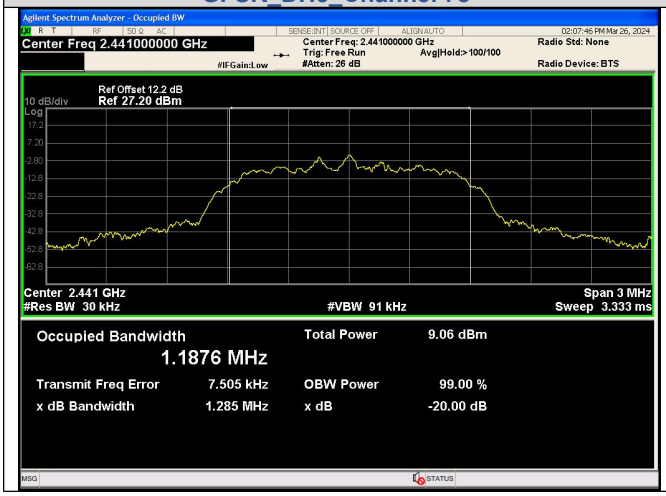


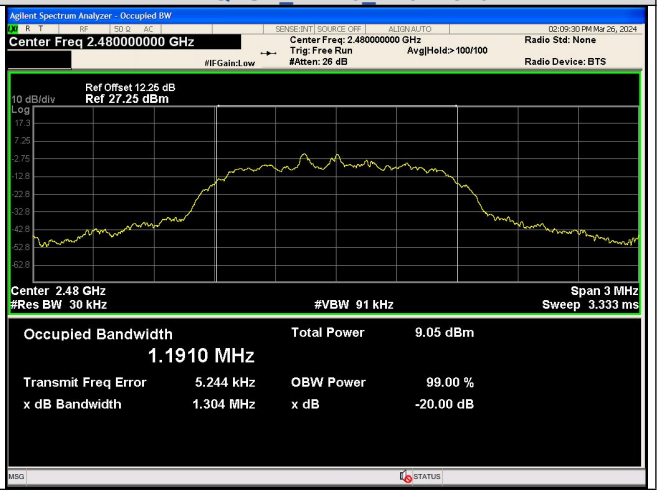
GFSK_DH5_Channel 39

GFSK_DH5_Channel 78

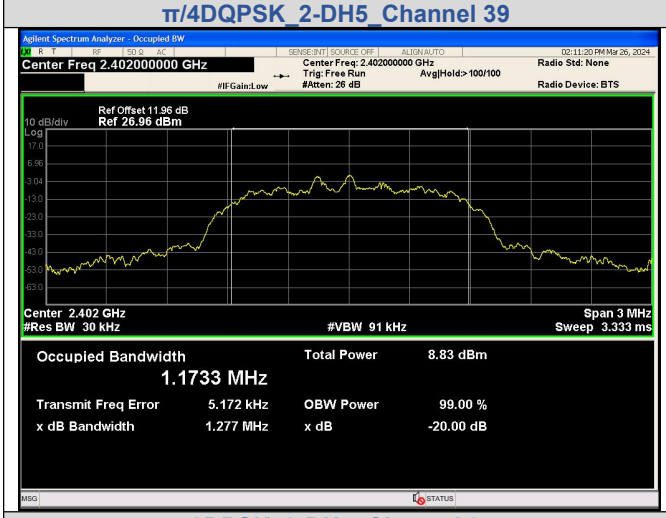


π/4DQPSK_2-DH5_Channel 0

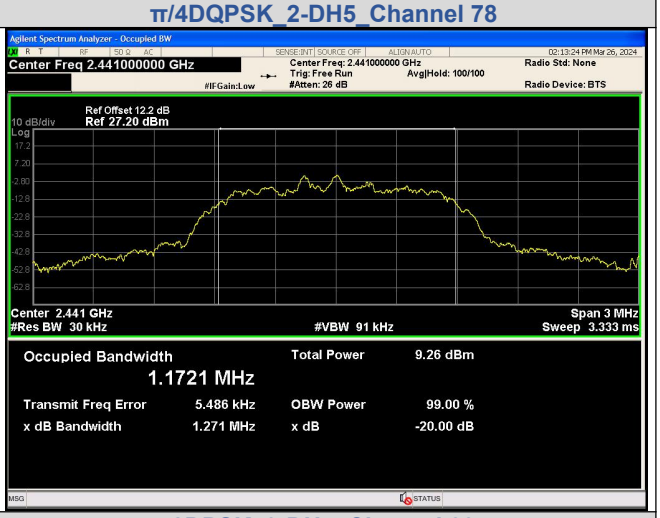




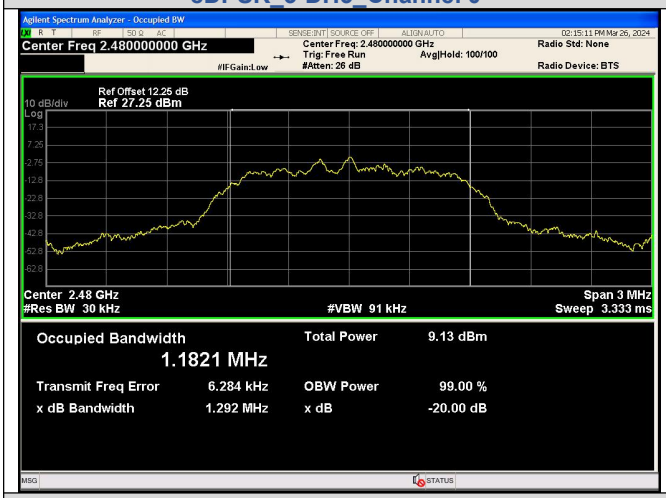
π/4DQPSK_2-DH5_Channel 39



π/4DQPSK_2-DH5_Channel 78



8DPSK_3-DH5_Channel 0



8DPSK_3-DH5_Channel 39

8DPSK_3-DH5_Channel 78

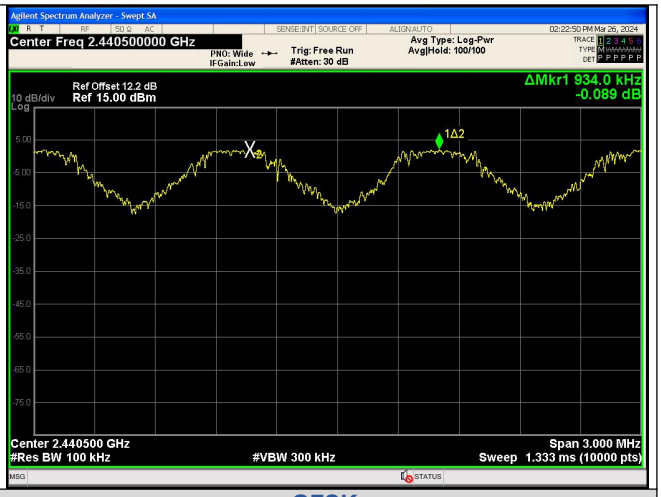
APPENDIX IV.Carrier Frequencies Separation

Test Result

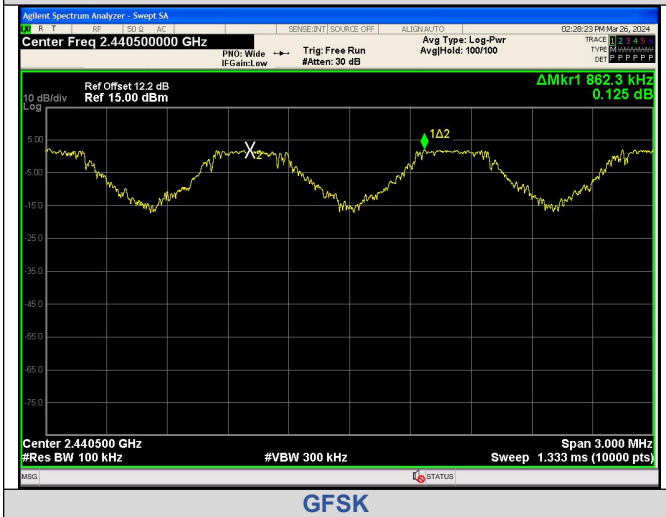
Modulation	Packet	Left Center frequency (MHz)	Right Center frequency (MHz)	Hopping Frequency Separation (MHz)	Limit (MHz)	Result
GFSK	DH5	2439.9025	2441.0156	1.1131	0.673	PASS
GFSK	DH5	2440.0663	2441.0003	0.9340	0.64	PASS
GFSK	DH5	2440.0078	2440.8701	0.8623	0.677	PASS
π/4DQPSK	2-DH5	2439.8449	2440.8563	1.0114	0.871	PASS
π/4DQPSK	2-DH5	2440.0027	2441.0132	1.0105	0.857	PASS
π/4DQPSK	2-DH5	2439.8518	2440.8491	0.9973	0.869	PASS
8DPSK	3-DH5	2439.8377	2440.8278	0.9901	0.851	PASS
8DPSK	3-DH5	2439.8488	2441.0087	1.1599	0.847	PASS
8DPSK	3-DH5	2439.8536	2440.8464	0.9928	0.861	PASS

Test Graphs

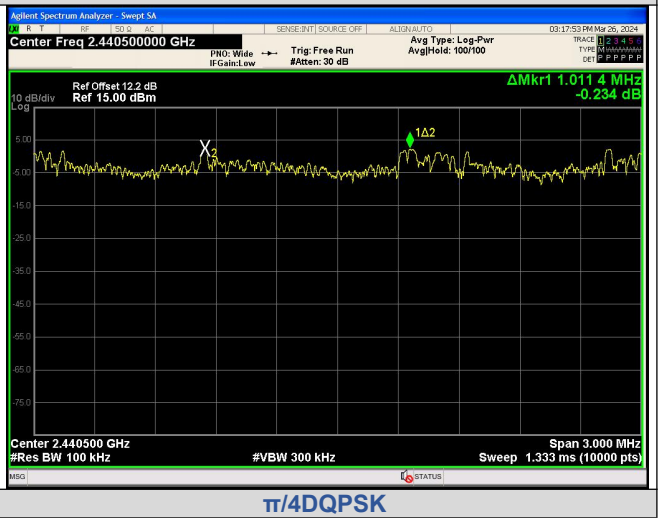
GFSK



GFSK



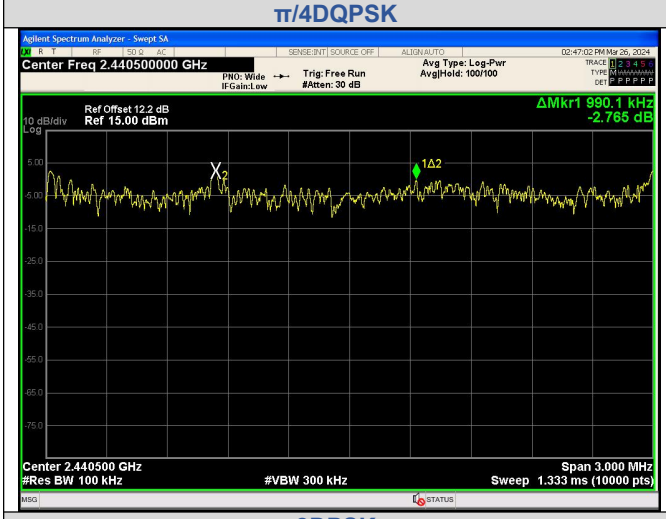
GFSK



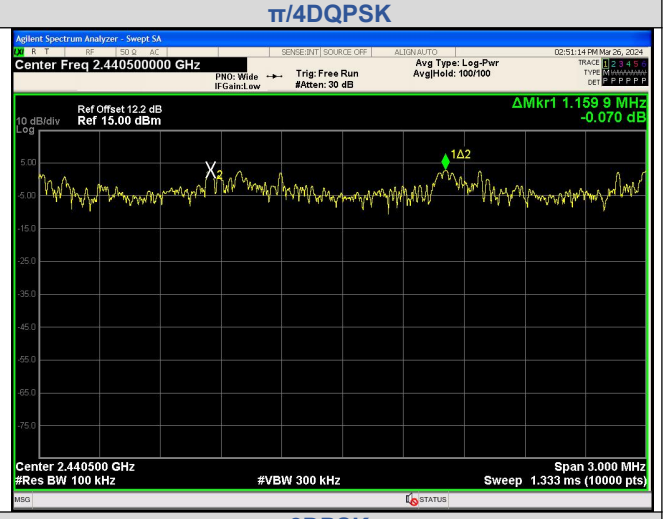
π/4DQPSK

π/4DQPSK

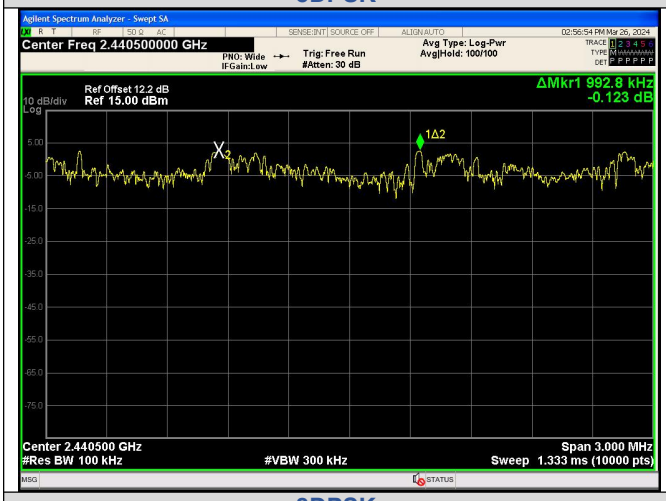
π/4DQPSK



8DPSK



8DPSK



8DPSK

APPENDIX V.Conducted Out Of Band Emission

Test Result

Non-Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	0	2400.00	-45.701	-17.86	-27.841	PASS
			4803.76	-44.018	-17.86	-26.158	PASS
			7205.93	-47.142	-17.86	-29.282	PASS
			9608.11	-44.139	-17.86	-26.279	PASS
			24902.0	-46.116	-17.86	-28.256	PASS
		39	4881.79	-41.943	-17.68	-24.263	PASS
			7323.30	-47.999	-17.68	-30.319	PASS
			9764.17	-42.668	-17.68	-24.988	PASS
			24893.9	-45.735	-17.68	-28.055	PASS
		78	2483.50	-51.619	-17.64	-33.979	PASS
			4959.83	-43.176	-17.64	-25.536	PASS
			7440.03	-47.286	-17.64	-29.646	PASS
			9920.24	-43.313	-17.64	-25.673	PASS
			24973.2	-44.663	-17.64	-27.023	PASS
π/4DQPSK	2-DH5	0	2400.00	-46.299	-17.93	-28.369	PASS
			4803.76	-45.213	-17.93	-27.283	PASS
			7205.93	-50.440	-17.93	-32.510	PASS
			9608.11	-43.763	-17.93	-25.833	PASS
			24912.6	-45.595	-17.93	-27.665	PASS
		39	4881.79	-43.619	-17.48	-26.139	PASS
			7323.30	-51.789	-17.48	-34.309	PASS
			9764.17	-42.458	-17.48	-24.978	PASS
			24925.1	-46.082	-17.48	-28.602	PASS
		78	2483.50	-50.571	-17.63	-32.941	PASS
			4959.83	-44.003	-17.63	-26.373	PASS
			7440.03	-49.176	-17.63	-31.546	PASS
			9920.24	-43.944	-17.63	-26.314	PASS
			25000.0	-45.630	-17.63	-28.000	PASS
8DPSK	3-DH5	0	2400.00	-44.567	-17.7	-26.867	PASS
			4803.76	-45.030	-17.7	-27.330	PASS
			7205.93	-48.296	-17.7	-30.596	PASS
			9608.11	-44.400	-17.7	-26.700	PASS
			24950.1	-46.189	-17.7	-28.489	PASS
		39	4882.42	-48.360	-17.22	-31.140	PASS
			7322.67	-52.019	-17.22	-34.799	PASS
			9764.80	-64.368	-17.22	-47.148	PASS
			24928.2	-46.237	-17.22	-29.017	PASS
		78	2483.50	-52.215	-17.27	-34.945	PASS
			4959.83	-47.123	-17.27	-29.854	PASS
			7440.03	-52.204	-17.27	-34.934	PASS
			9920.24	-44.004	-17.27	-26.734	PASS
			24902.6	-46.247	-17.27	-28.977	PASS

Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	Hopping	2400.00	-47.009	-18.09	-28.919	PASS
			2483.50	-49.998	-17.55	-32.448	PASS
			2400.00	-46.373	-18.1	-28.273	PASS
			2483.50	-49.427	-17.72	-31.707	PASS
			2400.00	-47.119	-18.05	-29.069	PASS
			2483.50	-49.066	-17.76	-31.306	PASS
π/4DQPSK	2-DH5		2400.00	-47.972	-18.0	-29.972	PASS
			2483.50	-50.506	-17.82	-32.686	PASS
			2400.00	-46.843	-17.94	-28.903	PASS
			2483.50	-49.092	-17.81	-31.282	PASS
			2400.00	-47.506	-17.86	-29.646	PASS
			2483.50	-49.644	-17.7	-31.944	PASS