Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

TEST REPORT

FCC PART 15 SUBPART C 15.247 & RSS-247

Report Reference No......:	**GTS20210531015-1-1**
FCC ID..... :	**2AU6S-RRD8400SB**
IC ..... :	**25701-RRD8400SB**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Aaron Tan
Approved by (position+printed name+signature)..:	Manager Jason Hu
Date of issue.....:	May 20, 2021

Representative Laboratory Name .:	**Shenzhen Global Test Service Co., Ltd.**
Address.....:	No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong
Applicant's name.....:	**LUCID AUDIO**
Address .....:	14301 Faa Blvd, Ft Worth, TX 76155 United States of America
Test specification .....**:**	
Standard .....:	**47 CFR FCC Part 15 Subpart C 15.247 & RSS-247 Issue 2, February 2017**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

Test item description .....:	Hearmuff Bluetooth
Trade Mark .....:	Lucid
Manufacturer.....:	**LUCID AUDIO**
Model/Type reference(HVIN) .....:	BT HEARMUFFS
Listed Models(HVIN) .....:	N/A
Ratings .....:	DC 3.7V from battery
Modulation .....:	GFSK, Π/4DQPSK, 8DPSK
Hardware version .....:	RRD-8400S-B V1.1
Software version .....:	V1.0
Test Software version .....:	V1.0.2.2
Frequency.....:	From 2402MHz to 2480MHz
Result.....:	**PASS**

T E S T R E P O R T

Test Report No. :	**GTS20210531015-1-1**	May 31, 2021 Date of issue

Equipment under Test : Hearmuff Bluetooth

Model /Type(HVIN) : BT HEARMUFFS

Listed Models(HVIN) : N/A

Applicant : **LUCID AUDIO**

Address : 14301 Faa Blvd, Ft Worth, TX 76155 United States of America

Manufacturer : **LUCID AUDIO**

Address : 14301 Faa Blvd, Ft Worth, TX 76155 United States of America

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 TEST STANDARDS

The tests were performed according to following standards:

RSS-247-Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

RSS-Gen Issue 5: — General Requirements for Compliance of Radio Apparatus
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	:	Apr. 28, 2021
Testing commenced on	:	Apr. 29, 2021
Testing concluded on	:	May 14, 2021

2.2 Product Description

Product Name:	Hearmuff Bluetooth
Model(HVIN):	BT HEARMUFFS
Power supply:	DC 3.7V from battery
Sample ID:	GTS20210531015-1-1#/ GTS20210531015-1-2#
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:	0 dBi

2.3 Test Sample

The application provides 2 samples to meet requirement.

Sample Number	Description
GTS20210531015-1-1#	Engineer sample – continuous transmit
GTS20210531015-1-2#	Normal sample – Intermittent transmit

2.4 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 3.7V from battery

2.5 Short description of the Equipment under Test (EUT)

This is a Hearmuff Bluetooth.

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

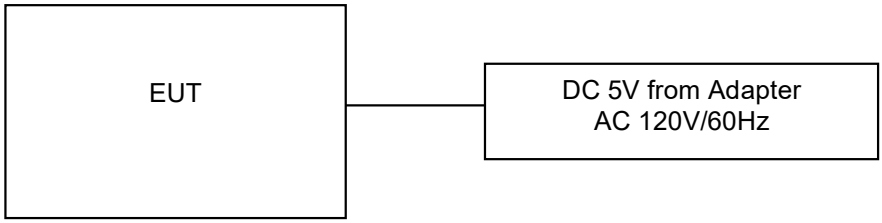
2.6 EUT operation mode

The Applicant provides communication tools software(FCC_assist_1.0.2.2) 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

2.7 Block Diagram of Test Setup



2.8 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
AC-DC Adapter	MOSO	EP-TA10CBC	Input:AC100-240V-50/60Hz，0.5A Output:DC 5V,1A	FCC	Laboratory
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/

2.9 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for cerfication filing to comply with the rules of FCC Part 15 Subpart C and RSS-247.

2.10 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

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.

3.2 Test Facility

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

A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test 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.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

IC Registration

The 3m alternate test site of Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 24189 and CAB identifier: CN0082.

FCC-Registration

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been registered to test radio equipmentto meet the requirements for (FCC) Federal Communications Commission with the Registration No.165725.and Designation Number: CN1234.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
AC Conducted emission

Temperature:	25.6 ° C
Humidity:	52.1 %
Atmospheric pressure:	950-1050mbar

Radiation emission

Temperature:	24.6 ° C
Humidity:	49.1 %
Atmospheric pressure:	950-1050mbar

RF Conducted Testing

Temperature:	25.4 ° C
Humidity:	51.6%
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

FCC PART 15.247 & RSS 247		
FCC Part 15.207 RSS-Gen 8.8	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i) RSS 247 5.1 (a) RSS-Gen 6.7	20dB Bandwidth& 99% Bandwidth	PASS
FCC Part 15.247(d) RSS 247 5.5	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b) RSS 247 5.4 (b)	Maximum Peak Output Power	PASS
FCC Part 15.247(b) RSS 247 5.1 (a)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii) RSS 247 5.1 (d)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1) RSS 247 5.1 (b)	Frequency Separation	PASS
FCC Part 15.205/15.209 RSS-Gen 8.9	Radiated Emissions	PASS
FCC Part 15.247(d) RSS-Gen 8.10	Band Edge Compliance of RF Emission	PASS

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report

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 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 Global Test 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 GTS laboratory 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)

(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

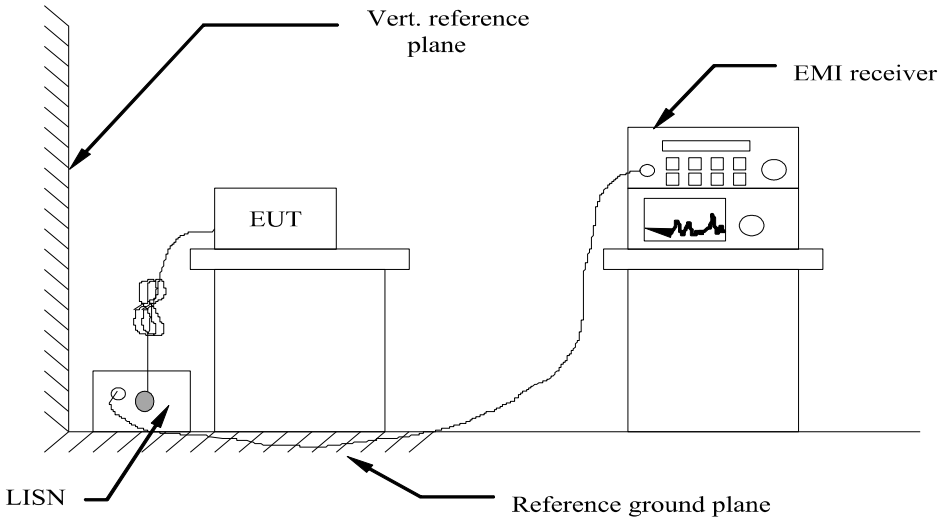
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2020/09/19	2021/09/18
LISN	R&S	ESH2-Z5	893606/008	2020/09/19	2021/09/18
EMI Test Receiver	R&S	ESPI3	101841-cd	2020/09/19	2021/09/18
EMI Test Receiver	R&S	ESCI7	101102	2020/09/19	2021/09/18
Spectrum Analyzer	Agilent	N9020A	MY48010425	2020/09/19	2021/09/18
Spectrum Analyzer	Agilent	E4407B	MY45132751	2020/09/19	2021/09/18
Spectrum Analyzer	R&S	FSV40	100019	2020/09/19	2021/09/18
Vector Signal generator	Agilent	N5181A	MY49060502	2020/09/19	2021/09/18
Spectrum Analyzer	Agilent	E4421B	3610AO1069	2020/09/19	2021/09/18
Climate Chamber	ESPEC	EL-10KA	A20120523	2020/09/19	2021/09/18
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2020/09/19	2021/09/18
Active Loop Antenna	Beijing Da Ze Technology Co.,Ltd.	ZN30900C	15006	2020/10/11	2021/10/10
Bilog Antenna	Schwarzbeck	VULB9163	000976	2020/05/26	2021/05/25
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2020/09/19	2021/09/18
Amplifier	Schwarzbeck	BBV 9743	#202	2020/09/19	2021/09/18
Amplifier	Schwarzbeck	BBV9179	9719-025	2020/09/19	2021/09/18
Amplifier	EMCI	EMC051845B	980355	2020/09/19	2021/09/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2020/09/19	2021/09/18
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2020/09/19	2021/09/18
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2020/09/19	2021/09/18
RF Cable(below 1GHz)	HUBER+SUHNER	RG214	RE01	2020/09/19	2021/09/18
RF Cable(above 1GHz)	HUBER+SUHNER	RG214	RE02	2020/09/19	2021/09/18
Data acquisition card	Agilent	U2531A	TW53323507	2020/09/19	2021/09/18
Power Sensor	Agilent	U2021XA	MY5365004	2020/09/19	2021/09/18
Test Control Unit	Tonscend	JS0806-1	178060067	2020/06/19	2021/06/18
Automated filter bank	Tonscend	JS0806-F	19F8060177	2020/06/19	2021/06/18
EMI Test Software	Tonscend	JS1120-1	Ver 2.6.8.0518	/	/
EMI Test Software	Tonscend	JS1120-3	Ver 2.5.77.0418	/	/
EMI Test Software	Tonscend	JS32-CE	Ver 2.5	/	/
EMI Test Software	Tonscend	JS32-RE	Ver 2.5.1.8	/	/

Note: The Cal.Interval was one year.

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 DC 12V 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 bad; 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

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207 and RSS Gen 8.8, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

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.		

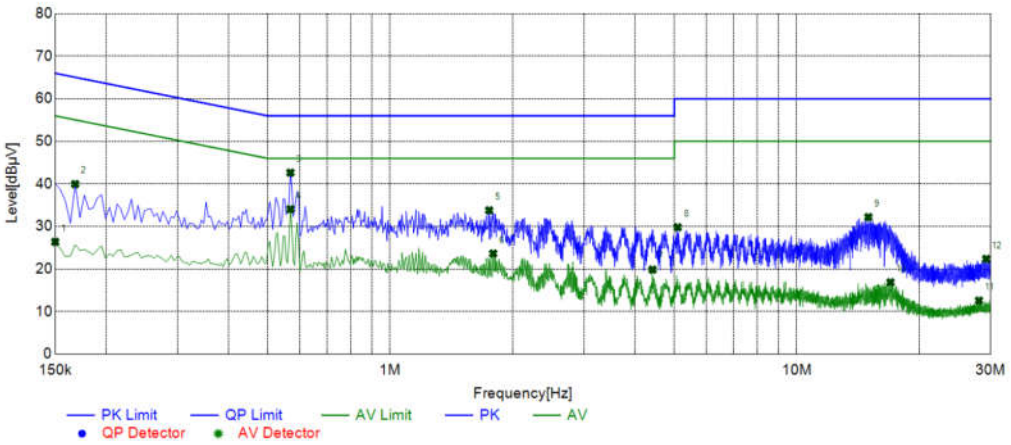
TEST RESULTS

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:

Power supply:	AC 120V/60Hz(adapter)	Polarization	L

Test Graph



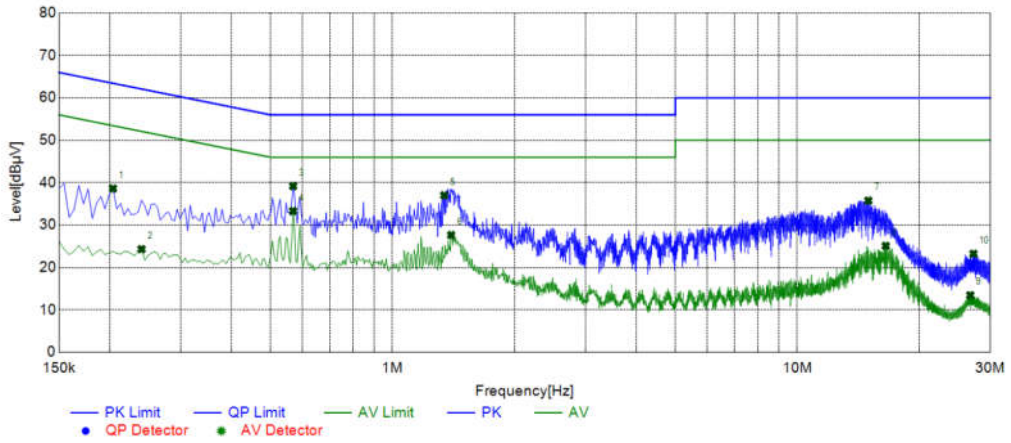
Suspected List									
NO.	Frequency [MHz]	Reading [dBµV]	Factor [dB]	Result [dBµV]	Limit [dBµV]	Margin [dB]	Detector	Line	Remark
1	0.1500	16.34	10.05	26.39	56.00	29.61	AV	L1	PASS
2	0.1680	29.92	10.05	39.97	65.06	25.09	PK	L1	PASS
3	0.5685	32.59	10.06	42.65	56.00	13.35	PK	L1	PASS
4	0.5685	24.03	10.06	34.09	46.00	11.91	AV	L1	PASS
5	1.7520	23.66	10.13	33.79	56.00	22.21	PK	L1	PASS
6	1.7925	13.52	10.13	23.65	46.00	22.35	AV	L1	PASS
7	4.4205	9.43	10.44	19.87	46.00	26.13	AV	L1	PASS
8	5.0955	19.31	10.50	29.81	60.00	30.19	PK	L1	PASS
9	15.0045	21.14	11.06	32.20	60.00	27.80	PK	L1	PASS
10	17.0025	5.65	11.23	16.88	50.00	33.12	AV	L1	PASS
11	28.0635	0.83	11.76	12.59	50.00	37.41	AV	L1	PASS
12	29.2425	10.59	11.79	22.38	60.00	37.62	PK	L1	PASS

Note:1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

Power supply:	AC 120V/60Hz(adapter)	Polarization	N

Test Graph



Suspected List									
NO.	Frequency [MHz]	Reading [dBµV]	Factor [dB]	Result [dBµV]	Limit [dBµV]	Margin [dB]	Detector	Line	Remark
1	0.2040	28.56	10.06	38.62	63.45	24.83	PK	N	PASS
2	0.2400	14.30	10.03	24.33	52.10	27.77	AV	N	PASS
3	0.5685	29.14	10.06	39.20	56.00	16.80	PK	N	PASS
4	0.5685	23.27	10.06	33.33	46.00	12.67	AV	N	PASS
5	1.3425	26.93	10.09	37.02	56.00	18.98	PK	N	PASS
6	1.3965	17.56	10.10	27.66	46.00	18.34	AV	N	PASS
7	14.9820	24.71	11.06	35.77	60.00	24.23	PK	N	PASS
8	16.5435	13.94	11.17	25.11	50.00	24.89	AV	N	PASS
9	26.7540	1.78	11.69	13.47	50.00	36.53	AV	N	PASS
10	27.2445	11.54	11.71	23.25	60.00	36.75	PK	N	PASS

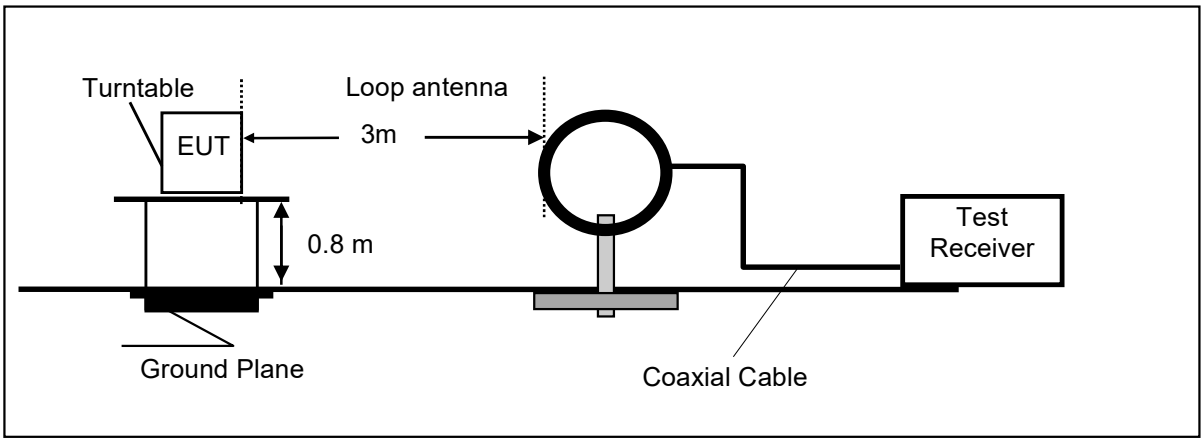
Note:1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

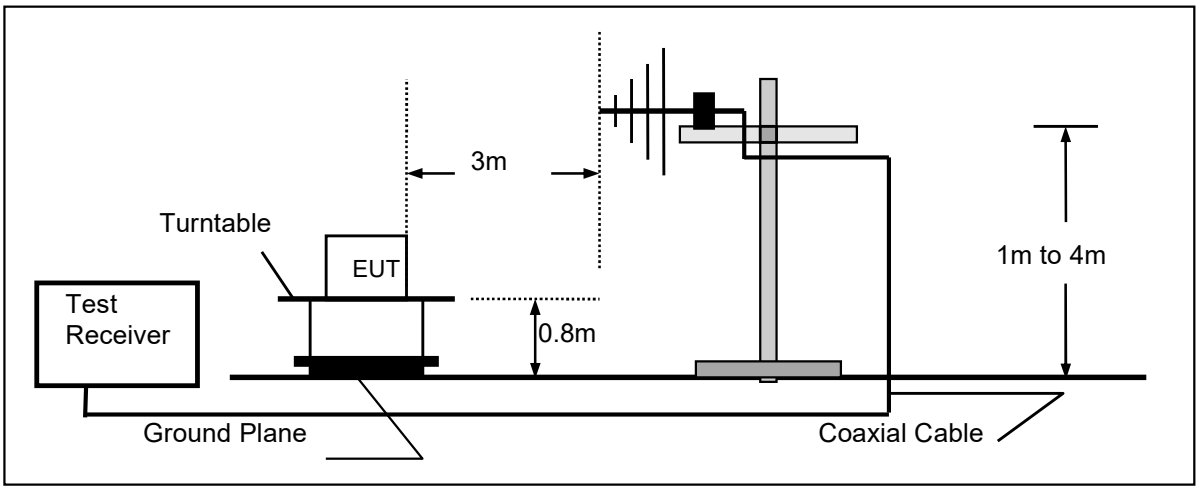
4.2 Radiated Emission

TEST CONFIGURATION

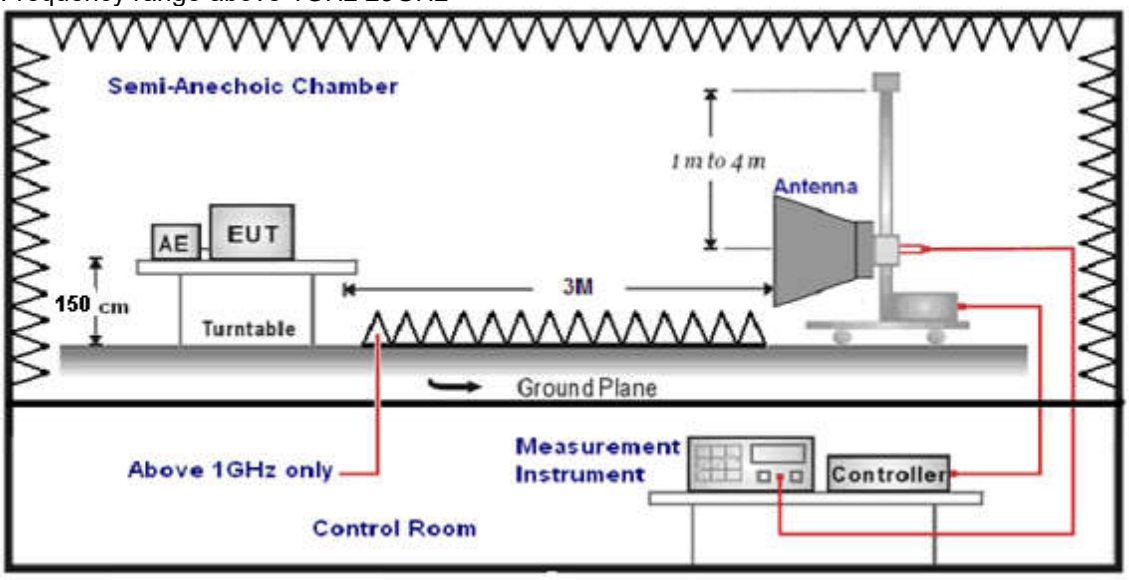
Frequency range 9 KHz – 30MHz



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

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission

Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

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

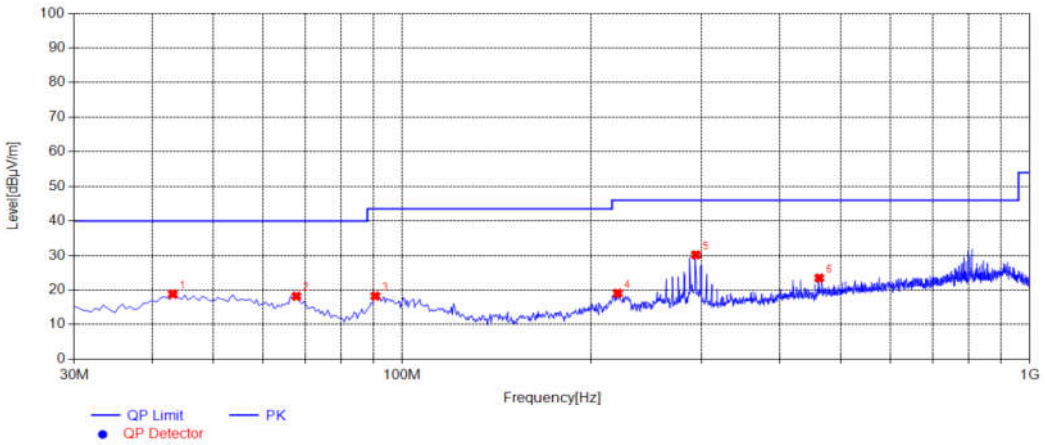
Remark:

1. 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.
2. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
3. 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

Horizontal

Test Graph



Suspected List

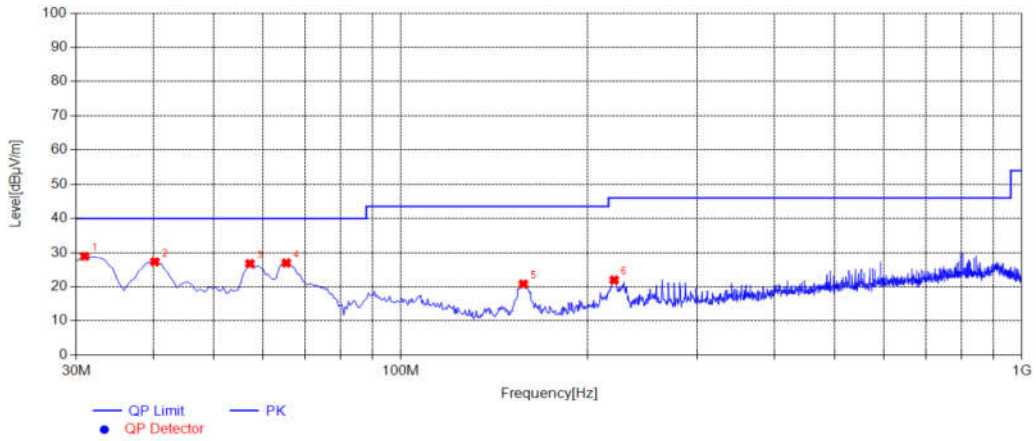
NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	43.0950	25.65	-6.84	18.81	40.00	21.19	100	140	PK	Horizonta	PASS
2	67.8300	27.60	-9.41	18.19	40.00	21.81	100	240	PK	Horizonta	PASS
3	90.6250	28.50	-10.26	18.24	43.50	25.26	100	160	PK	Horizonta	PASS
4	220.6050	28.34	-9.29	19.05	46.00	26.95	100	260	PK	Horizonta	PASS
5	293.8400	37.61	-7.46	30.15	46.00	15.85	100	80	PK	Horizonta	PASS
6	462.1350	27.65	-4.20	23.45	46.00	22.55	100	330	PK	Horizonta	PASS

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

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

Vertical

Test Graph



Suspected List											
NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	30.9700	38.47	-9.58	28.89	40.00	11.11	100	140	PK	Vertical	PASS
2	40.1850	34.92	-7.66	27.26	40.00	12.74	100	320	PK	Vertical	PASS
3	57.1600	33.82	-7.08	26.74	40.00	13.26	100	110	PK	Vertical	PASS
4	65.4050	36.47	-9.55	26.92	40.00	13.08	100	280	PK	Vertical	PASS
5	157.5550	32.88	-12.13	20.75	43.50	22.75	100	140	PK	Vertical	PASS
6	220.6050	31.24	-9.29	21.95	46.00	24.05	100	360	PK	Vertical	PASS

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

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

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	55.24	PK	74	18.76	53.34	31.42	6.98	36.50	1.90
4804.00	46.25	AV	54	7.75	44.35	31.42	6.98	36.50	1.90
7206.00	48.53	PK	74	25.47	37.93	37.03	8.87	35.30	10.60
7206.00	--	AV	54	--	--	--	--	--	--

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	55.84	PK	74	18.16	53.94	31.42	6.98	36.50	1.90
4804.00	47.05	AV	54	6.95	45.15	31.42	6.98	36.50	1.90
7206.00	49.43	PK	74	24.57	38.83	37.03	8.87	35.30	10.60
7206.00	--	AV	54	--	--	--	--	--	--

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	54.83	PK	74	19.17	52.77	30.98	7.58	36.50	2.06
4882.00	46.70	AV	54	7.30	44.64	30.98	7.58	36.50	2.06
7323.00	49.10	PK	74	24.90	38.18	37.66	8.56	35.30	10.92
7323.00	--	AV	54	--	--	--	--	--	--

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	55.43	PK	74	18.57	53.37	30.98	7.58	36.50	2.06
4882.00	48.20	AV	54	5.80	46.14	30.98	7.58	36.50	2.06
7323.00	50.20	PK	74	23.80	39.28	37.66	8.56	35.30	10.92
7323.00	--	AV	54	--	--	--	--	--	--

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	56.00	PK	74	18.00	52.93	31.47	7.80	36.20	3.07
4960.00	46.68	AV	54	7.32	43.61	31.47	7.80	36.20	3.07
7440.00	48.99	PK	74	25.01	37.25	38.32	8.72	35.30	11.74
7440.00	--	AV	54	--	--	--	--	--	--

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	57.10	PK	74	16.90	54.03	31.47	7.80	36.20	3.07
4960.00	47.28	AV	54	6.72	44.21	31.47	7.80	36.20	3.07
7440.00	49.89	PK	74	24.11	38.15	38.32	8.72	35.30	11.74
7440.00	--	AV	54	--	--	--	--	--	--

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	49.52	PK	74.00	24.48	54.93	27.49	3.32	36.22	-5.41
2390.00	--	AV	54	--	--	--	--	--	--
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	50.72	PK	74.00	23.28	56.13	27.49	3.32	36.22	-5.41
2390.00	--	AV	54	--	--	--	--	--	--
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	48.77	PK	74.00	25.23	54.28	27.45	3.38	36.34	-5.51
2483.50	--	AV	54	--	--	--	--	--	--
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	51.27	PK	74.00	22.73	56.78	27.45	3.38	36.34	-5.51
2483.50	--	AV	54	--	--	--	--	--	--

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.

4.3 Maximum Peak Output Power

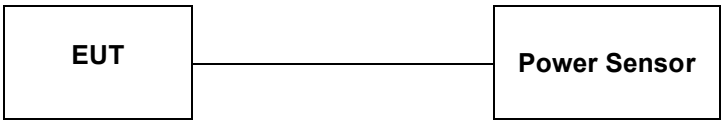
Limit

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 powersensor.

Test Configuration



Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	-0.86	20.97	Pass
	39	-0.57		
	78	-0.86		
π/4DQPSK	00	-0.12	20.97	Pass
	39	0.17		
	78	-0.12		
8DPSK	00	0.28	20.97	Pass
	39	0.20		
	78	0.24		

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

4.4 20dB Bandwidth

Limit

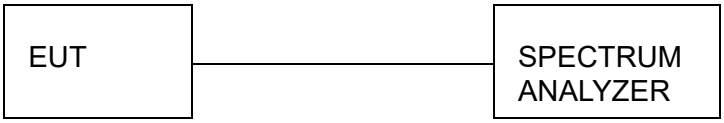
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

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.

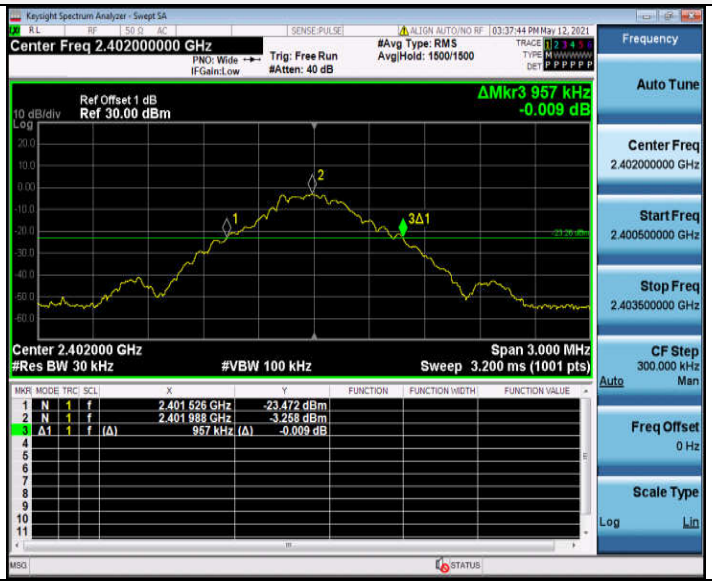
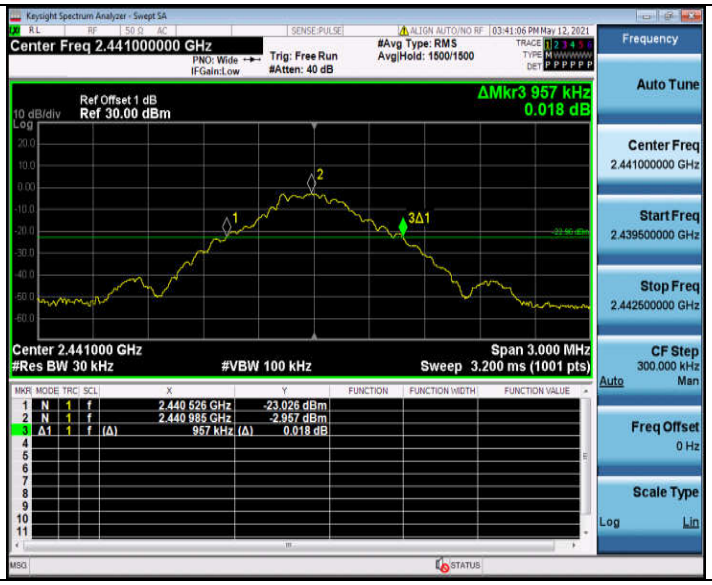
Test Configuration



Test Results

Modulation	Channel	20dB bandwidth (MHz)	Result
GFSK	CH00	0.957	Pass
	CH39	0.957	
	CH78	0.960	
π/4DQPSK	CH00	1.311	
	CH39	1.314	
	CH78	1.314	
8DPSK	CH00	1.302	
	CH39	1.305	
	CH78	1.305	

Test plot as follows:

GFSK Modulation

CH00

CH39

CH78

π/4DQPSK Modulation

CH00

CH39

CH78

8DPSK Modulation

CH00

CH39

CH78

4.5 99% Occupied Bandwidth

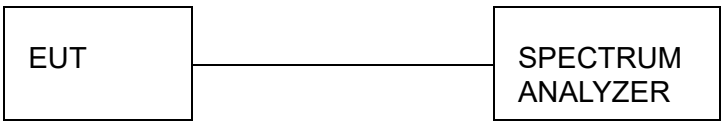
Limit

N/A

Test Procedure

1. The testing follows ANSI C63.10:2013.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 1%~5% OBW. Set the Video bandwidth (VBW) = 3*RBW. In order to make an accurate measurement.
4. 4Use the 99% power bandwidth function of the spectrum analyzer to measure and record the results in the test report.

Test Configuration



Test Results

Modulation	Channel	99% OBW (MHz)	Result
GFSK	CH00	0.84554	Pass
	CH39	0.84931	
	CH78	0.85082	
π/4DQPSK	CH00	1.1706	
	CH39	1.1711	
	CH78	1.1726	
8DPSK	CH00	1.1840	
	CH39	1.1861	
	CH78	1.1867	

Test plot as follows:

GFSK Modulation

CH00

CH39

CH78

π/4DQPSK Modulation

CH00

CH39

CH78

8DPSK Modulation

CH00

CH39

CH78

4.6 Frequency Separation

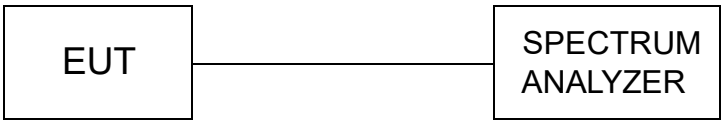
LIMIT

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

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	1.012	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
π/4DQPSK	CH39	1.008	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
8DPSK	CH39	1.002	25KHz or 2/3*20dB bandwidth	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

8DPSK

π/4DQPSK

4.7 Number of hopping frequency

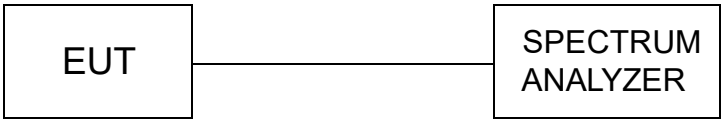
Limit

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.

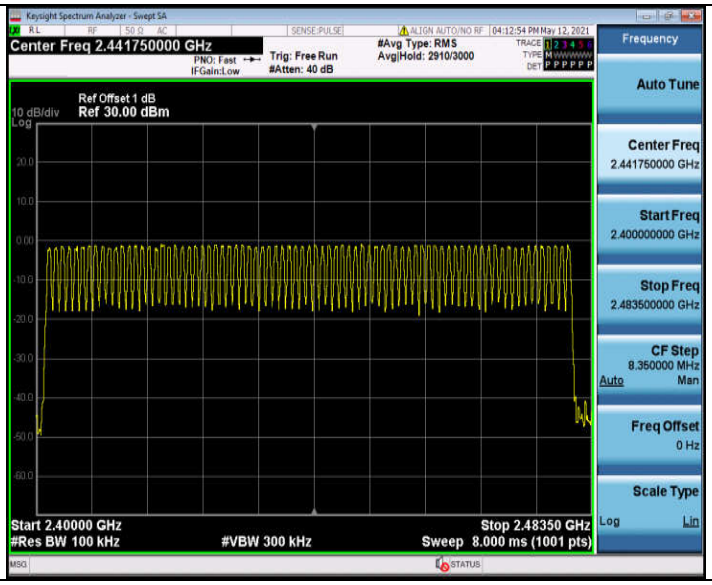
Test Configuration



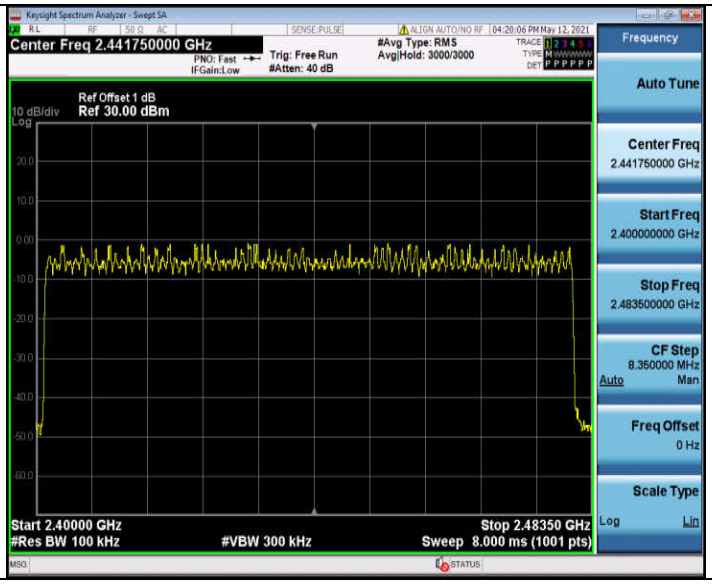
Test Results

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

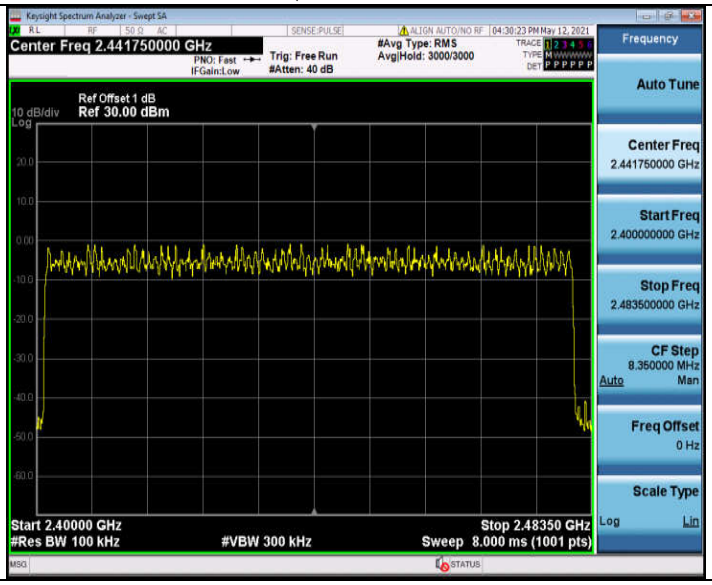
Test plot as follows:



GFSK Modulation



π/4DQPSK Modulation



8DPSK Modulation

4.8 Time of Occupancy (Dwell Time)

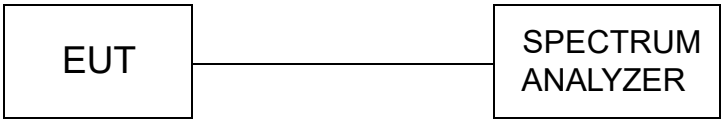
Limit

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

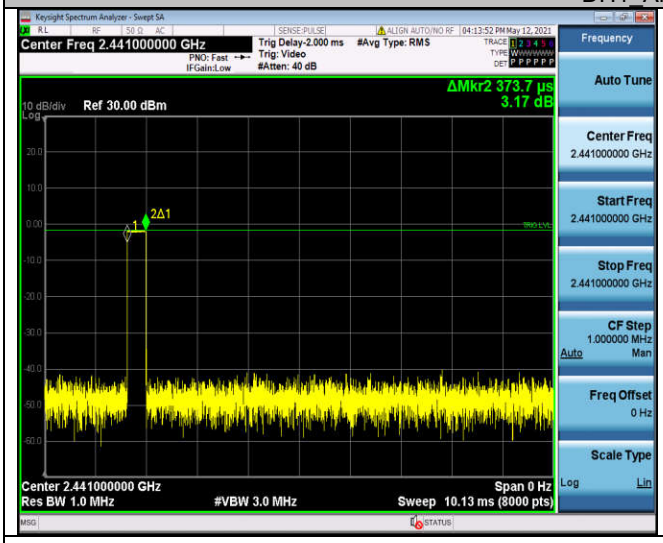


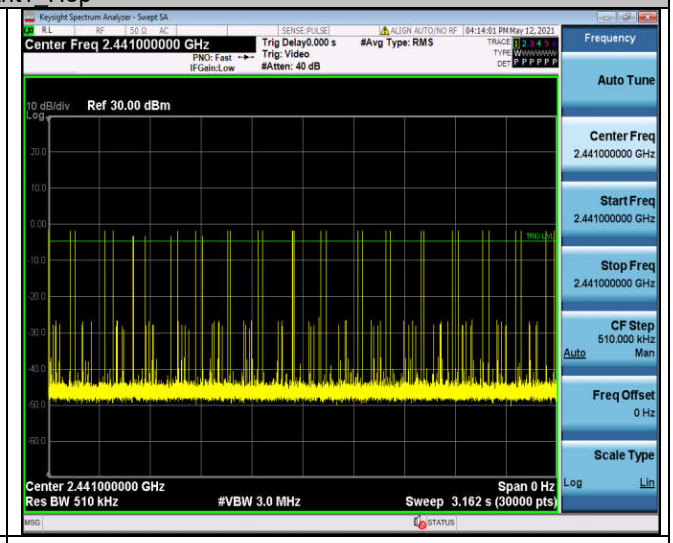
Test Results

TestMode	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Hop	0.37	330	0.123	<=0.4	PASS
DH3	Hop	1.63	160	0.261	<=0.4	PASS
DH5	Hop	2.88	100	0.288	<=0.4	PASS
2DH1	Hop	0.38	330	0.127	<=0.4	PASS
2DH3	Hop	1.64	180	0.295	<=0.4	PASS
2DH5	Hop	2.88	90	0.260	<=0.4	PASS
3DH1	Hop	0.39	330	0.127	<=0.4	PASS
3DH3	Hop	1.64	200	0.327	<=0.4	PASS
3DH5	Hop	2.88	100	0.288	<=0.4	PASS

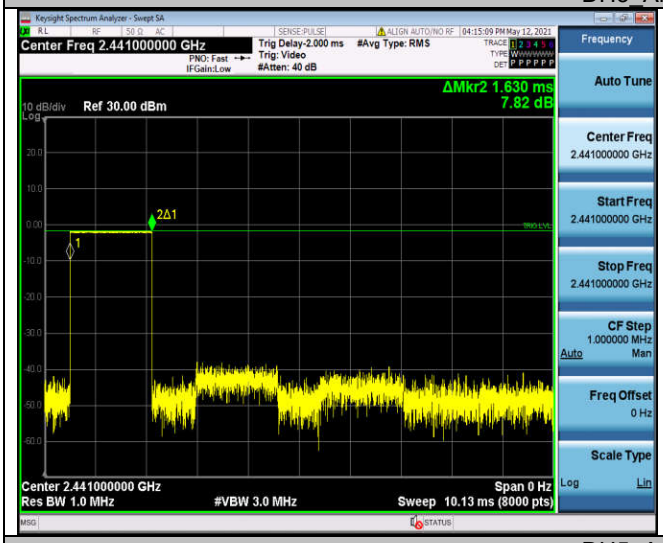
Test plot as follows:

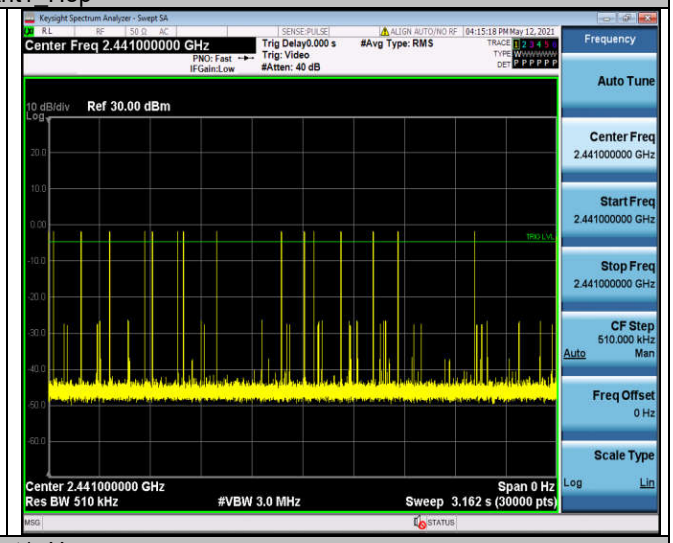
DH1_Ant1_Hop



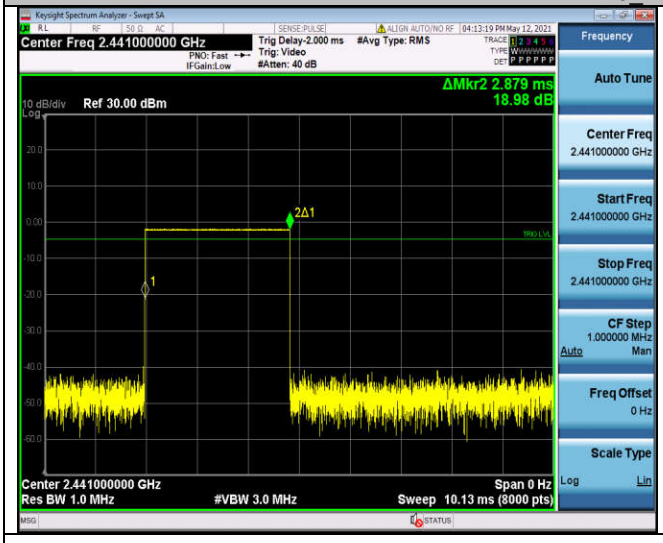


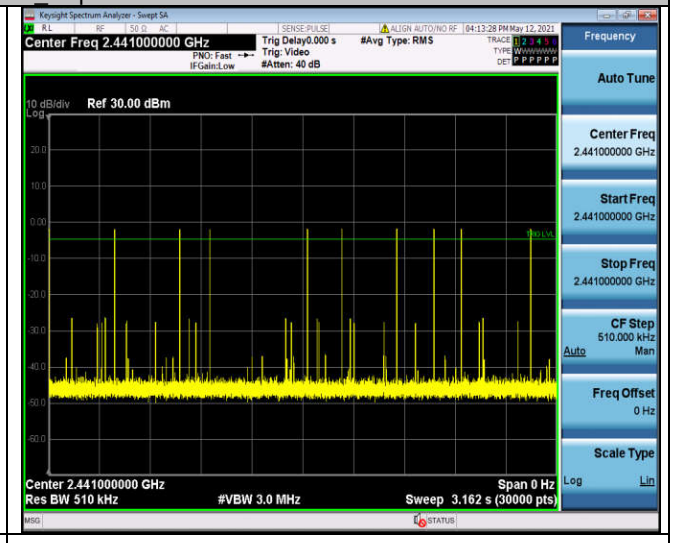
DH3_Ant1_Hop



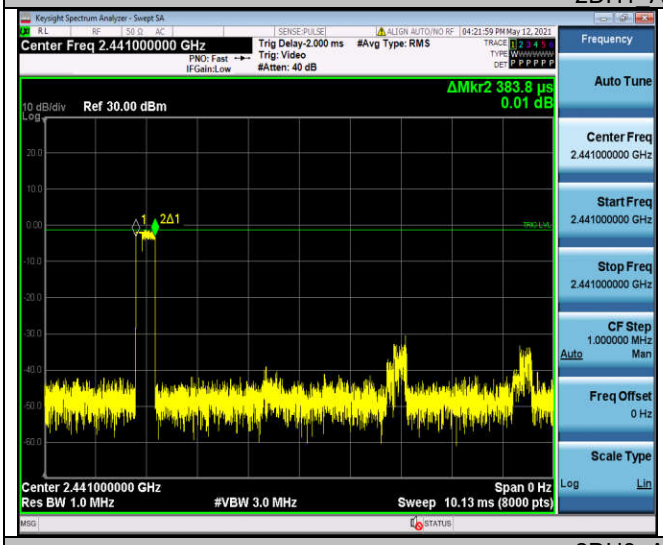


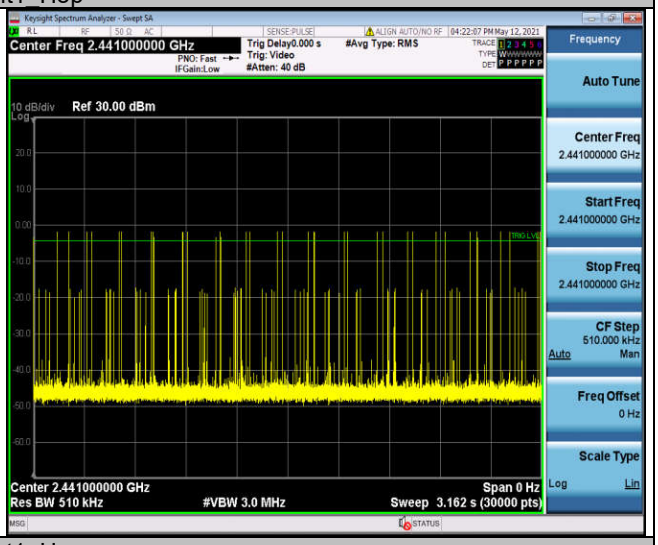
DH5_Ant1_Hop



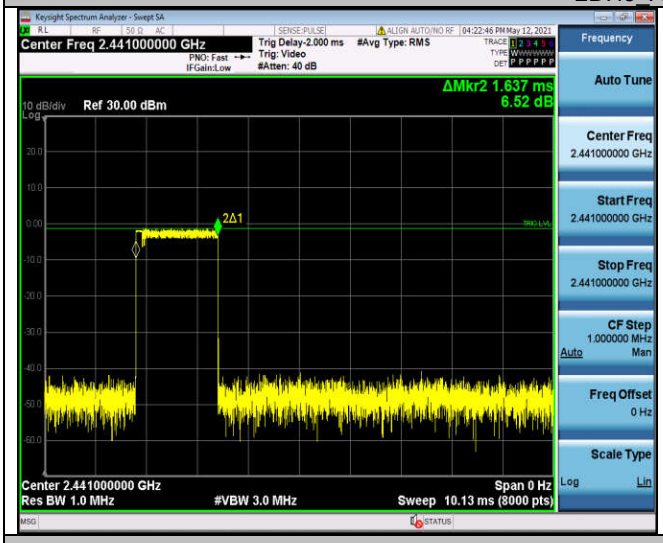


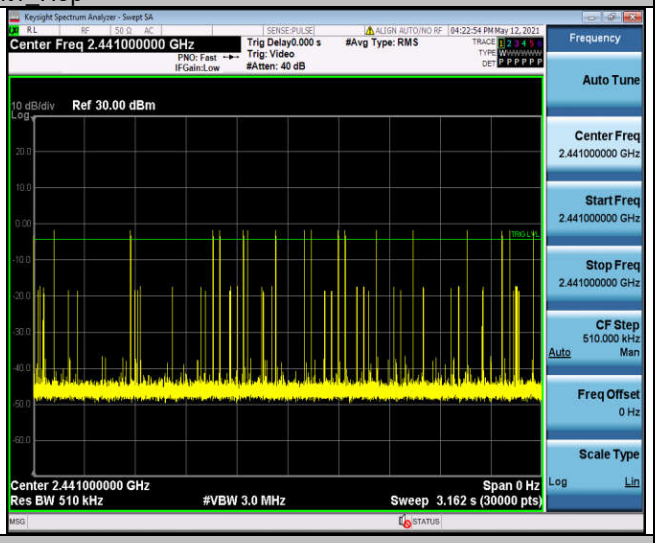
2DH1_Ant1_Hop



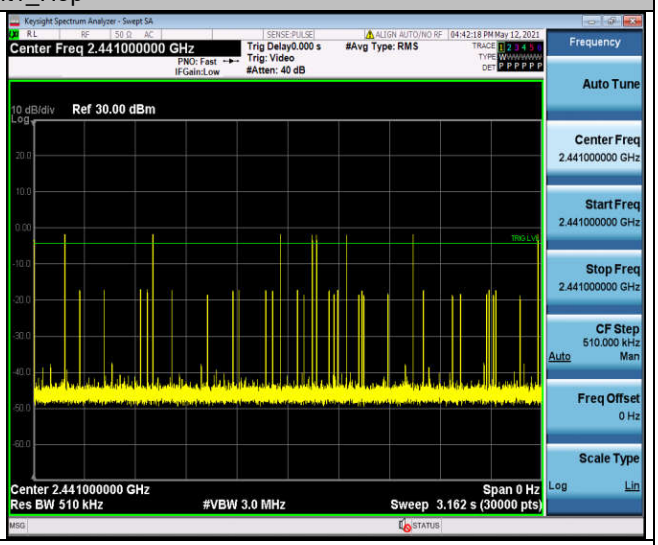


2DH3_Ant1_Hop

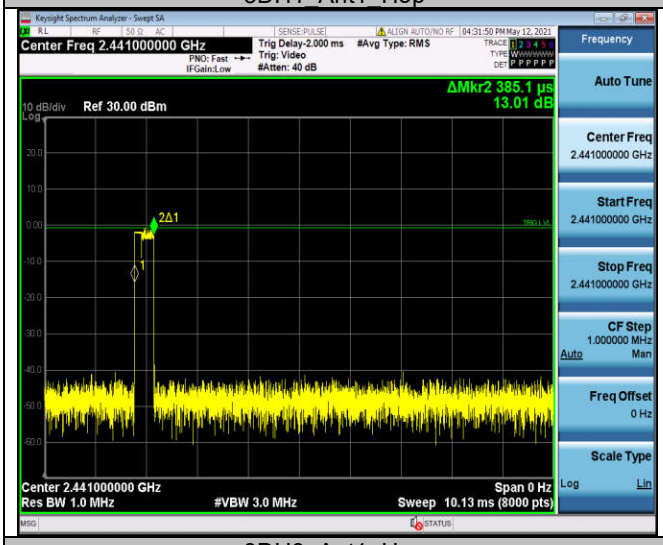


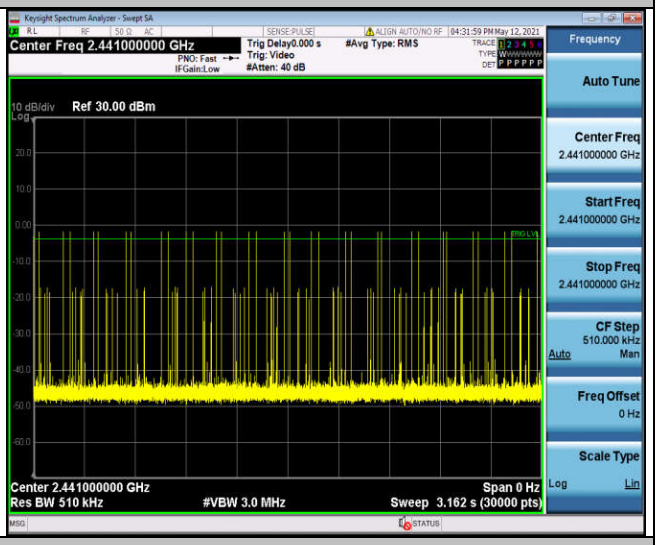


2DH5_Ant1_Hop

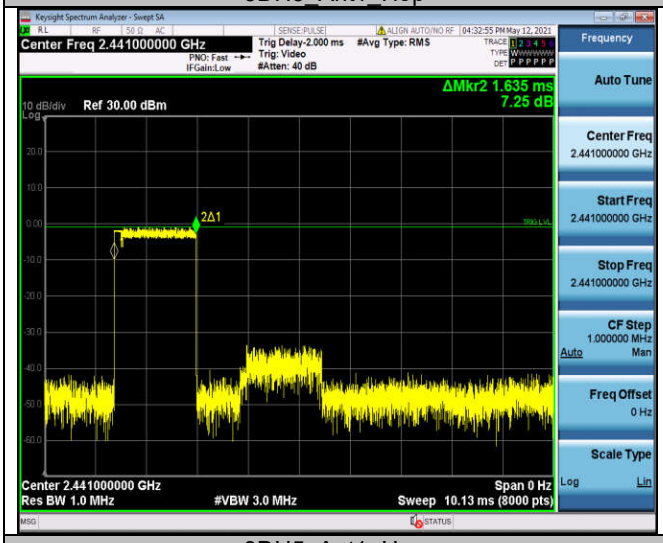


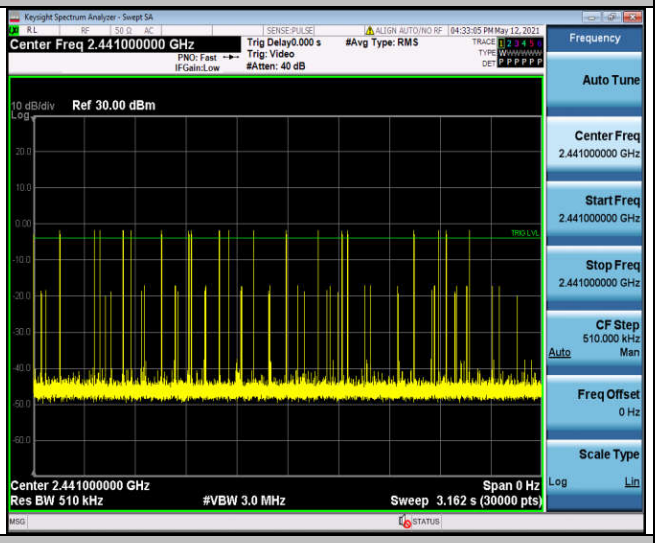
3DH1_Ant1_Hop



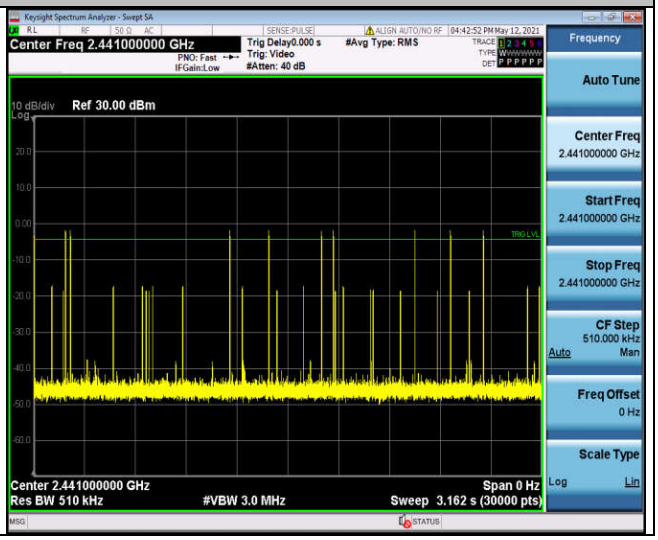


3DH3_Ant1_Hop





3DH5_Ant1_Hop



4.9 Out-of-band Emissions

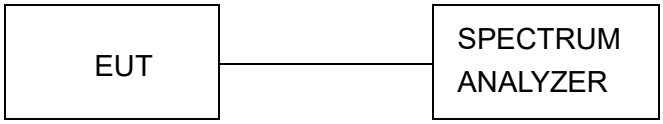
Limit

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: