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FCC RADIO TEST REPORT

FCC ID: 2AJRDIT-36

Product : Wireless Sports Earbuds

Trade Name : ISOtunes

Model Name: IT-38(ISOtunes PRO 2.0 + Aware, 85dB)

Series Model : IT-36(ISOtunes Sport ADVANCE, 85dB), IT-39(ISOtunes PRO 2.0 + Aware EN352, 79dB)

Report No.: UNIA20102707ER-01

Prepared for

Haven Technologies, Inc 1025 Pine Hill Way, Carmel, Indiana 46021 USA

Prepared by

Shenzhen United Testing Technology Co., Ltd.

2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

深圳市优耐检测技术有限公司 Shenzhen United Testing Technology Co.,Ltd. United Testing Technology(Hong Kong) Limited

TEST RESULT CERTIFICATION

Applicant's name:	Haven Technologies, Inc
Address:	1025 Pine Hill Way, Carmel, Indiana 46021 USA
Manufacture's Name:	ASKA Electronics Co., Ltd
Address:	No.5 Puxin Road, Keyuancheng Industrial Tangxia Town, Dongguan, Guangdong, China
Product description	
Product name:	Wireless Sports Earbuds
Trade Mark:	ISOtunes
	IT-36(ISOtunes Sport ADVANCE, 85dB),
Model and/or type reference :	IT-38(ISOtunes PRO 2.0 + Aware, 85dB),
	IT-39(ISOtunes PRO 2.0 + Aware EN352, 79dB)
Standards	FCC Rules and Regulations Part 15 Subpart C Section 15.247, ANSI C63.10: 2013

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test	
Date (s) of performance of tests:	Oct. 19 ~ 27, 2020
Date of Issue:	Oct. 28, 2020
Test Result	Pass

Tested by:

Reviewer:

Approved & Authorized Signer:

Kahn yang/Enginee

Shorwin Qian/Supervisor inte

Liuze/Manager

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Report No.: UNIA20102707ER-01

1. TEST SUMMARY

1.1 TEST PROCEDURES AND RESULTS

DESCRIPTION OF TEST CONDUCTED EMISSIONS TEST RADIATED EMISSION TEST BAND EDGE OCCUPIED BANDWIDTH MEASUREMENT MAXIMUM PEAK OUTPUT POWER FREQUENCY SEPARATION CONDUCTED BANDEGE MEASUREMENT SPURIOUS RF CONDUCTED EMISSION NUMBER OF HOPPING FREQUENCY TIME OF OCCUPANCY(DWELL TIME) ANTENNA REQUIREMENT RESULT COMPLIANT COMPLIANT COMPLIANT COMPLIANT COMPLIANT COMPLIANT COMPLIANT COMPLIANT COMPLIANT

1.2 TEST FACILITY

Test Firm

: Shenzhen United Testing Technology Co., Ltd.

Address : 2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

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

CNAS-LAB Code: L6494

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of testing Laboratories.

Designation Number: CN1227

Test Firm Registration Number: 674885

The 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 Certificate Number: 4747.01

1.3 MEASUREMENT UNCERTAINTY

Measurement Uncertainty

Conducted Emission Expanded Uncertainty=2.23dB, k=2Radiated emission expanded uncertainty(9kHz-30MHz)=3.08dB, k=2Radiated emission expanded uncertainty(30MHz-1000MHz)=4.42dB, k=2Radiated emission expanded uncertainty(Above 1GHz)=4.06dB, k=2

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Wireless Sports Earbuds
Trade Mark	ISOtunes
Test Model Name	IT-38(ISOtunes PRO 2.0 + Aware, 85dB)
Sample ID	UNIA20102707ER-1#
Serial No.	IT-36(ISOtunes Sport ADVANCE, 85dB), IT-39(ISOtunes PRO 2.0 + Aware EN352, 79dB)
Model Difference	All models have same circuits diagram, PCB Layout, construction and rated power; Only different is the model name and Appearance color.
FCC ID	2AJRDIT-36
IC	N/A
Antenna Type	Internal Antenna
Antenna Gain	2dBi
Frequency Range	2402-2480MHz
Number of Channels	79CH
Modulation Type	GFSK, π/4 DQPSK, 8DPSK
Power Source	DC 5V from Adapter
Battery Information	-550638 3.7V, 150mAh

Table for auxiliary equipment:

Equipment Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	Lenovo G475	GB14477457
Adapter	Lenovo	SC-41	N/A



2.2 Carrier Frequency of Channels

			Channe	el List			V
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequenc (MHz)
00	2402	21	2423	42	2444	63	2465
01	2403	22	2424	43	2445	64	2466
02	2404	23	2425	44	2446	65	2467
03	2405	24	2426	45	2447	66	2468
04	2406	25	2427	46	2448	67	2469
05	2407	26	2428	47	2449	68	2470
06	2408	27	2429	48	2450	69	2471
07	2409	28	2430	49	2451	70	2472
08	2410	29	2431	50	2452	71	2473
09	2411	30	2432	51	2453	72	2474
10	2412	31	2433	52	2454	73	2475
11	2413	32	2434	53	2455	74	2476
12	2414	33	2435	54	2456	75	2477
13	2415	34	2436	55	2457	76	2478
14	2416	35	2437	56	2458	77	2479
15	2417	36	2438	57	2459	78	2480
16	2418	37	2439	58	2460		
17	2419	38	2440	59	2461	15	
18	2420	39	2441	60	2462		
19	2421	40	2442	61	2463		
20	2422	41	2443	62	2464		1

2.3 Operation of EUT during testing

Operating Mode

The mode is used: Transmitting mode Low Channel: 2402MHz Middle Channel: 2441MHz High Channel: 2480MHz

Test SW Version: BlueTest3

2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:



Operation of EUT during Radiation testing:

AC 120V/60Hz

Adapter



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2.5 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated unti
	N	CONDUCTED	EMISSIONS TEST		
1	AMN	Schwarzbeck	NNLK8121	8121370	2021.09.05
2	AMN	ETS	3810/2	00020199	2021.09.05
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2021.09.05
4	AAN	TESEQ	T8-Cat6	38888	2021.09.05
		RADIATED	EMISSION TEST	V	
1	Horn Antenna	Sunol	DRH-118	A101415	2021.09.05
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2021.09.05
3	PREAMP	HP	8449B	3008A00160	2021.09.05
4	PREAMP	HP	8447D	2944A07999	2021.09.05
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2021.09.05
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2021.09.05
7	Signal Generator	Agilent	E4421B	MY4335105	2021.09.05
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2021.09.05
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2021.09.05
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2021.09.05
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2021.09.05
12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2021.09.05
13	RF Power sensor	DARE	RPR3006W	15100041SNO88	2021.09.05
14	RF Power sensor	DARE	RPR3006W	15100041SNO89	2021.09.05
15	RF power divider	Anritsu	K241B	992289	2021.09.05
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2021.09.05
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2021.09.05
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2021.09.05
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2021.09.05
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2021.09.05
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2021.09.05
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2021.09.05
23	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2021.09.05
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2021.09.05
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2021.09.05
26	Frequency Meter	VICTOR	VC2000	997406086	2021.09.05
27	DC Power Source	HYELEC	HY5020E	055161818	2021.09.05
			software		à
1	E3	Audix	6.101223a	N/A	N/A

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3. CONDUCTED EMISSIONS TEST

3.1 Conducted Power Line Emission Limit

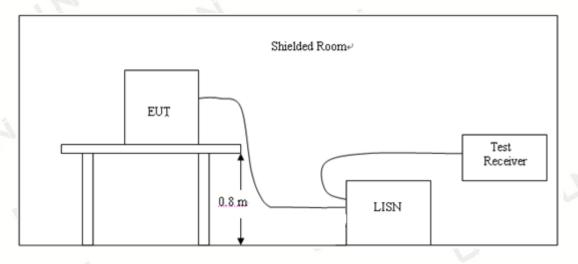
For unintentional device, according to § 15.107(a) & RSS-Gen [8.8] Line Conducted Emission Limits is as following

	Maximum RF Line Voltage(dBµV)					
Frequency	CLASS A		CLASS B			
(MHz)	Q.P.	Ave.	Q.P.	Ave.		
0.15~0.50	79	66	66~56*	56~46*		
0.50~5.00	73	60	56	46		
5.00~30.0	73	60	60	50		

* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

3.2 Test Setup



3.3 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.
- 2, Support equipment, if needed, was placed as per ANSI C63.10.
- 3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/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.

3.4 Test Result

Pass

Remark:

1. All modes were tested at AC 120V and 240V, only the worst result of AC 120V was reported.

2. All modes of Low, Middle, and High channel were tested, only the worst result of High Channel was reported as below:

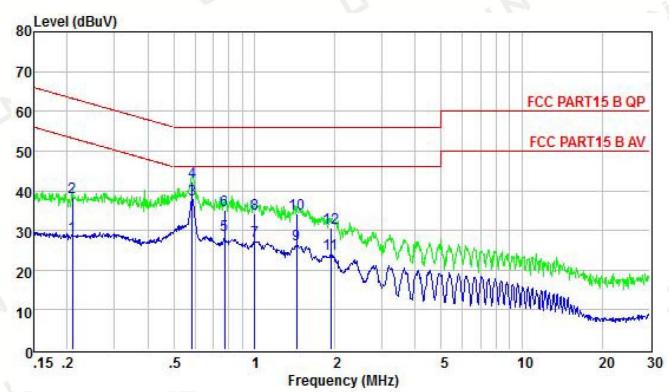
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Report No.: UNIA20102707ER-01

Temperature:	26°C	Relative Humidity:	48%			
Test Date:	Oct. 20, 2020	Pressure:	1010hPa			
Test Voltage:	AC 120V, 60Hz	Phase:	Line			
Test Mode:	Transmitting mode of GFSK 2480MHz					



			LISN	Cable	Limit	Over		
	Freq	Level	Factor	Loss	Line	Limit	Remark	
1	MHz	dBuV	dB	dB	dBuV	dB	1	
1	0.21	28.45	9.46	0.01	53.23	-24.78	Average	
2	0.21	38.47	9.46	0.01	63.23	-24.76	QP	
3	0.59	37.84	9.49	0.01	46.00	-8.16	Average	
4	0.59	42.12	9.49	0.01	56.00	-13.88	QP	
5	0.78	28.95	9.50	0.01	46.00	-17.05	Average	
6	0.78	34.98	9.50	0.01	56.00	-21.02	QP	
7	1.00	27.42	9.51	0.01	46.00	-18.58	Average	
8	1.00	34.18	9.51	0.01	56.00	-21.82	QP	
9	1.44	26.48	9.52	0.01	46.00	-19.52	Average	
.0	1.44	34.18	9.52	0.01	56.00	-21.82	QP	
.1	1.93	24.03	9.53	0.01	46.00	-21.97	Average	
.2	1.93	30.60	9.53	0.01	56.00	-25.40	QP	

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result - Limit.

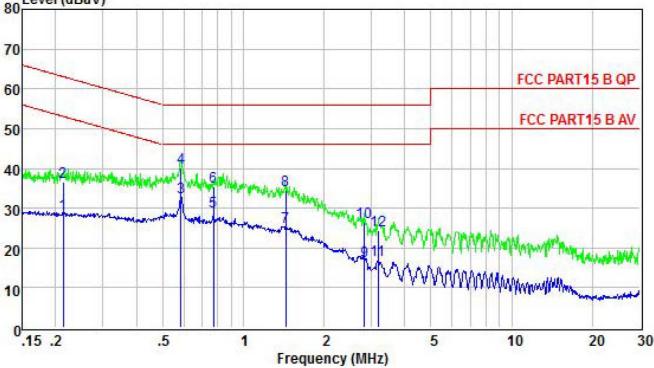
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1

LN

Temperature:	26°C	Relative Humidity:	48%			
Test Date:	Oct. 20, 2020	Pressure:	1010hPa			
Test Voltage:	AC 120V, 60Hz	Phase:	Neutral			
Test Mode:	Transmitting mode of GFSK 2480MHz					

Level (dBuV)



Freq MHz	Level dBuV	LISN Factor dB				Remark
					Limit	Remark
MHz	dBuV	dB	dB			
			ub	dBuV	dB	-
0.21	28.42	9.38	0.01	53.05	-24.63	Average
0.21	36.60	9.38	0.01	63.05	-26.45	QP
0.59	32.82	9.42	0.01	46.00	-13.18	Average
0.59	40.12	9.42	0.01	56.00	-15.88	QP
0.78	29.10	9.43	0.01	46.00	-16.90	Average
0.78	35.26	9.43	0.01	56.00	-20.74	QP
1.44	25.28	9.44	0.01	46.00	-20.72	Average
1.44	34.53	9.44	0.01	56.00	-21.47	QP
2.82	16.54	9.48	0.01	46.00	-29.46	Average
2.82	26.36	9.48	0.01	56.00	-29.64	QP
3.17	17.06	9.49	0.01	46.00	-28.94	Average
3.17	24.45	9.49	0.01	56.00	-31.55	QP
	0.21 0.59 0.59 0.78 0.78 1.44 1.44 2.82 2.82 3.17	0.21 36.60 0.59 32.82 0.59 40.12 0.78 29.10 0.78 35.26 1.44 25.28 1.44 34.53 2.82 16.54 2.82 26.36 3.17 17.06	0.21 28.42 9.38 0.21 36.60 9.38 0.59 32.82 9.42 0.59 40.12 9.42 0.78 29.10 9.43 0.78 35.26 9.43 1.44 25.28 9.44 1.44 34.53 9.44 2.82 16.54 9.48 2.82 26.36 9.48 3.17 17.06 9.49	0.2128.429.380.010.2136.609.380.010.5932.829.420.010.5940.129.420.010.7829.109.430.010.7835.269.430.011.4425.289.440.011.4434.539.440.012.8216.549.480.012.8226.369.480.013.1717.069.490.01	0.2128.429.380.0153.050.2136.609.380.0163.050.5932.829.420.0146.000.5940.129.420.0156.000.7829.109.430.0146.000.7835.269.430.0156.001.4425.289.440.0146.001.4434.539.440.0156.002.8216.549.480.0146.003.1717.069.490.0146.00	0.21 28.42 9.38 0.01 53.05 -24.63 0.21 36.60 9.38 0.01 63.05 -26.45 0.59 32.82 9.42 0.01 46.00 -13.18 0.59 40.12 9.42 0.01 56.00 -15.88 0.78 29.10 9.43 0.01 46.00 -16.90 0.78 35.26 9.43 0.01 56.00 -20.74 1.44 25.28 9.44 0.01 56.00 -20.72 1.44 34.53 9.44 0.01 56.00 -21.47 2.82 16.54 9.48 0.01 56.00 -29.46 2.82 26.36 9.48 0.01 56.00 -29.64 3.17 17.06 9.49 0.01 46.00 -28.94

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result - Limit.

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4. RADIATED EMISSION TEST

4.1 Radiation Limit

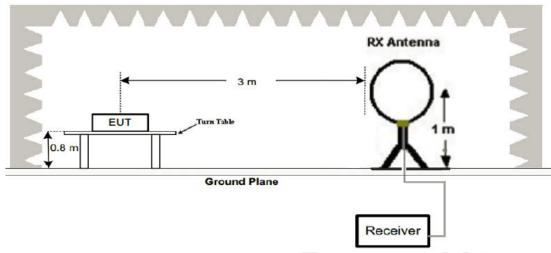
For unintentional device, according to § 15.109(a) & RSS-247 [5.5], except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

and remembering randoor			
Frequency	Distance	Radiated	Radiated
(MHz)	(Meters)	(dBµV/m)	(µV/m)
30-88	3	40	100
88-216	3	43.5	150
216-960	3	46	200
Above 960	3	54	500

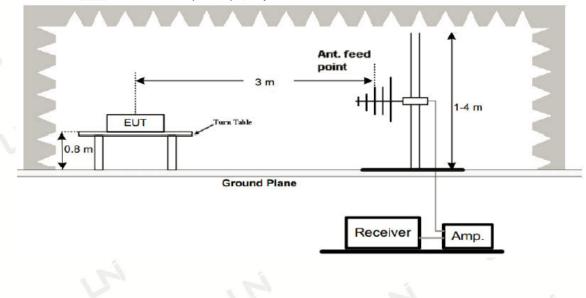
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

4.2 Test Setup

1. Radiated Emission Test-Up Frequency Below 30MHz



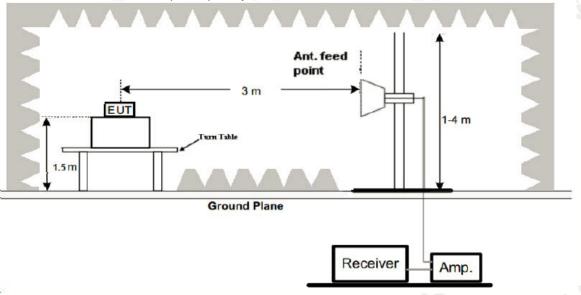
2. Radiated Emission Test-Up Frequency 30MHz~1GHz



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3. Radiated Emission Test-Up Frequency Above 1GHz



- 4.3 Test Procedure
 - 1. Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
 - 2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
 - 3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
 - 4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
 - 5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
 - 6. Repeat above procedures until the measurements for all frequencies are complete.
 - 7. The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).
 - 8. 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	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

Note:

For battery operated equipment, the equipment tests shall be performed using a new battery.

4.4 Test Result

- PASS
- Remark:

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

2. For BT3.0 above 1GHz test all modes of GFSK, $\pi/4$ DQPSK, and 8DPSK were test at Low, Middle, and High channel, only the worst result of GFSK DH5 was reported.

3. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "Z axis" position was the worst, and test data recorded in this report.

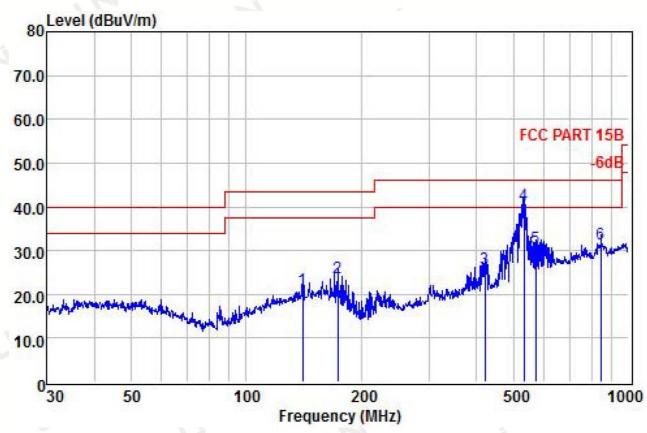
4. Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9KHz to 30MHz and not recorded in this report.

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Below 1GHz Test Results:

Temperature:	22 °C	Relative Humidity:	48%	U.
Test Date:	Oct. 20, 2020	Pressure:	1010hPa	
Test Voltage:	AC 120V, 60Hz	Polarization:	Horizontal	
Test Mode:	Transmitting mode of GF	SK 2480MHz	V	



			Read	Antenna	Cable		Limit	Over	
		Freq	Level	Factor	Loss	Level	Line	Limit	Remark
	10	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1		140.34	5.76	14.53	0.85	21.14	43.50	-22.36	QP
2		173.81	9.35	13.62	0.87	23.84	43.50	-19.66	QP
3		420.58	8.69	15.95	1.38	26.02	46.00	-19.98	QP
4	1	531.96	20.58	18.19	1.59	40.36	46.00	-5.64	QP
5		572.61	10.19	18.81	1.52	30.52	46.00	-15.48	QP
6		848.06	7.10	22.27	2.16	31.53	46.00	-14.47	QP

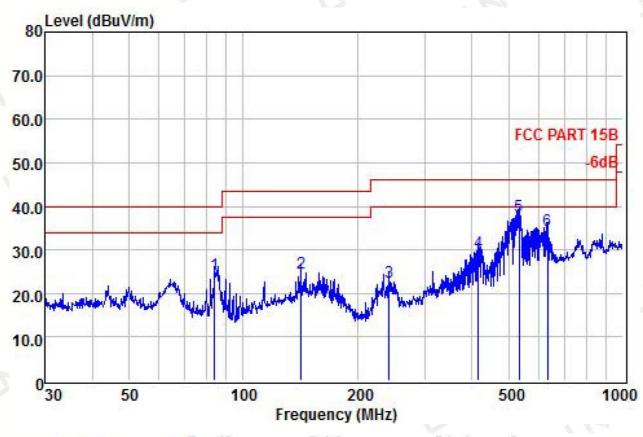
Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit Factor = Ant. Factor + Cable Loss

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Report No.: UNIA20102707ER-01

Temperature:	22 °C	Relative Humidity:	48%
Test Date:	Oct. 20, 2020	Pressure:	1010hPa
Test Voltage:	AC 120V, 60Hz	Polarization:	Vertical
Test Mode:	Transmitting mode of GFSK 248	OMHz	



		Read	Antenna	Cable		Limit	Over	
	Freq	Level	Factor	Loss	Level	Line	Limit	Remark
,	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	84.11	1 <mark>4.</mark> 57	8.86	0.86	24.29	40.00	-15.71	QP
2	141.83	9.07	14.62	0.85	24.54	43.50	-18.96	QP
3	242.53	10.76	10.98	0.87	22.61	46.00	-23.39	QP
4	416.18	12.12	15.90	1.36	29.38	46.00	-16.62	QP
5	531.96	18.06	18.19	1.59	37.84	46.00	-8.16	QP
6	633.91	12.81	19.93	1.65	34.39	46.00	-11.61	QP

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit Factor = Ant. Factor + Cable Loss

Remark:

- (1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.
- (2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

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Above 1 GHz Test Results (8DPSK Worst Case): CH Low (2402MHz)

			Horizontal			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2402	111.33	-5.84	105.49	114.00	-8.51	PK
2402	83.36	-5.84	77.52	94.00	-16.48	AV
4804	62.32	-3.64	58.68	74.00	-15.32	PK
4804	51.31	-3.64	47.67	54.00	-6.33	AV
7206	58.25	-0.95	57.30	74.00	-16.70	PK
7206	48.76	-0.95	47.81	54.00	-6.19	AV
Remark: Fact	or = Antenna	Factor + Cabl	e Loss – Pre-ampli	fier. Margin =	Absolute Le	vel – Limit

Vertical Reading **Emission Level** Frequency Factor Limits Margin Result Detector (MHz) (dBµV) (dBµV/m) (dBµV/m) (dB) (dB) Туре 2402 111.41 -5.84 105.57 114.00 -8.43 ΡK 81.75 94.00 2402 -5.84 75.91 -18.09 A٧ 60.37 -3.64 56.73 74.00 -17.27 ΡK 4804 51.36 47.72 4804 -3.64 54.00 -6.28 AV 56.39 55.44 74.00 -18.56 ΡK 7206 -0.95 7206 47.53 -0.95 46.58 54.00 -7.42 AV Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH Middle (2441MHz)

		- i	Horizontal			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2441	112.15	-5.84	106.31	114.00	-7.69	PK
2441	82.35	-5.84	76.51	94.00	-17.49	AV
4882	62.28	-3.64	58.64	74.00	-15.36	N PK
4882	52.54	-3.64	48.90	54.00	-5.10	AV
7323	56.47	-0.95	55.52	74.00	-18.48	PK
7323	47.15	-0.95	46.20	54.00	-7.80	AV
Remark: Fact	or = Antenna	Factor + Cabl	e Loss – Pre-ampli	fier.Margin =	Absolute Le	evel – Limit

			Vertical			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2441	112.55	-5.71	106.84	114.00	-7.16	PK
2441	82.49	-5.71	76.78	94.00	-17.22	AV
4882	61.37	-3.51	57.86	74.00	-16.14	PK
4882	50.24	-3.51	46.73	54.00	-7.27	AV
7323	56.26	-0.82	55.44	74.00	-18.56	PK
7323	46.74	-0.82	45.92	54.00	-8.08	AV
Remark: Fac	tor = Antenna	Factor + Cab	le Loss – Pre-amp	lifier. Margin =	= Absolute Le	evel – Limit

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			Horizontal			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2480	113.39	-5.65	107.74	114.00	-6.26	PK
2480	82.37	-5.65	76.72	94.00	-17.28	AV
4960	61.81	-3.43	58.38	74.00	-15.62	PK
4960	50.35	-3.43	46.92	54.00	-7.08	AV
7440	57.29	-0.75	56.54	74.00	-17.46	PK
7440	46.22	-0.75	45.47	54.00	-8.53	AV
Remark: Fact	or = Antenna	Factor + Cabl	e Loss – Pre-ampli	fier. Margin =	Absolute Le	vel – Limit

Vertical

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2480	113.49	-5.65	107.84	114.00	-6.16	PK
2480	82.15	-5.65	76.50	94.00	-17.50	AV
4960	61.32	-3.43	57.89	74.00	-16.11	PK
4960	50.37	-3.43	46.94	54.00	-7.06	AV
7440	57.12	-0.75	56.37	74.00	-17.63	PK
7440	46.37	-0.75	45.62	54.00	-8.38	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Remark:

(1) Measuring frequencies from 1 GHz to the 25 GHz.

(2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.

(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(4) Data of measurement within this frequency range shown "--- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.

(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

(7) All modes of operation were investigated and the worst-case emissions are reported.

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5. BAND EDGE

5.1 Limits

FCC PART 15.247 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

5.2 Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 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 to 1MHz and VBM to 3MHz to measure the peak field strength and set RBW to 1MHz and VBW to 10kHz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz, to measure the conducted peak band edge.

5.3 Test Result

PASS

Remark: All modes of GFSK, $\pi/4$ DQPSK, 8DPSK were tested, only the worst result of $\pi/4$ DQPSK was reported as below.

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Radiated Band Edge Test:

Worst case on $\pi/4DQPSK$

Operation Mode: TX CH Low (2402MHz)

			Horizontal			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2310	53.42	-5.81	47.61	74.00	-26.39	PK
2310	/	-5.81	/	54.00	/	AV
2390	53.38	-5.84	47.54	74.00	-26.46	PK
2390	1	-5.84	/	54.00	/	AV
2400	53.23	-5.84	47.39	74.00	-26.61	PK
2400	1	-5.84		54.00	/	AV
Remark: Fact	tor = Antenna Facto	or + Cable Lo	oss – Pre-amplifier			1 200

	S	3	Vertical		1	
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2310	52.27	-5.81	46.46	74.00	-27.54	PK
2310	/	-5.81	/	54.00	/	AV
2390	53.19	-5.81	47.38	74.00	-26.62	PK
2390	/	-5.84	/	54.00	1	AV
2400	53.26	-5.84	47.42	74.00	-26.58	PK
2400		-5.84		54.00	/	AV
Remark: Fact	or = Antenna Facto	or + Cable L	oss – Pre-amplifier			in the second se

Operation Mode: TX CH High (2480MHz)

		1	Horizontal			
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2483.5	53.57	-5.65	47.92	74.00	-26.08	PK 🔹
2483.5	/	-5.65	/	54.00	/	AV
2500	53.28	-5.72	47.56	74.00	-26.44	PK
2500	/	-5.72	/	54.00	/	AV
Remark: Fact	tor = Antenna Facto	or + Cable Lo	oss – Pre-amplifier		U	

		1	Vertical	4		1
Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
2483.5	52.44	-5.65	46.79	74.00	-27.21	PK
2483.5		-5.65		54.00	1	AV
2500	53.25	-5.72	47.53	74.00	-26.47	PK
2500	/	-5.72	/	54.00	/	AV
Remark: Fact	or = Antenna Facto	or + Cable Lo	oss – Pre-amplifier			

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6. OCCUPIED BANDWIDTH MEASUREMENT

6.1 Test Setup

Same as Radiated Emission Measurement

- 6.2 Test Procedure
 - 1. The EUT was placed on a turn table which is 0.8m above ground plane.
 - 2. Set EUT as normal operation.
 - 3. Based on ANSI C63.10 section 6.9.2: RBW=30KHz, VBW=100KHz, Span=3MHz.
 - 4. The useful radiated emission from the EUT was detected by the spectrum analyser with peak detector.
- 6.3 Measurement Equipment Used

Same as Radiated Emission Measurement

6.4 Test Result

PASS

GFSK Modulation:

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402	0.869	1.388	PASS
2441	0.862	1.259	PASS
2480	0.853	1.254	PASS



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CH: 2441MHz



CH: 2480MHz 10:11:20 AM Oct 23, 2020 Radio Std: None SENSE:INT] ALIGN AUTO Center Freq: 2.48000000 GHz Trig: Free Run Trig: Free Run Avg|Hold:>10/10 #Atten: 10 dB Avg|Hold:>10/10 Frequency Center Freq 2.480000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm 0 dB/di **Center Freq** 2.480000000 GHz Span 3 MHz Sweep 4.133 ms Center 2.48 GHz #Res BW 30 kHz CF Step 300.000 kHz Man #VBW 100 kHz Auto **Occupied Bandwidth** 1.2544 MHz Freq Offset 0 Hz -240.06 kHz % of OBW Power 99.00 % **Transmit Freq Error** x dB Bandwidth 852.6 kHz x dB -20.00 dB

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π/4 DQPSK Modulation:

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402	1.219	1.172	PASS
2441	1.219	1.169	PASS
2480	1.222	1.172	PASS



CH: 2402MHz

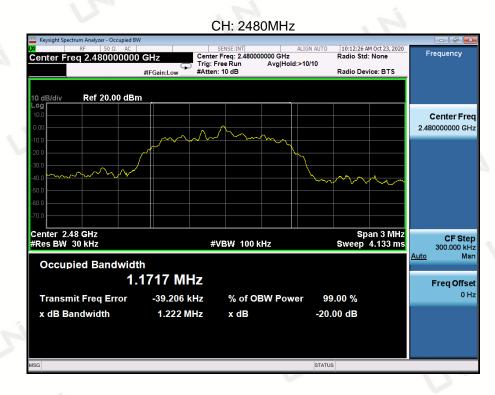
CH: 2441MHz



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8DPSK Modulation:

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402	1.207	1.155	PASS
2441	1.208	1.154	PASS
2480	1.209	1.150	PASS

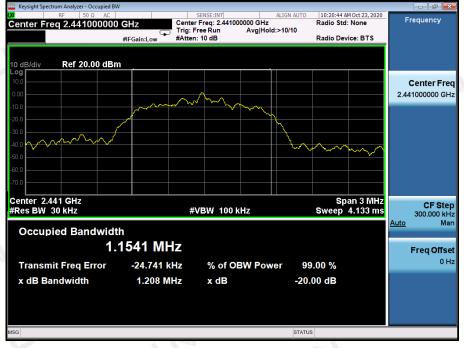


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CH: 2441MHz



CH: 2480MHz 10:21:03 AM Oct 23, 2020 Radio Std: None Center Freq: 2.480000000 GHz Trig: Free Run Avg|Hold:>10/10 #Atten: 10 dB Frequency Center Freq 2.480000000 GHz Radio Device: BTS #IFGain:Low Ref 20.00 dBm **Center Freq** 2.480000000 GHz Span 3 MHz Sweep 4.133 ms Center 2.48 GHz #Res BW 30 kHz **CF Step** 300.000 kHz Man #VBW 100 kHz Auto **Occupied Bandwidth** 1.1500 MHz Freq Offset 0 Hz -23.350 kHz % of OBW Power 99.00 % Transmit Freq Error x dB Bandwidth 1.209 MHz x dB -20.00 dB

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Report No.: UNIA20102707ER-01



7. MAXIMUM PEAK OUTPUT POWER

7.1 Test Setup



7.2 Test Procedure

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices: The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple derector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

7.3 Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

7.4 Test Result

PASS

Туре	Channel	Peak Output power (dBm)	Limit (dBm)	Result	
	Low	4.051			
GFSK	Mid	3.952	30	Pass	
1	High	4.854			
1	Low	3.365	- S.		
π/4DQPSK	Mid	3.256	21	Pass	
	High	3.185			
	Low	3.378			
8DPSK	Mid	3.056	21	Pass	
	High	3.189			

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8. FREQUENCY SEPARATION

8.1 Test Setup



8.2 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 RBW=30KHz and VBW=100KHz.

8.3 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.

8.4 Test Result

PASS

Type/Modulation	СН	CH Frequency (MHz)	CH Separation (MHz)	Limit (MHz)	Result	
i	Low Channel	2402	0.992	0.869		
5	Adjacency Channel	2403			pass	
CH Separation	Mid Channel	2441	1.002	0.000	pass	
GFSK	Adjacency Channel	2442	1.002	0.862		
17	High Channel	2480	0.994	0.050		
	Adjacency Channel	2479	0.994	0.853	pass	



CH: 2402MHz

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CH: 2441MHz



CH: 2480MHz



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Type/Modulation	СН	CH Frequency (MHz)	CH Separation (MHz)	Limit (MHz)	Result
1	Low Channel	2402	0.002	0.040	2000
	Adjacency Channel	cy Channel 2403 0.992		0.813	pass
CH Separation	Mid Channel	2441	1 000	0.813	pass
π/4DQPSK	Adjacency Channel	2442	1.000	0.013	
	High Channel	2480	0.998	0.045	
	Adjacency Channel	2479	0.998	0.815	pass

CH: 2402MHz



CH: 2441MHz



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LNi

CH: 2480MHz

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Type/Modulation	СН	CH Frequency (MHz)	CH Separation (MHz)	Limit (MHz)	Result
À	Low Channel	2402	1.006	0.005	
U.	Adjacency Channel	2403		0.805	pass
CH Separation	Mid Channel	2441	1.002	0.005	pass
8DPSK	Adjacency Channel	2442	1.002	0.805	
S	High Channel	2480	1.006	0.000	
	Adjacency Channel	2479	1.000	0.806	pass

CH: 2402MHz



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CH: 2441MHz



CH: 2480MHz



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http://www.uni-lab.hk

9. CONDUCTED BANDEGE MEASUREMENT

9.1 Test Setup



9.2 Test Procedure

- 1. The EUT was placed on a turn table which is 0.8m above ground plane.
- 2. Set EUT as TX operation and connect directly to the spectrum analyzer.
- 3. Based on FCC Part15 C Section 15.247: RBW=100KHz, VBW=300KHz.
- 4. Set detected by the spectrum analyzer with peak detector.

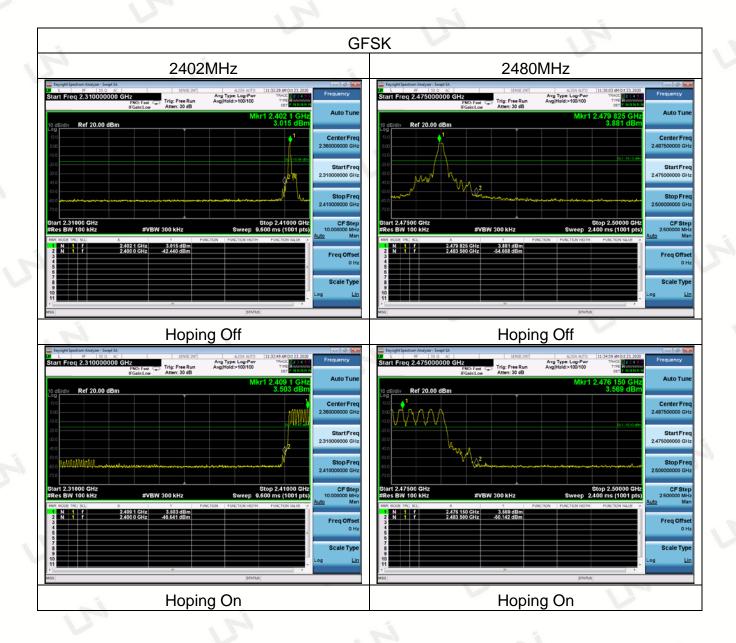
9.3 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20dB.

9.4 Test Result

PASS	5		in its	4	
Mo	dulation	Frequency Band	Delta Peak to band emission (dBc)	> Limit (dBc)	Result
C C	Non honning	Left Band	45.46	20	Pass
OFOK	GFSK	Right Band	58.55	20	Pass
Gran		Left Band	50.14	20	Pass
not	hopping	Right Band	63.71	20	Pass
	Non honning	Left Band	36.13	20	Pass
	Non-hopping	Right Band	59.01	20	Pass
π/4DQPSK	hopping	Left Band	38.44	20	Pass
	hopping	Right Band	60.89	20	Pass
	Nee hopping	Left Band	36.10	20	Pass
00001/	Non-hopping	Right Band	55.78	20	Pass
8DPSK	hopping	Left Band	38.47	20	Pass
r	hopping	Right Band	61.15	20	Pass

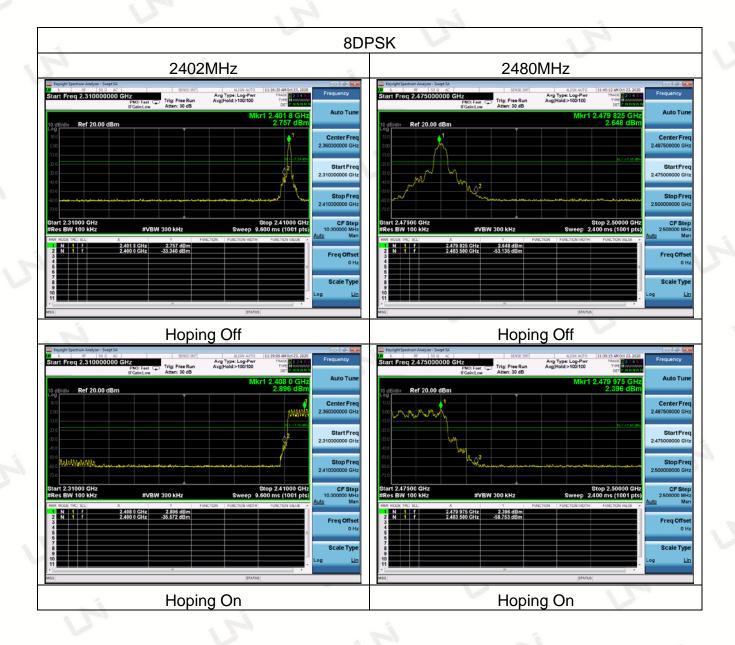
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10. SPURIOUS RF CONDUCTED EMISSION

10.1 Test Limit

1. Below -20dB of the highest emission level in operating band.

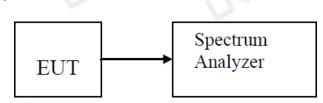
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

3.For below 30MHz,For 9KHz-150kHz,150K-10MHz,We use the RBW 1KHz,10KHz, So the limit need to calculated by "10lg(BW1/BW2)". for example For9KHz-150kHz,RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

10.2 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013, For 9KHz-150kHz, Set RBW=1kHz and VBW= 3KHz; For 150KHz-10MHz, Set RBW=10kHz and VBW= 30KHz:For 10MHz-25GHz, Set RBW=100kHz and VBW= 300KHz in order to measure the peak field strength, and mwasure frequeny range from 9KHz to 25GHz.

10.3 Test Setup



10.4 Test Result

PASS

Remark: All modes of GFSK, $\pi/4$ DQPSK, 8DPSK were tested, only the worst result of GFSK was reported as below:

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GFSK

CH: 2402MHz



Keysight Sp	ectrum Analyzer - Swept	SA									- 6 론
<mark>a</mark> –	RF 50 Ω	AC		SEN	NSE:INT		ALIGN AUTO		M Oct 23, 2020		
tart Fre	g 30.000000	MHZ				Avg Type	e: Log-Pwr	TRA	CE 1 2 3 4 5 6	Fre	equency
	9 001000000		IO: Fast 🗔	Trig: Free	e Run	Avg Hold	:>100/100	TY	PE M WWWWW		
			ain:Low	Atten: 30) dB			D	ET P N N N N N		
											Auto Tun
							M	Kr1 218	.18 MHz		Auto Tun
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	1(c) 20.00 UD	<u></u>									
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											Start Fre
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									DL1 -16.11 dBm		
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											Scale Typ
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	100 kHz		#\/D\/	300 kHz			Swoon (12 72 mc	(1001 pts)		
ICS DW				000 11112			encep (2.11 0 1113	(

30MHz~1GHz

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2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China 深圳市宝安区西乡街道铁岗社区宝田一路365号嘉皇源科技园附楼2楼 邮编:518102 Tel:+86-755-86180996 Fax:+86-755-86180156

http://www.uni-lab.hk

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Keysight Sp	ectrum Analyzer - S	wept SA						-	- @ <mark>-</mark> X
X	RF 50 2 q 1.00000	Ω AC 0000 GHz PN0		SENSE:IN	Avg	ALIGN AUTO Type: Log-Pwr Hold:>100/100	02:36:13 PM Oct 23, 202 TRACE 1 2 3 4 5 TYPE M WWWW DET P NNNN	0 Frec	quency
10 dB/div	Ref 20.00					М	kr3 21.640 GH -38.134 dBn	2	Auto Tune
10.0 (0.00)	↓ 1								enter Fred
-20.0	\$ ²				فيتوينام الميسوريين		3	5	Start Fred
-50.0	معاصر بديندي والمسالي		AND	and a fair of the source of th					Stop Freq 100000 GHz
Start 1.00 #Res BW	1.0 MHz	×	#VBW 3.0	0 MHz	FUNCTION	Sweep 6	Stop 25.00 GH 0.00 ms (1001 pts		CF Step 000000 GHz Man
1 N 2 N	1 f 1 f 1 f	2.392 4.816 21.640	GHz -42	4.273 dBm 2.201 dBm 3.134 dBm				Fr	r eq Offsel 0 Hz
7 8 9									cale Type
				m			Þ	- Log	Lir
MSG						STATUS	3		

1GHz~25GHz

ALIGN AUTO Avg Type: Log-Pwr Avg|Hold:>100/100 7:33 PM Oct 23, 20 TRACE 1 2 3 4 Frequency Center Freq 2.441000000 GHz PNO: Wide Trig: Free Run IFGain:Low Atten: 30 dB Auto Tun Mkr1 2.440 805 GHz 3.588 dBm 0 dB/div Ref 20.00 dBm Center Freq 2.441000000 GHz Start Freq 2.439500000 GHz Stop Freq 2.442500000 GHz CF Step 300.000 kHz Man <u>Auto</u> Freq Offset 0 Hz Scale Type Span 3.000 MHz Sweep 1.000 ms (1001 pts) Center 2.441000 GHz #Res BW 100 kHz Lir #VBW 300 kHz

CH: 2441MHz

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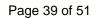
					<u>6</u>		
🔤 Keysight Spe	ectrum Analyzer - Swept SA						- 7
Start Fre	RF 50 Ω AC q 30.000000 MH	Z PNO: Fast G	SENSE: Trig: Free Ru Atten: 30 dE	Avg Ty un Avg Ho	ALIGN AUTO rpe: Log-Pwr Id:>100/100	02:38:01 PM Oct 23, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P NNNNN	Frequency
10 dB/div Log	Ref 20.00 dBm				М	kr1 954.41 MHz -59.054 dBm	Auto Tune
10.0							Center Freq 515.000000 MHz
-10.0						DL1 -16 41 dBm	Start Freq 30.000000 MHz
-20.0							Stop Freq 1.000000000 GHz
-40.0							CF Step 97.000000 MHz <u>Auto</u> Man
-60.0	walland the attribution of the second	Monah Maradol Marado and Marado	yl. H. M. Marson and the	the way of solid and the solid and the	مريانياريارير الرياني الرياني المراوي الم	umumla vortranseiliefuarte	Freq Offset 0 Hz
-70.0							Scale Type
Start 0.03 #Res BW		#VBW	300 kHz		Sweep 9	Stop 1.0000 GHz 2.73 ms (1001 pts)	Log <u>Lin</u>
MSG					STATUS	3	

30MHz~1GHz

Keysight Spectrum Analyzer - Swept SA RF 50 Ω AC		SENSE:INT		ALIGN AUTO	02:40:30 PM Oct 23, 2020	
tart Freq 1.000000000 GI	HZ PNO: Fast ♀ IFGain:Low	Trig: Free Run Atten: 30 dB		Type: Log-Pwr łold:>100/100	TRACE 1 2 3 4 5 TYPE MWWWW DET P NNNN	Frequency
0 dB/div Ref 20.00 dBm				N	lkr3 4.888 GHz -40.885 dBm	
					DL1 -16.41 dBm	Center Fr 13.000000000 G
		u d o moderativ	ale and the second	Mar and a Station State of a state of		Start Fr 1.000000000 G
0.0						Stop Fr 25.000000000 G
tart 1.00 GHz Res BW 1.0 MHz	#VBW 3	8.0 MHz		Sweep 6	Stop 25.00 GHz 0.00 ms (1001 pts	
	2.440 GHz	Y 3.782 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	
		38.279 dBm 40.885 dBm			=======================================	Freq Offs 0
7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9						Scale Ty
						Log <u>I</u>

1GHz~25GHz

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Report No.: UNIA20102707ER-01



CH: 2480MHz



Analyzer - Swept SA 50 Ω AC 1.000000 MHz f 20.00 dBm	PNO: Fast G	SENSE: Trig: Free Ru Atten: 30 dB	Av un Av	ALIGN AUTO vg Type: Log-Pwr g Hold:>100/100	TRAC TYP	M Oct 23, 2020		equency
.000000 MHz	PNO: Fast 🔾	Trig: Free Ru	Av un Av	vg Type: Log-Pwr rg Hold:>100/100	TRAC TYP DE	E 1 2 3 4 5 6 E M WWWWW T P N N N N N		equency
	PNO: Fast 🔾		ın Av	g Hold:>100/100	TYF			equency
f 20.00 dBm					DE	PNNNN		
^r 20.00 dBm	IFGain:Low	Atten: 30 dB		N				
⁷ 20.00 dBm				N	Akr1 191			
f 20.00 dBm								Auto Tur
20.00 dBm					50.0	92 dBm		
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						DL1 -16.33 dBm		
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iHz					Stop 1.0	0000 GHz	Log	<u>L</u>
	#VBW	300 kHz		Sweep				
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		geographic to a state of the st	geun Hictorikaldyriusinarylysowienskyrawistrikduitan. Hz	geografication ครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปประกอบครูปป Hz	por stand and a stand of the second stand and a stand of the second stand sta	geografiester Aubleprinzien en die neueren Brunnenster Anderster Auftern der für geschenden Berlinster ander Ausberlinster Aubleprinzen auf der Ausberlinster Ausberlinister Ausberlinster Ausberlinster Ausb	مراجع #VBW 300 kHz Sweep 92.73 ms (1001 pts)	Image: Stop 1.0000 GHz Hz #VBW 300 kHz Sweep 92.73 ms (1001 pts)

30MHz~1GHz

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Report No.: UNIA20102707ER-01

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Keysight Spectrum Analyzer - Swept SA							_	- 6
RF 50 Ω AC Start Freq 1.000000000 G	Hz	SENSE:I	Avg	ALIGN AUTO Type: Log-Pwr	TRACE	Oct 23, 2020	Fre	quency
	PNO: Fast G	Trig: Free Ru Atten: 30 dB	n Avg	Hold:>100/100	DE	52 GHz		Auto Tune
10 dB/div Ref 20.00 dBm					-38.46	67 dBm		
								e nter Fred 000000 GH:
-20.0						0L1 -16.33 dBm		Start Free
-30.0					3			000000 GH
-40.0				والمستعام والمستعلم المستحد والمستحد والمستحد	and the second	monorm		
-50.0								Stop Fred
Start 1.00 GHz #Res BW 1.0 MHz	#VB\	W 3.0 MHz		Sweep 6	Stop 25 0.00 ms (1	5.00 GHz 1001 pts)	2.4000 Auto	CF Step 000000 GH: Mar
MKR MODE TRC SCL X	.488 GHz	Ƴ 3.861 dBm	FUNCTION	FUNCTION WIDTH	FUNCTIO	N VALUE	Auto	INIAI
2 N 1 f 3 N 1 f 4 5	.466 GH2 I.960 GHz I.352 GHz	-42.196 dBm -38.467 dBm					F	req Offse 0 Ha
6 7 8 9							s	cale Type
10						-	Log	Lir
<		m		STATUS		Þ		

1GHz~25GHz

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11. NUMBER OF HOPPING FREQUENCY

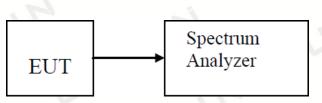
11.1 Test Limit

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

11.2 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=1MHz and VBW=3MHz.

11.3 Test Setup



11.4 Test Result

PASS

Modulation	Number of Hopping Channel	Limit	Result	
GFSK	79	1		
π/4DQPSK	79	≥15	Pass	
8DPSK	79			

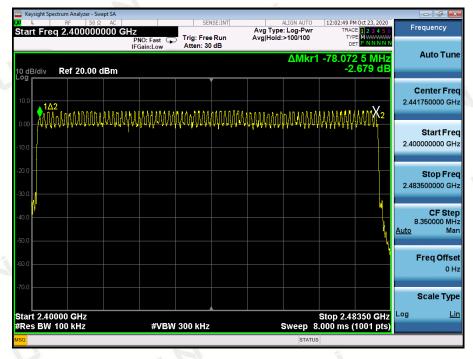
Frequency Avg Type: Log-Pw Avg|Hold:>100/100 Trig: Free Run Atten: 30 dB PNO: Fast Auto Tun ΔMkr1 -78.156 0 MHz -0.883 dE Ref 20.00 dBm 0 dB/div Center Free 2.441750000 GH; X2 Start Free 2.40000000 GHz Stop Free 2.483500000 GH CF Step 8.350000 MH Auto Freq Offset 0 H; Scale Type Stop 2.48350 GHz Sweep 8.000 ms (1001 pts) Start 2.40000 GHz #Res BW 100 kHz Lir #VBW 300 kHz

GFSK

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π/4DQPSK



8DPSK

Keysight S	pectrum Analyz										[- J J X
Start Fre	^{R⊧} eq 2.400					VSE:INT		LIGN AUTO	TRAC	E 1 2 3 4 5 6	Fre	quency
10 dB/div Log	Ref 20.	.00 dBr	IFG	IO: Fast 😱 Gain:Low	Atten: 30		Avginoid.		-78.23			Auto Tune
10.0	52 11/11/1/1 (h n	50 0 A NM.	1) D A D A	<u>ል ከቤቲ አስታ</u> ስ	ለአለታልቀይ	4 ቢ በ በ ስ ለ ተ በ	44111411	<u>ሉ አመጠታስ ከ</u>	1 So SKA A 1 /	MM X2		enter Freq 750000 GHz
-10.0	AN A	UTU AAA	₩¥¥¥¥	AAAAAAAAAA	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	Y Y Y Y Y Y Y Y Y Y	WWWWW	IYIPYYYUU	ANNAA.	AUM AUM		Start Freq 000000 GHz
-20.0											2.483	Stop Freq 500000 GHz
-40.0											8. <u>Auto</u>	CF Step 350000 MH: Mar
-50.0											F	req Offse 0 H;
-70.0												cale Type
	0000 GHz / 100 kHz			#VBW	300 kHz			Sweep 8	Stop 2.48 .000 ms (350 GHz 1001 pts)	Log	<u>Lin</u>
MSG								STATUS				

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12. TIME OF OCCUPANCY(DWELL TIME)

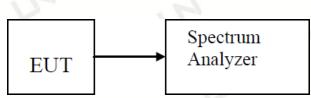
12.1 Test Limit

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

12.2 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

12.3 Test Setup



12.4 Test Result

PASS

Туре	Modulation	СН	Pulse time(ms)	Dwell Time(ms)	Limit(ms)	Result
Dwell Time GFSK		Low	2.98	317.87	400	Pass
	GFSK	Mid	2.96	315.73	400	Pass
	4	High	2.98	317.87	400	Pass

CH: 2402MHz

L	ectrum Analyzer - Swept SA RF 50 Ω A		SEI	SE:INT		ALIGN AUTO	12:06:32 PM	1 Oct 23, 2020		- 6
enter F	req 2.4020000	00 GHz PNO: Fast ↔ IFGain:Low	Trig: Free		Avg Type	: Log-Pwr	TYP	E 1 2 3 4 5 6 E WWWWWW T P N N N N N	Fre	equency
dB/div	Ref 20.00 dBn					L	Mkr1 2. -	.975 ms 2.31 dB		Auto Tun
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0.0									2.402	Stop Fre 0000000 GH
D.0									1. <u>Auto</u>	CF Ste 000000 MH Ma
0.0 10	MANUX2		גיין דין	ê h iyana	AND AND A	dired director	hotenanalite	pt of the lines	F	FreqOffso 0⊦
enter 2.4	402000000 GHz						s	pan 0 Hz	s Log	Scale Typ <u>Li</u>
es BW 1			V 3.0 MHz			Sweep 8	.333 ms (

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CH: 2441MHz

Keysight Spectrum Analyzer - Swept SA				
L RF 50 Ω AC Center Freq 2.44100000		Avg Type: Log-Pwr	12:07:21 PM Oct 23, 2020 TRACE 1 2 3 4 5 6 TYPE WWWWWW	Frequency
10 dB/div Ref 20.00 dBm	PNO: Fast 🛶 Ing: Free Run IFGain:Low Atten: 30 dB		Mkr1 2.958 ms -0.77 dB	Auto Tun
-og				Center Fre 2.441000000 G⊦
0.00				Start Fre 2.441000000 G⊦
30.0				Stop Fre 2.441000000 G⊦
40.0				CF Ste 1.000000 MH <u>Auto</u> Ma
	₩¥2		vymenen and an and a start	Freq Offs 0 ⊦
70.0				Scale Typ
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 8	Span 0 Hz 3.333 ms (1001 pts)	Log <u>L</u>
ISG		STATU	S	

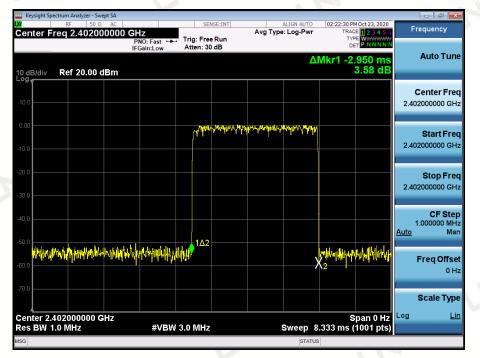
Keysight Spectrum Analyzer - Swept SA				- 7 -
Center Freq 2.4800000	SENSE:I	Avg Type: Log-Pwr	12:08:40 PM Oct 23, 2020 TRACE 1 2 3 4 5 6 TYPE WWWWWW	Frequency
10 dB/div Ref 20.00 dBm	IFGain:Low Atten: 30 dB		Mkr1 2.983 ms -3.10 dB	Auto Tune
10.0				Center Freq 2.480000000 GHz
-10.0				Start Freq 2.480000000 GHz
-20.0				Stop Freq 2.480000000 GHz
-40.0				CF Step 1.000000 MHz <u>Auto</u> Man
-60.0	Marth199419941991199119911222		<u>1,2,2,10</u> (b,1), A, A, A, M,	Freq Offset 0 Hz
Center 2.480000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Sween 8	Span 0 Hz .333 ms (1001 pts)	Scale Type
MSG		STATUS		

CH: 2480MHz

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Туре	Modulation	СН	Pulse time(ms)	Dwell Time(ms)	Limit(ms)	Result
Dwell Time		Low	2.95	314.67	400	Pass
	π/4DQPSK	Mid	3.00	320.00	400	Pass
		High	2.98	317.87	400	Pass

CH: 2402MHz



CH: 2441MHz

Reysight Spe	ctrum Analyzer - Sw RF 50 Ω			SEI	NSE:INT		ALIGN AUTO	02:21:47 PM	Oct 23, 2020		- 6
enter Fr	req 2.44100		HZ PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 30		Avg Typ	e: Log-Pwr	TYPE	123456 WWWWWWWW PNNNNN		quency
dB/div g √	Ref 20.00 (dBm					L	1 Mkr1 3.	000 ms I.42 dB	1	Auto Tur
.0											enter Fre
.0				ah utan Unitati	alul 42/44200/v						Start Fre 000000 G⊦
											Stop Fre 000000 GI
0										1.0 <u>Auto</u>	CF Ste 000000 MH Ma
• +1/* \%	allilling showing the	WII (Maring	2			142	nyululunyul	ullyn ffarfyrnu	Nothern	F	req Offs 0 F
											cale Typ
	l41000000 G .0 MHz	SHz	#VB)	V 3.0 MHz			Sween 8	S 1,333 ms (1		Log	L

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CH: 2480MHz

Center Freq 2.480000000 GHz Avg Type: Log-Pwr Trace fil2 3 4 3 5 0 m PN0: Fast +	sg	10 HHH/2		<i>"</i> •En	010 10112			STATUS		199 F (10)	_	
Center Freq 2.480000000 GHz Avg Type: Log-Pwr Trace 12.33 450 Processor Autor Trace 12.33 450 Autor Trace			GHz	#VBW	3.0 MHz			Sweep_8	S 333 ms.(pan 0 Hz 1001 pts)	Log	L
Center Freq 2.480000000 GHz Avg Type: Log-Pwr Trace 12.34.350 Processor Autor Trace 12.34.350 Processor Processor Autor Trace 12.34.350 Processor Processor Autor Trace 12.34.350 Processor Procesor <td></td> <td>Scale Typ</td>												Scale Typ
enter Freq 2.480000000 GHz Avg Type: Log-Pwr Trace fl2 3 4 3 4 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	70.0											0 H
enter Freq 2.480000000 GHz PNO: Fast ++ (FGain:Low Trig: Free Run Atten: 30 dB Avg Type: Log-Pwr Trace 12.34.350 Trace 12.34.350 Dec Physics Auto Trace 12.34.350 Dec Physics 0 dB/div Ref 20.00 dBm -3.07 dB -3.07 dB -3.07 dB 0 dB/div Ref 20.00 dBm -3.07 dB -3.07 dB -3.07 dB 0 dB/div Ref 20.00 dBm -3.07 dB -3.07 dB -3.07 dB 0 dB/div Ref 20.00 dBm -3.07 dB -3.07 dB -3.07 dB 0 dB/div Ref 20.00 dBm -3.07 dB -3.07 dB -3.07 dB 0 d -3.07 dB -3.07 dB -3.07 dB -3.07 dB -3.07 dB 0 d -3.07 dB -3.00 dB -3.07 dB -3.00 dB </td <td>0.0</td> <td></td> <td></td> <td></td> <td></td> <td>1<u>∆2</u> //</td> <td>alitration in the second s</td> <td>htter and the second second</td> <td>verytet fortende</td> <td>West Thursty</td> <td></td> <td>Freq Offs</td>	0.0					1 <u>∆2</u> //	alitration in the second s	htter and the second	verytet fortende	West Thursty		Freq Offs
enter Freq 2.480000000 GHz Avg Type: Log-Pwr Trace 12.3 4 300 Frequency PN0: Fast ++ Trig: Free Run Avg Type: Log-Pwr Trace 12.3 4 300 Autor Type: Log-Pwr 0 dB/div Ref 20.00 dBm -3.07 dB Center F 2.480000000 00	50.0											n.000000 MF Ma
Avg Type: Log-Pwr Trace Biz as type: Log-Pwr Autor Type: Log-Pwr	40.0											CF Ste
Avg Type: Log-Pwr Trace fil2 3 4 50 Frequency PN0: Fast ++	30.0										2.48	0000000 GH
enter Freq 2.480000000 GHz PNC: Fast \rightarrow Trig: Free Run IFGain:Low 0 dB/div Ref 20.00 dBm Center F 2.480000000 Center F 2.480000000 Center F 2.480000000	0.0											Stop Fre
enter Freq 2.480000000 GHz PNC: Fast	0.0										2.48	
enter Freq 2.480000000 GHz PNO: Fast												Start Fre
enter Freq 2.480000000 GHz PNO: Fast	10.0		1) w 44.5 % w 47.4 w		,~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	7					2.48	0000000 GH
enter Freq 2.480000000 GHz PNO: Fast	°g											Center Fre
enter Freq 2.480000000 GHz Avg Type: Log-Pwr TRACE 12:3:3:5 Frequency PN0: Fast	0 dB/div	Ref 20.00	dBm					L	Mkr1 2.	.983 ms 3.07 dB		Auto Tur
	enter Fr	req 2.4800		PNO: Fast +			Avg Type	E LOG-F WI	TYP	E WWWWW		
	L	RF 50 S		211-	SEI	NSE:INT		ALIGN AUTO			F	requency

Туре	Modulation	СН	Pulse time(ms)	Dwell Time(ms)	Limit(ms)	Result
		Low	2.95	314.67	400	Pass
Dwell Time	8DPSK	Mid	2.96	315.73	400	Pass
1.110		High	2.95	314.67	400	Pass

CH: 2402MHz

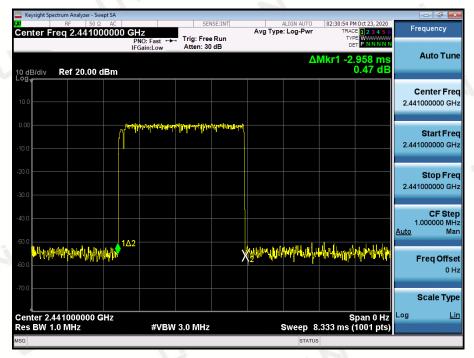
Keysight S	pectrum Analyzer - Swept SA		1					- 7	
enter I	RF 50 Ω AC Freq 2.402000000	GHz	SENSE:INT	Avg Type: L	GN AUTO og-Pwr		123456	Frequency	У
		PNO: Fast ↔	Trig: Free Run Atten: 30 dB		Δ	DET /ikr1 -2.9		Auto T	ſun
dB/div g	Ref 20.00 dBm					-0	.06 dB		
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		with the second		Pre-had-spenning-had-spen					-
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CH: 2441MHz



CH: 2480MHz

🔤 Keys	sight Spect	trum Analy:													- 6 💌
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13. PSEUDORANDOM FREQUENCY HPPPING SEQUENCE

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

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency

hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies

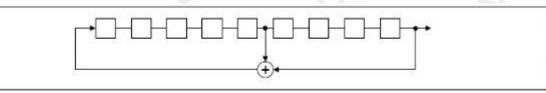
that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shal I hop

to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

TEUT 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 frist stage. The sequence begins with the frist 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 explame of pseudorandom frequency hopping sequence as follows:

0	2	4	6	62 64	78 1	73 75 77
Г						
						111
				1 1 1		

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.

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14. ANTENNA REQUIREMENT

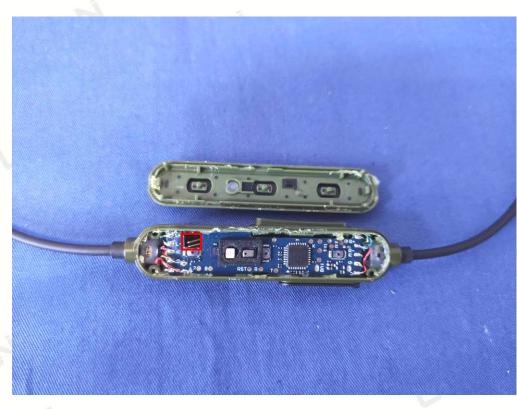
Standard Applicable:

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.

Antenna Connected Construction

The antenna used in this product is an Internal Antenna, The directional gains of antenna used for transmitting is 2dBi.

BT ANTENNA:



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15. PHOTOGRAPH OF TEST



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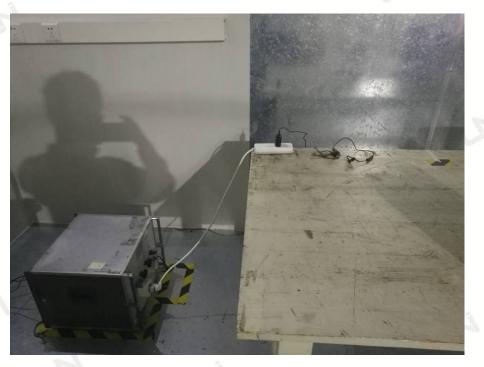
Radiated Emission (Below 1G)



Radiated Emission (Above 1G)

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Report No.: UNIA20102707ER-01



End of Report

Conducted Emission

LN

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