

TEST REPORT

Product Nam	ıe	 Bluetooth Portable Stereo Speaker with Durable, rubberized, waterproof cabinet 	
Model Number		: iBT157, iBT157B, iBT157X (X would be any 1/2 alphabet(s) combination denotes different	
FCC ID		cabinet color) : EMOIBT157A	
Prepared for Address	:	SDI Technologies Inc. 1299, Main Street, Rahway, NJ 07065, U.S.A.	
Prepared by Address	:	EMTEK (SHENZHEN) CO., LTD. Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China	
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Report Number	:	ES200305020E
Date(s) of Tests	:	March 05, 2020 to April 02, 2020
Date of issue	:	April 02, 2020

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VERIFICATION OF COMPLIANCE

Applicant:	SDI Technologies Inc 1299, Main Street, Rahway, NJ 07065, U.S.A.	
Manufacturer:	SDI Technologies Inc 1299, Main Street, Rahway, NJ 07065, U.S.A.	
Factory:	DONGGUAN SYNST ELECTRONICS CO.,LTD THE SCIENCE & TECHNOLOGY INDUSTRIAL PARK, HOUJIE TOWN, DONGGUAN,GUANGDONG, CHINA, China	
Product Description:	Bluetooth Portable Stereo Speaker with Durable, rubberized, waterproof cabinet	
Trade Mark:	iHome	
Model Number:	iBT157, iBT157B, iBT157X (X would be any 1/2 alphabet(s) combination denotes different cabinet color) (note: The models are the same except color of appearance and model number, here we prepare iBT157 for the all test)	

We hereby certify that:

The above equipment was tested by EMTEK(SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2018).

Date of Test :	March 05, 2020 to April 02, 2020
Prepared by :	Loren Luo Loren Luo /Editor
Reviewer :	Tim Dong /SupervisorENZHEN
Approved & Authorized Signer :	Lisa Wang /Manager ESTING

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Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	1	ES200305020E



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1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description	
Product Name	Bluetooth Portable Stereo Speaker with Durable, rubberized, waterproof cabinet	
Model number	iBT157, iBT157B, iBT157X (X would be any 1/2 alphabet(s) combination denotes different cabinet color)	
Power Supply	DC 5V from adapter, DC 3.7V Battery	
Kind of Device	Bluetooth Ver.5.0	
Modulation	GFSK, π/4-DQPSK, 8DPSK	
Operating Frequency Range	2402-2480MHz	
Number of Channels	79	
Transmit Power Max(PK)	1.21dBm(0.001321W)	
Antenna Type	Internal PCB antenna	
Antenna Gain	0dBi	

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1.2 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10-2013. Radiated testing was performed at an antenna to EUT distance 3 meters.



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1.3Test Facility

Site Description		
EMC Lab.	:	Accredited by CNAS, 2016.10.24 The certificate is valid until 2022.10.28 The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2005) The Certificate Registration Number is L2291.
		Accredited by TUV Rheinland Shenzhen 2016.5.19 The Laboratory has been assessed according to the requirements ISO/IEC 17025.
		Accredited by FCC, August 03, 2017 Designation Number: CN1204 Test Firm Registration Number: 882943
		Accredited by Industry Canada, November 24, 2015 The Certificate Registration Number is 4480A.
		Accredited by A2LA, July 31, 2017 The Certificate Number is 4321.01.
Name of Firm	•	EMTEK(SHENZHEN) CO., LTD.
Site Location	:	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China.

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2. System Test Configuration

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of EUT was fixed in a particular direction according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

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2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System



Table 2-1 Equipment Used in Tested System

Item	Equipment	Trademar k	Model No.	FCC ID	Note
1.	Bluetooth Portable Stereo Speaker with Durable, rubberized, waterproof cabinet	iHome	iBT157	EMOIBT157A	EUT
2	Adapter	N/A	Model:ASSA44A-050230 Input:100-240V 50/60Hz 0.5A Max Output:5V	N/A	Support Equipment

Note:

(1) Unless otherwise denoted as EUT in [Remark] column , device(s) used in tested system is a support equipment.

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FCC Rules	Description Of Test	Result
§15.207	AC Power Conducted Emission	Compliant
§15.247(d),§15.209	Radiated Emission	Compliant
§15.247(a)(1)	Channel Separation test	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Compliant
§15.247(b)	Max Peak output Power test	Compliant
§15.247(d)	Band edge test	Compliant
15.203 Antenna Requirement Compli		Compliant

3. Summary of Test Results

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4. Description of test modes

The EUT has been tested under its typical operating condition and fully-charged battery for EUT tested alone. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, $\Pi/4$ -DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
40	2441
79	2480

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5. TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Radio Frequency	±1x10^-5
Maximum Peak Output Power Test	±1.0dB
Conducted Emissions Test	±2.0dB
Radiated Emission Test	±2.0dB
Power Density	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

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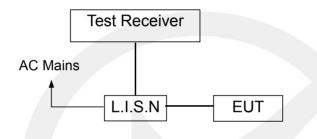


6. Conducted Emissions Test

6.1 Measurement Procedure:

- 1. The EUT was placed on a table, which is 0.8m above ground plane.
- 2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 3. Repeat above procedures until all frequency measured was complete.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 Measurement Equipment Used:

	Conducted Emission Test Site								
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	Last Cal.	Due date			
Test Receiver	Rohde & Schwarz	ESCS30	100018	9kHz~3GHz	05/23/2019	05/22/2020			
L.I.S.N	Rohde & Schwarz	ENV216	100017	9KHz-300MHz	05/23/2019	05/22/2020			
RF Switching Unit	CDS	RSU-M2	38401	9KHz-300MHz	05/23/2019	05/22/2020			
Coaxial Cable	CDS	79254	46107086	9kHz~3GHz	05/23/2019	05/22/2020			

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6.4 Measurement Result:

Operation Mode:	ТХ	Test Date :	March 16, 2020
Frequency Range:	0.15MHz~30MHz	Temperature :	28 ℃
Test Result:	PASS	Humidity :	65 %
Test By:	Loren		

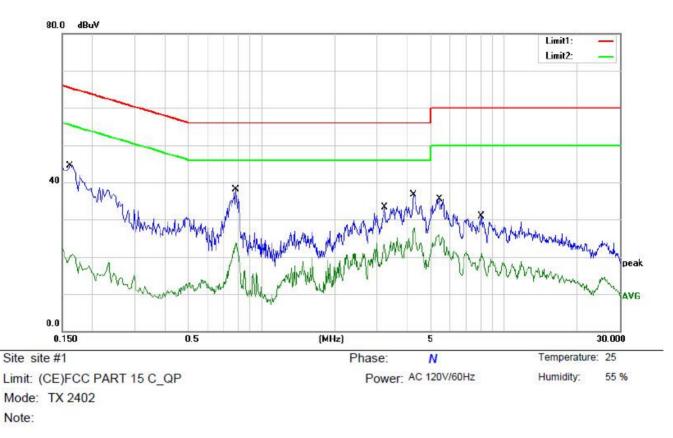
Pass.

Conducted emission at both 120V & 240V, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.

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No. M	k.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	2	0.1620	34.46	10.02	44.48	65.36	-20.88	QP	
2	1	0.1620	10.71	10.02	20.73	55.36	-34.63	AVG	
3 *	1	0.7820	28.00	10.18	38.18	56.00	-17.82	QP	
4	1	0.7820	13.46	10.18	23.64	46.00	-22.36	AVG	
5	10.00	3.2140	23.09	10.18	33.27	56.00	-22.73	QP	
6	1	3.2140	13.58	10.18	23.76	46.00	-22.24	AVG	
7	1	4.2420	26.49	10.18	36.67	56.00	-19.33	QP	
8	1	4.2420	17.42	10.18	27.60	46.00	-18.40	AVG	
9	1	5.4060	25.42	10.18	35.60	60.00	-24.40	QP	
10	3	5.4060	15.86	10.18	26.04	50.00	-23.96	AVG	
11	1	8.0460	20.62	10.20	30.82	60.00	-29.18	QP	
12	1	8.0460	10.67	10.20	20.87	50.00	-29.13	AVG	

*		data
. IV	laximum	data

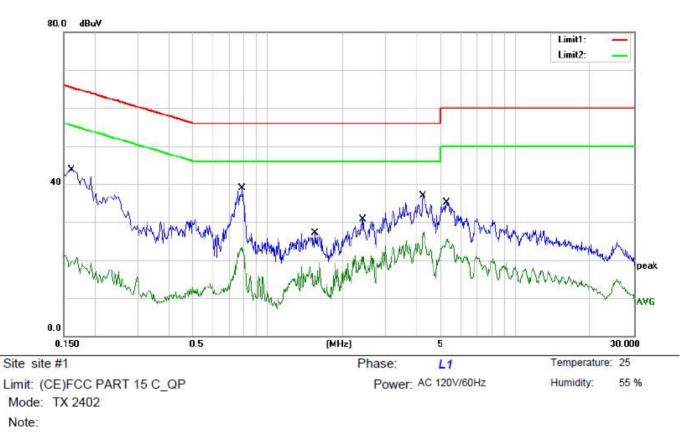
x:Over limit I:over margin

Comment: Factor build in receiver.

Operator: HU

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No. I	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	33.74	10.02	43.76	65. <mark>3</mark> 6	-21.60	QP	
2		0.1620	10.78	10.02	20.80	55.36	-34.56	AVG	
3	*	0.7900	28.64	10.18	38.82	56.00	-17.18	QP	
4		0.7900	13.16	10.18	23.34	46.00	-22.66	AVG	
5		1.5540	16.99	10.18	27.17	56.00	-28.83	QP	
6		1.5540	9.12	10.18	19.30	46.00	-26.70	AVG	
7		2.4340	20.53	10.18	30.71	56.00	- <mark>25.2</mark> 9	QP	
8		2.4340	10.92	10.18	21.10	46.00	-24.90	AVG	
9		4.2460	26.81	10.18	36.99	56.00	-19.01	QP	
10		4.2460	17.12	10.18	27.30	46.00	-18.70	AVG	
11		5.2580	24.90	10.18	35.08	60.00	-24.92	QP	
12		5.2580	15.23	10.18	25.41	50.00	-24.59	AVG	

*. 14	kimum	data
" Ma	amum	data

x:Over limit I:over margin

Comment: Factor build in receiver.

Operator: HU

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6.5 Conducted Measurement Photos:

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7. Radiated Emission Test

7.1 Measurement Procedure

- 1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
- 2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
- 3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 5. Set to the maximum power setting and enable the EUT transmit continuously.
- 6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
- 7. Test Procedure of measurement (For Above 1GHz):
 - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
 - 2) Change the antenna polarization and repeat 1) with vertical polarization.
 - 3) Make a hardcopy of the spectrum.
 - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
 - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
 - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
 - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
 - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

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Use the following spectrum analyzer settings:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	120KHz
VB	300KHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

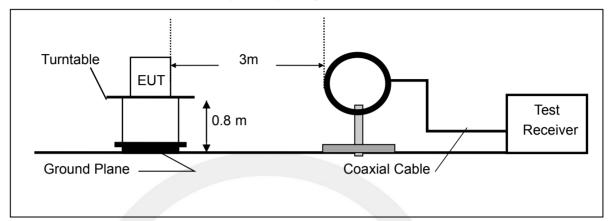
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Average
Trace	Max hold

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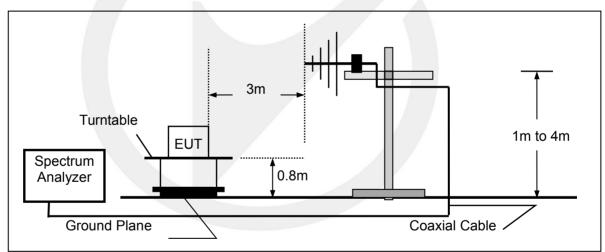


7.2 Test SET-UP (Block Diagram of Configuration)

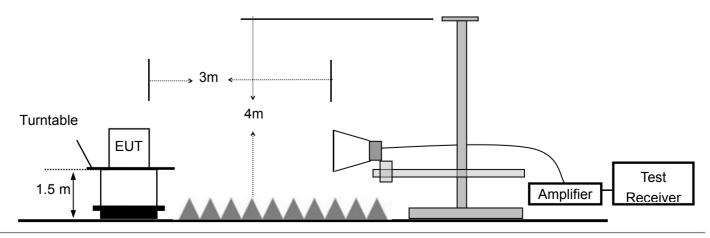
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



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Report No. ES200305020E



7.3 Measurement Equipment Used:

Item	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.0 3	9KHz-3GHz	05/23/2019	1 Year
2.	Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	05/23/2019	1 Year
3.	Bilog Antenna	Schwarzbeck	VULB9163	000141	25MHz-2GHz	05/23/2019	1 Year
4.	Power Amplifier	CDS	RSU-M352	818	1MHz-1GHz	05/23/2019	1 Year
5.	Power Amplifier	HP	8447F	OPT H64	1GHz-26.5GHz	05/23/2019	1 Year
6.	Color Monitor	SUNSPO	SP-140A	N/A		05/23/2019	1 Year
7.	Single Line Filter	JIANLI	XL-3	N/A		05/23/2019	1 Year
8.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	-	05/23/2019	1 Year
9.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A		05/23/2019	1 Year
10.	DC Power Filter	JIANLI	DL-2X50B	N/A		05/23/2019	1 Year
11.	Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	05/23/2019	1 Year
12.	Cable	Rosenberger	CIL02	A0783566	9KHz-3GHz	05/23/2019	1 Year
13.	Cable	Rosenberger	RG 233/U	525178	9KHz-3GHz	05/23/2019	1 Year
14.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	9KHz-40GHz	05/23/2019	1 Year
15.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	1GHz-18GHz	05/23/2019	1 Year
16.	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA91703 99	14GHz -26.5GHz	05/23/2019	1 Year
17.	Power Amplifier	LUNAR EM	LNA1G18-4 0	J101000000 81	1GHz-26.5GHz	05/23/2019	1 Year
18.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/23/2019	1 Year
19.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/23/2019	1 Year
20.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/23/2019	1 Year

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7.4 Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

Frequencies	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

15.205 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

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Remark 1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

7.5 Measurement Result

Operation Mode:	ТХ	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	28 ℃
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m		

Below 30MHz:

Freq.	Ant.Pol.	Emission	Limit 3m	Over
		Level		
(MHz)	H/V	(dBuV/m)	(dBuV/m)	(dB)

Note: The low frequency, which started from 9KHz-30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

Below 1000MHz:

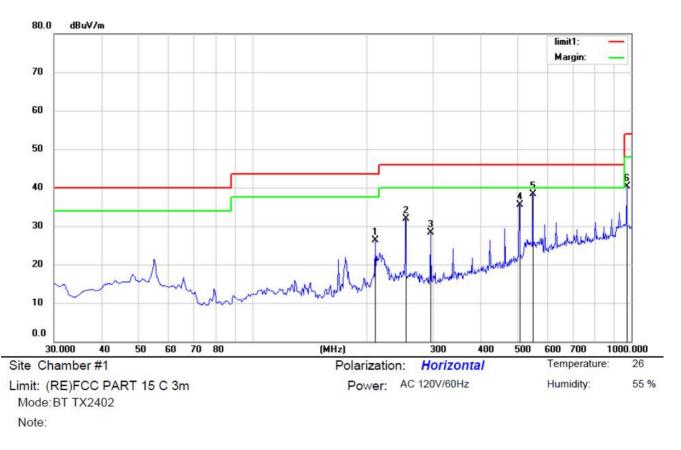
Pass.

All modulation modes have been tested, the worst mode is (GFSK TX 2402MHz), the data is recorded on the following page, other modulation modes do not exceed this limit.

Please refer to the following data.

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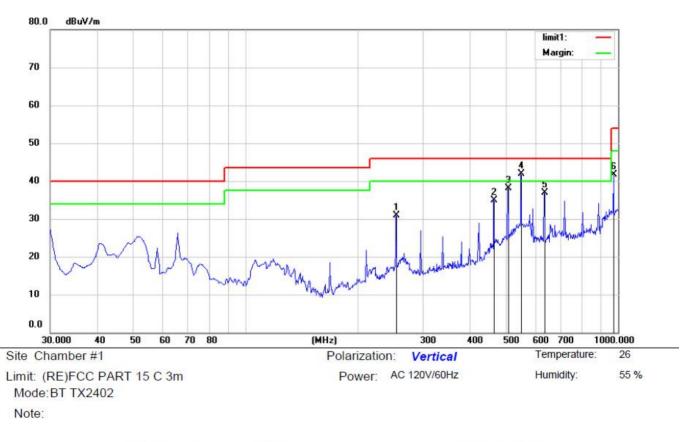
No.	Mk	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		211.3900	43.60	-17.38	26.22	43.50	- 1 7.28	QP			
2		254.0700	47.32	-15.51	31.81	46.00	-14.19	QP			
3		295.7800	42.07	-13.81	28.26	46.00	-17.74	QP			
4		508.2100	44.20	-8.71	35.49	46.00	- <mark>10.5</mark> 1	QP			
5	*	550.8900	46.00	-7.71	38.29	<u>46.00</u>	-7.71	QP			
6		974.7800	40.44	-0.09	40.35	54.00	-13.65	QP			

*:Maximum data x:Over limit 1:over margin

Operator: HUANG

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No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	2	254.0700	46.43	-15.51	30.92	46.00	-15.08	QP			
2	4	65.5300	44.67	-9.78	34.89	46.00	-11.11	QP			
3	5	08.2100	46.80	-8.71	38.09	46.00	-7.91	QP			
4	* 5	50.8900	49.70	-7.71	<mark>41</mark> .99	46.00	-4.01	QP			
5	6	35.2800	42.30	-5.45	36.85	<u>46.00</u>	-9. <mark>1</mark> 5	QP			
6	9	74.7800	41.79	-0.09	41.70	54.00	-12.30	QP			

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

Operator: HUANG

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March 16, 2020

Above 1000MHz~10th Harmonics:

Operation Mode: GFSK (CH1: 2402MHz)

All modulation modes have been tested, the worst mode is (GFSK), the data is recorded on the following page, other modulation modes do not exceed this limit.Please refer to the following data.

Test Date :

Reading Correct Emission Limit Ant. Freq. Margin(dB) Pol. Level(dBuV/m) Factor Level(dBuV/m) 3m (MHz) H/V ΡK AV dB ΡK AV ΡK AV ΡK AV 4804 V 92.27 73.63 -32.3 59.97 41.33 74 54 -14.03 -12.67 7206 70.09 -37.2 32.89 74 -17.05 V 94.15 56.95 54 -21.11 -21.83 9608 V 91.97 72.90 -39.8 52.17 33.10 74 54 -20.90 12010 V 98.14 76.64 -40.5 57.64 36.14 74 54 -16.36 -17.86 V 72.34 -41.7 74 54 -21.32 14412 94.38 52.68 30.64 -23.36 74 16814 V 97.93 74.17 -40.0 57.93 34.17 54 -16.07 -19.83 4804 н 91.09 75.01 -31.6 59.49 43.41 74 54 -14.51 -10.59 36.58 7206 Н 98.62 72.08 -35.5 63.12 74 54 -10.88 -17.429608 Н 98.46 70.93 -38.3 60.16 32.63 74 54 -13.84 -21.37 98.22 36.57 74 12010 Н 75.57 -39.0 59.22 54 -14.78 -17.43 14412 Н 94.49 76.37 -42.0 52.49 34.37 74 54 -21.51 -19.63 74 16814 н 95.44 74.66 -39.3 56.14 35.36 54 -17.86 -18.64

Operation Mode: GFSK (CH40: 2441MHz)

Test Date : March 16, 2020

Freq.	Ant.	Rea	Reading		Emis	sion	Lij	mit	Margin(dB)	
	Pol.	Level(d	_evel(dBuV/m) Factor Level(dBuV/m) 3m(dBuV/m)		BuV/m)					
(MHz)	H/V	ΡK	AV	dB	PK	AV	PK	AV	PK	AV
4882	V	91.60	70.53	-32.3	59.3	38.23	74	54	-14.70	-15.77
7323	V	93.44	70.85	-37.2	56.24	33.65	74	54	-17.76	-20.35
9764	V	96.04	76.80	-39.8	56.24	37	74	54	-17.76	-17.00
12205	V	91.97	70.97	-40.5	51.47	30.47	74	54	-22.53	-23.53
14646	V	94.97	75.40	-41.0	53.97	34.4	74	54	-20.03	-19.60
17087	V	97.10	73.95	-41.1	56	32.85	74	54	-18.00	-21.15
4882	н	97.95	71.81	-31.6	66.35	40.21	74	54	-7.65	-13.79
7323	Н	96.04	73.12	-35.5	60.54	37.62	74	54	-13.46	-16.38
9764	н	92.02	76.03	-38.3	53.72	37.73	74	54	-20.28	-16.27
12205	Н	93.07	74.44	-39.0	54.07	35.44	74	54	-19.93	-18.56
14646	н	92.10	76.89	-42.0	50.1	34.89	74	54	-23.90	-19.11
17087	н	95.47	70.63	-41.5	53.97	29.13	74	54	-20.03	-24.87

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Freq.	Ant.	Rea	ding	Correct	Emis	sion	Lir	nit	Margin(dB)	
	Pol.	Level(d	BuV/m)	Factor	Level(dBuV/m)		3m(dBuV/m)			
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4960	V	95.51	76.67	-32.3	63.21	44.37	74	54	-10.79	-9.63
7440	V	94.04	70.42	-37.2	56.84	33.22	74	54	-17.16	-20.78
9920	V	93.90	75.20	-39.8	54.1	35.4	74	54	-19.90	-18.60
12400	V	97.46	71.92	-40.5	56.96	31.42	74	54	-17.04	-22.58
14880	V	95.88	76.10	-41.0	54.88	35.1	74	54	-19.12	-18.90
17360	V	98.02	74.70	-41.1	56.92	33.6	74	54	-17.08	-20.40
4960	Н	93.94	71.93	-31.6	62.34	40.33	74	54	-11.66	-13.67
7440	Н	98.47	70.35	-35.5	62.97	34.85	74	54	-11.03	-19.15
9920	Н	91.38	75.75	-38.3	53.08	37.45	74	54	-20.92	-16.55
12400	Н	97.89	70.50	-39.0	58.89	31.5	74	54	-15.11	-22.50
14880	Н	93.13	70.74	-42.0	51.13	28.74	74	54	-22.87	-25.26
17360	Н	94.10	70.90	-41.5	52.6	29.4	74	54	-21.40	-24.60

Operation Mode: GFSK (CH79: 2480MHz)

Test Date : March 16, 2020

Other harmonics emissions are lower than 20dB below the allowable limit.

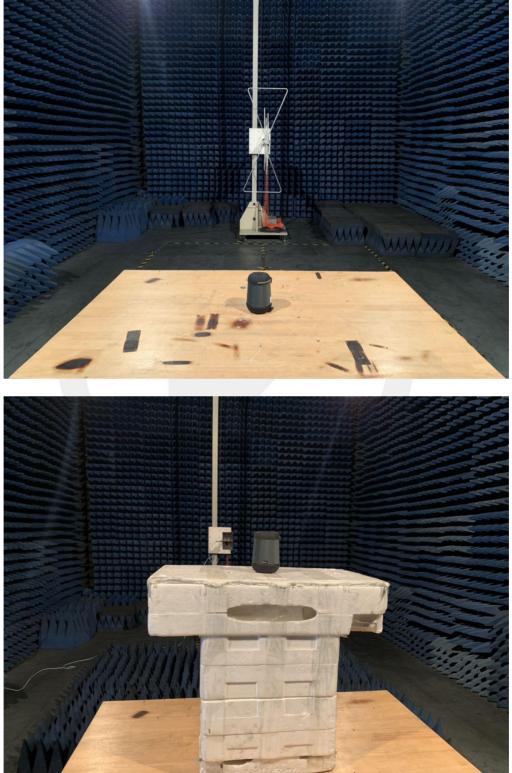
Note: (1) All Readings are Peak Value and AV.

- (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
- (3) The average measurement was not performed when the peak measured data under the limit of average detection.
- (4) Measuring frequencies from 1GHz to 25GHz.

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7.5 Radiated Measurement Photos:



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Report No. ES200305020E



8. Channel Separation test

8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

8.2 Test SET-UP (Block Diagram of Configuration)

EUT Spectrum Analyzer

8.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

8.4 Measurement Results:

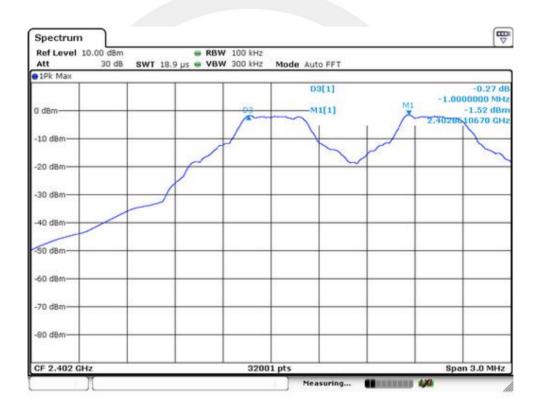
Refer to attached data chart.

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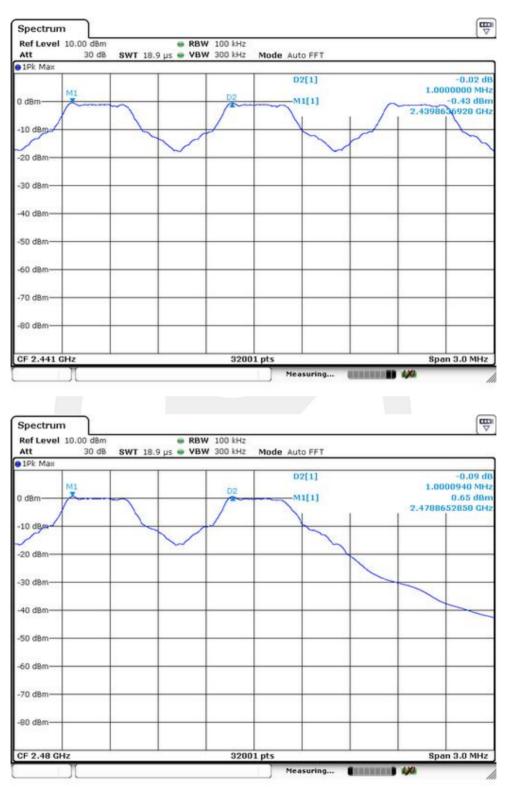


Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	24℃
Test Result: Modulation:	PASS GFSK	Humidity :	53 %

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1000	>757
40	2441	1000	>750
79	2480	1000	>741

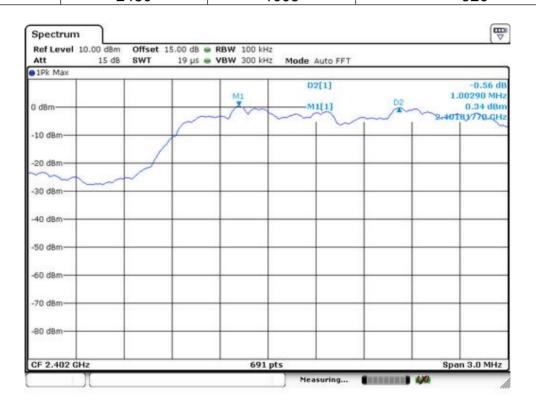








Spectrum Detector: Test By: Test Result: Modulation:	РК Loren PASS П/4-DQPSK	Test Date : Temperature : Humidity :	March 16, 2020 24℃ 53 %
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
		· · · · · · · · · · · · · · · · · · ·	
1	2402	1003	>941
40	2441	1003	>935
79	2480	1003	>926









Spectrum Detector:	PK	Test Date :	March 16, 2020		
Test By:	Loren	Temperature :	24 ℃		
Test Result:	PASS	Humidity :	53 %		
Modulation:	8DPSK	-			
Channel number	Channel	Separation Read	Separation Limit		
	frequency (MHz)	Value (kHz)	2/3 20dB Down BW(kHz)		
1	2402	1003	>958		
40	2441	1003	>958		
79	2480	1000	>947		

Ref Level Att	10.00 dBm 15 dB	SWT	COLUMN STREET	RBW 100 kH: VBW 300 kH:		FT	
1Pk Max							
0 dBm				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	D2[1]	M1	-1.76 d -1.00290 MH 0.20 dBr 2:40281190-6H
-10 dBm			/				
-20 d8m-	~~	\square					
-40 dBm		-					
-50 d8m			-				
-60 dBm		1					
-70 dBm			-				
-80 dBm							
CF 2.402 G	11-			691	nte		Span 3.0 MHz





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-40 d8m

-50 d8m

-60 dBm

-70 dBm

-80 dBm

CF 2.48 GHz

32001 pts

Measuring...

Span 3.0 MHz



9. 20dB Bandwidth test

9.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

9.2 Test SET-UP (Block Diagram of Configuration)

EUT Spectrum Analyzer

9.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

9.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1136
40	2441	1125
79	2480	1111

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Ref Level Att	10.00 dB 30 d		3W 100 kHz 3W 300 kHz Mo	de Auto FFT		
1 Av Max				and shakes		-
0 dBm			MI	M1[1]		-1.15 dBr 410610 GH 20.00 dl
-10 dBm				Q'actor	1.136	121000 MH 2114.
-20 d8m		TI			TR.	
-30 d8m						-
-40 d8m	/					
-50 dBm-						
-60 dBm						
-70 dBm						
-80 dBm						
CF 2.402 G Marker	HZ		32001 pt	5	sp	an 3.0 MHz
	Trc	X-value	Y-value	Function	Function Resu	
M1	1	2.402041061 GHz	-1.15 dBm	ndB down		136121 MHz
T1	1	2.401462267 GHz	-21.15 dBm	ndB		20.00 dB
T2	1	2.402598388 GHz	-21.15 dBm	Q factor		2114.2

Ref Le Att	vel 1	0.00 dB 30 d	2.4 Annual Annua	RBW 100 kHz /BW 300 kHz M	ode Auto FFT		
AV M	lax		0111 1015 pr				
0 dBm-				- Mi	M1[1] ndB Bw Q lostor	-	-0.11 dBr 2.4410421860 GH 20.00 d 1.124965000 MH 2169.
-20 d8n			11				
-30 dBn							
-40 dBn	-	/					
-50 dBn	-					+ +	
60 dBn	-					+ +	
70 dBn	-					+ +	
-80 dBn	,						
CF 2.4	41 GH	z		32001 p	ts		Span 3.0 MHz
larker	2						10
Type	Ref	Trc	X-value	Y-value	Function	Functi	on Result
M1	1000 C	1	2.441042186 GHz	-0.11 dBm	ndB down	10000000	1.124965 MHz
T1 T2		1	2.440467704 GHz 2.441592669 GHz	-20.11 d8m -20.11 d8m	0 factor		20.00 d8 2169.9
16	_		6.111232003 GHz	-20.11 000	d lactor		2109.9



Ref Level 1 Att	0.00 dB 30 d		3W 100 kHz BW 300 kHz Mc	de Auto FFT		
1Av Max				the desidence		
0 dBm			MI	M1[1]		0.97 dBn 2.4800449050 GH 20.00 dl
-10 dBm		71		Q factor	72 1	1.110997000 MH 2232.
-20 d8m			+ +			
-30 d8m						
-40 d8m-	/		+ +		+ +	
-50 dBm-					+ +	
-60 dBm					+ +	
-70 dBm					+ +	
-80 dBm						
CF 2.48 GH	2		32001 pt	s		Span 3.0 MHz
Marker Type Ref	I Ten I	X-value	Y-value	Function	Ermet	ion Result
M1	1	2.480044905 GHz	0.97 dBm	ndB down	Funct	1.110997 MHz
T1	1	2.479470329 GHz	-19.03 dBm	ndB		20.00 dB
T2	1	2.480581326 GHz	-19.03 dBm	Q factor		2232.3



Spectrum D Test By: Test Result: Modulation:	etecto	er:	PK Loren PASS Π/4-DQPSI	Ter Hui	t Date : nperature : midity :	: :	March 16, 24℃ 53 %	2020
	Cł	nanne	el number		l frequency MHz)		0dB Down BW(kHz)	l
			1	2	2402		1411	
		4	40	2	2441		1402	
			40 79		2480		1389	
l			/9	2	480		1369	
Ri	oectrum af Level 1 It Pk Max	0.00 dBn 15 dE		RBW 100 kHz VBW 300 kHz	Mode Auto FFT		-4.1	(₩
23	2				wiftl		2.402178	and the second second
0.0	IBm-				T ndB			0.00 dB
-10	dBm-				Q factor		1.4110000	1702.5
	d8m-		-		and the second second	X	1	Standard .
-20	Jubin		3			R		
-30	dam-					-		
	d8m		1				\sim	
	J GDIII							
-50) dBm			-				12
.61	dBm							
								i i
-70	0 dBm					-	+ +	15
-80) dBm				-			25
	12220							
CF	2.402 G	1z		691 pts	•		Span 3.	0 MHz
	rker							
	M1 Ref	Trc 1	X-value 2.402178 GHz	-4.51 dBm	Function ndB down	Fu	nction Result	1 MHz
	T1	1	2.4012836 GHz	-24.53 dBm	ndB			.00 dB
	T2	1	2.4026946 GHz	-24.50 d8m	Q factor			702.5
	- L,)(Measuring	Contrasta (4,40	la



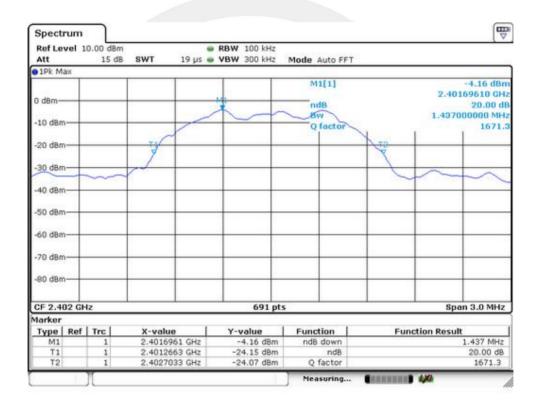
1Pk Max 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -60 dBm	15 dB SWT		VBW 300 kHz	Mode Auto FFT M1[1] M1 P N Q factor	100 million		3.16 dBr 7370 GH 20.00 d 0000 MH 1740.
0 d8m -10 d8m -20 d8m -20 d8m -30 d8m -50 d8m -60 d8m				M1 T ndB	The second	2.4411	7370 GH 20.00 d 0000 MH
-20 dBm -30 dBm -40 dBm -50 dBm -60 dBm				Rbs	The second	1.402300	
-30 dBm -40 dBm -50 dBm -60 dBm					100 miles		
-40 d8m -50 d8m -60 d8m					-		_
-50 dBm		_					
-60 dBm							
1000200-01					-		
-70 d8m		_			-		
-80 dBm					-		
CF 2.441 GHz			691 pts			Span	3.0 MHz
1arker						2.5	
Type Ref Tr			Y-value	Function	Fun	ction Result	
M1	- C	11737 GHz	-3.16 dBm	ndB down			4023 MHz
T1		40288 GHz	-23.10 dBm	ndB			20.00 dB
T2	1 2.441	16903 GHz	-23.29 dBm	Q factor			1740.8

Att	10.00 dBm 15 dB		Contraction of the	RBW 100 kHz VBW 300 kHz	Mode Auto FFT		
1Pk Max					10.000		
0 dBm					M1[1]		-5.23 dBr 2.48016930 GH 20.00 d
-10 dBm			1	\rightarrow	Q factor	\	1.389300000 MH 1785.
-20 d8m		17	-			13	
-30 dBm			-				
-40 dBm							
-50 dBm			-			_	
-60 dBm		-				-	
-70 dBm		-	-			-	
-80 dBm—			-	<u>.</u>			
CF 2.48 G	4z	-		691 pt	s		Span 3.0 MHz
tarker				2.0			2017
Type Re		X-valu		Y-value	Function	Fund	tion Result
M1	1		693 GHz	-5.23 dBm	ndB down		1.3893 MHz
T1 T2	1		288 GHz 773 GHz	-25.29 d8m -25.19 d8m	Q factor		20.00 d8 1785.2



Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	24℃
Test Result: Modulation:	PASS 8DPSK	Humidity :	53 %

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1437
40	2441	1437
79	2480	1420





	3	Mode Auto FFT	RBW 100 kHz VBW 300 kHz	Contraction of the second s		0.00 dBr 15 d	vel 1	Ref Le Att
		10000			-		ах	P1Pk M
-2.74 dB 2.44069610 GF		M1[1]		1			1	
20.00 0		ndB	Ma	-	-			0 dBm-
1.437000000 MH		BW	T					1212
1698	~	Q factor		1	1.00			-10 dBm
	T2				TV			-20 d8m
	X				7			20 001
								-30 dBm
4mm					-			~
	-		+ +		-		1	-40 d8m
								-50 dBm
					11.			-50 GBI
								-60 dBm
				1			200	
			+ +		+			-70 dBm
							,	-80 dBm
			1					
Span 3.0 MH			691 pts			z	41 GH	CF 2.4
								Marker
unction Result 1.437 MH:	Fu	Function ndB down	-2.74 dBm	961 GHz	X-valu 2.4406	Trc 1	Ret	Type M1
20.00 de		ndB	-22.92 dBm	2663 GHz		1	-	T1
1698.4		Q factor	-22.83 dBm	7033 GHz		1	-	T2

Ref Lev Att	el 10	0.00 dBm 15 dB		100 C	RBW 100 kHz VBW 300 kHz	Mode Auto FF1			
P1Pk Ma	0X					100000			
0 dBm—						M1[1]		-4.70 dBr 2.47969180 GH 20.00 d	
-10 dBm	+		-	1		Q factor		1.419700000 MH 1746.	
-20 d8m	+		TY	1	-		12		
-30 dBm	-		-/-						
-40.d8m			/						
-50 dBm									
-60 dBm			10	-			_		
-70 dBm	-		1.	-	+ +				
-80 dBm			11	-					
CF 2.48	GHz			1	691 pt	s		Span 3.0 MHz	
Marker									
Type	Ref		X-val		Y-value	Function	Func	Function Result	
M1		1		918 GHz	-4.70 dBm			1.4197 MHz	
T1 T2	-	1		275 GHz	-24.37 dBm -24.74 dBm	Q factor		20.00 d8 1746.7	



10. Quantity of Hopping Channel Test

10.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

10.2Test SET-UP (Block Diagram of Configuration)

EUT Spectrum Analyzer

10.3Measurement Equipment Used:

EQUIPMENT	MFR	MODEL	SERIAL	Characteristics	LAST	CAL DUE.
TYPE		NUMBER	NUMBER		CAL.	
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

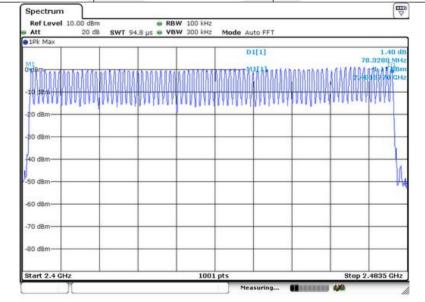
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

10.4 Measurement Results:

Refer to attache	d data chart.
Worst Test Mode	GFSK
Test By:	Loren
Test Result:	PASS

Test Date : Temperature : Humidity : March 16, 2020 25 ℃ 50 %

Hopping Channel	Quantity of Hopping	Quantity of Hopping
Frequency Range	Channel	Channel
2402-2480	79	>15



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11. Time of Occupancy (Dwell Time) test

11.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s

with:

- hop rate = $1600 \times 1/s$ for DH1 packets = 1600 s^{-1}

- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 s⁻¹

- number of hopping channels = 79

- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

11.2 Test SET-UP (Block Diagram of Configuration)

EUT

Spectrum Analyzer

11.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

11.4 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to

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attached data chart.

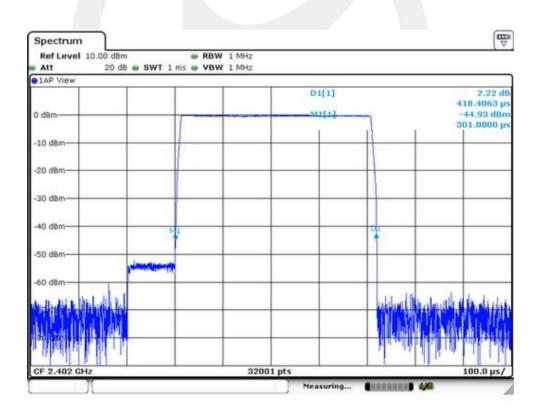
Modulation:	GFSK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

11.5 Test result

Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	1600/(2*79) x 31.6 = 320	0.418	133.76	400
DH3	1600/(4*79) x 31.6 =160	1.675	268.00	400
DH5	1600/(6*79) x 31.6 =106.67	2.921	311.58	400

Remark: The results of worst cased was recorded.

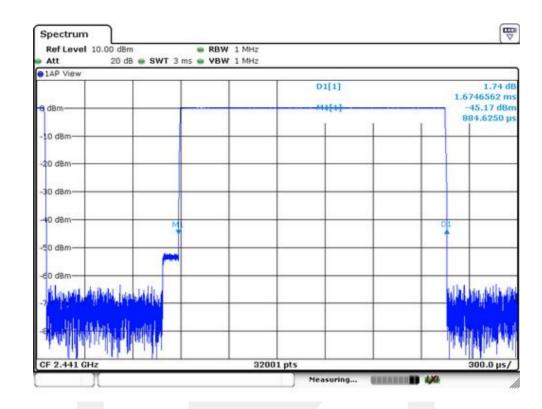
DH1:



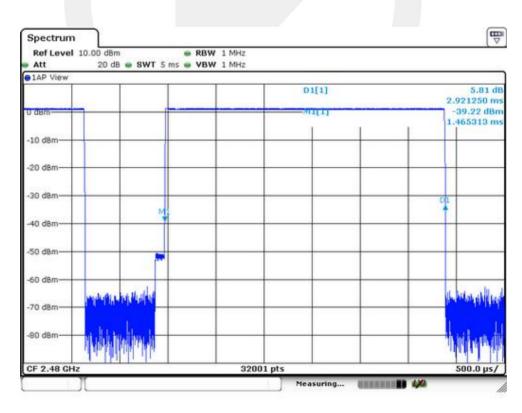
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DH5:



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12. MAXIMUM PEAK OUTPUT POWER TEST

12.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.

- d. Measure the captured power within the band and recording the plot.
- e. Repeat above procedures until all frequencies required were complete.

12.2 Test SET-UP (Block Diagram of Configuration)



12.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

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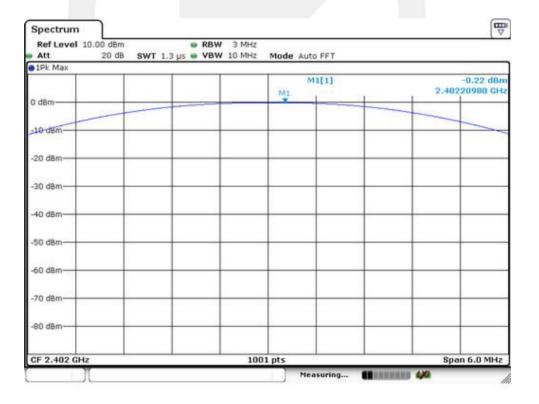


12.4Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK	-	

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-0.22	0.951	1000	PASS
40	2441	0.38	1.091	1000	PASS
79	2480	1.21	1.321	1000	PASS



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-Spectrum Ref Level 10.00 dBm RBW 3 MHz SWT 1.3 µs 🖷 VBW 10 MHz Att 20 dB Mode Auto FFT • 1Pk Max M1[1] 0.38 dBn 2.44123980 GH M1 0 dBm 10 dBm--20 d8m--30 d8m--40 d8m--50 d8m--60 dBm--70 dBm -80 dBm-Span 6.0 MHz CF 2.441 GHz 1001 pts Second 400 Measuring... -Spectrum



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Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	25 ℃
Test Result: Modulation:	PASS Π/4-DQPSK	Humidity :	50 %

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-1.11	0.774	125	PASS
40	2441	-0.72	0.847	125	PASS
79	2480	0.25	1.059	125	PASS

SWI 1.3 µS - VBW 10 /	MODE AUTO FFT	
	M1[1]	-1.11 dBr 2.40229370 GH
	SWT 1.3 µs • VBW 10 1	ACT OF A DECK OF



Ref Level 10	0.00 dBm		● RB	W 3 MHz					
Att	20 dB	SWT 1.3	µs 🖷 VB	W 10 MHz	Mode Auto Fl	FT			
1Pk Max					1				0.00.10
					MI	r]			-0.72 dBi 6970 GH
l dBm		-		-			-		
-									100
10-d8m				-				-	
20 d8m									
30 d8m									
ob dom									
40 d8m	-			-					
100000000000000000000000000000000000000									
-50 dBm				-					
60 dBm	-	-		-				-	
				-					
70 dBm									
-80 dBm				-					
oo dom									
									6.0 MHz
CF 2.441 GHz									
J				100	1 pts Measu	ring 🚺		KA	
						ring 🚺	annan d 4	KA	
Ref Level 10		SWT 1 3		W 3 MHz	Measu	-	CREAK® 44	KA.	(T
Ref Level 10 Att		SWT 1.3				-			(4
Spectrum Ref Level 10 Att 1Pk Max		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max		SWT 1.3		W 3 MHz	Measu Mode Auto Fi	FT			
Ref Level 10 Att 1Pk Max		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 40 dBm 20 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 20 dBm 30 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 40 dBm 20 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 30 dBm 40 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 1Pk Max 0 dBm 20 dBm 30 dBm 40 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 30 dBm 30 dBm 50 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 30 dBm 30 dBm 50 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 20 dBm 30 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max 0 dBm 20 dBm 30 dBm 30 dBm 50 dBm 60 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max dBm dBm 20 dBm 30 dBm 40 dBm 50 dBm 50 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dBr
Ref Level 10 Att 1Pk Max dBm dBm 20 dBm 20 dBm 30 dBm 50 dBm 50 dBm 70 dBm		SWT 1.3		W 3 MHz	Mode Auto F	FT			0.25 dB



Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	25 ℃
Test Result: Modulation:	PASS 8DPSK	Humidity :	50 %

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
01	2402	-1.10	0.776	125	PASS
40	2441	-0.70	0.851	125	PASS
79	2480	0.50	1.122	125	PASS

Att 20 dB			
1Pk Max		M1[1]	-1.10 dBr
		MI	2.40225770 GH
0 dBm			
-10-dem			
-20 d8m			
-20 06/11-			
-30 dBm			
-40 dBm			
-50 dBm			
-60 dBm-			
-60 dBm-			
-70 dBm			
68.89888 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1			
-80 dBm			
CF 2.402 GHz	<u> </u>	1001 pts	Span 6.0 MHz



Ref Level 10.00) dBm	RBW	3 MHz				1
		1.3 µs 👄 VBW	10 MHz	Mode Auto FFT			
1Pk Max							
	ľ			M1[1]		-0.70 2.44127570	
dBm	-			MI		<u> </u>	
10 dBm		-			-		-
		1 1					
20 d8m					-		
10000							
30 dBm-							
40 d8m							
40 0811							
50 d8m-		-			_		
60 dBm					_		
70 dBm					-		
-80 dBm	-				-		
		1 1					
CF 2.441 GHz			100	L pts	-	Span 6.0	MHz
Spectrum	ž			Measuring	H EREER	490	Ģ
) dBm	e RBW			H ERERARY	490	(E
Ref Level 10.00		● RBW 1.3 µs ● VBW	3 MHz		A RRANAR	490	
Ref Level 10.00 Att			3 MHz	Measuring Mode Auto FFT			
			3 MHz	Measuring Mode Auto FFT M1[1]		0.50	
Ref Level 10.00 Att 1Pk Max			3 MHz	Measuring Mode Auto FFT			dBr
Ref Level 10.00 Att 1Pk Max			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm ±0 dBm 20 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm #0 dBm 20 dBm 30 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm ±0 dBm 20 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max IPk Max IdBm IdIm IdIm <t< td=""><td></td><td></td><td>3 MHz</td><td>Mode Auto FFT M1[1]</td><td></td><td>0.50</td><td>dBr</td></t<>			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 0 dBm #0 dBm 20 dBm 30 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max IPk Max IdBm IdIm IdIm <t< td=""><td></td><td></td><td>3 MHz</td><td>Mode Auto FFT M1[1]</td><td></td><td>0.50</td><td>dBr</td></t<>			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 1Pk Max 1dBm 1dBm 20 dBm 30 dBm 40 dBm 50 dBm 60 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max 1Pk Max 0 dBm 20 dBm 30 dBm 40 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max dBm dBm 20 dBm 30 dBm 40 dBm 50 dBm 50 dBm 70 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dBr
Ref Level 10.00 Att 1Pk Max dBm dBm c0 dBm 20 dBm 30 dBm 50 dBm 50 dBm 70 dBm			3 MHz	Mode Auto FFT M1[1]		0.50	dB
Ref Level 10.00 Att 1Pk Max dBm dBm 20 dBm 30 dBm 40 dBm 50 dBm 50 dBm			3 MHz	Measuring		0.50	



13. Band EDGE test

13.1 Measurement Procedure

For Conducted Test

- 1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.
- 2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

For Radiated emission Test

The EUT was placed on a styrofoam table which is 1.5m above ground plane.

The measurement procedure at the ban edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

The measurements were performed at the lower end of the 2.4GHz band. Use the following spectrum analyzer settings:

For Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

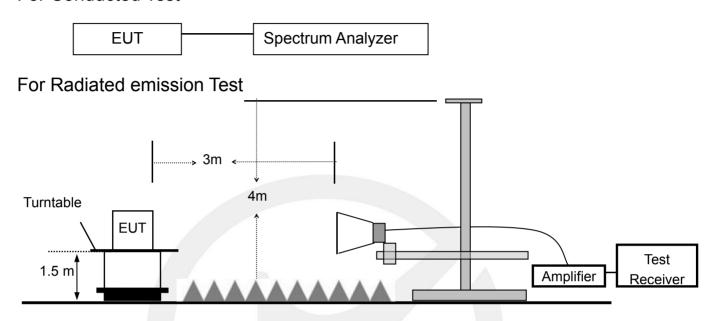
For Non-Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 100KHz, video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

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13.2 Test SET-UP (Block Diagram of Configuration) For Conducted Test



13.3 Measurement Equipment Used:

For Conducted Test

ſ	EQUIPMENT	MFR	MODEL	SERIAL	Characteristics	LAST	CAL DUE.
	TYPE		NUMBER	NUMBER		CAL.	
	Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/23/2019	05/22/2020
	Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/23/2019	05/22/2020
	Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/23/2019	05/22/2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list. For Radiated emission Test

Characteristics Cal. Equipment Manufacturer Model No. Serial No. Last Cal. Item Interval Signal Rohde & 9KHz-40GHz 1 FSV30 103040 05/23/2019 1 Year Analyzer Schwarz 9120D-12 1GHz-18GHz 1 Year **BBHA9120D** 2 Horn Antenna Schwarzbeck 05/23/2019 72 Power J1010000 1GHz-26.5GHz 3 LUNAR EM LNA1G18-40 05/23/2019 1 Year Amplifier 0081 1GHz-26.5GHz 4 Cable H+S CBL-26 N/A 05/23/2019 1 Year 1GHz-26.5GHz 5 Cable H+S CBL-26 N/A 05/23/2019 1 Year 1GHz-26.5GHz 05/23/2019 6 Cable H+S CBL-26 N/A 1 Year

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13.4 Measurement Results:

Refer to attached data chart.

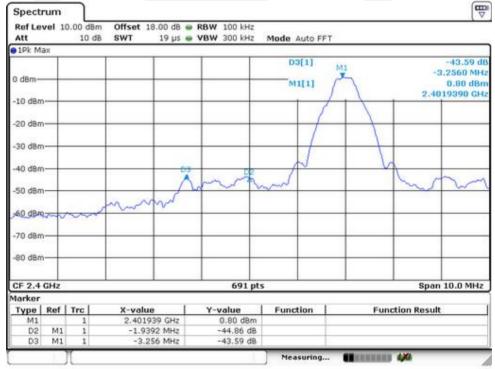
Spectrum Detector:	PK	Test Date :	March 16, 2020
Test By:	Loren	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %

1. Conducted Test

For Non-Hopping Mode:

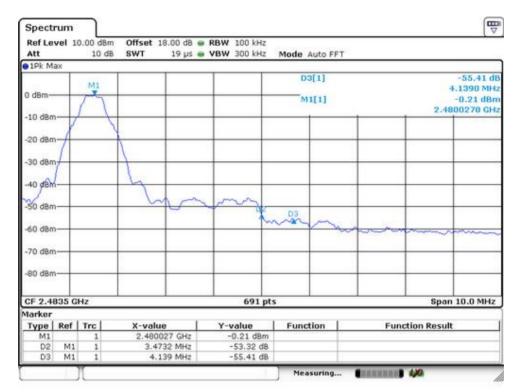
Frequency (MHz)	Modulation	Peak Power Output(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2401.82	GFSK	0.80	43.59	>20dBc
2401.82	pi/4-DQPSK	-1.42	42.1	>20dBc
2401.82	8DPSK	-1.06	41.39	>20dBc
2479.82	GFSK	-0.21	55.41	>20dBc
2479.82	pi/4-DQPSK	-2.53	48.79	>20dBc
2479.82	8DPSK	-2.09	45.65	>20dBc

Test plots of GFSK

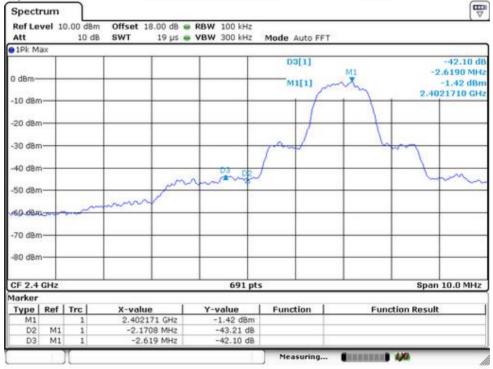


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Test plots of pi/4-DQPSK

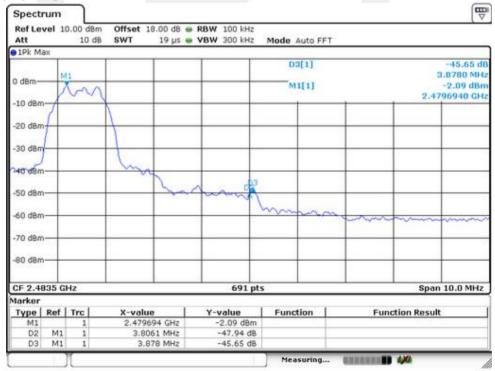


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Ref Lev Att	vel 10	0.00 dBm 10 dB	1 150 A 2 5 1 1 1 5 1		RBW 100 VBW 300	10.07 L	Mode	Auto FF1				
P1Pk Ma	30X											
0 dBm—	~	MI						3[1] 1[1]				-48.79 (3.4590 Mi -2.53 dB
-10 dBm	A		1			+-	-	-	-	-	2.48	301710 G
	1		1									
-20 d8m	T											
-30 d8m	\square		1			+			_			L
~ /			5									
40 dBm	-		1 Ma	1	-	+			-	-	-	
-50 dBm				Lun	n na	603						
	100		1			1						
-60 dBm			-	-	-	-	mm	m	m	m	m	tim
70 40 m												-
-70 dBm	201											
-80 dBm	-		-		-	-			-	-		
CF 2.48	135 G	Hz			69	1 pts	2				Spar	10.0 MH
larker												
Type	Ref		X-value		Y-value		Fund	tion		Funct	ion Result	t
M1 D2	M1	1	2,4801	71 GHz IS MHz	-2.53	and the second s						
D2	M1 M1	1		9 MHz	-48.29							

Test plots of 8DPSK



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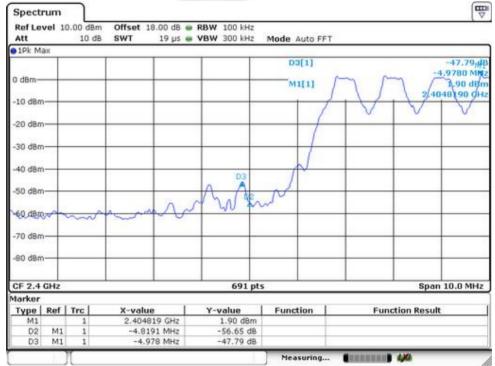
Ref Le Att	vel 1	0.00 dBn 10 dB	 J. T. M. Z. Z. T. M. T. M. S. 		RBW 100 kHz VBW 300 kHz	Mode Aut	to FFT			
P1Pk M	ах									
0 dBm-						D3[1 M1[:	M1	N		-41.39 d .0550 MH -1.06 dBr 16930 GH
-10 dBn			+ +		+ +		1			
-20 d8n										
-30 dBn	-					mil		-6	~	
-40 d8n					03 02	$ \vdash$			5	
-50 dBn				m	mit				h	~~~
60,d9n		med	m							1
-70 dBn										
-80 dBn	+									
CF 2.4	GHz				691 pt	s			Span	10.0 MHz
larker			2200002000							
Type M1	Ref	Trc 1	2.401693	CUN	-1.06 dBm	Functio	n	Functi	ion Result	
D2	M1	1	-1.6932		-43.51 dB		-			
D3	M1	1	-2.055		-41.39 dB		_			



For Hopping Mode:

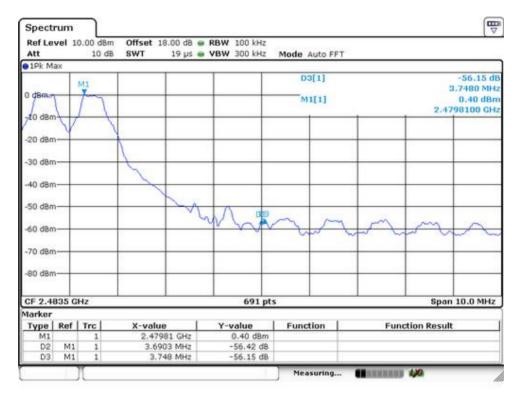
Frequency (MHz)	Modulation	Peak Power Output(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
2401.82	GFSK	1.90	47.79	>20dBc
2401.82	pi/4-DQPSK	3.68	41.14	>20dBc
2401.82	8DPSK	3.49	38.7	>20dBc
2479.82	GFSK	0.40	56.15	>20dBc
2479.82	pi/4-DQPSK	3.59	52.93	>20dBc
2479.82	8DPSK	3.54	55.98	>20dBc

Test plots of GFSK



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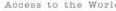


Test plots of pi/4-DQPSK



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Att	vel 1	0.00 dBm 10 dB	1. 1		RBW 100 kHz VBW 300 kHz	Mode Au	to FFT			
1Pk M										
12250		M1				D3[1]			-52.93 d
g dBm	h	we			-	M1[1]			3.59 dB
	1		1				10.00	2	2.4	798240 GH
-10 dBn	1									
-20 d8n								_	-	
-30 dBn			and		-			-		
			A							
-40 d8n	1		1 1						-	1
-50 dBn				my	man	.				
-20 000	· –					mr.	An	NO.	ma	1000
-60 dBn			+ +			n n	~	m. n	man	mm
-70 dBn	-		+ +		-	-		-	-	-
-80 dBn	100									
-00 ubii										
CF 2.4	835 G	Hz			691 pt	s			Snai	n 10.0 MH
larker						-				
Type	Ref	Trc	X-value	1	Y-value	Functio	on	Fu	nction Resul	lt
		1	2.479824 3.6758		3.59 dBm -54.19 dB	1.0231.000.097		1650		20
M1 D2	M1	1								

Test plots of 8DPSK



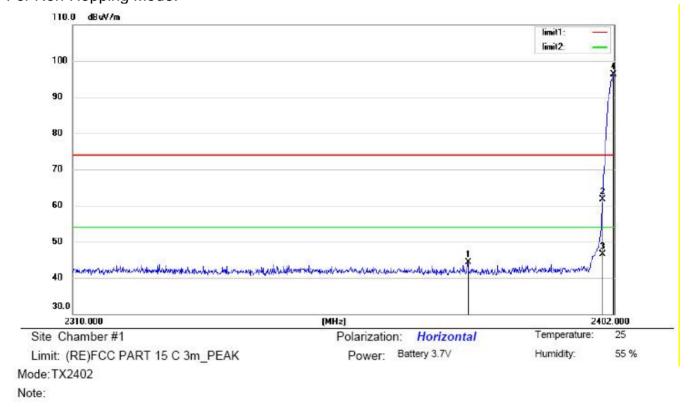
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Ref Le Att	vel 1	0.00 dBm 10 dB	1		RBW 100 kHz VBW 300 kHz	Mode A	uto FFT	2		
1Pk M	ах									
erdeniv4	~	m				D3 M1	[1] [1]			-55.98 d 4.9930 MH 3.54 dB 788260 GH
-10 dBm			1	-				1		
-20 d8n	+									
-30 dBr	-+-		10	1				-		
-40 d8n	+			1	+ +			-	-	
-50 dBrr	+		1		mader	Ann	04.	0	-	
60 dBr	-		10	-	with	· · · · ·	~~~~	mm	han	m
70 dBn	-			-					-	
-80 dBm	+			-					-	
CF 2.4	335 G	Hz		1	691 pt	s			Spar	10.0 MH
larker			a100003			1				
Type M1	Ref	Trc 1	2 479	ue 1826 GHz	Y-value 3.54 dBm	Funct	ion	Fun	ction Result	1
D2	M1	1		744 MHz	-61.84 d8		-			
D3	M1	1		993 MHz	-55.98 dB					



2. Radiated emission Test Worst test modulation 8DPSK For Non-Hopping Mode:



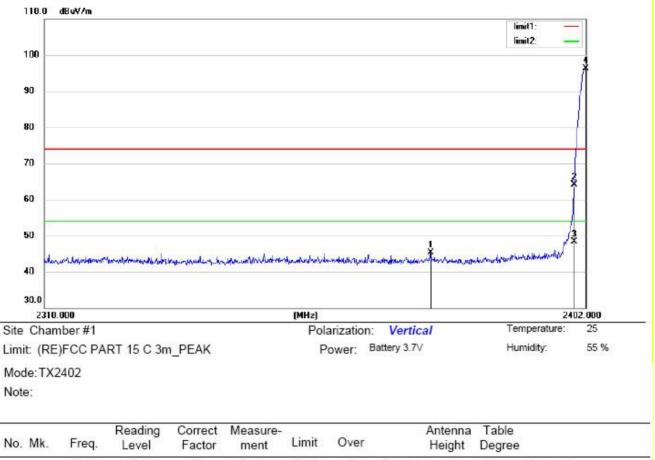
No.	Mk	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBu∨	dB	dBu∀/m	dBu∨/m	dB	Detector	cm	degree	Comment
1		2376.884	55.92	-11.68	44.24	74.00	-29.76	peak			
2	3	2400.000	73.27	-11.63	61.64	74.00	-12.36	peak			
3		2400.000	58.15	-11.63	46.52	54.00	-7.48	AVG			
4	*	2401.816	108.00	-11.63	96.37	74.00	22.37	peak			

*:Maximum data x:Over limit 1:over margin

Operator: HUANG

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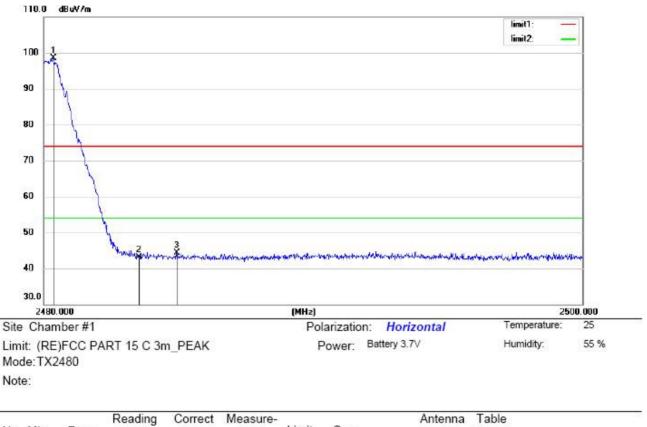
MHz	Martine and the								
IVIE12	dBuV	dB	dBu∀/m	dBu∀/m	dB	Detector	cm	degree	Comment
2375.228	55.92	-10.61	45.31	74.00	-28.69	peak			
2400.000	74.54	-10.47	64.07	74.00	-9.93	peak			
2400.000	58.69	-10.47	48.22	54.00	-5.78	AVG			
2401.908	106.81	-10.46	96.35	74.00	22.35	peak			
	2400.000 2400.000	2400.000 74.54 2400.000 58.69	2400.00074.54-10.472400.00058.69-10.47	400.00074.54-10.4764.07400.00058.69-10.4748.22	400.00074.54-10.4764.0774.00400.00058.69-10.4748.2254.00	400.00074.54-10.4764.0774.00-9.93400.00058.69-10.4748.2254.00-5.78	2400.000 74.54 -10.47 64.07 74.00 -9.93 peak 2400.000 58.69 -10.47 48.22 54.00 -5.78 AVG	2400.000 74.54 -10.47 64.07 74.00 -9.93 peak 2400.000 58.69 -10.47 48.22 54.00 -5.78 AVG	2400.000 74.54 -10.47 64.07 74.00 -9.93 peak 2400.000 58.69 -10.47 48.22 54.00 -5.78 AVG

*:Maximum data x:Over limit 1:over margin

Operator: HUANG

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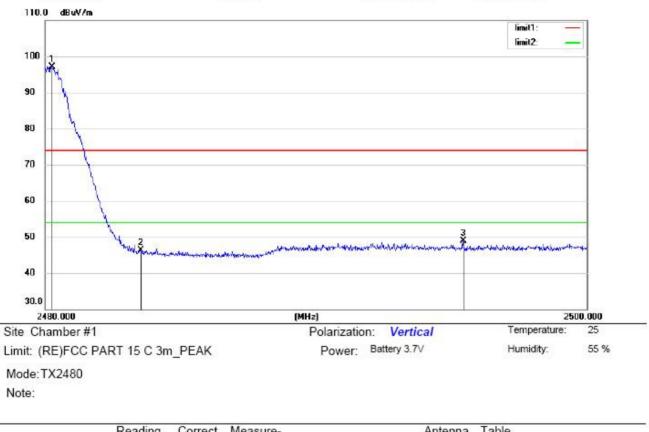
No.	М	k. Freq	- Leve	9	or ment	Limit	Over		Height		
		MHz	dBu∨	′ dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.34) 110.0	1 -11.45	98.56	74.00	24.56	peak			
2		2483.50) 54.4	9 -11.46	43.03	74.00	-30.97	peak			
3		2484.92	55.7	9 -11.44	44.35	74.00	-29.65	peak			
								N12			

*:Maximum data x:Over limit 1:over margin

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No.	Mk	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	l able Degree	
		MHz	dBuV	dB	dBuV/m	dBu∀/m	dB	Detector	cm	degree	Comment
1	*	2480.240	107.19	-10.02	97.17	74.00	23.17	peak			
2		2483.500	56.30	-10.01	46.29	74.00	-27.71	peak			
3		2495.420	58.88	-9.95	48.93	74.00	-25.07	peak			

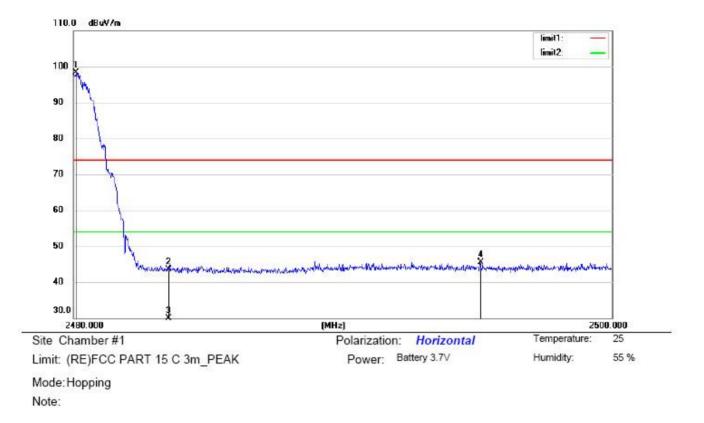
*:Maximum data x:Over limit I:over margin

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For Hopping Mode:



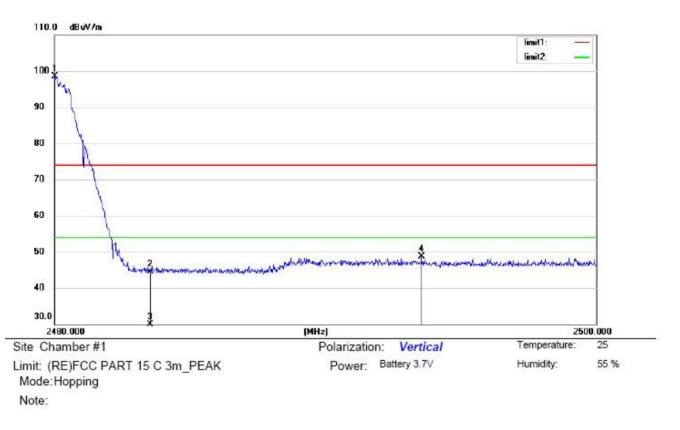
No.	Mk	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.080	109.73	-11.45	98.28	74.00	24.28	peak			
2		2483.500	54.89	-11.46	43.43	74.00	-30.57	peak			
3		2483.500	38.66	-11.46	27.20	54.00	-26.80	AVG			
4		2495.100	56.98	-11.43	45.55	74.00	-28.45	peak			

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

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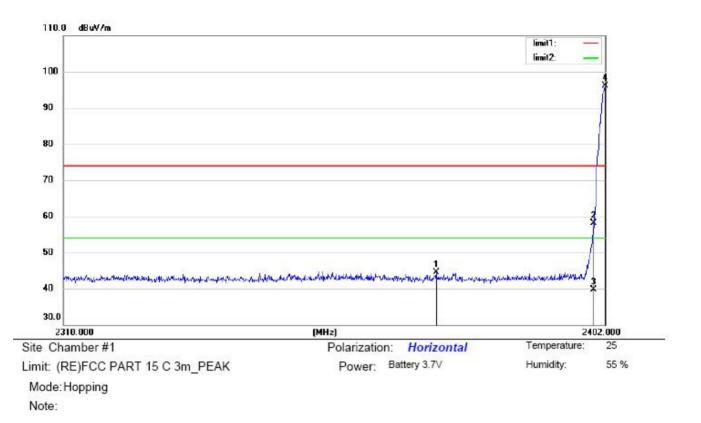
No.	Mk	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBu∀	dB	dBuV/m	dBu∀/m	dB	Detector	cm	degree	Comment
1	*	2480.000	108.57	-10.02	98.55	74.00	24.55	peak	a		
2		2483.500	54.49	-10.01	44.48	74.00	-29.52	peak			
3		2483.500	37.98	-10.01	27.97	54.00	-26.03	AVG			
4		2493.540	58.57	-9.95	48.62	74.00	-25.38	peak			

*:Maximum data x:Over limit 1:over margin

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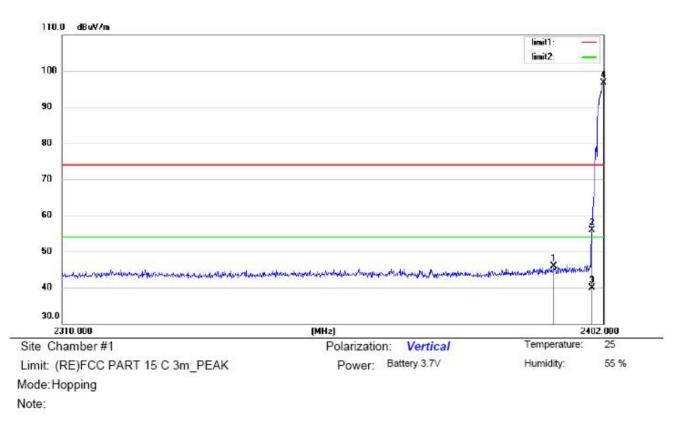
No.	Mk.	. Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBu∀/m	dB	Detector	cm	degree	Comment
1	}	2372.928	56.11	-11.69	44.42	74.00	-29.58	peak			
2		2400.000	69.69	-11.63	58.06	74.00	-15.94	peak			
3		2400.000	51.36	-11.63	39.73	54.00	-14.27	AVG			
4	*	2402.000	107.73	-11.63	96.10	74.00	22.10	peak			

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

Operator: HUANG

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No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBu∀	dB	dBuV/m	dBu∀/m	dB	Detector	cm	degree	Comment
1		2393.444	56.41	-10.51	45.90	74.00	-28.10	peak		2.08	
2		2400.000	66.45	-10.47	55.98	74.00	-18.02	peak			
3		2400.000	50.36	-10.47	39.89	54.00	-14.11	AVG			
4	*	2402.000	107.22	-10.46	96.76	74.00	22.76	peak			

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

Operator: HUANG

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14. Antenna Application

14.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

FCC part 15C section 15.247 requirements:

Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

14.2 Result

The EUT's antenna, permanent attached antenna, used a PCB antenna and integrated on PCB, The antenna's gain is 0 Bi and meets the requirement.



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Report No. ES200305020E



15. Photos of EUT





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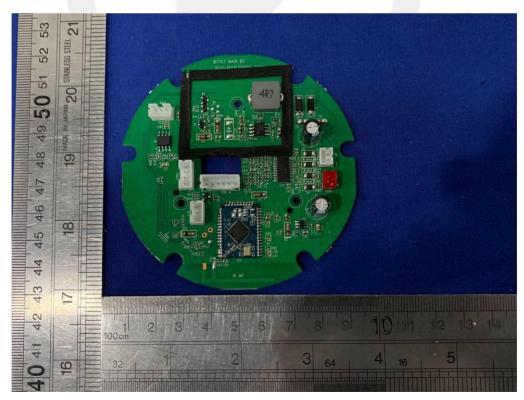


EMTEK (Shenzhen) Co., Ltd. Add: Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China Http://www.emtek.com.cn E-mail: cs.rep@emtek.com.cn

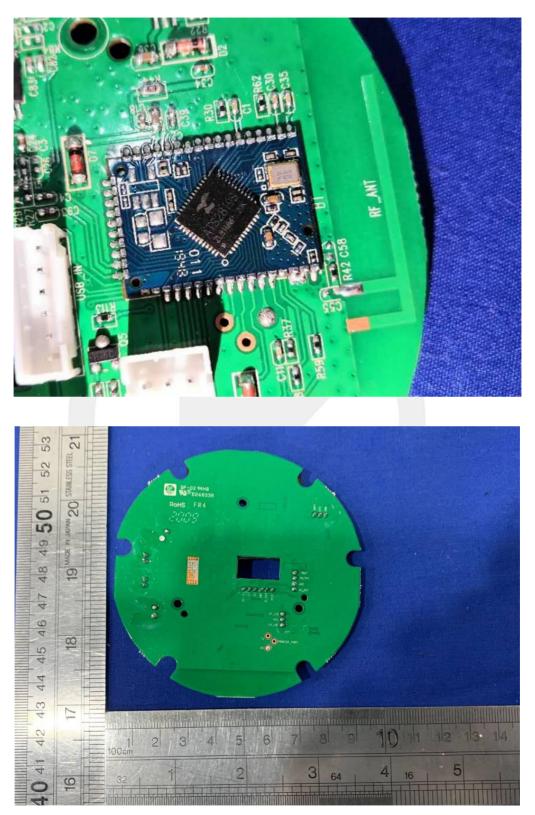
Report No. ES200305020E



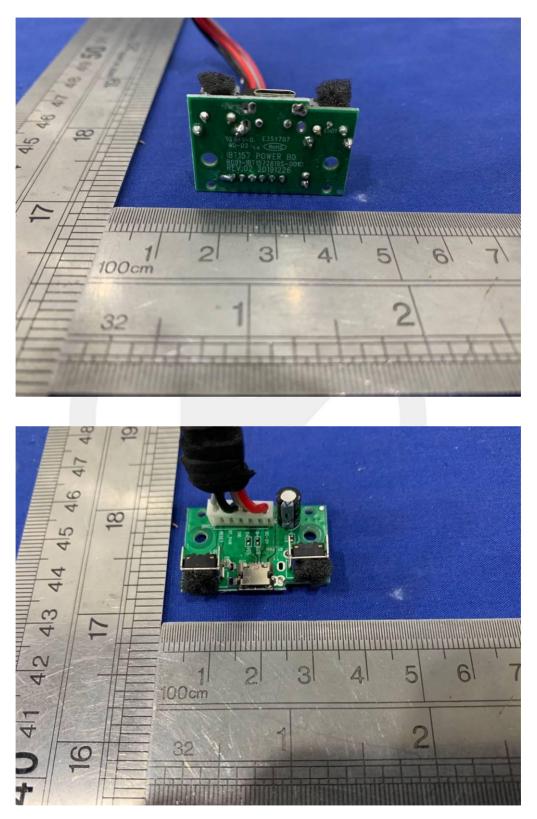












*** End of Report ***

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