Shenzhen HTT Technology Co., Ltd.

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No. .....:	**HTT202512337F01**
FCC ID. ..... :	**2BTPL-INV01163**
Compiled by (position+printed name+signature) .:	File administrators Heber He
Supervised by (position+printed name+signature) .:	Project Engineer Bruce zhu
Approved by (position+printed name+signature) .:	RF Manager Kevin Yang
Date of issue .....:	Dec. 16, 2025
Testing Laboratory Name.....:	**Shenzhen HTT Technology Co.,Ltd.**
Address .....:	1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China
Applicant's name .....:	**Hangzhou J&H Industrial Co.,Ltd**
Address .....:	No.48 Jiuhuan Road,Shangcheng District,Hangzhou City, Zhejiang Province, China
Test specification.....:	
Standard.....:	**FCC Part 15.247**

Shenzhen HTT Technology Co.,Ltd. All rights reserved.
This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen HTT Technology Co.,Ltd. is acknowledged as copyright owner and source of the material. Shenzhen HTT Technology Co.,Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Test item description.....:	**TB 16OZ TUMBLER WITH WIRELESS SPEAKER**
Trade Mark.....:	TommyBahama
Manufacturer .....:	**Yongkang Lingyou Industry and Trade Co. Ltd.**
Model/Type reference .....:	INV01163
Listed Models .....:	N/A
Modulation .....:	GFSK, Π/4DQPSK, 8DPSK
Frequency	From 2402MHz to 2480MHz
Ratings .....:	DC 3.7V From Battery and DC 5V From External Circuit
Result .....:	**PASS**

T E S T R E P O R T

Equipment under Test	:	TB 16OZ TUMBLER WITH WIRELESS SPEAKER
Model /Type	:	INV01163
Listed Models	:	N/A
Applicant	:	**Hangzhou J&H Industrial Co.,Ltd**
Address	:	No.48 Jiuhuan Road,Shangcheng District,Hangzhou City, Zhejiang Province, China
Manufacturer	:	**Yongkang Lingyou Industry and Trade Co. Ltd.**
Address	:	No. 43 Jiuding Road, Economic Development Zone, Yongkang City, Zhejiang Province, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1 TEST STANDARDS 4
2 SUMMARY 5
2.1 General Remarks 5
2.2 Product Description 5
2.3 Equipment Under Test 5
2.4 Short description of the Equipment under Test (EUT) 5
2.5 EUT configuration 6
2.6 EUT operation mode 6
2.7 Block Diagram of Test Setup 6
2.8 Related Submittal(s) / Grant (s) 6
2.9 Modifications 6
3 TEST ENVIRONMENT 7
3.1 Address of the test laboratory 7
3.2 Test Facility 7
3.3 Environmental conditions 7
3.4 Summary of measurement results 8
3.5 Statement of the measurement uncertainty 9
3.6 Equipments Used during the Test 10
4 TEST CONDITIONS AND RESULTS 11
4.1 AC Power Conducted Emission 11
4.2 Radiated Emission 14
4.3 Maximum Peak Output Power 21
4.4 On Time and Duty Cycle 22
4.5 20dB Bandwidth 23
4.6 Frequency Separation 24
4.7 Number of hopping frequency 25
4.8 Time of Occupancy (Dwell Time) 26
4.9 Out-of-band Emissions 27
4.10 Pseudorandom Frequency Hopping Sequence 28
4.11 Antenna Requirement 29
5 Test Setup Photos of the EUT 30
6 External and Internal Photos of the EUT 30

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2020 +Cor. 1-2023+ C63.10a-2024+ Errata to C63.10a-2024: American National Standard for Testing Unlicensed Wireless Devices

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Dec. 04, 2025
Testing commenced on	:	Dec. 04, 2025
Testing concluded on	:	Dec. 16, 2025

2.2 Product Description

Product description:	TB 16OZ TUMBLER WITH WIRELESS SPEAKER
Model/Type reference:	INV01163
Power supply:	DC 3.7V From Battery and DC 5V From External Circuit
Adapter Information (Auxiliary test provided by the lab):	Mode: GS-0500200 Input: AC100-240V, 50/60Hz, 0.3A max Output: DC 5V, 2A
Testing sample ID：	HTT202512337-1# (Engineer sample) HTT202512337-2# (Normal sample)
Hardware version:	/
Software version:	/
Bluetooth :	
Supported Type:	Bluetooth BR/EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB Antenna
Antenna gain:	2.499 dBi

2.3 Equipment Under Test

Power supply system utilised

Refer to section 2.2

2.4 Short description of the Equipment under Test (EUT)

This is a TB 16OZ TUMBLER WITH WIRELESS SPEAKER.
For more details, refer to the user's manual of the EUT.

Test Software Version	BT_Tool		
Frequency	2402 MHz	2441MHz	2480 MHz
GFSK	4	4	4
π /4-DQPSK	4	4	4
8-DPSK	4	4	4

2.5 EUT configuration

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

○ - supplied by the manufacturer
● - supplied by the lab

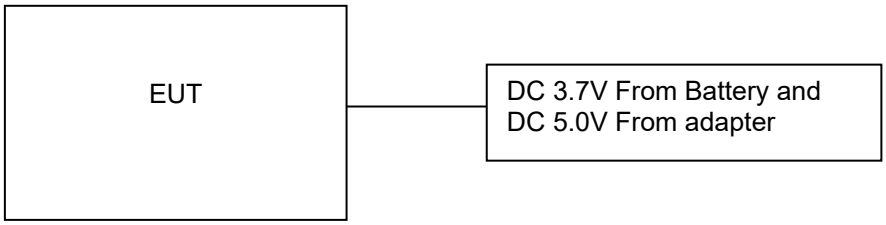
2.6 EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

Operation Frequency：

Channel	Frequency (MHz)
00	2402
01	2403
⋮	⋮
38	2440
39	2441
40	2442
⋮	⋮
77	2479
78	2480

2.7 Block Diagram of Test Setup



2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.9 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen HTT Technology Co.,Ltd.
1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China

3.2 Test Facility

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

FCC-Registration No.: 779513 Designation Number: CN1319
Shenzhen HTT Technology Co.,Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6435.01
Shenzhen HTT Technology Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

ISED#: 27952 CAB identifier: CN0128
Shenzhen HTT Technology Co.,Ltd. has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

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

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

AC Main Conducted testing：

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

Conducted testing：

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

3.4 Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Test result
§15.247(a)(1)	Carrier Frequency separation	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Number of Hopping channels	GFSK Π/4DQPSK 8DPSK	☒ Full	GFSK	☒ Full	Compliant
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Spectrumbandwidth of aFHSS system20dB bandwidth	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(b)(1)	Maximum output peak power	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	Band edgecompliance conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.205	Band edgecompliance radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.209(a)	TX spurious Emissions radiated Below 1GHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant
§15.107(a) §15.207	Conducted Emissions 9KHz-30 MHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant

Remark:

1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report
3. RF Conducted test Offset= cable loss,For conducted spurious emission test, cable loss is the maximum value in the range of test.

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen HTT Technology Co.,Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Shenzhen HTT Technology Co.,Ltd. :

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.12 dB	(1)
Radiated Emission	30~1000MHz	4.37 dB	(1)
Radiated Emission	1~18GHz	5.40 dB	(1)
Radiated Emission	18-40GHz	5.45 dB	(1)
Conducted Disturbance	0.15~30MHz	2.68 dB	(1)
Spectrum bandwidth	/	1.2%	(1)
Output Peak power	30MHz~18GHz	0.57dB	(1)
Time	/	±10%	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

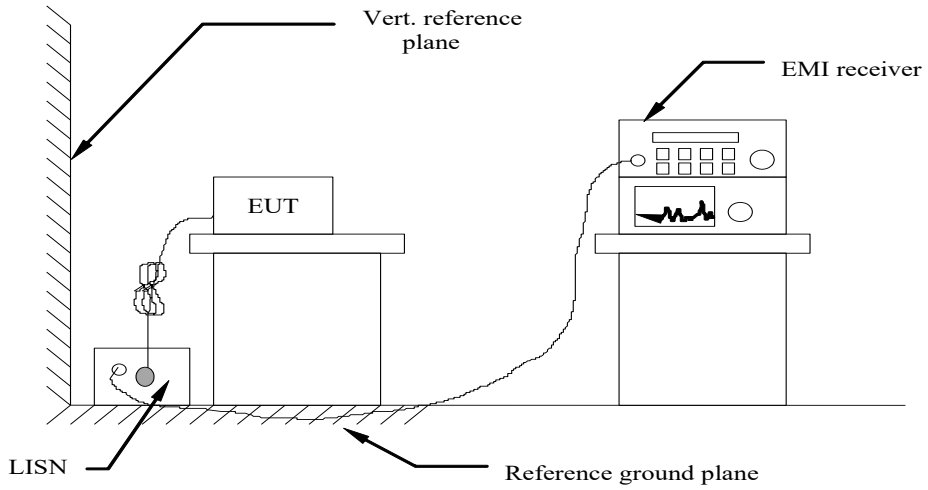
3.6 Equipments Used during the Test

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	Shenzhen C.R.T technology co., LTD	9*6*6	HTT-E028	Aug. 10 2024	Aug. 09 2027
2	Control Room	Shenzhen C.R.T technology co., LTD	4.8*3.5*3.0	HTT-E030	Aug. 10 2024	Aug. 09 2027
3	EMI Test Receiver	Rohde&Schwar	ESCI7	HTT-E022	Apr. 22 2025	Apr. 21 2026
4	Spectrum Analyzer	ROHDE&SCHWARZ	FSV40-N	HTT-E050	Jun. 09 2025	Jun. 08 2026
5	Coaxial Cable	ZDecl	ZT26-NJ-NJ-0.6M	HTT-E018	Apr. 22 2025	Apr. 21 2026
6	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-2M	HTT-E019	Apr. 22 2025	Apr. 21 2026
7	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-0.6M	HTT-E020	Apr. 22 2025	Apr. 21 2026
8	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-8.5M	HTT-E021	Apr. 22 2025	Apr. 21 2026
9	Composite logarithmic antenna	Schwarzbeck	VULB 9168	HTT-E017	Apr. 19 2025	Apr. 18 2026
10	Horn Antenna	Schwarzbeck	BBHA9120D	HTT-E016	Apr. 19 2025	Apr. 18 2026
11	Loop Antenna	Zhinan	ZN30900C	HTT-E039	Apr. 19 2025	Apr. 18 2026
12	Horn Antenna	A.H. Systems, inc.	SAS-574	HTT-E040	Jun. 04 2025	Jun. 03 2026
13	low frequency Amplifier	Sonoma Instrument	310	HTT-E015	Apr. 22 2025	Apr. 21 2026
14	high-frequency Amplifier	HP	8449B	HTT-E014	Apr. 22 2025	Apr. 21 2026
15	Variable frequency power supply	Shenzhen Anbiao Instrument Co., Ltd	ANB-10VA	HTT-082	Apr. 22 2025	Apr. 21 2026
16	EMI Test Receiver	Rohde & Schwarz	ESCI3	HTT-E043	Apr. 22 2025	Apr. 21 2026
17	Artificial Mains	Rohde & Schwarz	ESH3-Z5	HTT-E006	Apr. 22 2025	Apr. 21 2026
18	Artificial Mains	Rohde & Schwarz	ENV-216	HTT-E038	Apr. 22 2025	Apr. 21 2026
19	Cable Line	Robinson	Z302S-NJ-BNCJ-1.5M	HTT-E001	Apr. 22 2025	Apr. 21 2026
20	Filter	ROHDE&SCHWARZ	ESH3-Z2	HTT-E045	May. 19 2025	May. 18 2026
21	Variable frequency power supply	Shenzhen Yanghong Electric Co., Ltd	YF-650（5KVA）	HTT-E032	Apr. 22 2025	Apr. 21 2026
22	Control Room	Shenzhen C.R.T technology co., LTD	8*4*3.5	HTT-E029	Aug. 10 2024	Aug. 09 2027
23	DC power supply	Agilent	E3632A	HTT-E023	Apr. 22 2025	Apr. 21 2026
24	EMI Test Receiver	Agilent	N9020A	HTT-E024	Apr. 22 2025	Apr. 21 2026
25	Analog signal generator	Agilent	N5181A	HTT-E025	Apr. 22 2025	Apr. 21 2026
26	Vector signal generator	Agilent	N5182A	HTT-E026	Apr. 22 2025	Apr. 21 2026
27	RF Switch box	Keysight	Switchbox	HTT-E047	May. 19 2025	May. 18 2026
28	Temperature and humidity meter	Shenzhen Anbiao Instrument Co., Ltd	TH10R	HTT-074	Apr. 21 2025	Apr. 20 2026
29	Radiated Emission Test Software	Farad	EZ-EMC	N/A	N/A	N/A
30	Conducted Emission Test Software	Farad	EZ-EMC	N/A	N/A	N/A
31	RF Test Software	panshanrf	TST	N/A	N/A	N/A
32	Power Meter	R&S	NRVS	HTT-E057	Apr. 22 2025	Apr. 21 2026

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2020.
2 Support equipment, if needed, was placed as per ANSI C63.10-2020
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2020
4 The EUT received power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

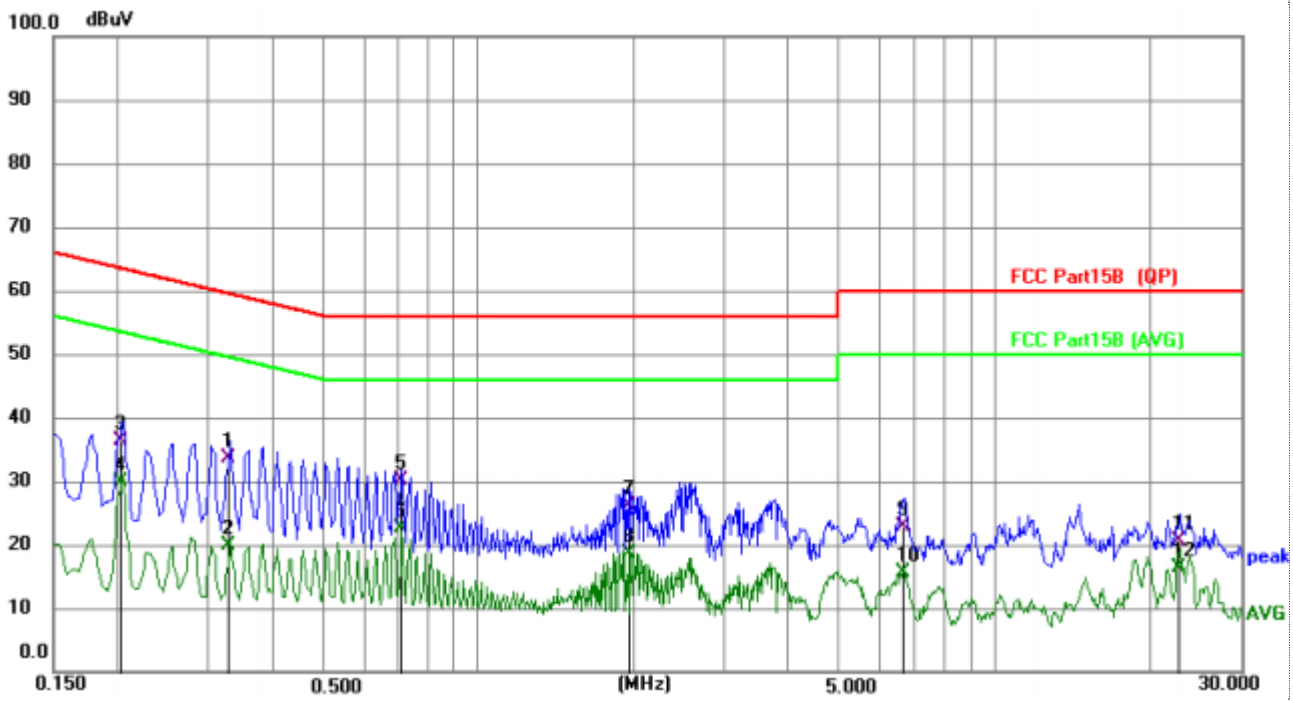
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

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

TEST RESULTS

Remark:
1. All modes of GFSK, Π/4 DQPSK and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

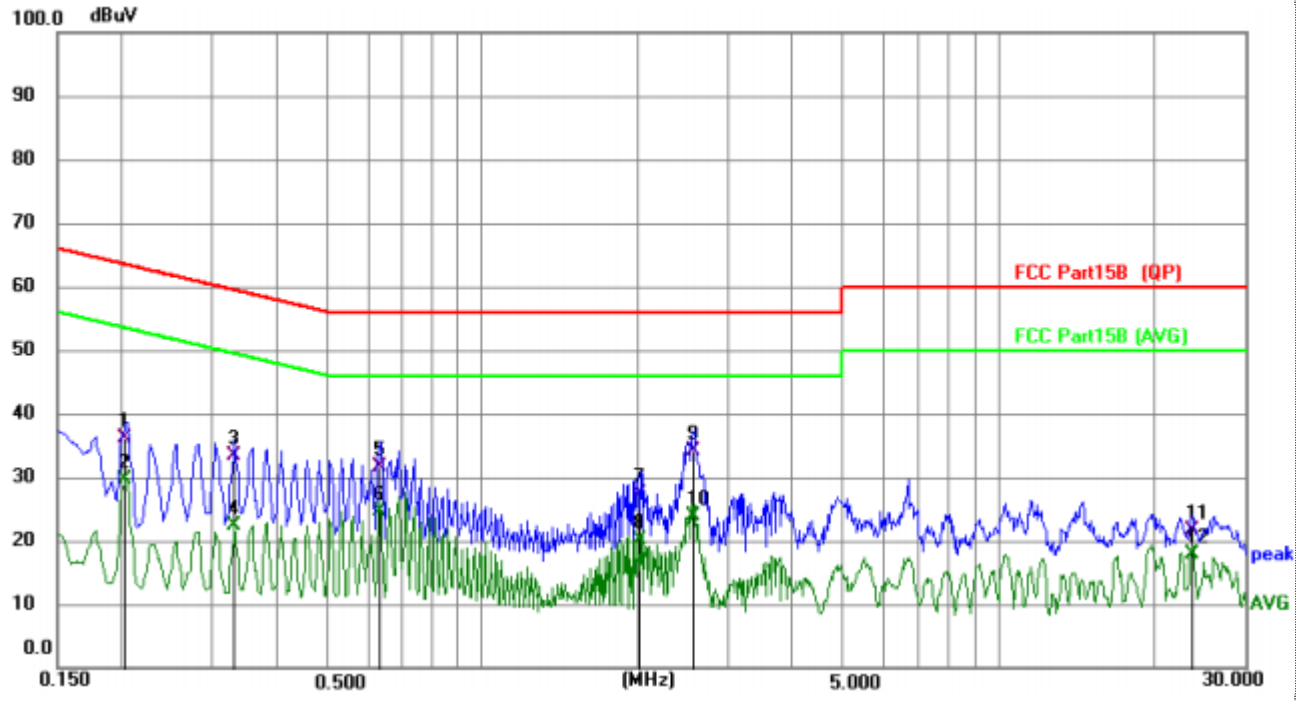
Polarization:	L



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1		0.3280	23.53	10.07	33.60	59.50	-25.90	QP
2		0.3280	9.82	10.07	19.89	49.50	-29.61	AVG
3		0.2027	26.42	10.07	36.49	63.50	-27.01	QP
4		0.2027	19.75	10.07	29.82	53.50	-23.68	AVG
5		0.7090	20.03	10.08	30.11	56.00	-25.89	QP
6	*	0.7090	12.61	10.08	22.69	46.00	-23.31	AVG
7		1.9511	15.94	10.14	26.08	56.00	-29.92	QP
8		1.9511	8.46	10.14	18.60	46.00	-27.40	AVG
9		6.6620	12.61	10.18	22.79	60.00	-37.21	QP
10		6.6620	5.49	10.18	15.67	50.00	-34.33	AVG
11		22.8074	9.42	11.13	20.55	60.00	-39.45	QP
12		22.8074	5.25	11.13	16.38	50.00	-33.62	AVG

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

Polarization:	N



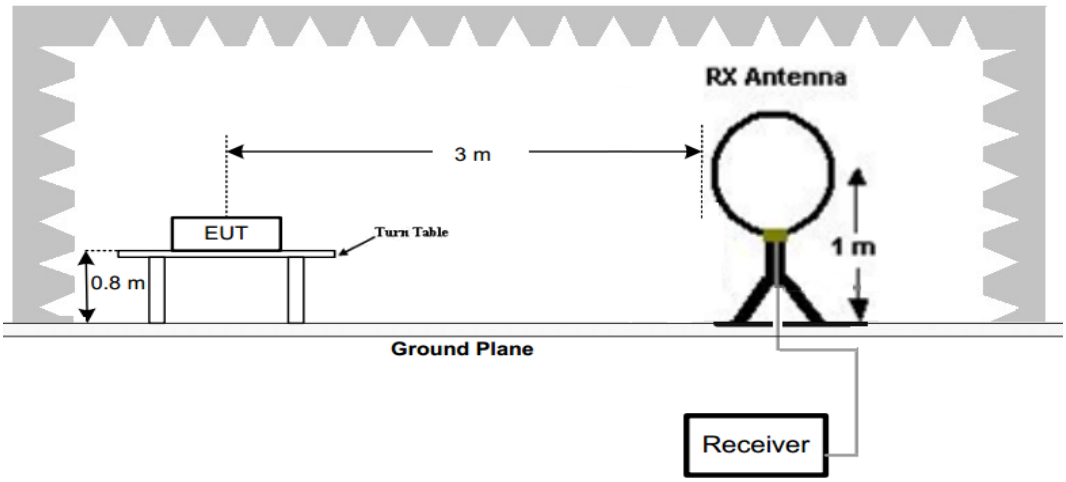
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1		0.2029	26.07	10.04	36.11	63.49	-27.38	QP
2		0.2029	19.60	10.04	29.64	53.49	-23.85	AVG
3		0.3297	23.22	10.08	33.30	59.46	-26.16	QP
4		0.3297	12.42	10.08	22.50	49.46	-26.96	AVG
5		0.6335	21.62	10.05	31.67	56.00	-24.33	QP
6	*	0.6335	14.46	10.05	24.51	46.00	-21.49	AVG
7		2.0263	17.41	10.07	27.48	56.00	-28.52	QP
8		2.0263	10.12	10.07	20.19	46.00	-25.81	AVG
9		2.5625	23.92	10.09	34.01	56.00	-21.99	QP
10		2.5625	13.89	10.09	23.98	46.00	-22.02	AVG
11		23.7194	10.52	11.11	21.63	60.00	-38.37	QP
12		23.7194	6.85	11.11	17.96	50.00	-32.04	AVG

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

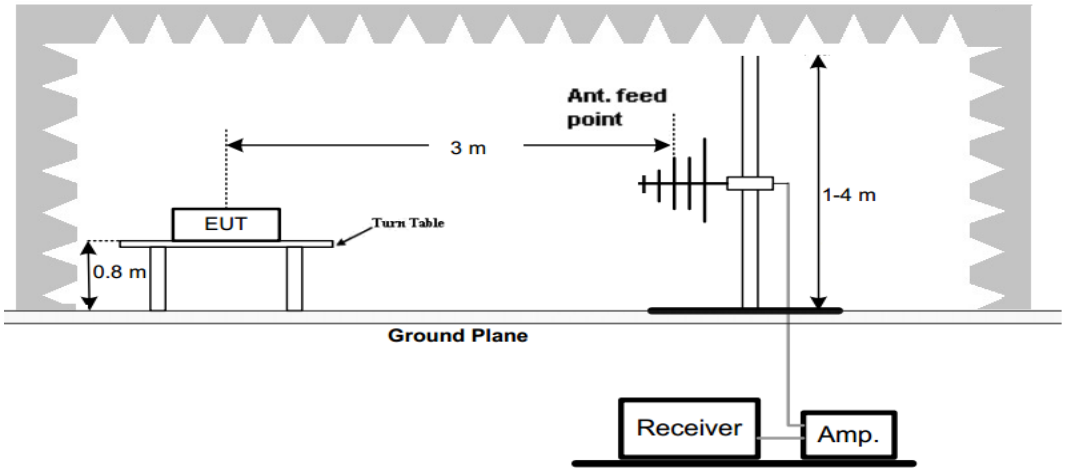
4.2 Radiated Emission

TEST CONFIGURATION

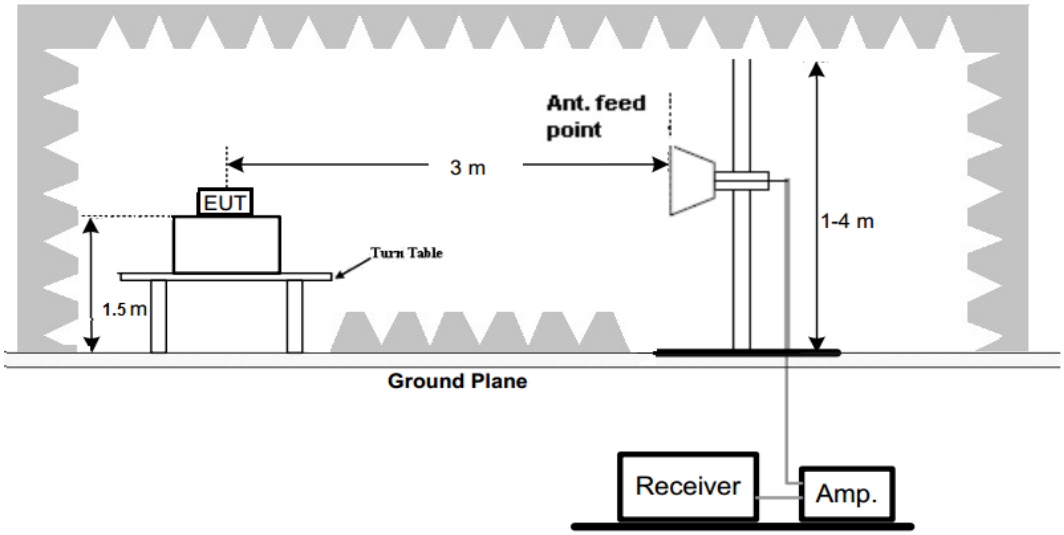
Frequency range 9 KHz – 30MHz

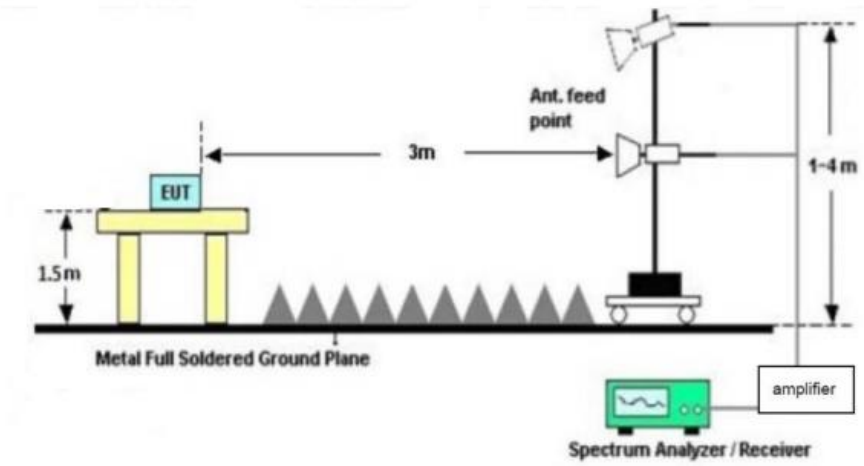


Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz





TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

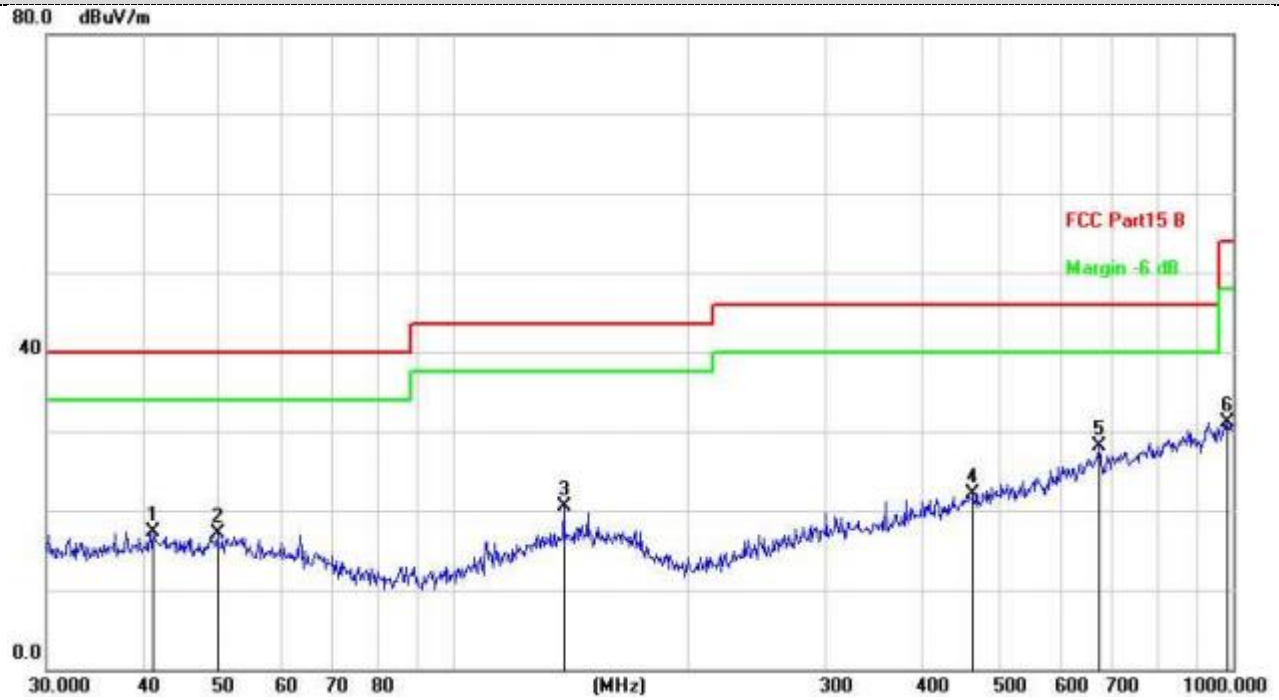
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST RESULTS

Remark:
1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. We measured Radiated Emission at GFSK,π/4 DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
3. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal



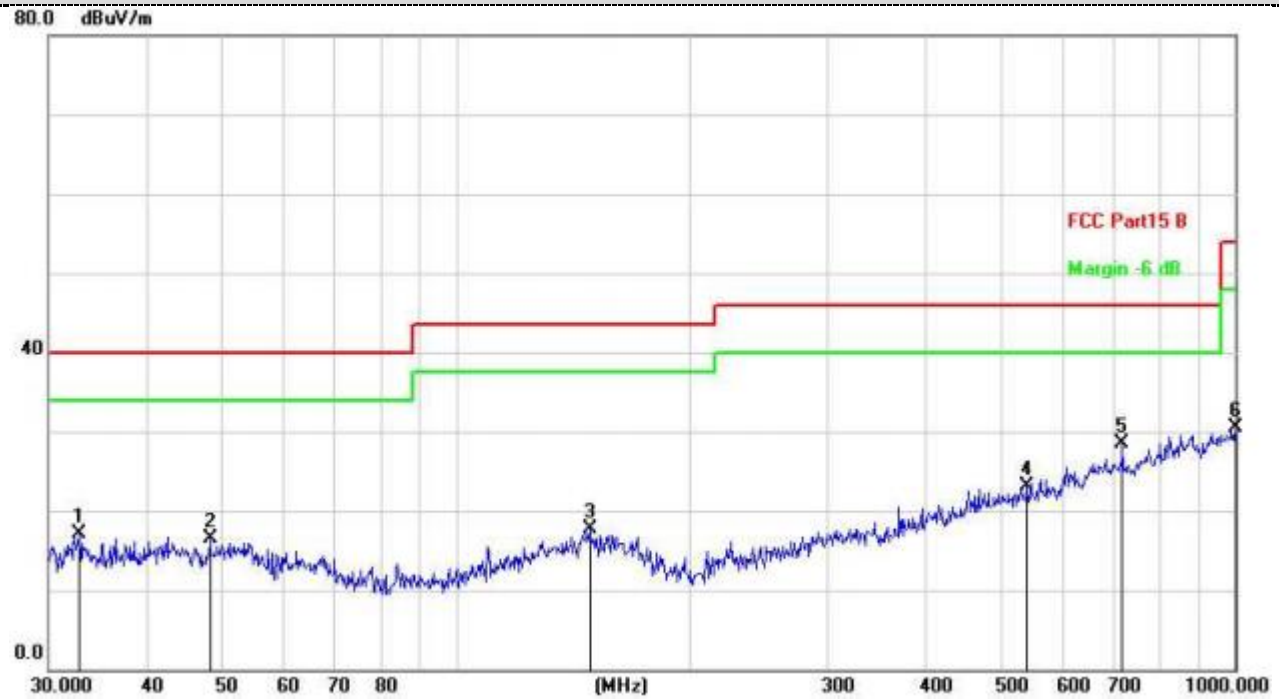
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dB/m	dB	Detector
1		41.1320	28.83	-11.46	17.37	40.00	-22.63	peak
2		49.7068	28.36	-11.32	17.04	40.00	-22.96	peak
3		138.3873	31.05	-10.59	20.46	43.50	-23.04	peak
4		463.9696	28.09	-5.94	22.15	46.00	-23.85	peak
5	*	672.8444	30.61	-2.46	28.15	46.00	-17.85	peak
6		982.6200	28.59	2.45	31.04	54.00	-22.96	peak

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

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

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

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dB/m	dB	Detector
1		32.8637	29.75	-12.57	17.18	40.00	-22.82	peak
2		48.3318	27.85	-11.39	16.46	40.00	-23.54	peak
3		148.4410	27.70	-9.92	17.78	43.50	-25.72	peak
4		541.3724	27.93	-4.91	23.02	46.00	-22.98	peak
5	*	716.6820	30.26	-1.72	28.54	46.00	-17.46	peak
6		1000.0000	27.84	2.71	30.55	54.00	-23.45	peak

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

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

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

For 1GHz to 25GHz

Note: GFSK , π/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	58.54	PK	74	15.46	52.84	31	6.5	31.8	5.7
4804.00	42.33	AV	54	11.67	36.63	31	6.5	31.8	5.7
7206.00	54.32	PK	74	19.68	41.67	36	8.15	31.5	12.65
7206.00	44.86	AV	54	9.14	32.21	36	8.15	31.5	12.65

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	59.78	PK	74	14.22	54.08	31	6.5	31.8	5.7
4804.00	43.96	AV	54	10.04	38.26	31	6.5	31.8	5.7
7206.00	52.76	PK	74	21.24	40.11	36	8.15	31.5	12.65
7206.00	42.41	AV	54	11.59	29.76	36	8.15	31.5	12.65

Frequency(MHz):			2441		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4882.00	60.16	PK	74	13.84	54.00	31.2	6.61	31.65	6.16
4882.00	44.36	AV	54	9.64	38.20	31.2	6.61	31.65	6.16
7323.00	53.14	PK	74	20.86	40.19	36.2	8.23	31.48	12.95
7323.00	44.85	AV	54	9.15	31.90	36.2	8.23	31.48	12.95

Frequency(MHz):			2441		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4882.00	60.58	PK	74	13.42	54.42	31.2	6.61	31.65	6.16
4882.00	42.30	AV	54	11.70	36.14	31.2	6.61	31.65	6.16
7323.00	53.17	PK	74	20.83	40.22	36.2	8.23	31.48	12.95
7323.00	43.58	AV	54	10.42	30.63	36.2	8.23	31.48	12.95

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	62.13	PK	74	11.87	55.47	31.4	6.76	31.5	6.66
4960.00	42.65	AV	54	11.35	35.99	31.4	6.76	31.5	6.66
7440.00	53.60	PK	74	20.40	40.30	36.4	8.35	31.45	13.3
7440.00	44.47	AV	54	9.53	31.17	36.4	8.35	31.45	13.3

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	63.30	PK	74	10.70	56.64	31.4	6.76	31.5	6.66
4960.00	42.63	AV	54	11.37	35.97	31.4	6.76	31.5	6.66
7440.00	54.81	PK	74	19.19	41.51	36.4	8.35	31.45	13.3
7440.00	44.37	AV	54	9.63	31.07	36.4	8.35	31.45	13.3

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

Results of Band Edges Test (Radiated)

Note: GFSK, π/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.

GFSK

Frequency(MHz):			**2402**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	60.88	PK	74	13.12	62.27	27.2	4.31	32.9	-1.39
2390.00	46.19	AV	54	7.81	47.58	27.2	4.31	32.9	-1.39
Frequency(MHz):			**2402**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	59.48	PK	74	14.52	60.87	27.2	4.31	32.9	-1.39
2390.00	46.42	AV	54	7.58	47.81	27.2	4.31	32.9	-1.39
Frequency(MHz):			**2480**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	55.53	PK	74	18.47	56.46	27.4	4.47	32.8	-0.93
2483.50	44.82	AV	54	9.18	45.75	27.4	4.47	32.8	-0.93
Frequency(MHz):			**2480**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	54.41	PK	74	19.59	55.34	27.4	4.47	32.8	-0.93
2483.50	44.04	AV	54	9.96	44.97	27.4	4.47	32.8	-0.93

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3 Maximum Peak Output Power

Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels : 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

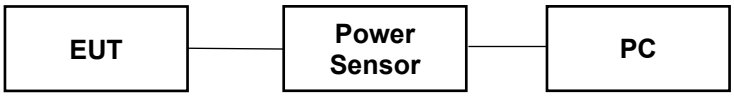
Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the powersensor.

Method PM is Measurement using an RF Peak power sensor. The procedure for this method is as follows:

1. The testing follows the ANSI C63.10 Section 7.8.5
2. The maximum peak conducted output power may be measured using a broadband peak RF power sensor.
3. The power sensor shall have a video bandwidth that is greater than or equal to the 20db bandwidth and shall use a fast-responding diode detector.

Test Configuration



Test Results

Please refer to Appendix RF Test Data for BT.

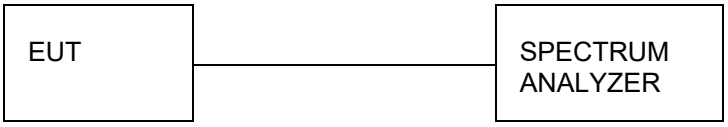
Note: 1.The test results including the cable loss.

4.4 On Time and Duty Cycle

Standard Applicable

None; for reporting purpose only.

TEST CONFIGURATION



Test Procedures

1). Set the Centre frequency of the spectrum analyzer to the transmitting frequency;
2). Set the span=0MHz, RBW=8MHz, VBW=8MHz, Sweep time=Auto;
3). Detector = peak;
4). Trace mode = Single hold.

Please refer to Appendix RF Test Data for BT.

4.5 20dB Bandwidth

Limit

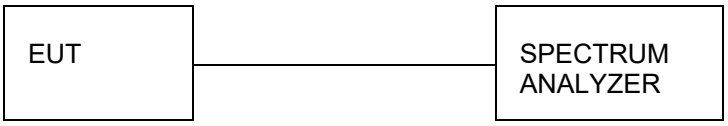
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW. 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 was 1% to 5% of the OBW and VBW shall be at least three times RBW.

a) Span: shall be between two times and five times the OBW.
b) RBW: 1% to 5% of the OBW.
c) Video bandwidth (VBW) ⩾ 3RBW
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max-hold.
g) Allow the trace to stabilize

Test Configuration



Test Results

Please refer to Appendix RF Test Data for BT.

4.6 Frequency Separation

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Wide enough to capture the peaks of two adjacent channels.

b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

c) Video (or average) bandwidth (VBW) ≥ RBW

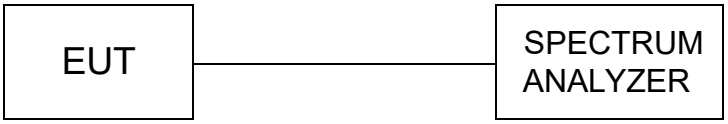
d) Sweep: Auto.

e) Detector function: Peak.

f) Trace: Max-hold.

g) Allow the trace to stabilize

TEST CONFIGURATION



TEST RESULTS

Please refer to Appendix RF Test Data for BT.

Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle

4.7 Number of hopping frequency

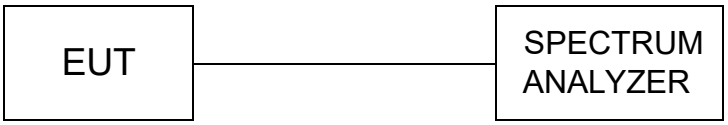
Limit

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

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator.
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
c) VBW ⩾ RBW.
d) Sweep: Auto time.
e) Detector function: Peak.
f) Trace: Max-hold.
g) Allow the trace to stabilize

Test Configuration



Test Results

Please refer to Appendix RF Test Data for BT.

4.8 Time of Occupancy (Dwell Time)

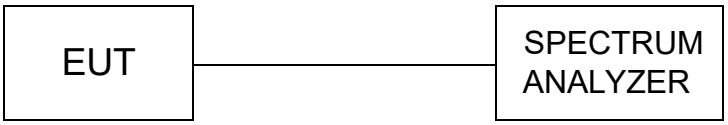
Limit

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

Test Procedure

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

Test Configuration



Test Results

Please refer to Appendix RF Test Data for BT.

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.

4.9 Out-of-band Emissions

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

The testing follows the ANSI C63.10 Section 6.10.4 and 7.8.7:

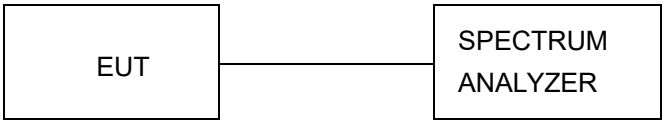
- Reference level measurement

Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
RBW = 100kHz
VBW = 300kHz
Detector = Peak
Sweep time = Auto couple
Trace mode = Max hold
Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

- Emission level measurement

Span = Wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100kHz
VBW = 300kHz
Detector = Peak
Sweep time = Auto couple
Trace mode = Max hold
Trace was allowed to stabilize
Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

Test Configuration



Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5

Please refer to Appendix RF Test Data for BT.

4.10 Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

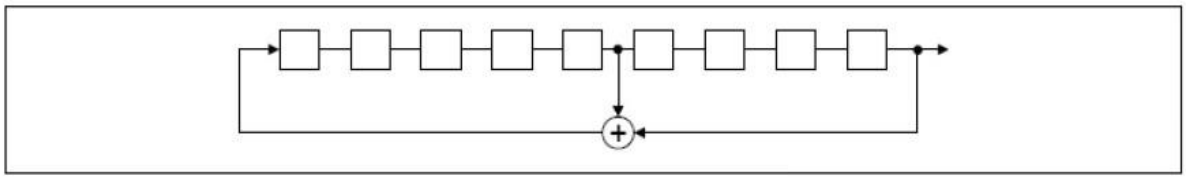
For 47 CFR Part 15C section 15.247 (a) (1) requirement:

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

EUT Pseudorandom Frequency Hopping Sequence Requirement

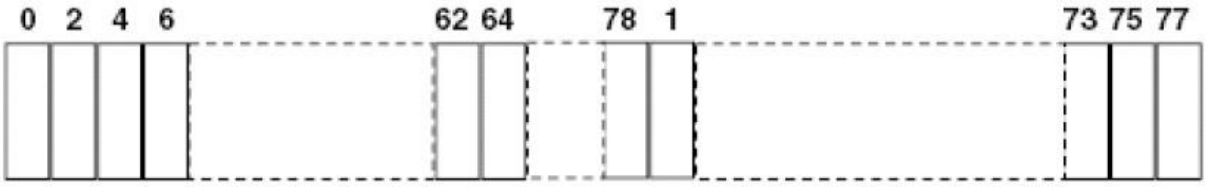
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: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

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



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

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

4.11 Antenna Requirement

Standard Applicable

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

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

Refer to statement below for compliance

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

Antenna Connected Construction

The PCB Antenna maximum gain of antenna was 2.499 dBi

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen HTT Technology Co.,Ltd. does not assume any responsibility.

5 Test Setup Photos of the EUT

Reference to the appendix I for details.

6 External and Internal Photos of the EUT

Reference to the appendix II for details.

.....End of Report.....