FCC TEST REPORT

FOR

Horseware Ireland

Sportzvibe-ZX

Test Model: RC9M

Additional Model No.: /

Prepared for	:	Horseware Ireland
Address	:	Finnabair Business Park , Dundalk , Co Louth , Ireland

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com

Date of receipt of test sample	:	November 02, 2017
Number of tested samples	:	1
Sample number	:	Prototype
Date of Test	:	November 02, 2017~ November 22, 2017
Date of Report	:	November 22, 2017

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FCC TEST REPORT

FCC CFR 47 PART 15 C(15.249)

Report Reference No.	**:**	**LCS171016068AE1**
Date of Issue.....	:	November 22, 2017
Testing Laboratory Name.....	**:**	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure.....	:	Full application of Harmonised standards ■ Partial application of Harmonised standards ☐ Other standard testing method ☐
Applicant's Name	**:**	Horseware Ireland
Address.....	:	Finnabair Business Park , Dundalk , Co Louth , Ireland
Test Specification		
Standard.....	:	FCC CFR 47 PART 15 C(15.249) / ANSI C63.10: 2013
Test Report Form No.....	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

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Test Item Description.	**:**	**Sportzvibe-ZX**
Trade Mark.....	:	Horseware
Test Model.....	:	RC9M
Ratings.....	:	DC 3.7V by battery 340mAh) Recharge Voltage: 5V⎓, 0.17A
Result	**:**	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Ace Chai	Dick Su	Gavin Liang
Ace Chai/ Administrators	Dick Su / Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : LCS171016068AE1	November 22, 2017 Date of issue

Test Model.....	: RC9M
EUT.....	: Sportzvibe-ZX
Applicant.....	**:** Horseware Ireland
Address.....	: Finnabair Business Park , Dundalk , Co Louth , Ireland
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Sentrix Technology Ltd.**
Address.....	: Studio F, 3/F, Centre 600, 82 King Lam Street, Cheung Sha Wan, Kowloon, Hong Kong.
Telephone.....	: /
Fax.....	: /
Factory.....	**: Sentrix Technology Ltd.**
Address.....	: Studio F, 3/F, Centre 600, 82 King Lam Street, Cheung Sha Wan, Kowloon, Hong Kong.
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

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.

Revision History

Revision	Issue Date	Revisions	Revised By
000	November 22, 2017	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	Sportzvibe-ZX
Test Model	RC9M
List Model No.	/
Model Declaration	/
Hardware Version	TX-V1.6 / RX-V1.5
Software Version	MCUX-RC9M-1C
Power Supply	DC 3.7V by battery 340mAh) Recharge Voltage: 5V⎓, 0.17A
2.4G	
Frequency Range	2412MHz, 2429MHz, 2451MHz, 2468MHz
Channel Number	4 channels
Channel Spacing	17~22MHz
Modulation Type	GFSK
Antenna Description	Internal antenna, 0dBi(max.)

1.2. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
--	--	--	--	--

1.3. External I/O

I/O Port Description	Quantity	Cable
Charge Interface	1	0.5M

1.4. Description of Test Facility

FCC Registration Number. is 254912.
Industry Canada Registration Number. is 9642A-1.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001
NVLAP Registration Code is 600167-0

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10:2013 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. List of Measuring Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	Power Meter	R&S	NRVS	100444	2017-06-17	2018-06-16
2	Power Sensor	R&S	NRV-Z81	100458	2017-06-17	2018-06-16
3	Power Sensor	R&S	NRV-Z32	10057	2017-06-17	2018-06-16
4	EPM Series Power Meter	Agilent	E4419B	MY45104493	2017-06-17	2018-06-16
5	E-SERIES AVG POWER SENSOR	Agilent	E9301H	MY41495234	2017-06-17	2018-06-16
6	ESA-E SERIES SPECTRUM ANALYZER	Agilent	E4407B	MY41440754	2016-11-18	2017-11-17
7	MXA Signal Analyzer	Agilent	N9020A	MY49100040	2017-06-17	2018-06-16
8	SPECTRUM ANALYZER	R&S	FSP	100503	2017-06-17	2018-06-16
9	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2017-06-17	2018-06-16
10	Positioning Controller	MF	MF-7082	/	2017-06-17	2018-06-16
11	EMI Test Software	AUDIX	E3	N/A	2017-06-17	2018-06-16
12	EMI Test Receiver	ROHDE & SCHWARZ	ESR 7	101181	2017-06-17	2018-06-16
13	AMPLIFIER	QuieTek	QTK-A2525G	CHM10809065	2016-11-18	2017-11-17
14	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2017-06-23	2018-06-22
15	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2017-05-02	2018-05-01

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16	Horn Antenna	EMCO	3115	6741	2017-06-23	2018-06-22
17	RF Cable-R03m	Jye Bao	RG142	CB021	2017-06-17	2018-06-16
18	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2017-06-17	2018-06-16
19	TEST RECEIVER	R&S	ESCI	101142	2017-06-17	2018-06-16
20	RF Cable-CON	UTIFLEX	3102-26886-4	CB049	2017-06-17	2018-06-16
21	10dB Attenuator	SCHWARZBECK	MTS-IMP136	261115-001-0032	2017-06-17	2018-06-16
22	Artificial Mains	R&S	ENV216	101288	2017-06-17	2018-06-16
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.

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1.6. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS 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.

1.7. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	3.10dB	(1)
		30MHz~200MHz	2.96dB	(1)
		200MHz~1000MHz	3.10dB	(1)
		1GHz~26.5GHz	4.00dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	1.63dB	(1)
Power disturbance	:	30MHz~300MHz	1.60dB	(1)

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

1.8. Description Of Test Modes

The EUT operates in the unlicensed ISM band at 2.4GHz. The following operating modes were applied for the related test items.

All test modes were tested, only the result of the worst case was recorded in the report. It was pre-tested on the positioned of each 3 axis. The worst case was found positioned on X-plane.

Mode of Operations	Transmitting Frequency (MHz)
GFSK	2412
	2429
	2451
	2468
For Conducted Emission	
Test Mode	TX Mode
For Radiated Emission	
Test Mode	TX Mode

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10: 2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

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 that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.249 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

According to the requirements in Section 6.2 of ANSI C63.10: 2013, AC power-line conducted emissions shall be measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table and the turntable 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 maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10: 2013

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3. CONNECTION DIAGRAM OF TEST SYSTEM

3.1. Justification

The system was configured for testing in a continuous transmit condition.

Using four samples to test, each sample was set up separately for a single transmitter frequency point, which was automatically launched

3.2. EUT Exercise Software

N/A

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207(a)	Power Line Conducted Emissions	Compliant
§15.205(a), §15.209(a), §15.249(a), §15.249(c)	Radiated Emissions Measurement	Compliant
§15.249	Band Edges Measurement	Compliant
§15.249, §15.215	20 dB Bandwidth	Compliant

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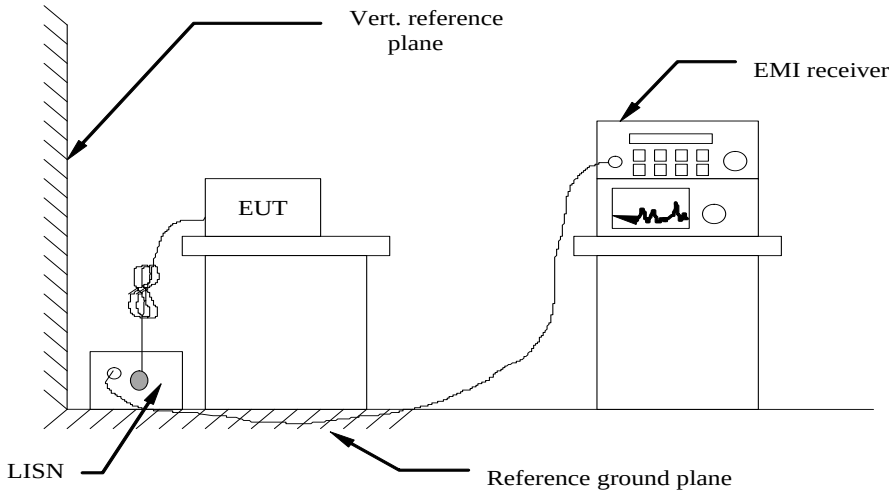
5. POWER LINE CONDUCTED EMISSIONS

5.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

5.2 Block Diagram of Test Setup



5.3 Test Results

Not applicable as the EUT is powered by 2*AA battery.

6. RADIATED EMISSION MEASUREMENT

6.1. Standard Applicable

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) and 15.249 limit in the table below has to be followed.

Fundamental Frequency	Field Strength of fundamental (millivolts/meter)	Field Strength of harmonics (microvolts/meter)
902-928MHz	50	500
2400-2483.5MHz	50	500
5725-5875MHz	50	500
24.0-24.25GHz	250	2500

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (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

6.2. Instruments Setting

The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1000KHz / 1000KHz for peak

6.3. Test Procedure

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

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2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

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3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

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4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

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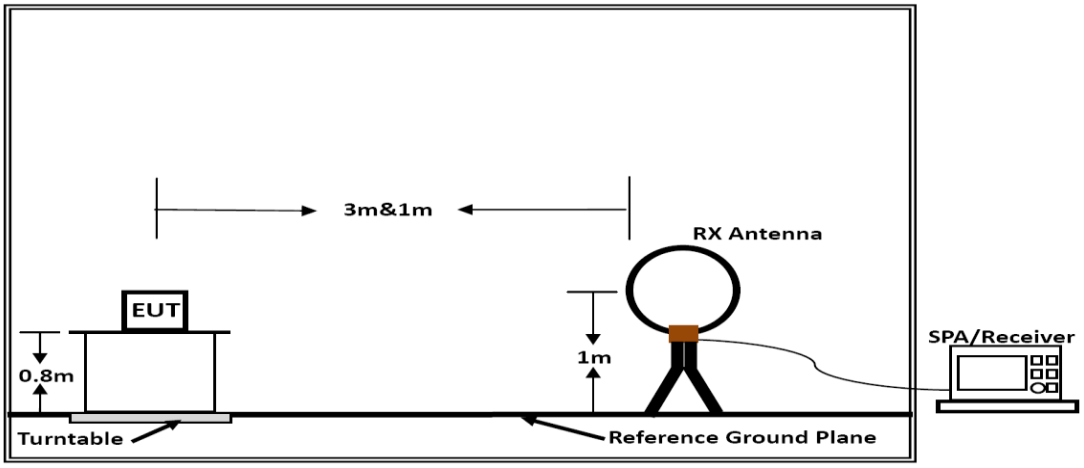
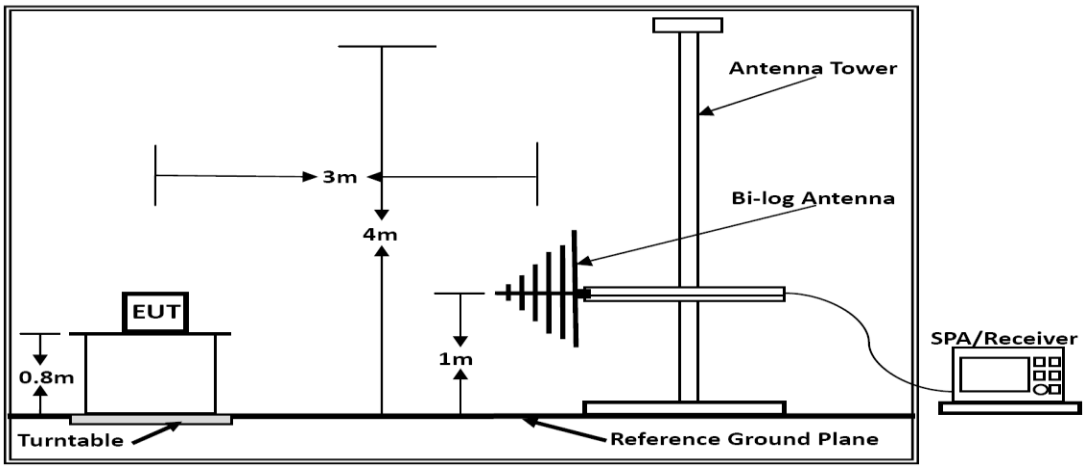
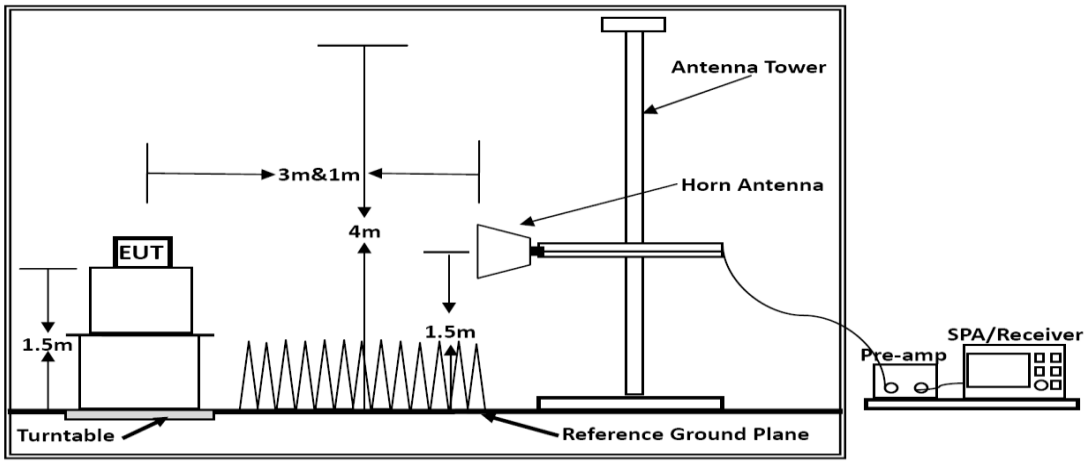
6.4. Block Diagram of Test Setup



Below 30MHz



Below 1GHz



Above 1GHz

6.5. Test Results

Results of Radiated Emissions (9 kHz~30MHz)

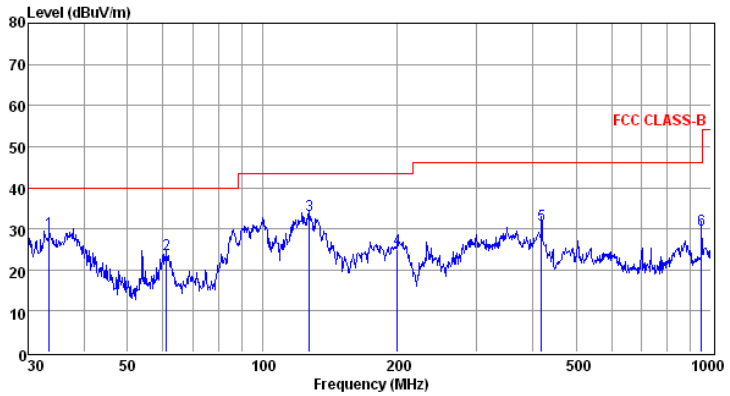
Frequency (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The radiated emissions from 9kHz to 30MHz are at least 20dB below the official limit and no need to report.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

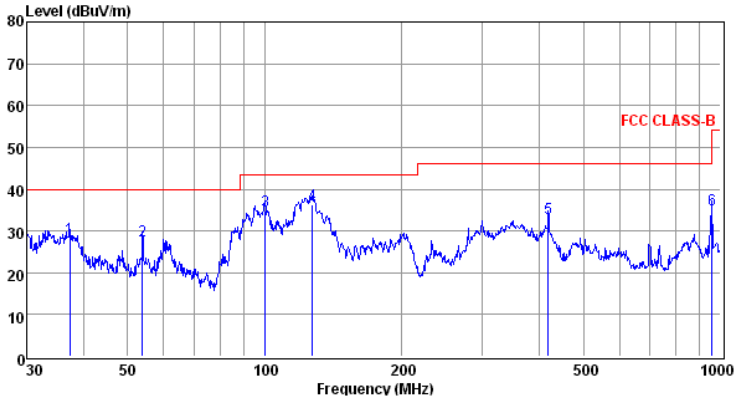
Results of Radiated Emissions (30MHz~1000MHz)



pol: VERTICAL

	Freq MHz	Reading dBuV	CabLos dB	Antfac dB/m	Measured dBuV/m	Limit dBuV/m	Over dB	Remark
1	33.44	16.40	0.37	12.31	29.08	40.00	-10.92	QP
2	61.13	11.07	0.49	12.24	23.80	40.00	-16.20	QP
3	127.22	23.27	0.67	9.36	33.30	43.50	-10.20	QP
4	199.99	13.54	0.84	10.57	24.95	43.50	-18.55	QP
5	419.11	14.14	1.32	15.45	30.91	46.00	-15.09	QP
6	952.09	6.40	1.93	21.43	29.76	46.00	-16.24	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported



pol: HORIZONTAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	37.29	14.94	0.41	12.89	28.24	40.00	-11.76	QP
2	53.88	14.12	0.46	13.07	27.65	40.00	-12.35	QP
3	100.23	21.04	0.60	13.14	34.78	43.50	-8.72	QP
4	127.22	26.27	0.67	9.36	36.30	43.50	-7.20	QP
5	419.11	16.14	1.32	15.45	32.91	46.00	-13.09	QP
6	958.79	11.71	1.90	21.47	35.08	46.00	-10.92	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

****Note: Pre-scan all modes and recorded the worst case results in this report (TX-2412MHz).*

6.6. Results for Radiated Emissions (Above 1GHz)

Field Strength Of Fundamental (TX-2412MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2412	H	83.26	72.23	114	94	Pass
2412	V	82.24	71.07	114	94	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4824.00	49.74	33.06	35.04	3.94	51.70	74.00	-22.30	Peak	Horizontal
4824.00	33.81	33.06	35.04	3.94	35.77	54.00	-18.23	Average	Horizontal
4824.00	49.00	33.06	35.04	3.94	50.96	74.00	-23.04	Peak	Vertical
4824.00	34.05	33.06	35.04	3.94	36.01	54.00	-17.99	Average	Vertical

Field Strength Of Fundamental (TX-2429MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2429	H	83.79	73.12	114	94	Pass
2429	V	83.55	71.82	114	94	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4858.00	47.48	33.16	35.15	3.96	49.45	74.00	-24.55	Peak	Horizontal
4858.00	31.53	33.16	35.15	3.96	33.50	54.00	-20.50	Average	Horizontal
4858.00	50.05	33.16	35.15	3.96	52.02	74.00	-21.98	Peak	Vertical
4858.00	33.06	33.16	35.15	3.96	35.03	54.00	-18.97	Average	Vertical

Field Strength Of Fundamental (TX-2451MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2451	H	83.23	73.26	114	94	Pass
2451	V	81.84	72.76	114	94	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4902.00	49.22	33.16	35.15	3.96	51.19	74.00	-22.81	Peak	Horizontal
4902.00	33.37	33.16	35.15	3.96	35.34	54.00	-18.66	Average	Horizontal
4902.00	52.26	33.16	35.15	3.96	54.23	74.00	-19.77	Peak	Vertical
4902.00	34.92	33.16	35.15	3.96	36.89	54.00	-17.11	Average	Vertical

Field Strength Of Fundamental (TX-2468MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2468	H	83.27	73.24	114	94	Pass
2468	V	81.81	72.78	114	94	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4936.00	48.78	33.26	35.14	3.98	50.88	74.00	-23.12	Peak	Horizontal
4936.00	33.10	33.26	35.14	3.98	35.20	54.00	-18.80	Average	Horizontal
4936.00	51.85	33.26	35.14	3.98	53.95	74.00	-20.05	Peak	Vertical
4936.00	34.77	33.26	35.14	3.98	36.87	54.00	-17.13	Average	Vertical

Notes:

1. *Measuring frequencies from 9k~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30MHz.*
2. *Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.*
3. *No emission was be recorded above 18GHz means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*

6.7. AC Power line conducted emissions

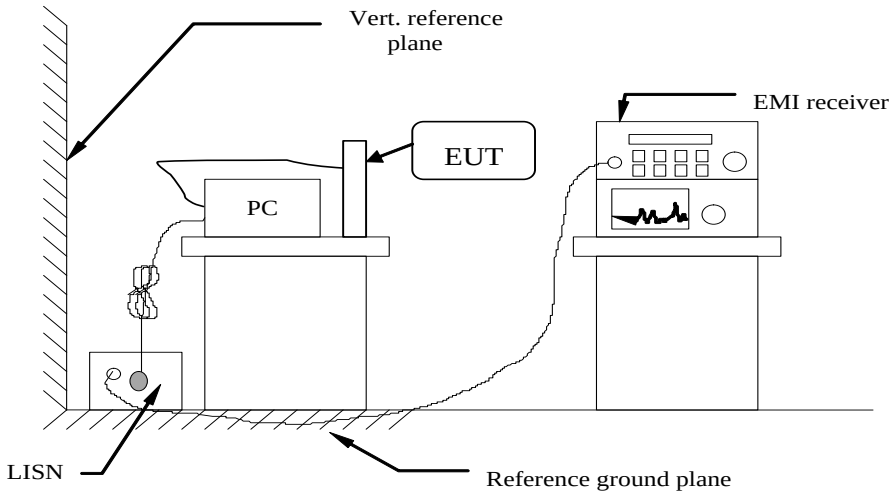
6.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

1.1.1.6.7.2 Block Diagram of Test Setup



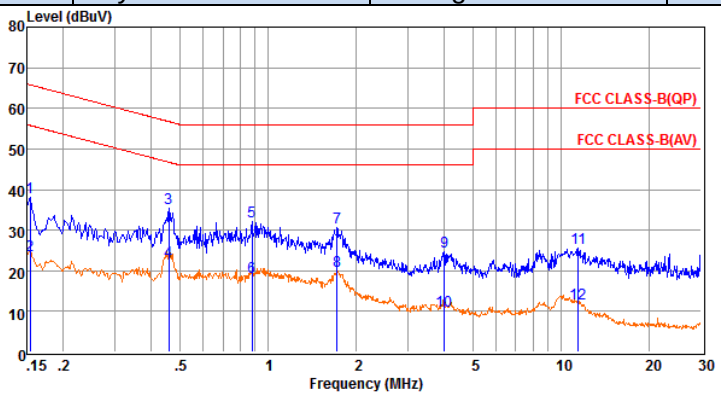
1.1.2.6.7.3 Test Results

PASS.

The test data please refer to following page.

Test Results for AC 120V/60Hz @ GFSK (worst case)

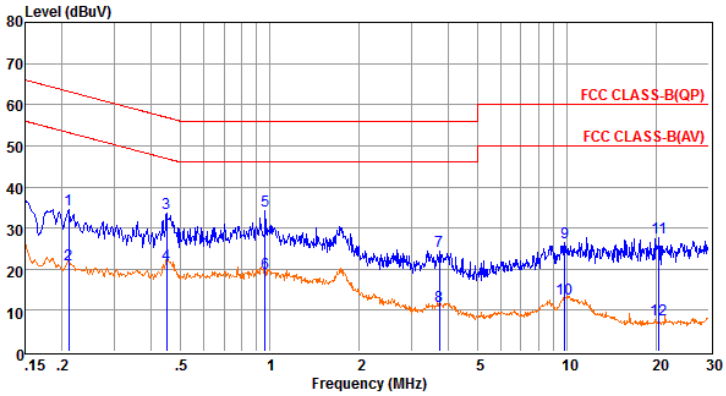
Temperature	25.3℃	Humidity	52.1%
Test Engineer	Jayden Zhuo	Configurations	BT



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.15	18.36	9.58	0.02	10.00	37.96	65.78	-27.82	QP
2	0.15	4.34	9.58	0.02	10.00	23.94	55.77	-31.83	Average
3	0.46	15.62	9.62	0.04	10.00	35.28	56.71	-21.43	QP
4	0.46	2.66	9.62	0.04	10.00	22.32	46.71	-24.39	Average
5	0.88	12.45	9.63	0.04	10.00	32.12	56.00	-23.88	QP
6	0.88	-1.28	9.63	0.04	10.00	18.39	46.00	-27.61	Average
7	1.72	11.07	9.64	0.05	10.00	30.76	56.00	-25.24	QP
8	1.72	0.26	9.64	0.05	10.00	19.95	46.00	-26.05	Average
9	3.99	5.12	9.65	0.06	10.00	24.83	56.00	-31.17	QP
10	3.99	-9.64	9.65	0.06	10.00	10.07	46.00	-35.93	Average
11	11.44	5.71	9.70	0.09	10.00	25.50	60.00	-34.50	QP
12	11.44	-7.77	9.70	0.09	10.00	12.02	50.00	-37.98	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.



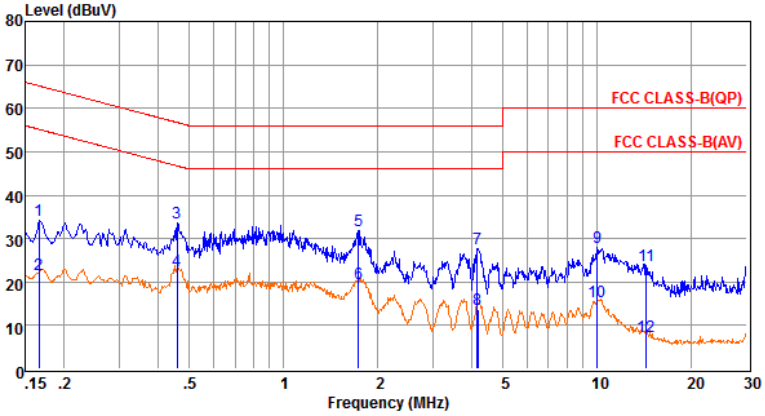
Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.21	14.83	9.59	0.03	10.00	34.45	63.18	-28.73	QP
2	0.21	1.51	9.59	0.03	10.00	21.13	63.18	-42.05	Average
3	0.45	13.88	9.62	0.04	10.00	33.54	56.89	-23.35	QP
4	0.45	1.58	9.62	0.04	10.00	21.24	56.89	-35.65	Average
5	0.96	14.48	9.63	0.05	10.00	34.16	56.00	-21.84	QP
6	0.96	-0.60	9.63	0.05	10.00	19.08	56.00	-36.92	Average
7	3.72	4.73	9.65	0.06	10.00	24.44	56.00	-31.56	QP
8	3.72	-8.58	9.65	0.06	10.00	11.13	56.00	-44.87	Average
9	9.81	6.53	9.72	0.08	10.00	26.33	60.00	-33.67	QP
10	9.81	-7.01	9.72	0.08	10.00	12.79	60.00	-47.21	Average
11	20.38	7.75	9.87	0.12	10.00	27.74	60.00	-32.26	QP
12	20.38	-12.33	9.87	0.12	10.00	7.66	60.00	-52.34	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

Test Results for AC 240V/50Hz @ GFSK (worst case)

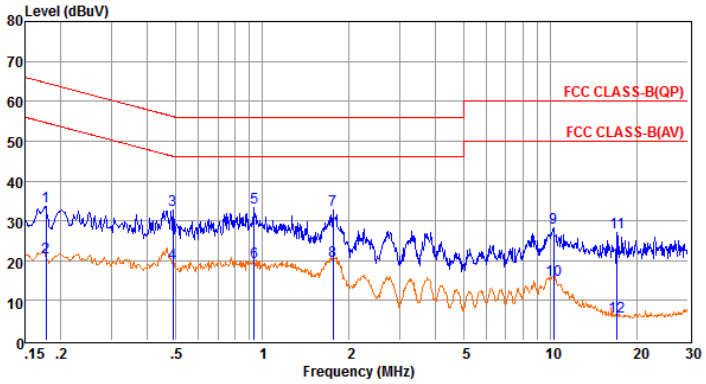
Temperature	25.3℃	Humidity	52.1%
Test Engineer	Jayden Zhuo	Configurations	BT



Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.17	14.60	9.66	0.02	10.00	34.28	65.16	-30.88	QP
2	0.17	2.10	9.66	0.02	10.00	21.78	55.16	-33.38	Average
3	0.46	13.92	9.62	0.04	10.00	33.58	56.71	-23.13	QP
4	0.46	2.98	9.62	0.04	10.00	22.64	46.71	-24.07	Average
5	1.73	12.21	9.63	0.05	10.00	31.89	56.00	-24.11	QP
6	1.74	0.05	9.63	0.05	10.00	19.73	46.00	-26.27	Average
7	4.16	7.84	9.65	0.06	10.00	27.55	56.00	-28.45	QP
8	4.16	-5.99	9.65	0.06	10.00	13.72	46.00	-32.28	Average
9	10.02	8.22	9.72	0.08	10.00	28.02	60.00	-31.98	QP
10	10.02	-4.26	9.72	0.08	10.00	15.54	50.00	-34.46	Average
11	14.36	4.01	9.74	0.10	10.00	23.85	60.00	-36.15	QP
12	14.37	-12.31	9.74	0.10	10.00	7.53	50.00	-42.47	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.18	14.04	9.61	0.02	10.00	33.67	64.59	-30.92	QP
2	0.18	1.08	9.61	0.02	10.00	20.71	54.59	-33.88	Average
3	0.49	12.98	9.62	0.04	10.00	32.64	56.19	-23.55	QP
4	0.49	-0.30	9.62	0.04	10.00	19.36	46.18	-26.82	Average
5	0.94	13.70	9.63	0.05	10.00	33.38	56.00	-22.62	QP
6	0.94	-0.02	9.63	0.05	10.00	19.66	46.00	-26.34	Average
7	1.76	12.93	9.64	0.05	10.00	32.62	56.00	-23.38	QP
8	1.76	0.38	9.64	0.05	10.00	20.07	46.00	-25.93	Average
9	10.23	8.60	9.69	0.08	10.00	28.37	60.00	-31.63	QP
10	10.23	-4.52	9.69	0.08	10.00	15.25	50.00	-34.75	Average
11	17.02	7.13	9.73	0.11	10.00	26.97	60.00	-33.03	QP
12	17.02	-13.96	9.73	0.11	10.00	5.88	50.00	-44.12	Average

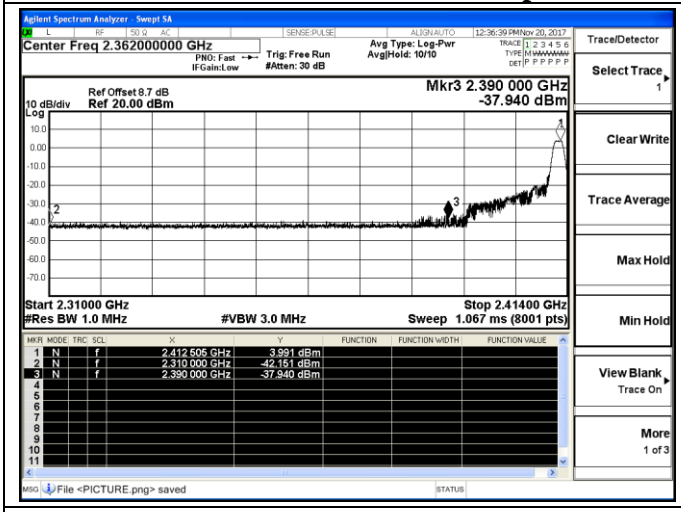
Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

6.8. Results for Band edge Testing

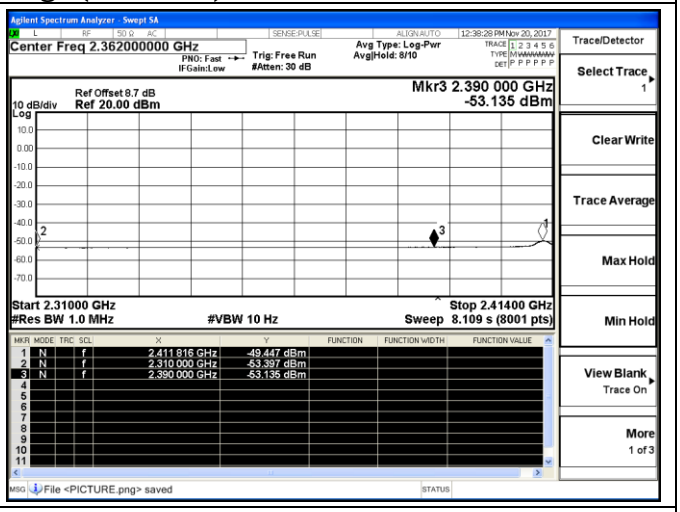
GFSK							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-42.151	2.0	0.0	55.109	Peak	74.00	PASS
2310.000	-53.397	2.0	0.0	43.863	AV	54.00	PASS
2390.000	-39.94	2.0	0.0	57.320	Peak	74.00	PASS
2390.000	-53.135	2.0	0.0	44.125	AV	54.00	PASS
2483.500	-27.35	2.0	0.0	69.910	Peak	74.00	PASS
2483.500	-52.898	2.0	0.0	44.362	AV	54.00	PASS
2500.000	-27.139	2.0	0.0	70.121	Peak	74.00	PASS
2500.000	-52.769	2.0	0.0	44.491	AV	54.00	PASS

NOTE: Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
Please refer to following test plots;

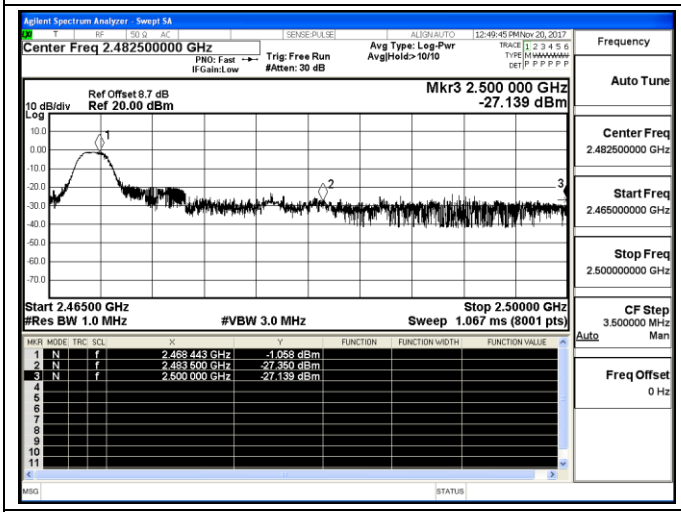
Test plot of Band Edge (Radiated)



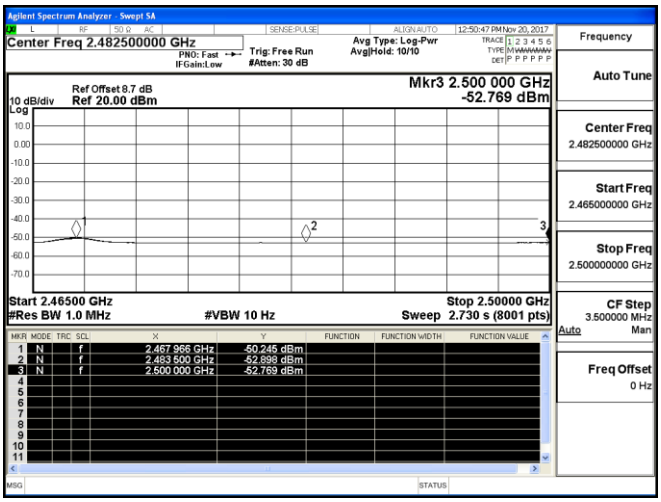
Low Channel / 2412MHz - Peak



Low Channel / 2412MHz – Average



High Channel / 2468MHz - Peak



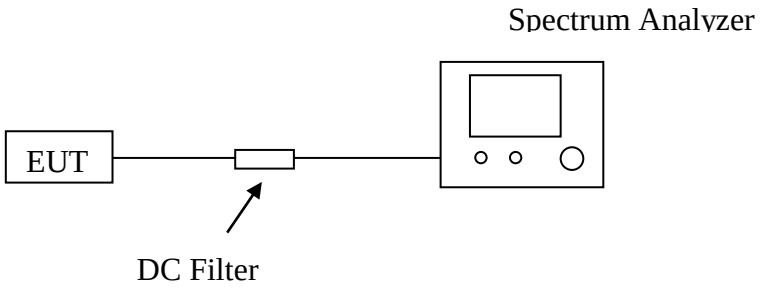
High Channel / 2468MHz – Average

7. 20 DB BANDWIDTH MEASUREMENT

7.1. Standard Applicable

According to §15.215

7.2. Block Diagram of Test Setup



7.3. Test Procedure

Use the following spectrum analyzer settings:

Span = 3MHz

RBW = 30KHz

VBW = 100KHz

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

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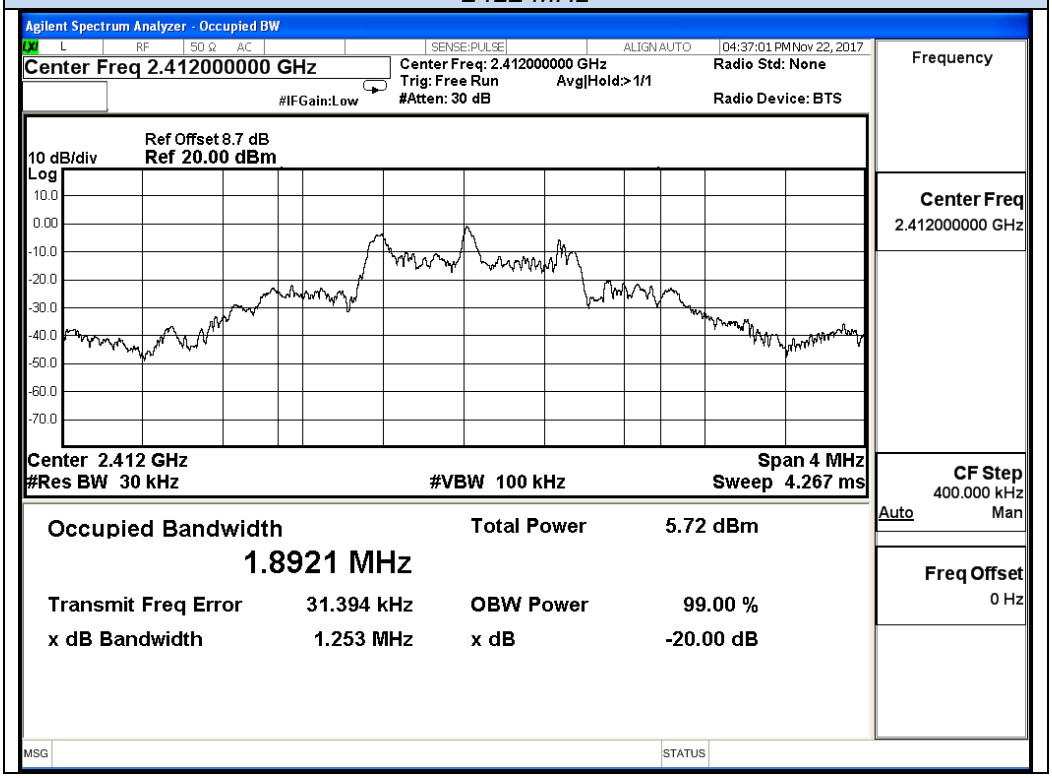
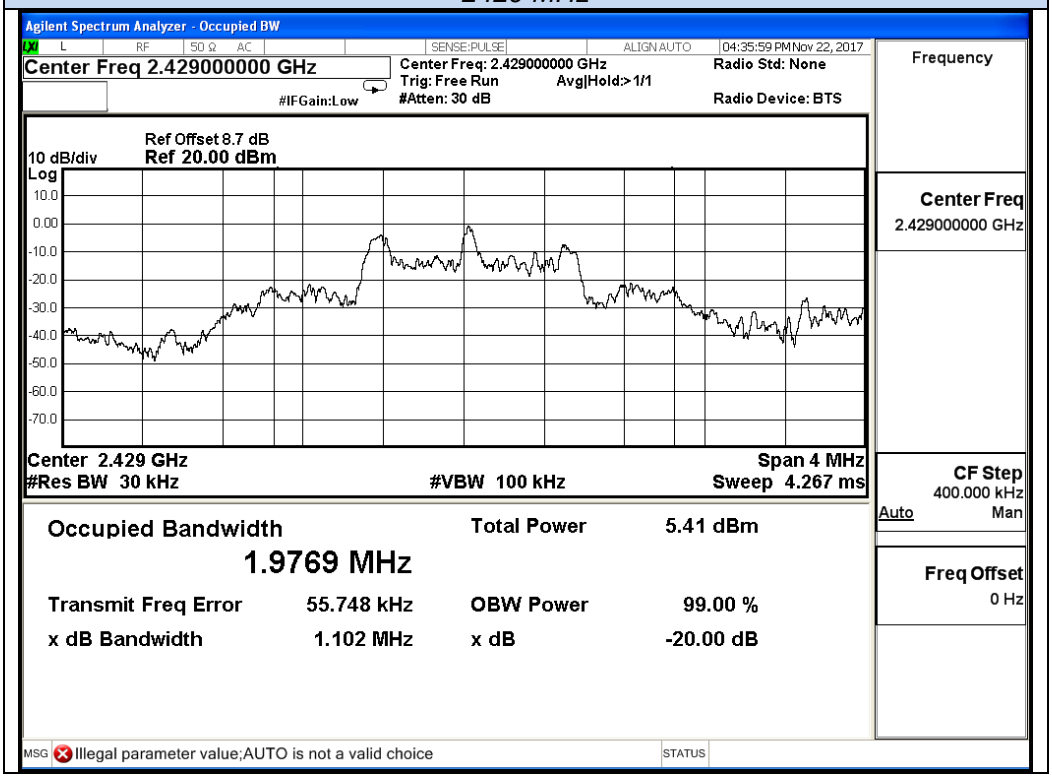
7.4. Test Results

Test Result Of 20dB Bandwidth Measurement		
Test Frequency (MHz)	20dB Bandwidth (KHz)	Limit (MHz)
2412	1.253	Non-Specified
2429	1.102	Non-Specified
2451	1.368	Non-Specified
2468	1.380	Non-Specified

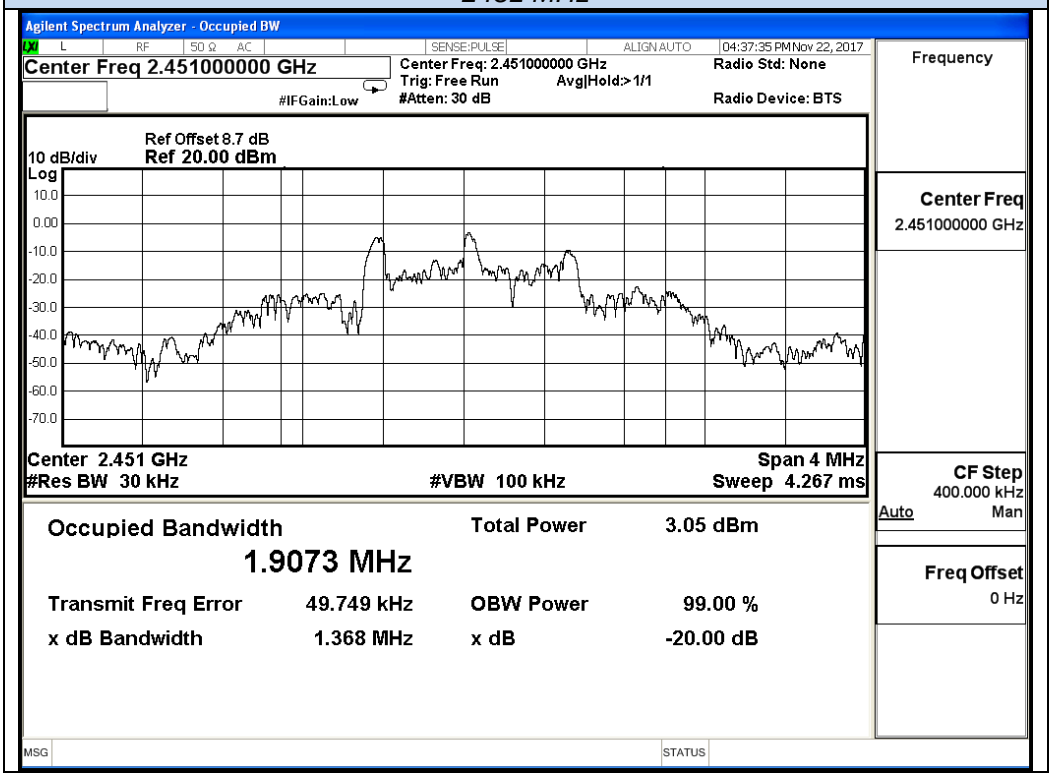
Test Plot of Test Result
GFSK
2412 MHz



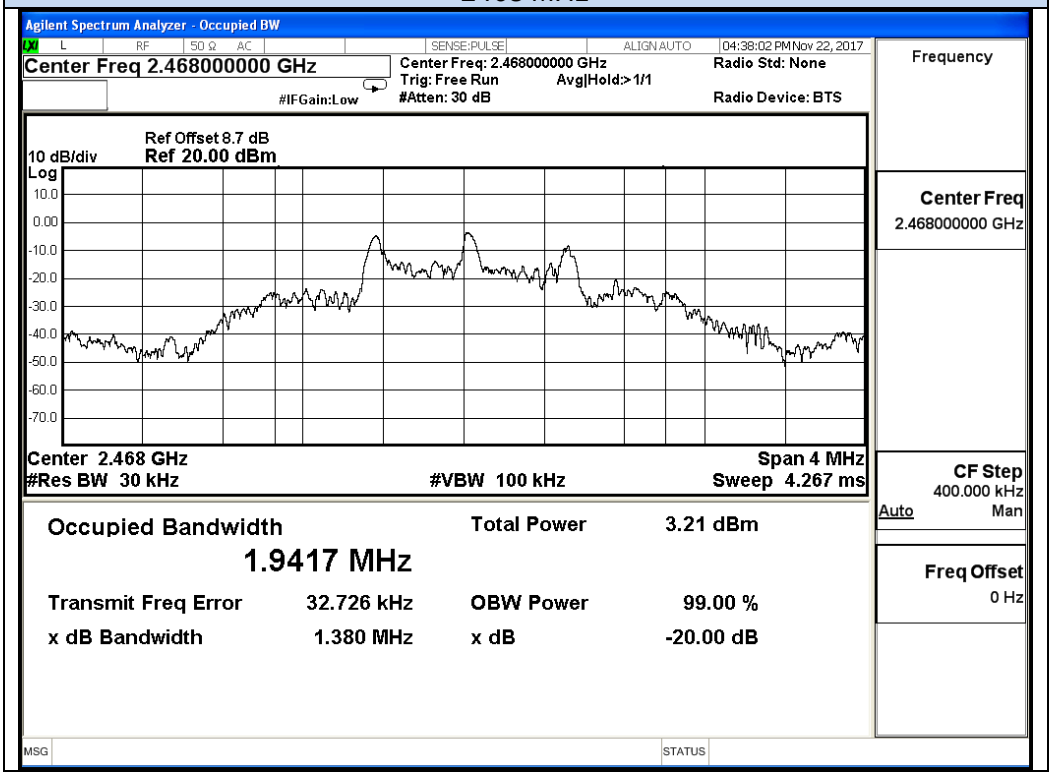
Test Plot of Test Result
GFSK
2429 MHz



Test Plot of Test Result
GFSK
2451 MHz



Test Plot of Test Result
GFSK
2468 MHz



8. ANTENNA REQUIREMENTS

8.1 Standard Applicable

According to antenna requirement of §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands 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 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

8.2 Antenna Connected Construction

8.2.1. Standard Applicable

According to § 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.

8.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 0.0dBi, and the antenna is a Internal antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

8.2.3. Results: Compliance.

----------THE END OF TEST REPORT----------