TEST REPORT

FCC ID: QIC-MSE12

IC:30055-MSE12

Product	**:**	**WorldPenScan Ai Reader**
Model Name	**:**	**MSE12**
Brand	**:**	**PenPower**
Report No.	**:**	**NCT24051473E1-2**

Prepared for

PENPOWER TECHNOLOGY LTD.

7F, NO.47, Lane 2, Sec.2, Kuang-Fu Rd., Hsinchu City 300, Taiwan

Prepared by

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1 TEST RESULT CERTIFICATION

Applicant's name	:	PENPOWER TECHNOLOGY LTD.
Address	:	7F, NO.47, Lane 2, Sec.2, Kuang-Fu Rd., Hsinchu City 300, Taiwan
Manufacture's name	:	PENPOWER TECHNOLOGY LTD.
Address	:	7F, NO.47, Lane 2, Sec.2, Kuang-Fu Rd., Hsinchu City 300, Taiwan
Product name	:	WorldPenScan Ai Reader
Model name	:	MSE12
Standards	:	FCC CFR47 Part 15 Section 15.247 RSS-247 Issue 3, August 2023 RSS-Gen Issue 5, Amendment 2, February, 2021
Test procedure	:	ANSI C63.10:2020
Date of test	:	Dec. 21, 2024 to Feb. 24, 2025
Date of Issue	:	Feb. 25, 2025

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

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Test Engineer:

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2 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	FCC part 15.207 RSS-Gen§8.8, RSS-247§ 3.1	PASS
Radiated Spurious Emissions	FCC part 15.205/15.209 RSS-Gen.6.13	PASS
Conducted Spurious Emission	FCC part 15. 247(d) RSS-247 5.5	PASS
Band edge	FCC part 15.247(d) RSS-247 5.5	PASS
6dB&99% Bandwidth	FCC part 15.247 (a)(2) RSS-Gen 5.2(a), RSS-Gen 6.7	PASS
Maximum Peak Output Power	FCC part 15.247 (b)(3) RSS-Gen 5.4(d)	PASS
Power Spectral Density	FCC part 15.247 (e) RSS-247 5.2(b)	PASS
Antenna Requirement	FCC part 15.203/15.247 (c) RSS-Gen 6.8	PASS

Remark:

1. “N/A” denotes test is not applicable in this Test Report.

2.1 Test Site

Site Description

EMC Lab.	:	Accredited by CNAS, 2022-09-27
		The certificate is valid until 2028.01.07
		The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2017)
		The Certificate Registration Number is L8251
		Designation Number: CN1347
		Test Firm Registration Number: 894804
		Accredited by A2LA, June 14, 2023
		The Certificate Registration Number is 6837.01
		Accredited by Industry Canada, November 09, 2018
		The Conformity Assessment Body Identifier is CN0150
		Company Number: 30806
Name of Firm	:	Shenzhen NCT Testing Technology Co., Ltd.
Site Location	:	A101&2F B2, Fuqiao 6th Area, Xintian Community, Fuhai Street, Baoan District, Shenzhen, People's Republic of China

3 General Information

3.1 General Description of E.U.T.

Product Name	:	WorldPenScan Ai Reader
Model Name	:	MSE12
HVIN	:	MSE12
Sample ID	:	24051473-001#
Sample(s) Status:	:	Engineer sample
Series Model	:	N/A
Model Different.:	:	N/A
Operating frequency	:	2402-2480MHz
Number of Channels	:	40 channels
Type of Modulation	:	GFSK
Antenna installation	:	Internal Antenna
Antenna Gain	:	0.88 dBi
Power supply	:	DC 3.8V by battery (1200mAh); Charging input: DC 5V
Hardware Version	:	N/A
Software Version	:	N/A
Remark：the Antenna gain is provided by customer from Antenna spec. and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.		

3.2 Channel List

The EUT has been tested under its typical operating condition. 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 C63.10-2020 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 harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The details of test channels and bandwidth were for RF conductive measurement.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	**2402**	14	2430	28	2458
01	2404	15	2432	29	2460
02	2406	16	2434	30	2462
03	2408	17	2436	31	2464
04	2410	18	2438	32	2466
05	2412	**19**	**2440**	33	2468
06	2414	20	2442	34	2470
07	2416	21	2444	35	2472
08	2418	22	2446	36	2474
09	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	**2480**
12	2426	26	2454		
13	2428	27	2456		

Note:

1. Test of channel was included the lowest, middle and highest frequency in highest data rate and to perform the test, then record on this report.

3.3 Test Setup Configuration

Conducted Emission

AC Line — Adapter — DC Line — EUT

Radiated Emission(30MHz-1GHz)

EUT

Radiated Emission(above 1GHz)

EUT

Conducted Spurious

EUT — Spectrum Analyzer

3.4 Test Mode

Transmitting mode	Keep the EUT in continuously transmitting mode.

Test Software	The EUT enters engineering mode
Power level setup	0 dBm

	Channel	Frequency(MHz)
Low Channel	0	2402
Mid Channel	19	2440
High Channel	39	2480

4 Equipment During Test

4.1 Equipments List

Conducted emission Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
944 Shielded Room	944 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESPI	101604	Rohde & Schwarz	2024/6/17	2025/6/16
LISN	ENV 216	102796	Rohde & Schwarz	2024/6/17	2025/6/16
LISN	VN1-13S	004023	CRANAGE	2024/6/17	2025/6/16
Cable	RG223-1500MM	NA	RG	2024/6/17	2025/6/16

Radiated emission & Radio Frequency Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
966 Shielded Room	966 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESCI	101178	Rohde & Schwarz	2024/6/17	2025/6/16
Amplifi（30MHz-1GHz）	BBV 9743 B	00374	SCHNWARZBECK	2024/6/17	2025/6/16
Bilog Antenna（30MHz-1GHz）	VULB9162	00473	SCHNWARZBECK	2023/3/19	2025/3/18
Horn antenna（1GHz-18GHz）	BBHA 9120 D	02622	SCHNWARZBECK	2023/3/19	2025/3/18
Pream plifier（1GHz-18GHz）	BBV 9718D	0024	SCHNWARZBECK	2024/6/17	2025/6/16
Spectrum Analyze（10Hz-40GHz）	FSV 40	100952	Rohde & Schwarz	2024/6/17	2025/6/16
Pream plifier（18GHz-40GHz）	BBV 9721	0056	SCHNWARZBECK	2024/6/17	2025/6/16
Double Ridge Guide Horn Antenna（18GHz-40GHz）	SAS-574	588	A.H.System	2023/3/19	2025/3/18
Loop Antenna (9KHz-30MHz)	FMZB1519B	014	SCHNWARZBECK	2024/6/17	2025/6/16
Amplifier (9KHz-30MHz)	CVP 9222 C	00109	CHNWARZBECK	2024/6/17	2025/6/16

MXG Signal Analyzer	N9020A	MY50510202	Agilent	2024/6/17	2025/6/16
MXG Vector Signal Generator	N5182A	MY50140020	Agilent	2024/6/17	2025/6/16
MXG Analog Signal Generator	N5181A	MY47420919	Agilent	2024/6/17	2025/6/16
Power Sensor	TR1029-2	512364	Techoy	2024/6/17	2025/6/16
RF Swith	TR1029-1	512364	Techoy	2024/6/17	2025/6/16
Cable	DA800-4000MM	NA	DA	2024/6/17	2025/6/16
Cable	DA800-11000MM	NA	DA	2024/6/17	2025/6/16

Other

Item	Name	Manufacturer	Model	Software version
1	EMC Conduction Test System	FALA	EZ-EMC	Ver.EMC-CON 3A1.1+
2	EMC radiation test system	FALA	EZ-EMC	Ver.FA-03A2 RE+
3	RF test system	TACHOY	RFTest	V1.0.0
4	RF communication test system	TACHOY	RFTest	V1.0.0

4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10^{-6}
Bandwidth	± 1.5 x 10^{-6}
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(9kHz~30MHz)	±4.51dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	

4.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	WorldPenScan Ai Reader	PenPower	MSE12	N/A	EUT
E-2	Adapter	OMIX	X2903	N/A	Auxiliary

Note: (1)The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

5 Conducted Emission

Test Requirement	:	FCC CFR 47 Part 15 Section 15.207, RSS-Gen§8.8, RSS-247§ 3.1
Test Method	:	ANSI C63.10:2020
Test Result	:	PASS
Frequency Range	:	150kHz to 30MHz
Class/Severity	:	Class B

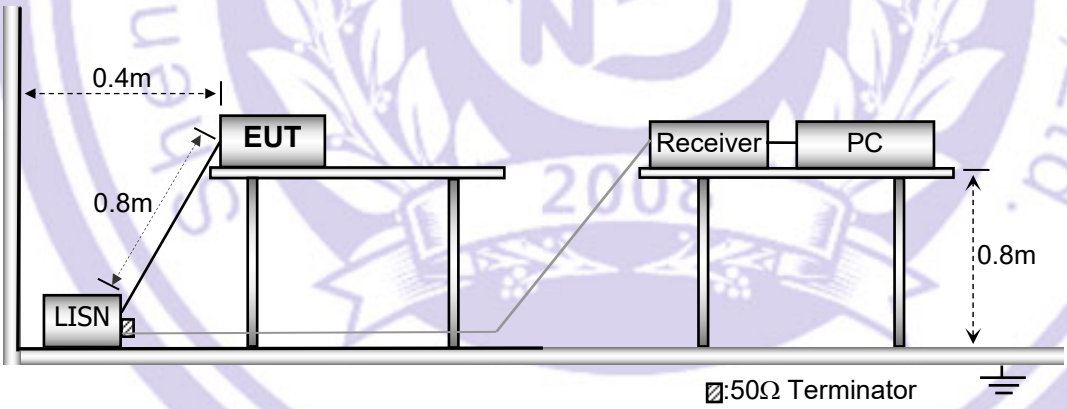
5.1 E.U.T. Operation

Operating Environment :

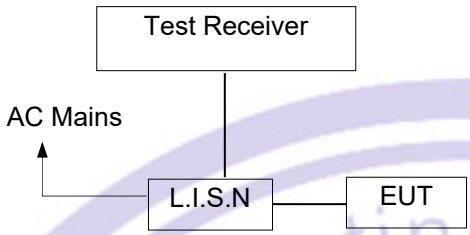
Temperature	:	25.5 °C
Humidity	:	51 % RH
Atmospheric Pressure	:	101.2kPa

5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2020.



5.3 Test SET-UP (Block Diagram of Configuration)



5.4 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.

5.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2.The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

5.6 Measurement Description

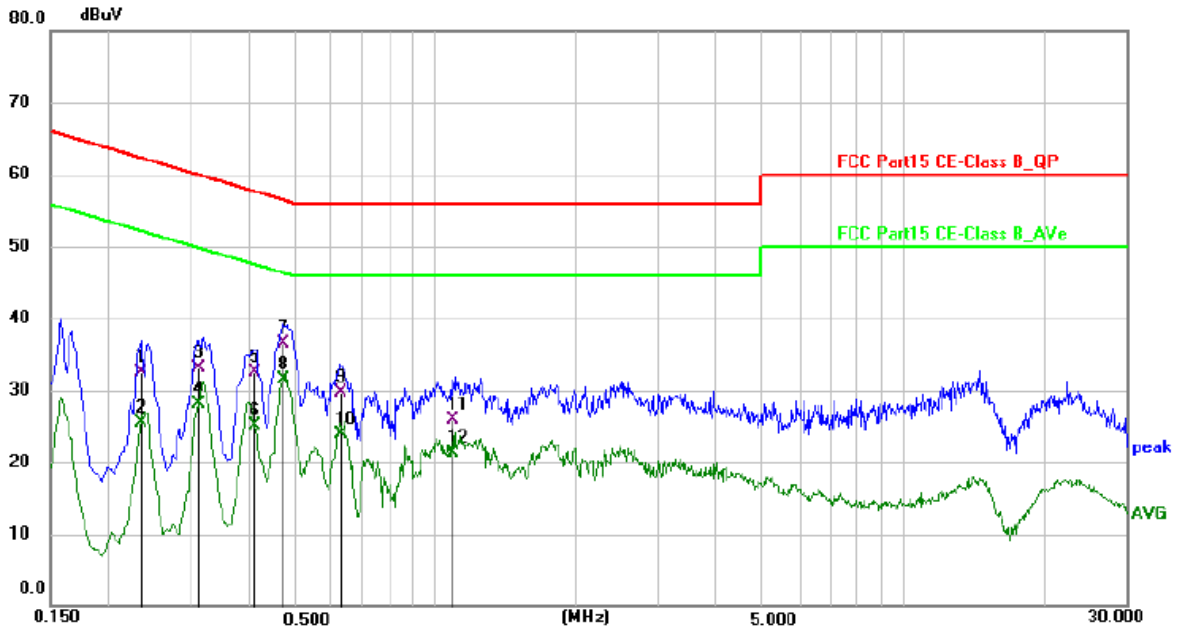
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

5.7 Conducted Emission Test Result

Pass

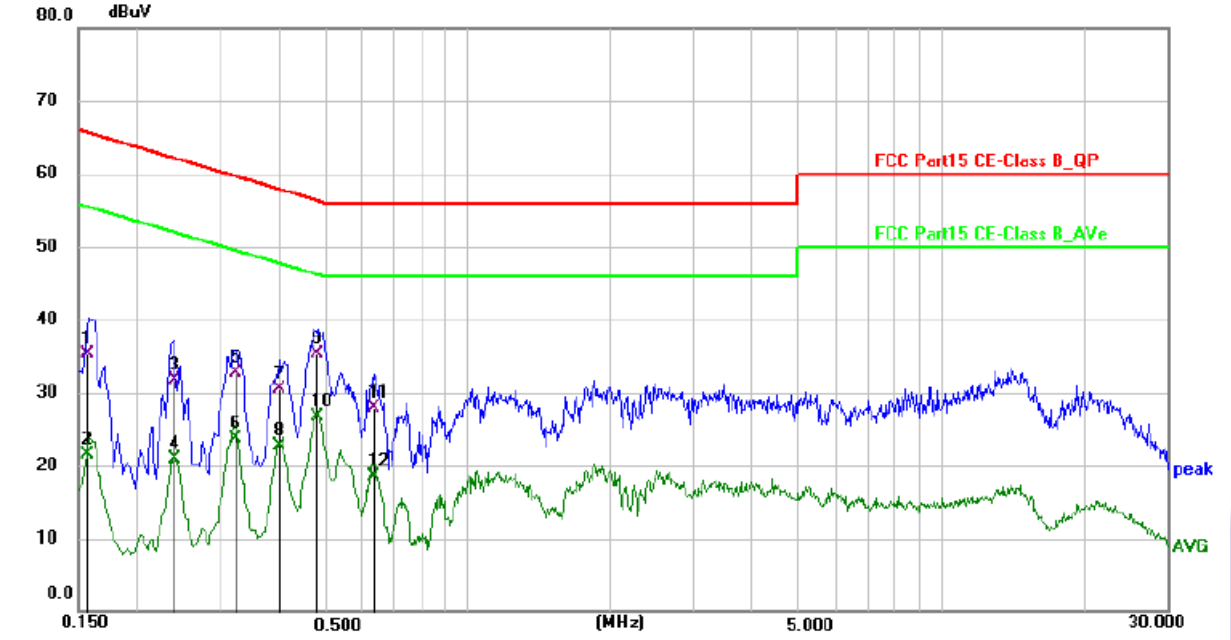
Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and the others modulation methods do not exceed the limits.

Channel:	Middle	Phase :	L



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.2357	22.76	9.67	32.43	62.25	-29.82	QP	P
2	0.2357	15.82	9.67	25.49	52.25	-26.76	AVG	P
3	0.3121	23.38	9.67	33.05	59.91	-26.86	QP	P
4	0.3121	18.40	9.67	28.07	49.91	-21.84	AVG	P
5	0.4118	22.87	9.67	32.54	57.61	-25.07	QP	P
6	0.4118	15.35	9.67	25.02	47.61	-22.59	AVG	P
7	0.4737	26.84	9.66	36.50	56.45	-19.95	QP	P
8 *	0.4737	21.85	9.66	31.51	46.45	-14.94	AVG	P
9	0.6293	19.97	9.67	29.64	56.00	-26.36	QP	P
10	0.6293	14.21	9.67	23.88	46.00	-22.12	AVG	P
11	1.0961	16.19	9.66	25.85	56.00	-30.15	QP	P
12	1.0961	11.67	9.66	21.33	46.00	-24.67	AVG	P

Channel:	Middle	Phase :	N



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1570	25.61	9.67	35.28	65.62	-30.34	QP	P
2	0.1570	11.93	9.67	21.60	55.62	-34.02	AVG	P
3	0.2398	22.00	9.66	31.66	62.10	-30.44	QP	P
4	0.2398	11.33	9.66	20.99	52.10	-31.11	AVG	P
5	0.3245	23.10	9.66	32.76	59.59	-26.83	QP	P
6	0.3245	14.01	9.66	23.67	49.59	-25.92	AVG	P
7	0.3992	20.90	9.67	30.57	57.87	-27.30	QP	P
8	0.3992	12.95	9.67	22.62	47.87	-25.25	AVG	P
9	0.4788	25.55	9.67	35.22	56.36	-21.14	QP	P
10 *	0.4788	17.01	9.67	26.68	46.36	-19.68	AVG	P
11	0.6302	18.33	9.67	28.00	56.00	-28.00	QP	P
12	0.6302	8.91	9.67	18.58	46.00	-27.42	AVG	P

Notes:
1.An initial pre-scan was performed on the line and neutral lines with peak detector.
2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3.Mesurement Level = Reading level + Correct Factor

6 Radiated Spurious Emissions

Test Requirement	:	FCC CFR47 Part 15 Section 15.209 & 15.247, RSS-Gen §8.9, RSS-Gen §8.10
Test Method	:	ANSI C63.10:2020
Test Result	:	PASS
Measurement Distance	:	3m
Limit	:	See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

6.1 EUT Operation

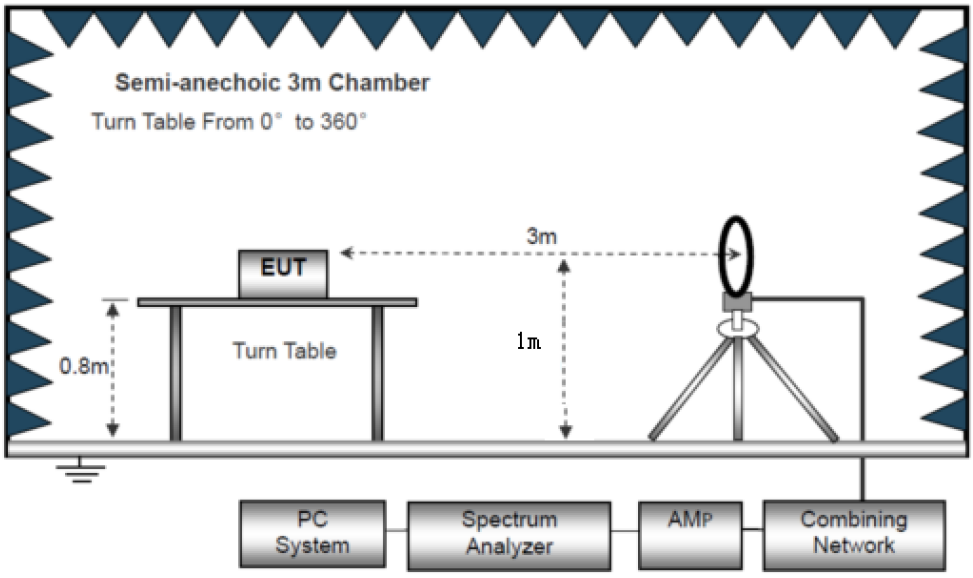
Operating Environment :

Temperature	:	23.5 °C
Humidity	:	51.1 % RH
Atmospheric Pressure	:	101.2kPa

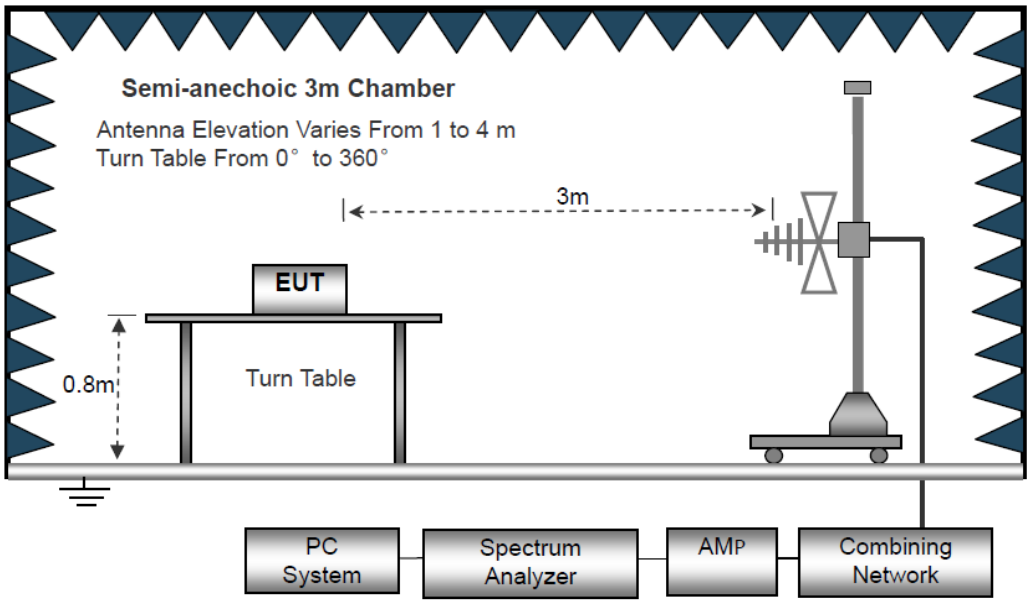
6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

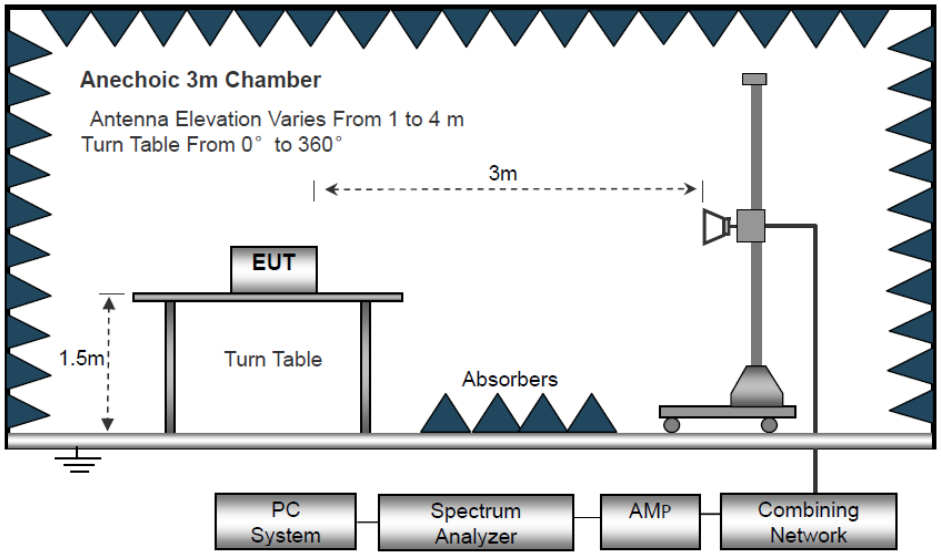
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



6.3 Spectrum Analyzer Setup

	Frequency	Detector	RBW	VBW	Remark
Receiver Setup	Below 30MHz	--	10kHz	10kHz	--
	30MHz ~ 1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		RMS	1MHz	3MHz	Average Value

6.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2020.

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.

8. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

6.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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

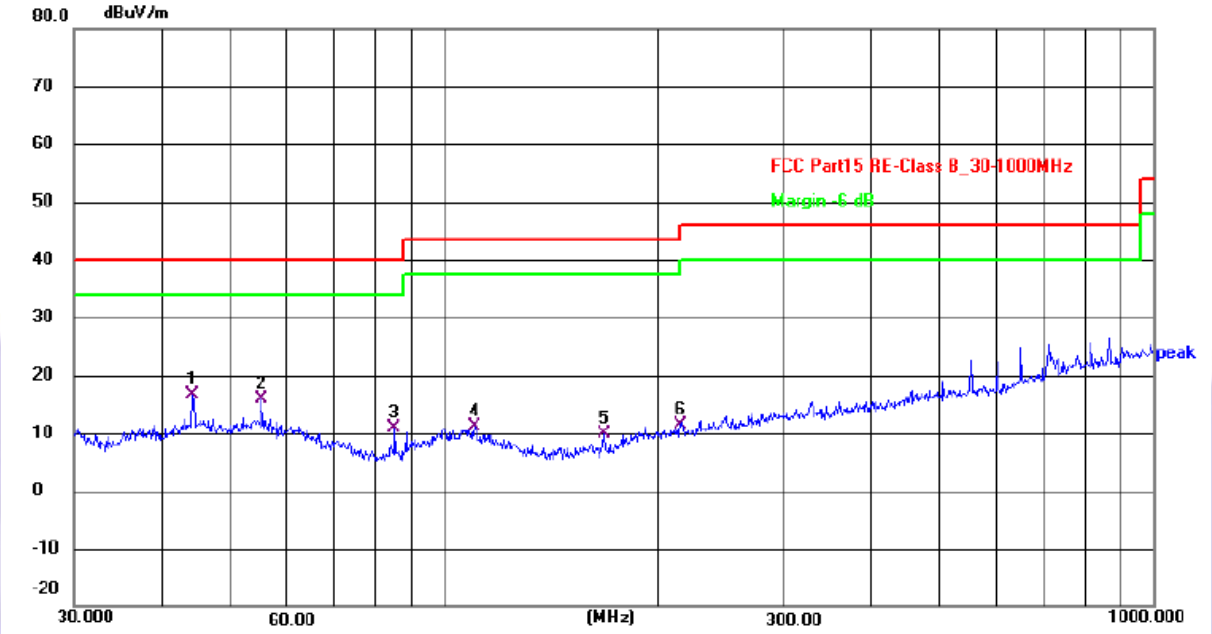
Test Frequency: 30MHz ~ 1GHz

Pass.

Please refer to the following test plots for the worst test mode (GFSK (CH00: 2402MHz)).

Shenzhen NCT Testing Technology Co., Ltd. 2008

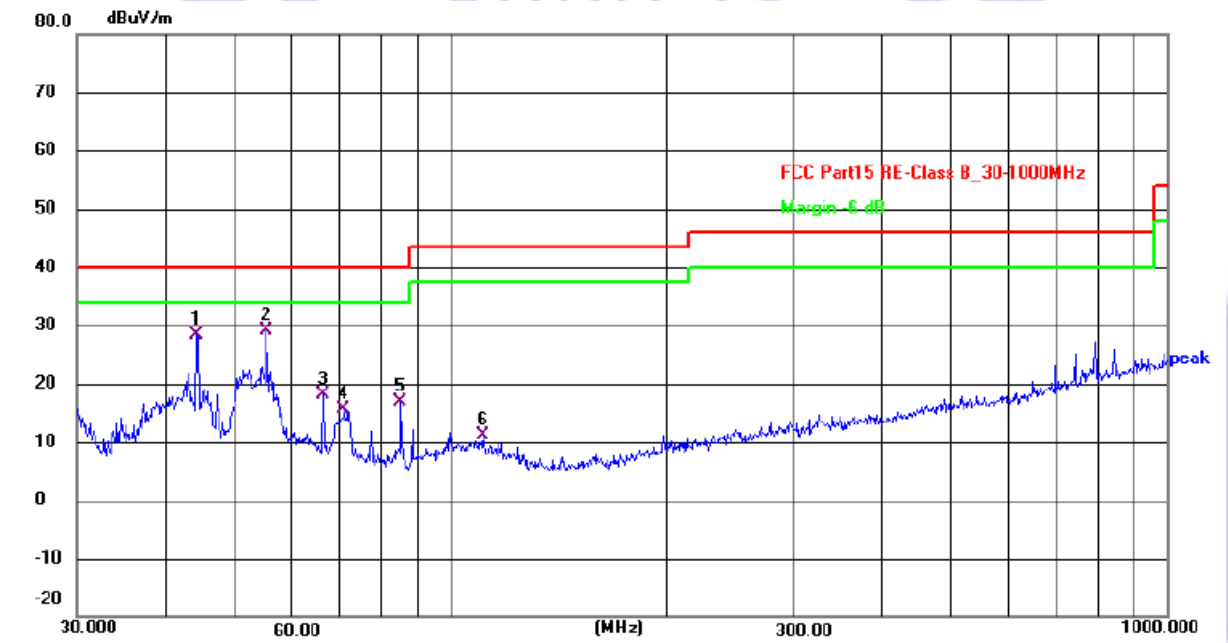
Temperature:	26℃	Relative Humidity:	54%
Pressure:	101 kPa	Polarization:	Horizontal
Test Voltage:	DC 3.8V		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	44.1202	31.18	-14.45	16.73	40.00	-23.27	QP
2	55.2207	30.62	-14.64	15.98	40.00	-24.02	QP
3	84.9993	30.15	-19.17	10.98	40.00	-29.02	QP
4	110.1816	26.85	-15.71	11.14	43.50	-32.36	QP
5	167.8242	28.54	-18.67	9.87	43.50	-33.63	QP
6	215.2678	27.26	-15.82	11.44	43.50	-32.06	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101 kPa	Polarization:	Vertical
Test Voltage:	DC 3.8V		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	44.1202	42.95	-14.45	28.50	40.00	-11.50	QP
2	55.2207	43.78	-14.64	29.14	40.00	-10.86	QP
3	66.2661	35.18	-16.95	18.23	40.00	-21.77	QP
4	70.8315	34.00	-18.26	15.74	40.00	-24.26	QP
5	84.9993	36.10	-19.17	16.93	40.00	-23.07	QP
6	110.5686	26.92	-15.78	11.14	43.50	-32.36	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Test Frequency 1GHz-25GHz:

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Low Channel:2402MHz									
V	4804.00	54.19	30.55	5.77	24.66	54.07	74.00	-19.93	Pk
V	4804.00	43.66	30.55	5.77	24.66	43.54	54.00	-10.46	AV
V	7206.00	52.84	30.33	6.32	24.55	53.38	74.00	-20.62	Pk
V	7206.00	43.88	30.33	6.32	24.55	44.42	54.00	-9.58	AV
V	9608.00	53.55	30.85	7.45	24.69	54.84	74.00	-19.16	Pk
V	9608.00	41.46	30.85	7.45	24.69	42.75	54.00	-11.25	AV
V	12010.00	52.63	31.02	8.99	25.57	56.17	74.00	-17.83	Pk
V	12010.00	43.01	31.02	8.99	25.57	46.55	54.00	-7.45	AV
H	4804.00	54.02	30.55	5.77	24.66	53.9	74.00	-20.1	Pk
H	4804.00	42.76	30.55	5.77	24.66	42.64	54.00	-11.36	AV
H	7206.00	51.4	30.33	6.32	24.55	51.94	74.00	-22.06	Pk
H	7206.00	44.13	30.33	6.32	24.55	44.67	54.00	-9.33	AV
H	9608.00	55.04	30.85	7.45	24.69	56.33	74.00	-17.67	Pk
H	9608.00	43.06	30.85	7.45	24.69	44.35	54.00	-9.65	AV
H	12010.00	53.72	31.02	8.99	25.57	57.26	74.00	-16.74	Pk
H	12010.00	43.77	31.02	8.99	25.57	47.31	54.00	-6.69	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Middle Channel:2440MHz									
V	4880.00	53.34	30.55	5.77	24.66	53.22	74.00	-20.78	Pk
V	4880.00	43.6	30.55	5.77	24.66	43.48	54.00	-10.52	AV
V	7320.00	51.75	30.33	6.32	24.55	52.29	74.00	-21.71	Pk
V	7320.00	42.75	30.33	6.32	24.55	43.29	54.00	-10.71	AV
V	9760.00	53.43	30.85	7.45	24.69	54.72	74.00	-19.28	Pk
V	9760.00	41.65	30.85	7.45	24.69	42.94	54.00	-11.06	AV
V	12200.00	51.98	31.02	8.99	25.57	55.52	74.00	-18.48	Pk
V	12200.00	43.37	31.02	8.99	25.57	46.91	54.00	-7.09	AV
H	4880.00	53.02	30.55	5.77	24.66	52.9	74.00	-21.1	Pk
H	4880.00	42.7	30.55	5.77	24.66	42.58	54.00	-11.42	AV
H	7320.00	53.81	30.33	6.32	24.55	54.35	74.00	-19.65	Pk
H	7320.00	42.87	30.33	6.32	24.55	43.41	54.00	-10.59	AV
H	9760.00	53.84	30.85	7.45	24.69	55.13	74.00	-18.87	Pk
H	9760.00	44.75	30.85	7.45	24.69	46.04	54.00	-7.96	AV
H	12200.00	53.26	31.02	8.99	25.57	56.8	74.00	-17.2	Pk
H	12200.00	42.84	31.02	8.99	25.57	46.38	54.00	-7.62	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
High Channel:2480MHz									
V	4960.00	54.45	30.55	5.77	24.66	54.33	74.00	-19.67	Pk
V	4960.00	43.36	30.55	5.77	24.66	43.24	54.00	-10.76	AV
V	7440.00	53.17	30.33	6.32	24.55	53.71	74.00	-20.29	Pk
V	7440.00	42.04	30.33	6.32	24.55	42.58	54.00	-11.42	AV
V	9920.00	55.03	30.85	7.45	24.69	56.32	74.00	-17.68	Pk
V	9920.00	41.66	30.85	7.45	24.69	42.95	54.00	-11.05	AV
V	12400.00	53.69	31.02	8.99	25.57	57.23	74.00	-16.77	Pk
V	12400.00	43.15	31.02	8.99	25.57	46.69	54.00	-7.31	AV
H	4960.00	51.99	30.55	5.77	24.66	51.87	74.00	-22.13	Pk
H	4960.00	44.21	30.55	5.77	24.66	44.09	54.00	-9.91	AV
H	7440.00	54.04	30.33	6.32	24.55	54.58	74.00	-19.42	Pk
H	7440.00	42.52	30.33	6.32	24.55	43.06	54.00	-10.94	AV
H	9920.00	53.71	30.85	7.45	24.69	55	74.00	-19	Pk
H	9920.00	44.3	30.85	7.45	24.69	45.59	54.00	-8.41	AV
H	12400.00	53.99	31.02	8.99	25.57	57.53	74.00	-16.47	Pk
H	12400.00	44.24	31.02	8.99	25.57	47.78	54.00	-6.22	AV

Note: 1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,

Margin= Emission Level - Limit

2. If peak below the average limit, the average emission was no test.

3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

	Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/m)	Detector Type	Result
GFSK	Low Channel: 2402MHz									
	H	2390.00	58.35	35.17	3.48	27.49	54.15	74.00	PK	PASS
	H	2390.00	51.12	35.17	3.48	27.49	46.92	54.00	AV	PASS
	H	2400.00	61.56	35.16	3.49	27.52	57.41	74.00	PK	PASS
	H	2400.00	51.46	35.16	3.49	27.52	47.31	54.00	AV	PASS
	V	2390.00	59.4	35.17	3.48	27.49	55.2	74.00	PK	PASS
	V	2390.00	51.87	35.17	3.48	27.49	47.67	54.00	AV	PASS
	V	2400.00	61.01	35.16	3.49	27.52	56.86	74.00	PK	PASS
	V	2400.00	50.67	35.16	3.49	27.52	46.52	54.00	AV	PASS
	High Channel: 2480MHz									
	H	2483.50	58.71	35.11	3.56	27.75	54.91	74.00	PK	PASS
	H	2483.50	50.19	35.11	3.56	27.75	46.39	54.00	AV	PASS
	H	2500.00	59.99	35.1	3.57	27.8	56.26	74.00	PK	PASS
	H	2500.00	50.34	35.1	3.57	27.8	46.61	54.00	AV	PASS
	V	2483.50	59.28	35.11	3.56	27.75	55.48	74.00	PK	PASS
	V	2483.50	51.5	35.11	3.56	27.75	47.7	54.00	AV	PASS
	V	2500.00	58.9	35.1	3.57	27.8	55.17	74.00	PK	PASS
	V	2500.00	51.02	35.1	3.57	27.8	47.29	54.00	AV	PASS

Remark:

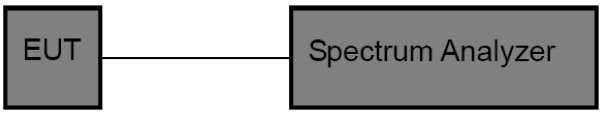
1. Emission Level = Meter Reading + Antenna Factor + Cable Loss − Pre-amplifier, Margin= Emission Level - Limit

2. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

7 Conduct Band Edge And Spurious Emissions Measurement

Test Requirement	:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). RSS-247 § 5.5
Test Method	:	ANSI C63.10:2020
Test Limit	:	Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). RSS-247 § 5.5: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.1 Test Setup



7.2 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

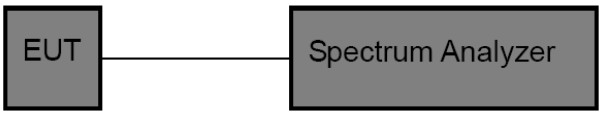
7.3 Test Result

Please see the attchment for the data.

8 6dB Bandwidth Measurement

Test Requirement	:	FCC CFR47 Part 15 Section 15.247, RSS-247, RSS-Gen 5.2(a), RSS-Gen 6.7
Test Method	:	ANSI C63.10:2020
Test Limit		Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1 Test Setup



8.2 Test Procedure

For 6dB Bandwidth Measurement

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

For 99% Bandwidth Measurement

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 1%-5% OBW, VBW ≥ 3RBW

8.3 Test Result

Please see the attchment for the data.

9 Maximum Peak Output Power

Test Requirement	:	FCC CFR47 Part 15 Section 15.247, RSS-247 § 5.4
Test Method	:	ANSI C63.10:2020
Test Limit	:	Regulation 15.247 (b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. RSS-247 § 5.4 For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e)

9.1 Test Setup

9.2 Test Procedure

A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

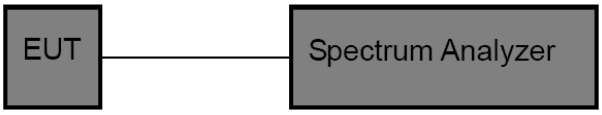
9.3 Test Result

Modulation	Channel Frequency (MHz)	Peak Power Output(dBm)	Conducted power limit(dBm)	Antenna Gain（dBi）	EIRP (dBm)	EIRP Limit(dBm)	Verdict
GFSK	2402	-0.21	30	0.88	0.67	36.02	PASS
	2440	-1.89	30	0.88	-1.01	36.02	PASS
	2480	-1.95	30	0.88	-1.07	36.02	PASS

10 Power Spectral density

Test Requirement	:	FCC CFR47 Part 15 Section 15.247,RSS-247 §5.2 (b)
Test Method	:	ANSI C63.10:2020
Test Limit	:	Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. RSS-247 §5.2 (b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

10.1 Test Setup



10.2 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

10.3 Test Result

Please see the attchment for the data.

11 Antenna Application

11.1 Antenna Requirement

15.203 requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

According to RSS-GEN section 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

11.2 Result

The antenna is Internal Antenna, the best case gain of the antennas is 0.88 dBi, reference to the attachment for details.

12 Test Setup Photos and EUT Photos

Please see the attachment for details.

******THE END REPORT******