TEST REPORT

Reference No.	:	WTF23D07163720W003
FCC ID	:	2AW4Z-SRADIO
Applicant.....	:	Spirit System
Address.....	:	K Olsine 28, 73514 Orlova-Lutyne Czech Republic
Manufacturer	:	Spirit System
Address.....	:	K Olsine 28, 73514 Orlova-Lutyne Czech Republic
Product.....	:	Spirit WAVE
Model(s).	:	Spirit WAVE
Standards.....	:	FCC 47CFR Part 15.247
Date of Receipt sample	:	2023-08-30
Date of Test	:	2023-09-15 to 2024-10-28
Date of Issue.....	:	2024-11-13
Test Result.....	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:
Waltek Testing Group Co., Ltd.
Address: No. 77, Houjie Section, Guantai Road, Houjie Town, Dongguan City, Guangdong, China
Tel: +86-769-2267 6998
Fax: +86-769-2267 6828

Compiled by:

James Cheng / Project Engineer

Approved by:

Deval Qin / Designated Reviewer

2 Contents

3 Revision History

Test Report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF23D07163720W003	2023-08-30	2023-09-15 to 2024-10-28	2024-11-13	Original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	Spirit WAVE
Model(s):	Spirit WAVE
Model Description:	N/A
Test Sample No.:	1-1/1
Bluetooth Version:	5.0
Hardware Version:	1.0
Software Version:	1.0.11

4.2 Details of E.U.T.

Operation Frequency:	2402~2480MHz
Max. RF output power:	6.5dBm
Type of Modulation:	GFSK, π/4DQPSK, 8DPSK
Antenna installation:	ProAnt 2.4G + 5G Niche antenna
Antenna Gain:	3.5dBi

Note:
#: The antenna gain is provided by the applicant, and the applicant should be responsible for its authenticity, WALTEK lab has not verified the authenticity of its information.

Ratings:	Input: DC 5V
Battery:	DC 3.8V, 6900mAh, 26.2Wh

4.3 Channel List

Normal

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	-	-

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests; the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2441MHz	2480MHz

4.5 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

5 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious emissions	15.247(d)	PASS*
Band edge	15.247(d) 15.205(a)	PASS*
Conducted Emission	15.207	PASS
20 dB Bandwidth and 99% Bandwidth	15.247(a)(1)	PASS*
Maximum Peak Output Power	15.247(b)(1)	PASS*
Frequency Separation	15.247(a)(1)	PASS*
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS*
Dwell time	15.247(a)(1)(iii)	PASS*
Antenna Requirement	15.203	Complies
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS
*: The test result refer to the report UL-RPT-RP13337971-1016A V3.0, which FCC ID is 2ABCB-RPIRM0. The date of modular grant is 11/03/2020.		

6 Equipment Used during Test

6.1 Equipments List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Calibration Due Date
Conducted Emissions 1#						
1	EMI Test Receiver	R&S	ESCI	100947	2023-07-27 2024-07-18	2024-07-18 2025-07-17
2	LISN	R&S	ENV216	100115	2023-07-27 2024-07-18	2024-07-18 2025-07-17
3	Cable	Top	TYPE16(3.5M)	-	2023-07-27 2024-07-18	2024-07-18 2025-07-17
3m Semi-anechoic Chamber for Radiation Emissions 1#						
1	Spectrum Analyzer	R&S	FSP30	100091	2023-04-24 2024-04-22	2024-04-23 2025-04-21
2	Amplifier	Agilent	8447D	2944A10178	2023-07-27 2024-07-18	2024-07-18 2025-07-17
3	Tri-log Broadband Antenna	SCHWARZBECK	VULB9163	336	2023-08-07 2024-07-21	2024-07-21 2025-07-20
4	Coaxial Cable	Top	TYPE16(13M)	-	2023-04-24 2024-04-22	2024-04-23 2025-04-21
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	667	2023-01-24 2024-01-23	2024-01-23 2025-01-22
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2023-07-27 2024-07-18	2024-07-18 2025-07-17
7	Broadband Preamplifier	COMPLIANCE	PAP-1G18	2004	2023-07-27 2024-07-18	2024-07-18 2025-07-17
8	Coaxial Cable	Top	ZT26-NJ-NJ-8M/FA	-	2023-04-24 2024-04-22	2024-04-23 2025-04-21
9	Microwave Amplifier	SCHWARZBECK	BBV 9721	100472	2023-07-27 2024-07-18	2024-07-18 2025-07-17
10	Coaxial Cable	Top	ZT40-2.92J-2.92J-2.0M	17100919	2023-04-24 2024-04-22	2024-04-23 2025-04-21
3m Semi-anechoic Chamber for Radiation Emissions 2#						
1	Test Receiver	R&S	ESCI	101296	2023-04-24 2024-04-22	2024-04-23 2025-04-21
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2022-11-05 2023-11-04	2023-11-04 2024-11-03
3	Active Loop Antenna	Com-Power	AL-130R	10160007	2024-04-27	2025-04-26
4	Amplifier	ANRITSU	MH648A	M43381	2023-04-24 2024-04-22	2024-04-23 2025-04-21
5	Cable	HUBER+SUHNER	CBL2	525178	2023-04-24 2024-04-22	2024-04-23 2025-04-21

Test Software:

Test Item	Software name	Software version
Conduction disturbance Radiated Emission(3m)	EZ-EMC	EZ-EMC(RA-03A1-1)

6.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
/	/	/	/

6.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 4.99 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	± 1 x 10^{-7}Hz
RF Power	± 0.42 dB
Dwell time	1.0%
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval：95%. Confidence factor:k=2	

7 Conducted Emission

Test Requirement: FCC 47CFR Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-pea	Average
0.15 to 0.5	66 to 56*	56 to 46
0.5 to 5	56	46
5to 30	60	50

7.1 E.U.T. Operation

Operating Environment**:**

Temperature: 25.9 °C

Humidity: 51.6 % RH

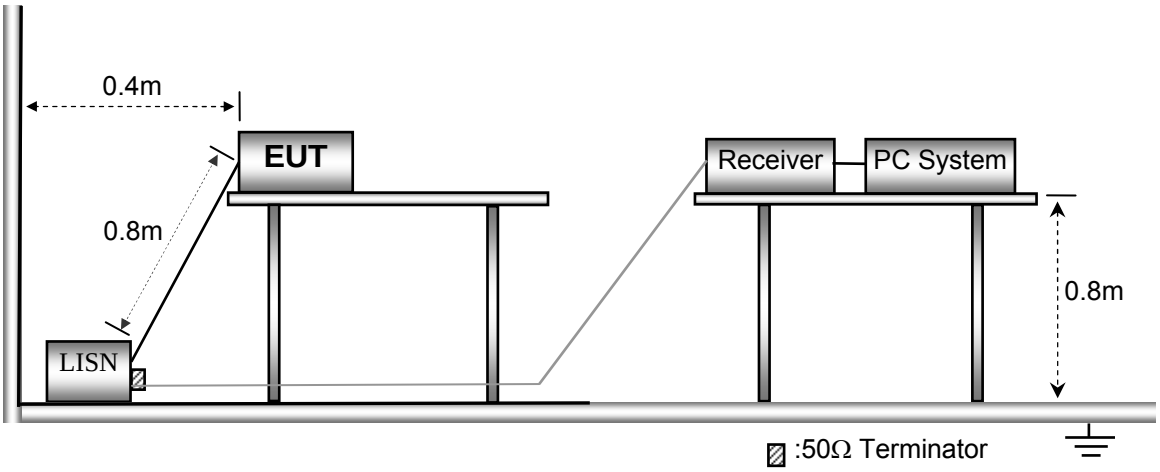
Atmospheric Pressure: 101.3kPa

EUT Operation:

The test was performed in Transmitting mode, the worst test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013.



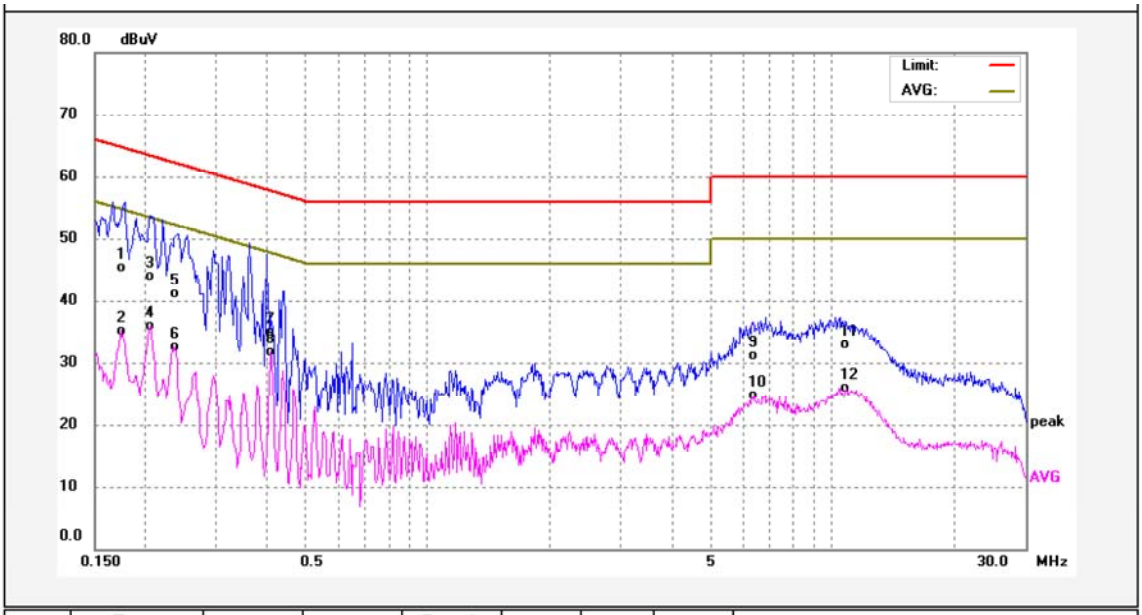
7.3 Measurement Description

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.

7.4 Conducted Emission Test Result

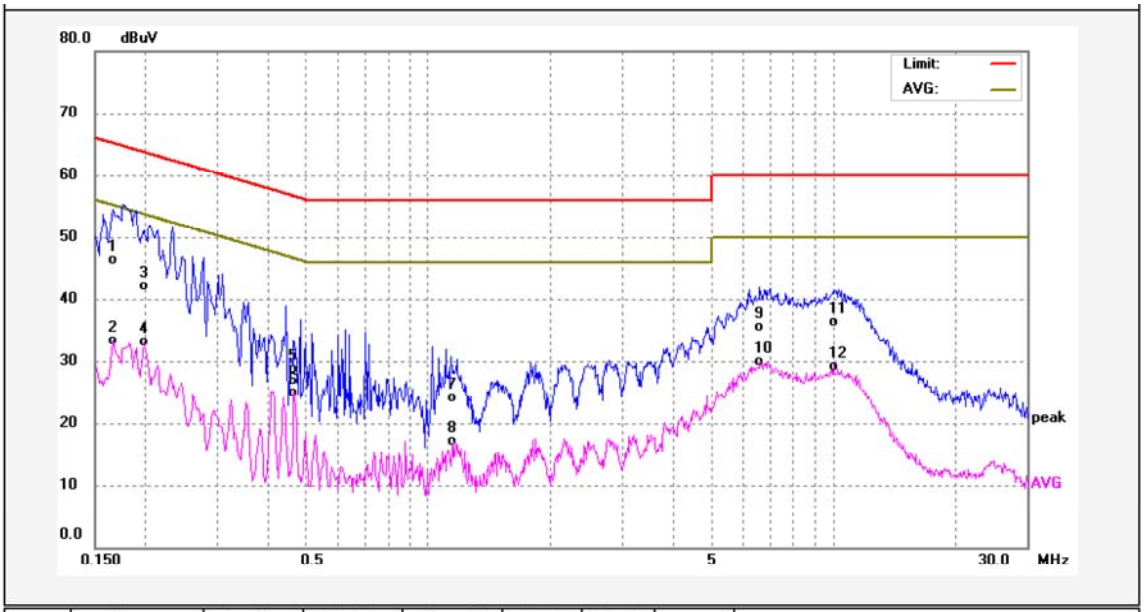
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1737	34.33	10.92	45.25	64.78	-19.53	QP	
2	0.1737	24.28	10.92	35.20	54.78	-19.58	AVG	
3	0.2058	33.07	10.93	44.00	63.37	-19.37	QP	
4	0.2058	25.06	10.93	35.99	53.37	-17.38	AVG	
5	0.2353	30.18	10.94	41.12	62.26	-21.14	QP	
6	0.2353	21.60	10.94	32.54	52.26	-19.72	AVG	
7	0.4097	24.02	10.98	35.00	57.65	-22.65	QP	
8	0.4097	20.73	10.98	31.71	47.65	-15.94	AVG	
9	6.3939	19.69	11.33	31.02	60.00	-28.98	QP	
10	6.3939	13.36	11.33	24.69	50.00	-25.31	AVG	
11	10.7939	21.46	11.50	32.96	60.00	-27.04	QP	
12	10.7939	14.49	11.50	25.99	50.00	-24.01	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1660	35.41	10.95	46.36	65.15	-18.79	QP	
2	0.1660	22.26	10.95	33.21	55.15	-21.94	AVG	
3	0.1980	31.06	10.96	42.02	63.69	-21.67	QP	
4	0.1980	22.22	10.96	33.18	53.69	-20.51	AVG	
5	0.4660	17.63	11.00	28.63	56.58	-27.95	QP	
6	0.4660	14.00	11.00	25.00	46.58	-21.58	AVG	
7	1.1496	12.98	11.03	24.01	56.00	-31.99	QP	
8	1.1496	6.06	11.03	17.09	46.00	-28.91	AVG	
9	6.6059	24.13	11.34	35.47	60.00	-24.53	QP	
10	6.6059	18.54	11.34	29.88	50.00	-20.12	AVG	
11	9.9977	24.77	11.48	36.25	60.00	-23.75	QP	
12	9.9977	17.72	11.48	29.20	50.00	-20.80	AVG	

8 Radiated Spurious Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.205 &15.209 & 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Measurement Distance: 3m

Limit:

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	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment **:**

Temperature: 25.9 °C

Humidity: 59.6 % RH

Atmospheric Pressure: 101.1kPa

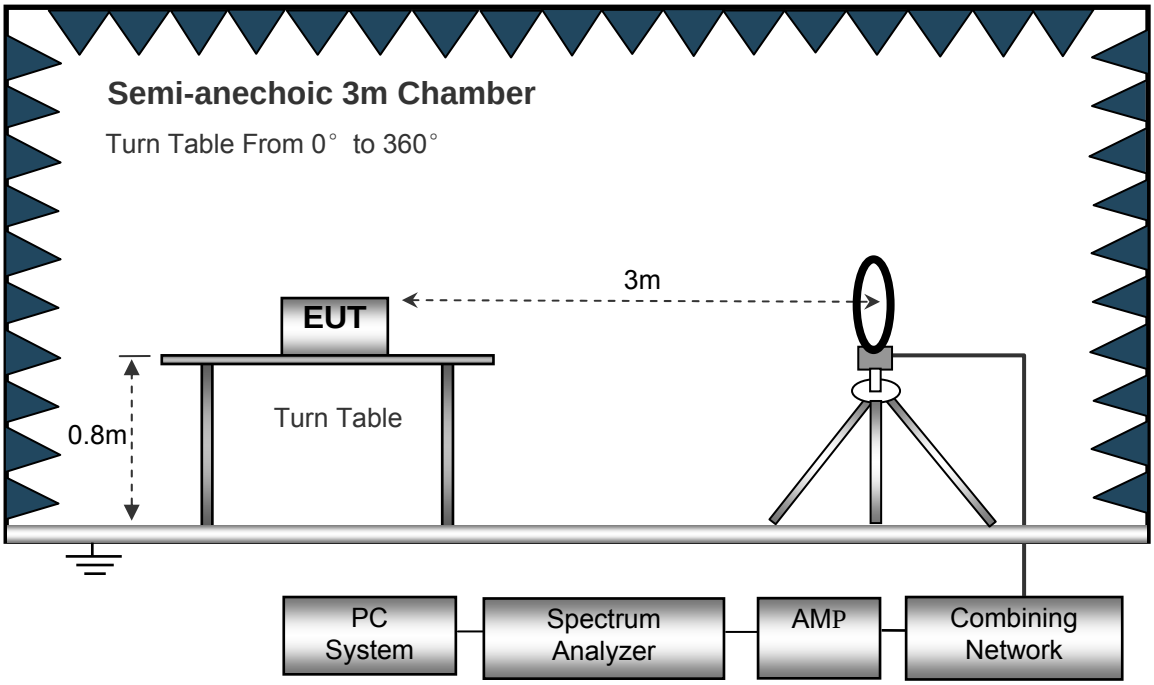
EUT Operation :

The test was performed in Transmitting mode, the worst test data were shown in the report.

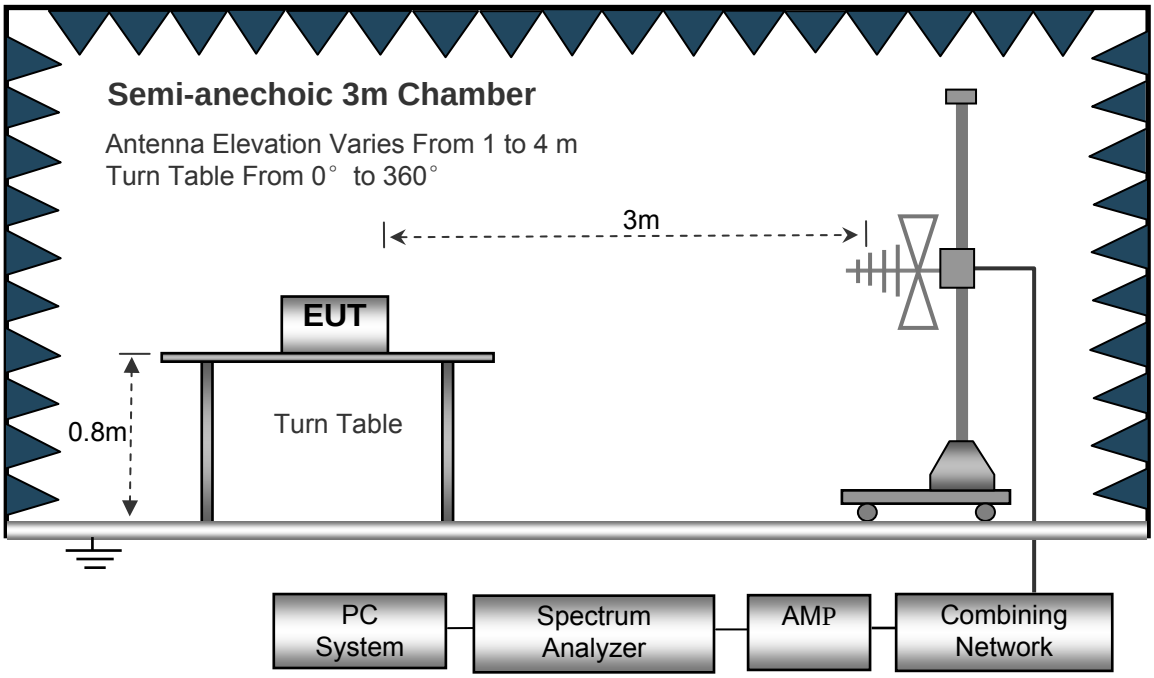
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

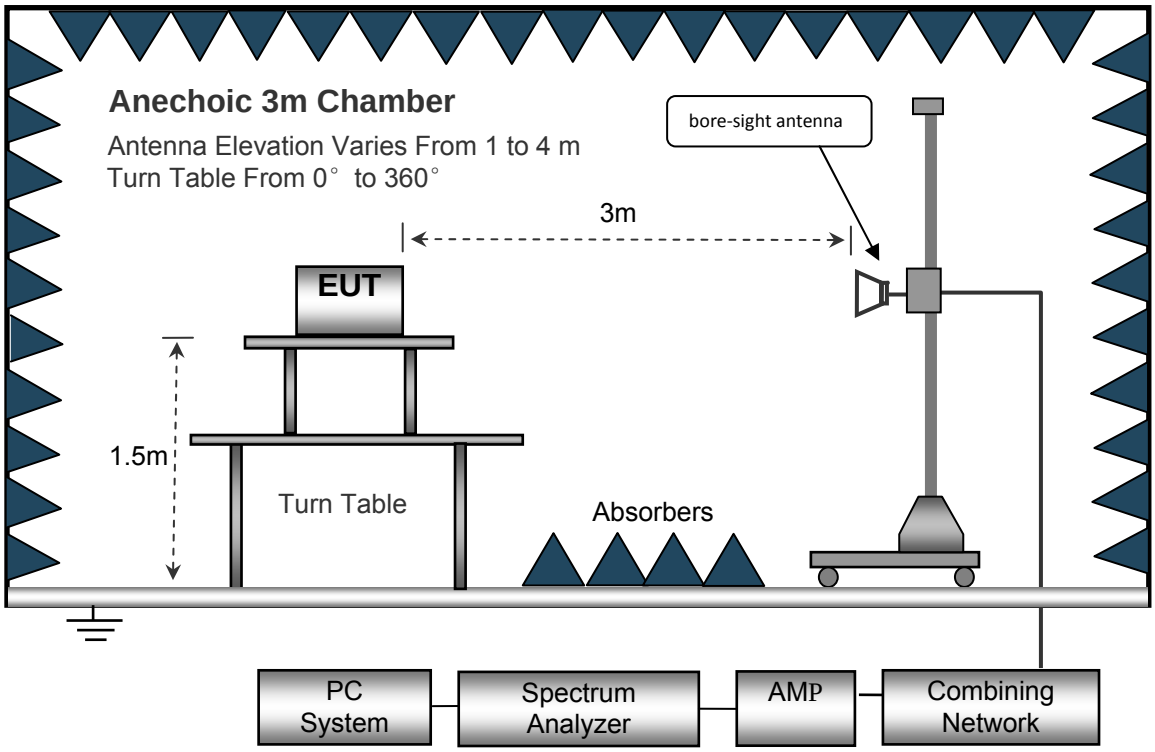
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector ..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The 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 Z position. So the data shown was the Z position only.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.6 Summary of Test Results

Test Frequency: 9kHz~30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 8GHz

Remark: only the worst data (GFSK modulation mode) were reported.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
220.45	42.00	QP	100	1.8	H	-13.22	28.78	46.00	-17.22
220.45	48.40	QP	302	1.5	V	-13.22	35.18	46.00	-10.82
4804.00	55.70	PK	59	1.8	V	-1.06	54.64	74.00	-19.36
4804.00	40.87	Ave	59	1.8	V	-1.06	39.81	54.00	-14.19
7206.00	52.05	PK	88	2.0	H	1.32	53.37	74.00	-20.63
7206.00	41.60	Ave	88	2.0	H	1.32	42.92	54.00	-11.08
2343.31	46.55	PK	93	1.9	V	-13.26	33.29	74.00	-40.71
2343.31	37.32	Ave	93	1.9	V	-13.26	24.06	54.00	-29.94
2385.84	44.39	PK	258	1.4	H	-13.02	31.37	74.00	-42.63
2385.84	37.62	Ave	258	1.4	H	-13.02	24.60	54.00	-29.40
2484.81	44.53	PK	88	1.1	V	-13.20	31.33	74.00	-42.67
2484.81	37.67	Ave	88	1.1	V	-13.20	24.47	54.00	-29.53

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel									
220.45	41.15	QP	202	1.2	H	-13.22	27.93	46.00	-18.07
220.45	47.57	QP	84	1.4	V	-13.22	34.35	46.00	-11.65
4882.00	55.51	PK	176	1.8	V	-0.62	54.89	74.00	-19.11
4882.00	39.67	Ave	176	1.8	V	-0.62	39.05	54.00	-14.95
7323.00	50.97	PK	280	1.6	H	2.21	53.18	74.00	-20.82
7323.00	40.46	Ave	280	1.6	H	2.21	42.67	54.00	-11.33
2324.73	46.28	PK	161	1.9	V	-13.19	33.09	74.00	-40.91
2324.73	36.72	Ave	161	1.9	V	-13.19	23.53	54.00	-30.47
2359.67	43.06	PK	232	1.7	H	-13.14	29.92	74.00	-44.08
2359.67	37.33	Ave	232	1.7	H	-13.14	24.19	54.00	-29.81
2491.87	44.36	PK	272	1.9	V	-13.08	31.28	74.00	-42.72
2491.87	36.30	Ave	272	1.9	V	-13.08	23.22	54.00	-30.78

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel									
220.45	40.53	QP	38	1.2	H	-13.22	27.31	46.00	-18.69
220.45	46.62	QP	183	1.4	V	-13.22	33.40	46.00	-12.60
4960.00	53.61	PK	342	1.2	V	-0.24	53.37	74.00	-20.63
4960.00	39.70	Ave	342	1.2	V	-0.24	39.46	54.00	-14.54
7440.00	51.33	PK	340	1.7	H	2.84	54.17	74.00	-19.83
7440.00	40.23	Ave	340	1.7	H	2.84	43.07	54.00	-10.93
2312.28	44.09	PK	335	1.7	V	-13.19	30.90	74.00	-43.10
2312.28	38.09	Ave	335	1.7	V	-13.19	24.90	54.00	-29.10
2353.42	39.95	PK	130	1.8	H	-13.14	26.81	74.00	-47.19
2353.42	36.69	Ave	130	1.8	H	-13.14	23.55	54.00	-30.45
2497.08	43.20	PK	346	1.2	V	-13.08	30.12	74.00	-43.88
2497.08	34.26	Ave	346	1.2	V	-13.08	21.18	54.00	-32.82

Test Frequency: 8GHz~25GHz

The measurements were more than 20 dB below the limit and not recorded

9 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a ProAnt 2.4G + 5G Niche antenna, fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

10 RF Exposure

Remark: Please refer to SAR test report: WTF23D07163720W006.

11 Photographs of test setup and EUT.

Note: Please refer to appendix: Appendix-Spirit WAVE-Photos.

======End of Report======