

FCC TEST REPORT
FCC ID:2BFDF-ML602

Report Number.....: ZHT-240322023E-2

Date of Test.....: Mar. 22, 2024 - June 25, 2024

Date of issue.....: June 25, 2024

Test Result: PASS

Testing Laboratory.....: Guangdong Zhonghan Testing Technology Co., Ltd.

Address: Room 104, Building 1, Yibaolai Industrial Park, Qiaotou Community,
Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Applicant's name: Qingdao Thunderobot Technology Co.,Ltd.

Address: No. 1, Haier Road, Laoshan District, Qingdao

Manufacturer's name: Qingdao Thunderobot Technology Co.,Ltd.

Address: No. 1, Haier Road, Laoshan District, Qingdao

Test specification:

Standard.....: FCC Part 15 Subpart C Section 15.249

Test procedure.....: ANSI C63.10:2013

Non-standard test method: N/A

This device described above has been tested by ZHT, 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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Product name.....: Thunderobot gaming mouse

Trademark: THUNDEROBOT

Model/Type reference.....: ML602, ML602 black, ML602 white

Model difference.....: ML602 is tested model, other models are derivative models.
The models are identical in circuit, only different on the model
Names and color. So the test data of ML602 can represent
the remaining models.

Ratings.....: DC 3.7V by battery or DC 5V by USB



Testing procedure and testing location:

Testing Laboratory.....: **Guangdong Zhonghan Testing Technology Co., Ltd.**

Address.....: Room 104, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Tested by (name + signature).....: Kevin Yang

Kevin Yang

Reviewer (name + signature).....: Baret Wu

Baret Wu

Approved (name + signature).....: Levi Lee





Table of Contents

Page

1. VERSION	5
2. SUMMARY OF TEST RESULTS	6
2.1 TEST FACILITY	7
2.2 MEASUREMENT UNCERTAINTY	7
3. GENERAL INFORMATION	8
3.1 GENERAL DESCRIPTION OF EUT	8
3.2 DESCRIPTION OF TEST MODES	10
3.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	10
3.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)	10
3.5 EQUIPMENTS LIST FOR ALL TEST ITEMS	11
4.1 CONDUCTED EMISSION MEASUREMENT	13
4.1.1 POWER LINE CONDUCTED EMISSION Limits	13
4.1.2 TEST PROCEDURE	13
4.1.3 DEVIATION FROM TEST STANDARD	13
4.1.4 TEST SETUP	14
4.1.5 EUT OPERATING CONDITIONS	14
4.1.6 TEST RESULTS	15
4.2 RADIATED EMISSION MEASUREMENT	17
4.2.1 RADIATED EMISSION LIMITS	17
4.2.2 TEST PROCEDURE	18
4.2.3 DEVIATION FROM TEST STANDARD	18
4.2.4 TEST SETUP	19
4.2.5 EUT OPERATING CONDITIONS	20
5.RADIATED BAND EMISSION MEASUREMENT	25
5.1 TEST REQUIREMENT:	25
5.2 TEST PROCEDURE	25
5.3 DEVIATION FROM TEST STANDARD	25
5.4 TEST SETUP	26
7. CHANNEL BANDWIDTH	27
7.1 APPLIED PROCEDURES / LIMIT	27
7.2 TEST PROCEDURE	27
7.3 DEVIATION FROM STANDARD	27
7.4 TEST SETUP	27
7.5 EUT OPERATION CONDITIONS	27
7.6 TEST RESULTS	28



Table of Contents

Page

8.ANTENNA REQUIREMENT	30
9. TEST SETUP PHOTOS	31
10. EUT CONSTRUCTIONAL DETAILS	31



1. VERSION

Report No.	Version	Description	Approved
ZHT-240322023E-2	Rev.01	Initial issue of report	June 25, 2024

2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.249) , Subpart C			
Standard Section	Test Item	Judgment	Remark
FCC part 15.207	AC Power Line Conducted Emission	PASS	
FCC part 15.249	Channel Bandwidth& 99% OCB	PASS	
FCC part 15.249	Band Edge	PASS	
FCC part 15.205/15.209	Spurious Emission	PASS	
FCC part 15.249 (a)	Field Strength of Fundamental	PASS	

NOTE:

(1)" N/A" denotes test is not applicable in this Test Report

2.1 TEST FACILITY

Guangdong Zhonghan Testing Technology Co., Ltd.
Add. : Room 104, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District
Shenzhen, Guangdong, China

FCC Registration Number:255941
Designation Number: CN0325
IC Registered No.: 29832
CAB identifier: CN0143

2.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 % .

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power conducted	$\pm 0.16\text{dB}$
3	Spurious emissions conducted	$\pm 0.21\text{dB}$
4	All emissions radiated(9k-30MHz)	$\pm 4.68\text{dB}$
5	All emissions radiated(<1G)	$\pm 4.68\text{dB}$
6	All emissions radiated(>1G)	$\pm 4.89\text{dB}$
7	Temperature	$\pm 0.5^{\circ}\text{C}$
8	Humidity	$\pm 2\%$
9	Occupied Bandwidth	$\pm 4.96\text{dB}$



3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Product Name:	Thunderobot gaming mouse
Test Model No.:	ML602
Hardware Version:	V1.0
Software Version:	V1.0
Sample(s) Status:	Engineer sample
Operation Frequency:	2402MHz~2480MHz
Channel Numbers:	40
Channel Separation:	1MHz
Modulation Type:	GFSK
Antenna Type:	PCB antenna
Antenna gain:	-2.39dBi
Power supply:	DC 3.7V by battery or DC 5V by USB

Channel List

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402 MHz	11	2422 MHz	21	2442 MHz	31	2462 MHz
2	2404 MHz	12	2424 MHz	22	2444 MHz	32	2464 MHz
3	2406 MHz	13	2426 MHz	23	2446 MHz	33	2466 MHz
4	2408 MHz	14	2428 MHz	24	2448 MHz	34	2468 MHz
5	2410 MHz	15	2430 MHz	25	2450 MHz	35	2470 MHz
6	2412 MHz	16	2432 MHz	26	2452 MHz	36	2472 MHz
7	2414 MHz	17	2434 MHz	27	2454 MHz	37	2474 MHz
8	2416 MHz	18	2436 MHz	28	2456 MHz	38	2476 MHz
9	2418 MHz	19	2438 MHz	29	2458 MHz	39	2478 MHz
10	2420 MHz	20	2440 MHz	30	2460 MHz	40	2480 MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

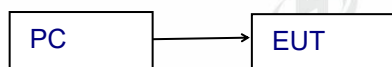
Channel	Frequency
The lowest channel	2402MHz
The middle channel	2440MHz
The Highest channel	2480MHz

3.2 DESCRIPTION OF TEST MODES

Transmitting mode	Keep the EUT in continuously transmitting mode
Remark: EUT use new battery during the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

3.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Emission



Conducted Spurious



3.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

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	Adapter	N/A	HW-059200CHQ	N/A	AE
E-2	Laptop	Lenovo	ThinkPad E480	/	AE

Item	Shielded Type	Ferrite Core	Length	Note

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.



3.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation Test equipment

Item	Equipment	Manufacturer	Model	Last Cal.	Next Cal.
1	Receiver	R&S	ESCI	May 10, 2024	May 09, 2025
2	Loop antenna	EMCI	LAP600	May 10, 2024	May 09, 2025
3	Amplifier	Schwarzbeck	BBV 9743 B	May 10, 2024	May 09, 2025
4	Amplifier	Schwarzbeck	BBV 9718 B	May 10, 2024	May 09, 2025
5	Bilog Antenna	Schwarzbeck	VULB9162	Aug 04, 2024	Aug 03, 2025
6	Horn Antenna	Schwarzbeck	BBHA9120D	May 16, 2024	May 15, 2025
7	Horn Antenna	A.H.SYSTEMS	SAS574	May 10, 2024	May 09, 2025
8	Amplifier	AEROFLEX	100KHz-40GHz	May 10, 2024	May 09, 2025
9	Spectrum Analyzer	R&S	FSV40	May 16, 2024	May 15, 2025
11	966 Anechoic Chamber	EMToni	9m6m6m	May 10, 2024	May 09, 2025
12	Spectrum Analyzer	KEYSIGHT	N9020A	May 10, 2024	May 09, 2025
13	WIDBAND RADIO COMMUNICATION TESTER	R&S	CMW500	May 10, 2024	May 09, 2025
14	Single Generator	Agilent	N5182A	May 10, 2024	May 09, 2025
15	Power Sensor	MWRFTest	MW100-RFCB	May 10, 2024	May 09, 2025
16	Audio analyzer	R&S	UPL	May 10, 2024	May 09, 2025
17	Single Generator	R&S	SMB100A	May 10, 2024	May 09, 2025
18	Power Amplifier Shielding Room	EMToni	2m3m3m	May 10, 2024	May 09, 2025

Conduction Test equipment

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Receiver	R&S	ESCI	May 10, 2024	May 09, 2025
LISN	R&S	ENV216	May 10, 2024	May 09, 2025
ISN CAT 6	Schwarzbeck	NTFM 8158	May 10, 2024	May 09, 2025
ISN CAT 5	Schwarzbeck	CAT5 8158	May 10, 2024	May 09, 2025
Capacitive Voltage Probe	Schwarzbeck	CVP 9222 C	May 10, 2024	May 09, 2025
Current Transformer Clamp	Schwarzbeck	SW 9605	May 10, 2024	May 09, 2025
CE Shielding Room	EMToni	9m4m3m	Nov. 25, 2021	Nov. 24, 2024

Conducted Test equipment

Equipment	Manufacturer	Model	Instrument number	Last Cal.	Next Cal.
Spectrum Analyzer	KEYSIGHT	N9020A	ZH-E032	May 10, 2024	May 09, 2025
Single Generator	Agilent	N5182A	ZH-E034	May 10, 2024	May 09, 2025



4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto

4.1.1 POWER LINE CONDUCTED EMISSION Limits

FREQUENCY (MHz)	Limit (dBuV)		Standard
	QP	AVG	
0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

(1) *Decreases with the logarithm of the frequency.

4.1.2 TEST PROCEDURE

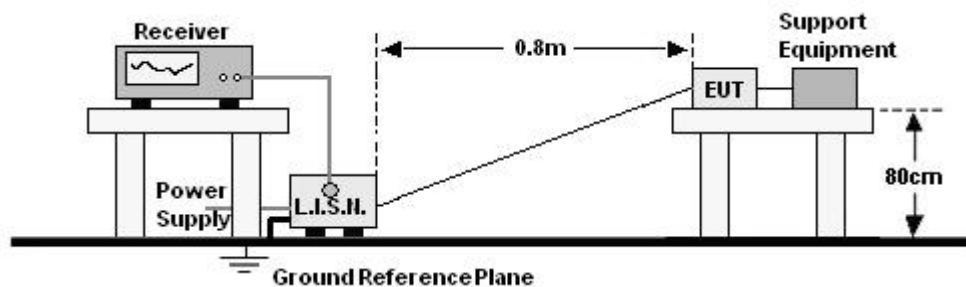
- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.3 DEVIATION FROM TEST STANDARD

No deviation



4.1.4 TEST SETUP



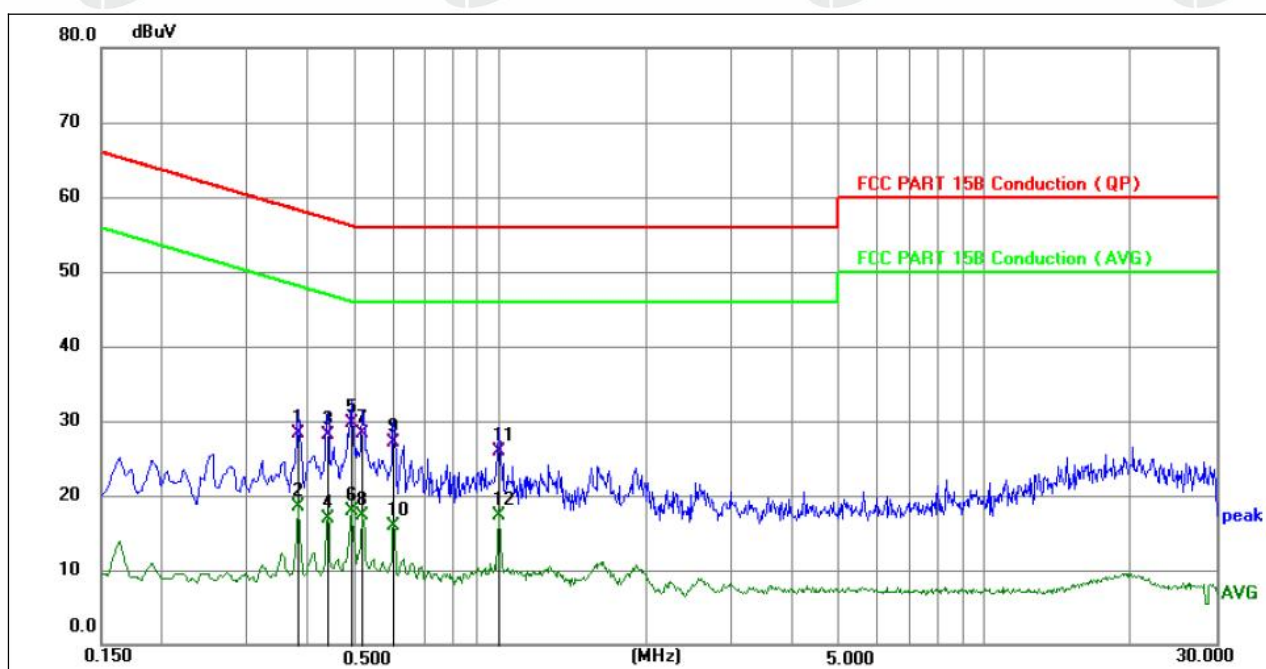
4.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.



4.1.6 TEST RESULTS

Temperature:	25.1℃	Relative Humidity :	50%
Pressure:	101kPa	Phase :	L
Test Voltage:	AC 120V/60Hz		



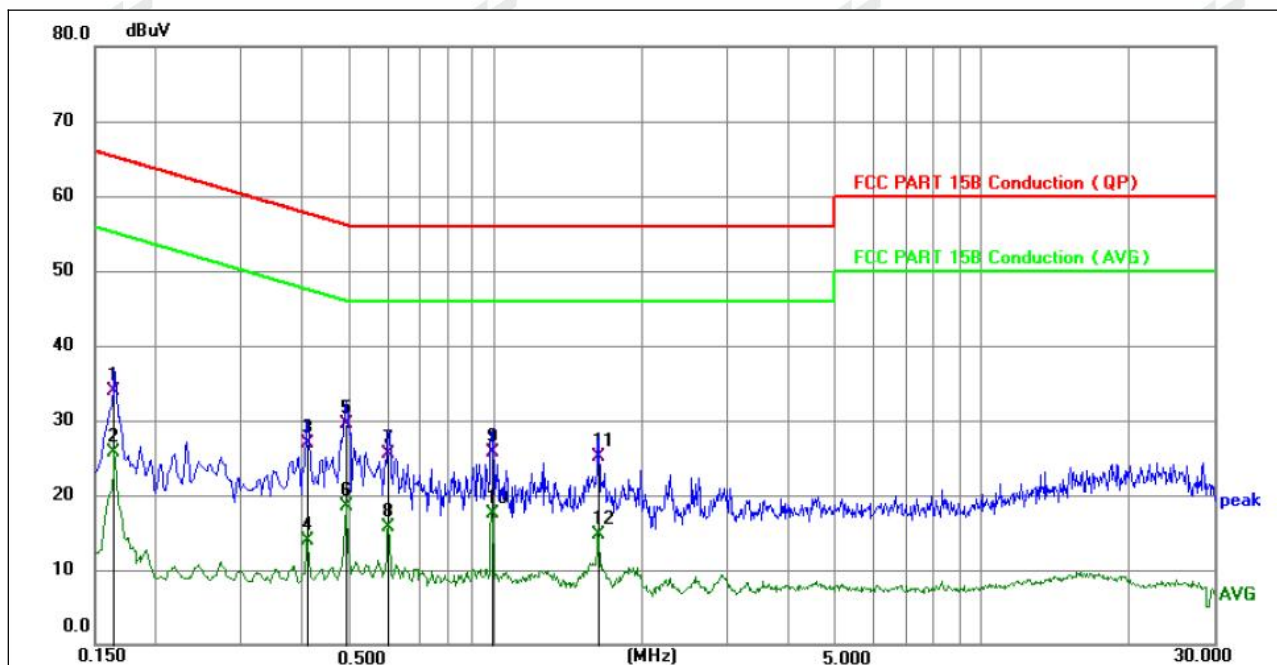
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.3831	18.39	9.91	28.30	58.21	-29.91	QP	P	
2	0.3831	8.52	9.91	18.43	48.21	-29.78	AVG	P	
3	0.4380	18.20	9.90	28.10	57.10	-29.00	QP	P	
4	0.4380	7.08	9.90	16.98	47.10	-30.12	AVG	P	
5 *	0.4920	19.81	9.89	29.70	56.13	-26.43	QP	P	
6	0.4920	8.07	9.89	17.96	46.13	-28.17	AVG	P	
7	0.5190	18.51	9.89	28.40	56.00	-27.60	QP	P	
8	0.5190	7.41	9.89	17.30	46.00	-28.70	AVG	P	
9	0.6000	17.30	9.90	27.20	56.00	-28.80	QP	P	
10	0.6000	5.92	9.90	15.82	46.00	-30.18	AVG	P	
11	0.9960	16.00	9.90	25.90	56.00	-30.10	QP	P	
12	0.9960	7.31	9.90	17.21	46.00	-28.79	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. Measurement Level = Reading level + Correct Factor
4. The test data shows only the worst case GFSK-1M Low Channel:2402MHz.



Temperature:	25.1℃	Relative Humidity :	50%
Pressure:	101kPa	Phase :	N
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1635	23.99	9.91	33.90	65.28	-31.38	QP	P	
2	0.1635	15.82	9.91	25.73	55.28	-29.55	AVG	P	
3	0.4104	17.00	9.90	26.90	57.64	-30.74	QP	P	
4	0.4104	4.06	9.90	13.96	47.64	-33.68	AVG	P	
5 *	0.4941	19.61	9.89	29.50	56.10	-26.60	QP	P	
6	0.4941	8.52	9.89	18.41	46.10	-27.69	AVG	P	
7	0.6000	15.70	9.90	25.60	56.00	-30.40	QP	P	
8	0.6000	5.78	9.90	15.68	46.00	-30.32	AVG	P	
9	0.9870	15.90	9.90	25.80	56.00	-30.20	QP	P	
10	0.9870	7.59	9.90	17.49	46.00	-28.51	AVG	P	
11	1.6305	15.21	9.89	25.10	56.00	-30.90	QP	P	
12	1.6305	4.83	9.89	14.72	46.00	-31.28	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. Measurement Level = Reading level + Correct Factor
4. The test data shows only the worst case GFSK-1M Low Channel:2402MHz.

4.2 RADIATED EMISSION MEASUREMENT

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average

4.2.1 RADIATED EMISSION LIMITS

Frequencies (MHz)	Field Strength (micorvolts/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

LIMITS OF RADIATED EMISSION MEASUREMENT

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

According 15.249, the field strength of emissions from intentional radiators operated within 2400MHz-2483.5 MHz shall not exceed 94dBuV/m (50mV/m).

FCC PART 15.249(a)Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:



Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
900-928MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
2400-2483.5MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
5725-5875MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
24.0-24.25GHz	250 (108dBuV/m @3m)	2500 (68dBuV/m @3m)

4.2.2 TEST PROCEDURE

- The measuring distance of at 3 m shall be used for measurements at frequency up to 25GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-chamber test. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment or of the substitution antenna shall be 0.8m; above 1GHz, the height was 1.5m, the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.
- For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.
The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
Note:
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

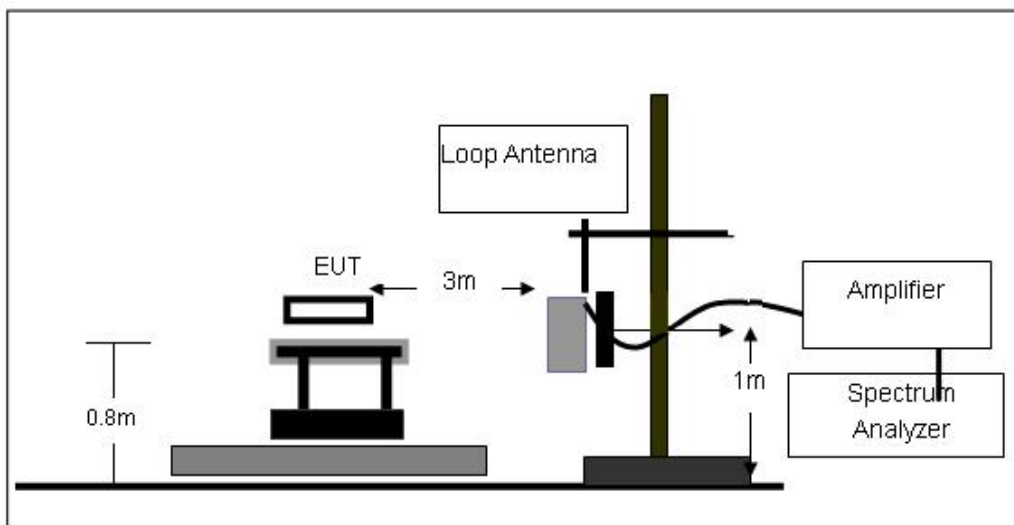
4.2.3 DEVIATION FROM TEST STANDARD

No deviation

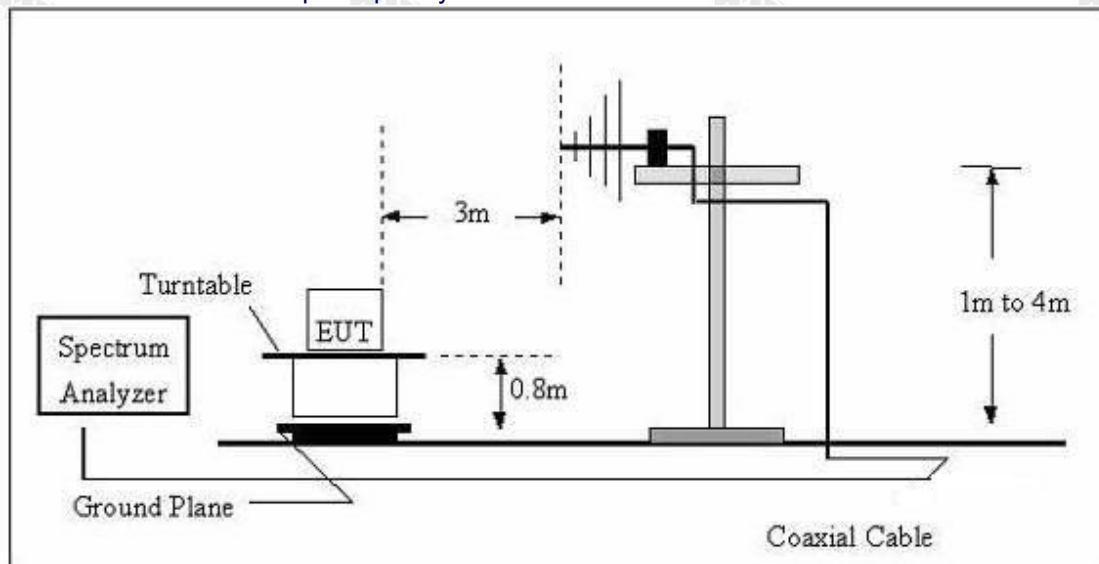


4.2.4 TEST SETUP

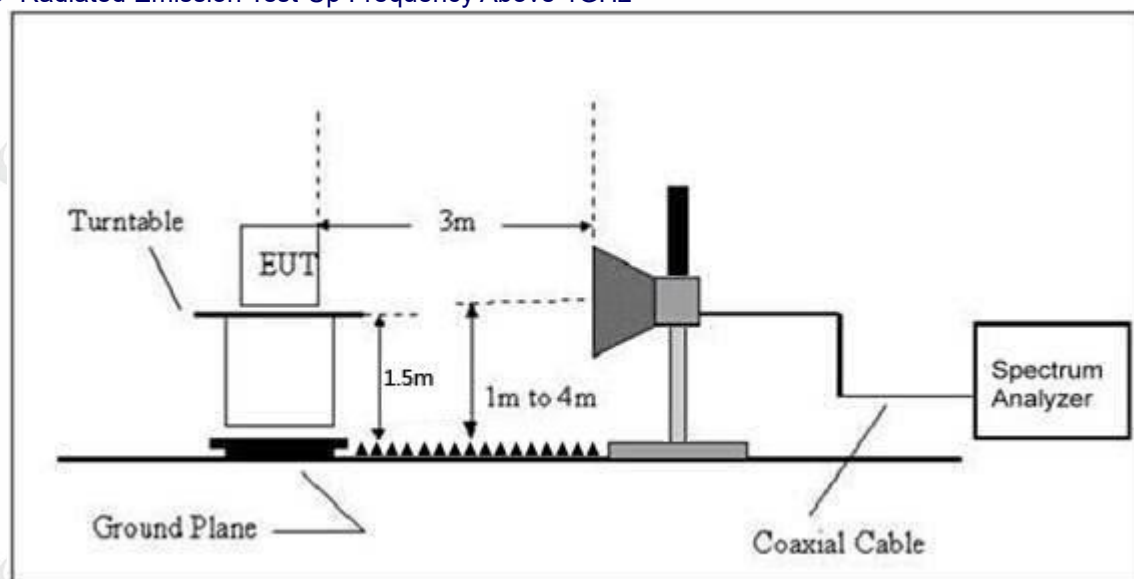
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.2.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

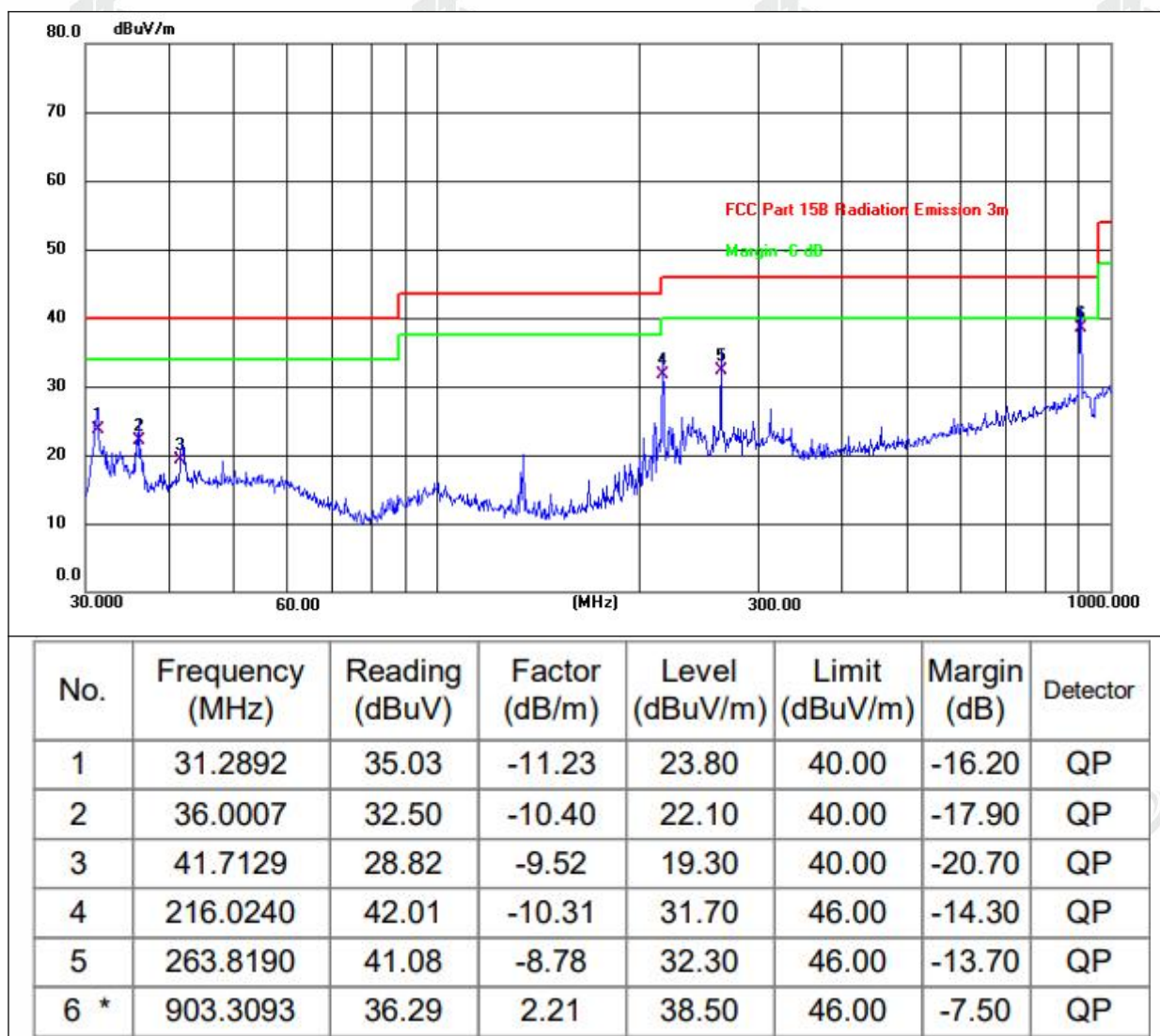
4.2.6 TEST RESULTS (Between 9KHz – 30 MHz)

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.



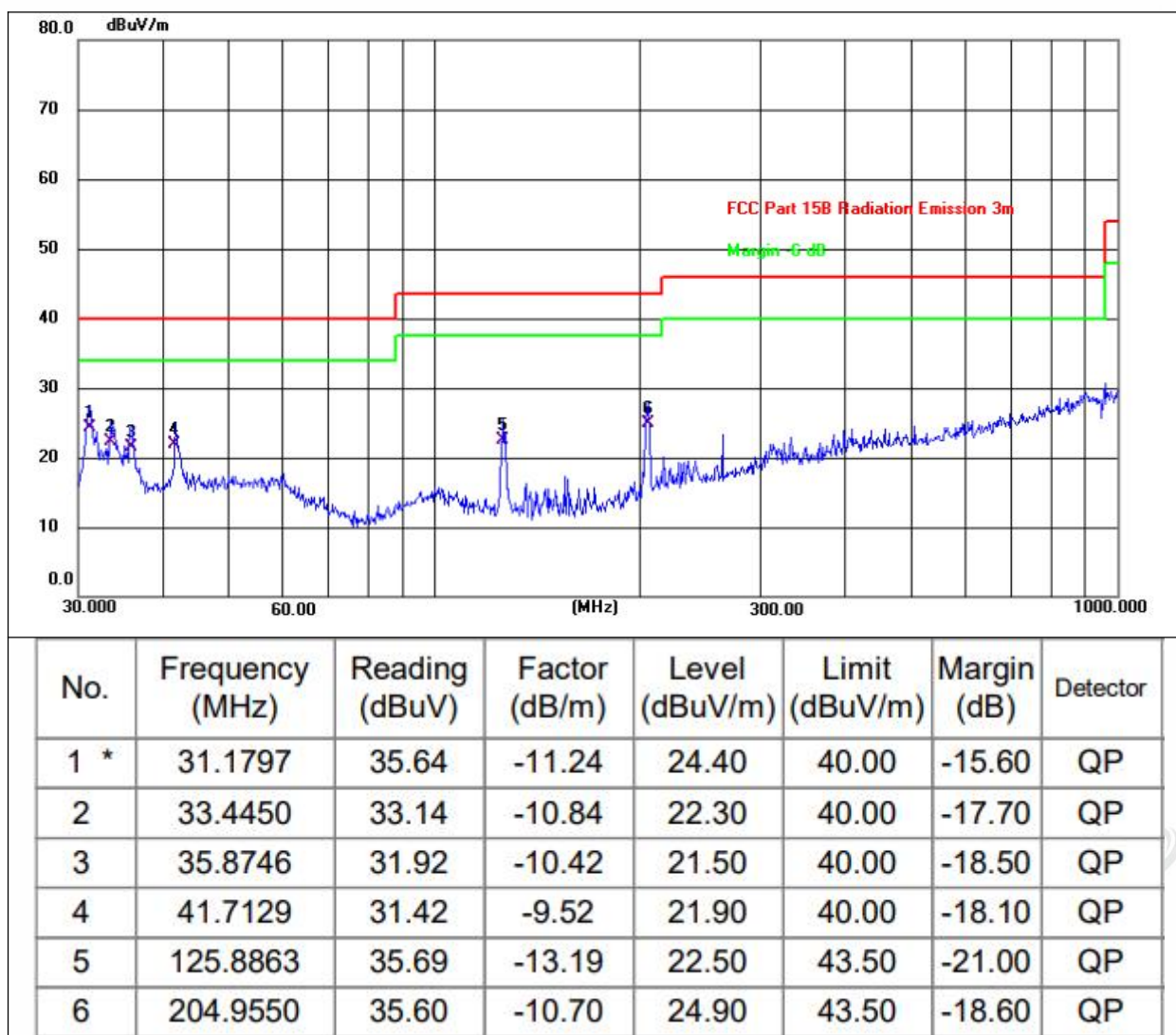
Between 30MHz – 1GHz

Temperature:	25.6°C	Relative Humidity:	47%
Pressure:	101 kPa	Polarization:	Horizontal
Test Voltage:	DC 3.7V		





Temperature:	25.6°C	Relative Humidity:	47%
Pressure:	101kPa	Polarization:	Vertical
Test Voltage:	DC 3.7V		



Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.



Fundamental Test

Mode	Polar (H/V)	Frequency	Meter Reading	Pre-amplifier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector Type
		(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
GFS K-1M	V	2402	79.64	30.55	5.77	24.66	79.52	114	-34.48	Pk
	V	2402	66.72	30.55	5.77	24.66	66.6	94	-27.4	AV
	V	2440	70.57	30.33	6.32	24.55	71.11	114	-42.89	Pk
	V	2440	62.35	30.33	6.32	24.55	62.89	94	-31.11	AV
	V	2480	71.09	30.55	5.77	24.66	70.97	114	-43.03	Pk
	V	2480	60.27	30.55	5.77	24.66	60.15	94	-33.85	AV
	H	2402	76.97	30.55	5.77	24.66	76.85	114	-37.15	Pk
	H	2402	69.27	30.55	5.77	24.66	69.15	94	-24.85	AV
	H	2440	76.48	30.33	6.32	24.55	77.02	114	-36.98	Pk
	H	2440	62.27	30.33	6.32	24.55	62.81	94	-31.19	AV
	H	2480	75.36	30.55	5.77	24.66	75.24	114	-38.76	Pk
	H	2480	61.55	30.55	5.77	24.66	61.43	94	-32.57	AV



1GHz~25GHz

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-ampli fier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Low Channel:2401MHz									
V	4802	56.59	30.55	5.77	24.66	56.47	74	-17.53	Pk
V	4802	42.88	30.55	5.77	24.66	42.76	54	-11.24	AV
V	7203	58.84	30.33	6.32	24.55	59.38	74	-14.62	Pk
V	7203	41.76	30.33	6.32	24.55	42.3	54	-11.7	AV
H	4802	59.77	30.55	5.77	24.66	59.65	74	-14.35	Pk
H	4802	42.67	30.55	5.77	24.66	42.55	54	-11.45	AV
H	7203	56.43	30.33	6.32	24.55	56.97	74	-17.03	Pk
H	7203	42.35	30.33	6.32	24.55	42.89	54	-11.11	AV
Middle Channel:2440MHz									
V	4880	56.43	30.55	5.77	24.66	56.31	74	-17.69	Pk
V	4880	41.83	30.55	5.77	24.66	41.71	54	-12.29	AV
V	7320	58.64	30.33	6.32	24.55	59.18	74	-14.82	Pk
V	7320	43.68	30.33	6.32	24.55	44.22	54	-9.78	AV
H	4880	59.08	30.55	5.77	24.66	58.96	74	-15.04	AV
H	4880	41.28	30.55	5.77	24.66	41.16	54	-12.84	Pk
H	7320	56.85	30.33	6.32	24.55	57.39	74	-16.61	AV
High Channel:2480MHz									
V	4960	55.04	30.55	5.77	24.66	54.92	74	-19.08	Pk
V	4960	41.94	30.55	5.77	24.66	41.82	54	-12.18	AV
V	7440	57.95	30.33	6.32	24.55	58.49	74	-15.51	Pk
V	7440	44.34	30.33	6.32	24.55	44.88	54	-9.12	AV
H	4960	56.55	30.55	5.77	24.66	56.43	74	-17.57	Pk
H	4960	42.97	30.55	5.77	24.66	42.85	54	-11.15	AV
H	7440	55.39	30.33	6.32	24.55	55.93	74	-18.07	Pk
H	7440	44.43	30.33	6.32	24.55	44.97	54	-9.03	AV

Remark:

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.



5. RADIATED BAND EMISSION MEASUREMENT

5.1 TEST REQUIREMENT:

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	Above	Peak	1MHz	3MHz	Peak
	1GHz	Average	1MHz	3MHz	Average

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

5.2 TEST PROCEDURE

Above 1GHz test procedure as below:

- a. 1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the Highest channel

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

5.3 DEVIATION FROM TEST STANDARD

No deviation



5.4 TEST SETUP

	Polar (H/V)	Frequenc y (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV /m)	Margi n (dB)	Detec tor Type	Result
GFSK	Low Channel: 2402MHz										
	H	2390.00	59.12	30.22	4.85	23.98	57.73	74	-16.27	PK	PASS
	H	2390.00	47.76	30.22	4.85	23.98	46.37	54	-7.63	AV	PASS
	H	2400.00	60.13	30.22	4.85	23.98	58.74	74	-15.26	PK	PASS
	H	2400.00	46.15	30.22	4.85	23.98	44.76	54	-9.24	AV	PASS
	V	2390.00	59.56	30.22	4.85	23.98	58.17	74	-15.83	PK	PASS
	V	2390.00	47.94	30.22	4.85	23.98	46.55	54	-7.45	AV	PASS
	V	2400.00	59.46	30.22	4.85	23.98	58.07	74	-15.93	PK	PASS
	V	2400.00	47.55	30.22	4.85	23.98	46.16	54	-7.84	AV	PASS
	High Channel: 2480MHz										
	H	2483.50	62.55	30.22	4.85	23.98	61.16	74	-12.84	PK	PASS
	H	2483.50	47.62	30.22	4.85	23.98	46.23	54	-7.77	AV	PASS
	H	2500.00	59.34	30.22	4.85	23.98	57.95	74	-16.05	PK	PASS
	H	2500.00	48.47	30.22	4.85	23.98	47.08	54	-6.92	AV	PASS
	V	2483.50	61.44	30.22	4.85	23.98	60.05	74	-13.95	PK	PASS
	V	2483.50	46.58	30.22	4.85	23.98	45.19	54	-8.81	AV	PASS
	V	2500.00	61.64	30.22	4.85	23.98	60.25	74	-13.75	PK	PASS
	V	2500.00	47.78	30.22	4.85	23.98	46.39	54	-7.61	AV	PASS

Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit
3. The test data shows only the worst case GFSK-1M.



7. CHANNEL BANDWIDTH

Test Requirement:	FCC Part15 C Section 15.249
Test Method:	ANSI C63.10:2013

7.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.249) , Subpart C			
Section	Test Item	Frequency Range (MHz)	Result
15.249(a)(2)	Bandwidth	2400-2483.5	PASS

7.2 TEST PROCEDURE

1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



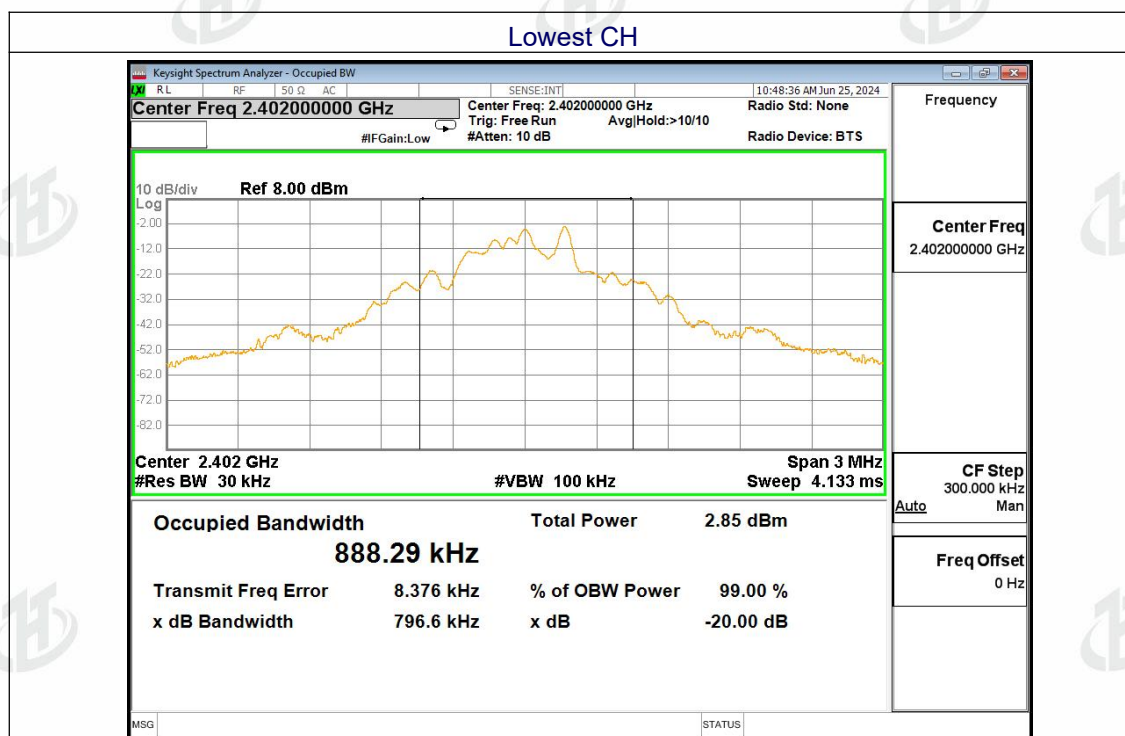
7.6 TEST RESULTS

Temperature :	25.6°C	Relative Humidity :	51%
Test Mode :	GFSK	Test Voltage :	DC 3.7V

Mode	Test channel	Channel Bandwidth (MHz)	Result
GFSK-1M	Lowest	0.797	Pass
	Middle	0.797	
	Highest	0.795	

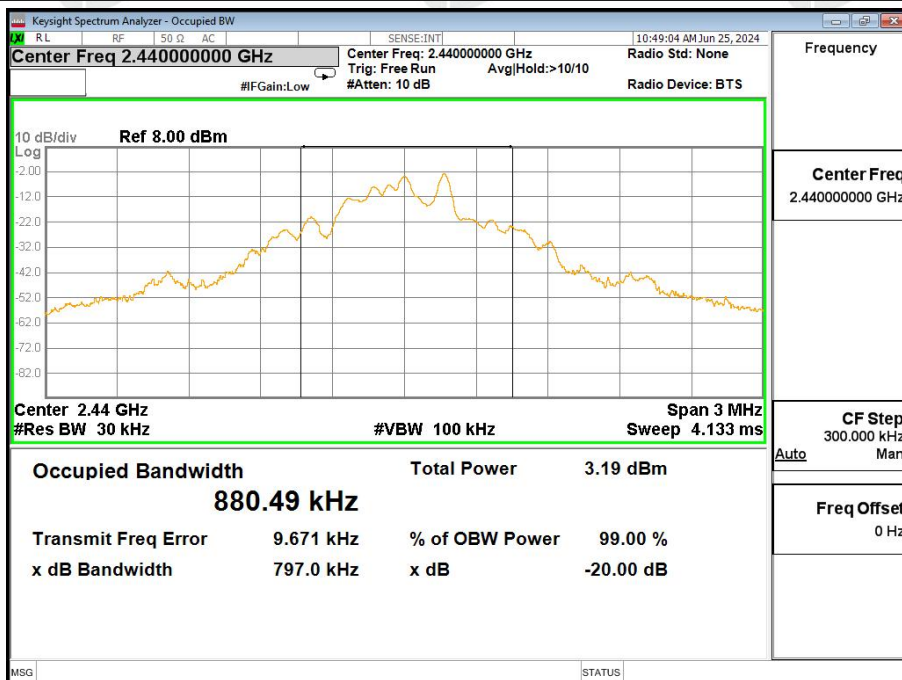
GFSK-1M

Lowest CH

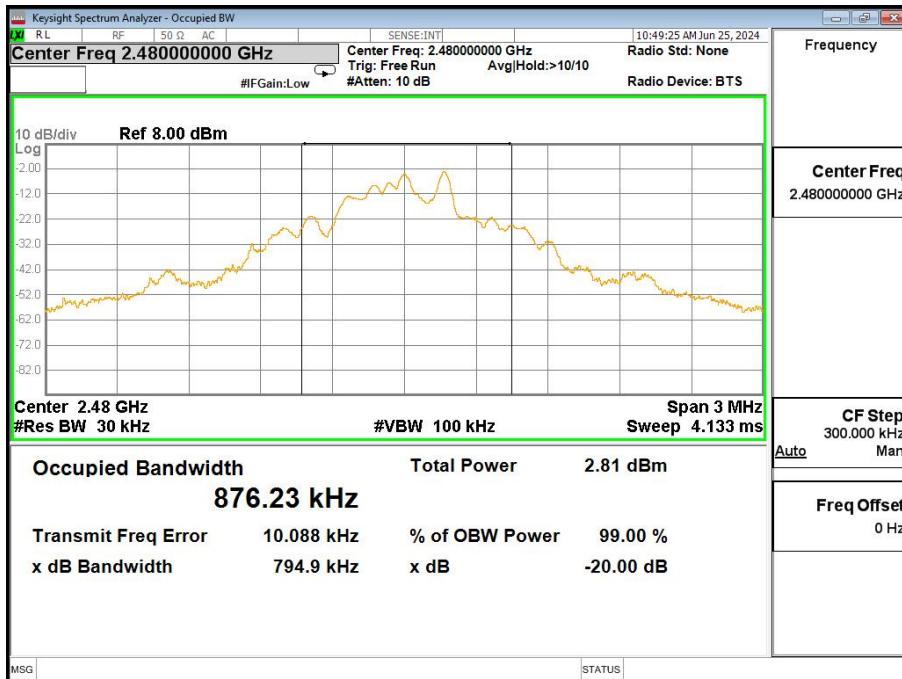




Middle CH



Highest CH



8.ANTENNA REQUIREMENT

Standard requirement:	FCC Part15 C Section 15.203 /249(b)(4)
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. 15.249(b) (4) requirement: (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
EUT Antenna:	
The antenna is PCB antenna, the best case gain of the antennas is -2.39dBi, reference to the appendix II for details	



9. TEST SETUP PHOTOS

Reference to the appendix I for details.

10. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

***** END OF REPORT *****