RADIO TEST REPORT

The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results, data evaluation, test procedures, and equipment of configurations shown in this report were made in accordance with the procedures in ANSI C63.10(2013).

Applicant/ Manufacturer	:	MhomeElectronic Technology Co., LTD
Address	:	Building B, Tangwei Industrial Zone, Dongyuan Road, Shipai Town, Dongguan City, Guangdong China
Factory	:	MhomeElectronic Technology Co., LTD
Address	:	Building B, Tangwei Industrial Zone, Dongyuan Road, Shipai Town, Dongguan City, Guangdong China
E.U.T.	:	2.4G Modular
Brand Name	:	Mhome
Model No.	:	RF-24G
FCC ID	:	2AM2X-RF24G
Measurement Standard	:	FCC PART 15.249: 2017
Date of Receiver	:	May 05, 2019
Date of Test	:	May 05, 2019 to May 10, 2019
Date of Report	:	May 10, 2019

This Test Report is Issued Under the Authority of :

Prepared by	Approved & Authorized Signer
Rose Hu / Engineer	Iori Fan / Authorized Signatory

This test report is for the customer shown above and their specific product only. This report applies to above tested sample only and shall not be reproduced in part without written approval of Dongguan Nore Testing Center Co., Ltd.

TEL: +86-769-22022444 FAX: +86-769-22022799 Web: www.ntc-c.com
Address: Building D, Gaosheng Science and Technology park, Hongtu road, Nancheng district, Dongguan city, Guangdong province, China

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Revision History of This Test Report

Report Number	Description	Issued Date
NTC1905006FV00	Initial Issue	2019-05-10

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test

Product Name	:	2.4G Modular
Main model number	:	RF-24G
Additional Model number	:	N/A
Brand Name	:	Mhome
Power Supply	:	DC 3.3V
Adapter	:	N/A
Test voltage	:	DC 3.3V
Model Difference Description	:	N/A
Hardware version	:	01
Software version	:	20180813
Note	:	N/A

Technical Specification:

2.4G Function:

Frequency Range	:	2406~2472MHz
Modulation Type	:	GFSK
Number of Channel	:	67
Channel Space	:	1MHz
Antenna Type	:	PCB
Antenna Gain	:	0 dBi (Declaration by manufacturer)

Channel List:

Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
1	2406	24	2429	47	2452
2	2407	25	2430	48	2453
3	2408	26	2431	49	2454
4	2409	27	2432	50	2455
5	2410	28	2433	51	2456
6	2411	29	2434	52	2457
7	2412	30	2435	53	2458
8	2413	31	2436	54	2459
9	2414	32	2437	55	2460
10	2415	33	2438	56	2461
11	2416	34	2439	57	2462
12	2417	35	2440	58	2463
13	2418	36	2441	59	2464
14	2419	37	2442	60	2465
15	2420	38	2443	61	2466
16	2421	39	2444	62	2467
17	2422	40	2445	63	2468
18	2423	41	2446	64	2469
19	2424	42	2447	65	2470
20	2425	43	2448	66	2471
21	2426	44	2449	67	2472
22	2427	45	2450		
23	2428	46	2451		

Note: The Lowest, middle, and the Highest frequency of channel were selected to perform the test. The frequency selected see below:

The Lowest frequency: 2406MHz
The middle frequency: 2440MHz
The Highest frequency: 2472MHz

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AM2X-RF24G** filing to comply with Section 15.249 of the FCC Part 15 (2017), Subpart C Rule.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters.

1.4 Equipment Modifications

Not available for this EUT intended for grant.

1.5 Support Device

N/A

1.6 Test Facility and Location

Site Description		
EMC Lab	:	Listed by CNAS, August 13, 2018 The certificate is valid until August 13, 2024 The Laboratory has been assessed and proved to be in compliance with CNAS/CL01 The Certificate Registration Number is L5795. Listed by A2LA, November 01, 2017 The certificate is valid until December 31, 2019 The Laboratory has been assessed and proved to be in compliance with ISO17025 The Certificate Registration Number is 4429.01 Listed by FCC, November 06, 2017 The Designation Number is CN1214 Test Firm Registration Number: 907417 Listed by Industry Canada, June 08, 2017 The Certificate Registration Number. Is 46405-9743
Name of Firm	:	Dongguan Nore Testing Center Co., Ltd. (Dongguan NTC Co., Ltd.)
Site Location	:	Building D, Gaosheng Science and Technology park, Hongtu road, Nancheng district, Dongguan city, Guangdong province, China

1.7 Summary of Test Results

FCC Rules	Description Of Test	Uncertainty	Result
§15.207(a)	AC Power Conducted Emission	±1.06dB	Not Applicable
§15.249(a)/ 15.209	Radiated Emissions	±3.70dB	Compliant
§15.249(d)/ 15.205	Band Edge	±1.70dB	Compliant
§15.215(c)	20dB Bandwidth	±1.42 $x10^{-4}$%	Compliant
§15.203	Antenna Requirement	---	Compliant

Note: Due to this EUT is powered by DC 3.3V, the AC Power Conducted Emission is not applicable.

2. System Test Configuration

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

2.2 Special Accessories

Not available for this EUT intended for grant.

2.3 Description of test modes

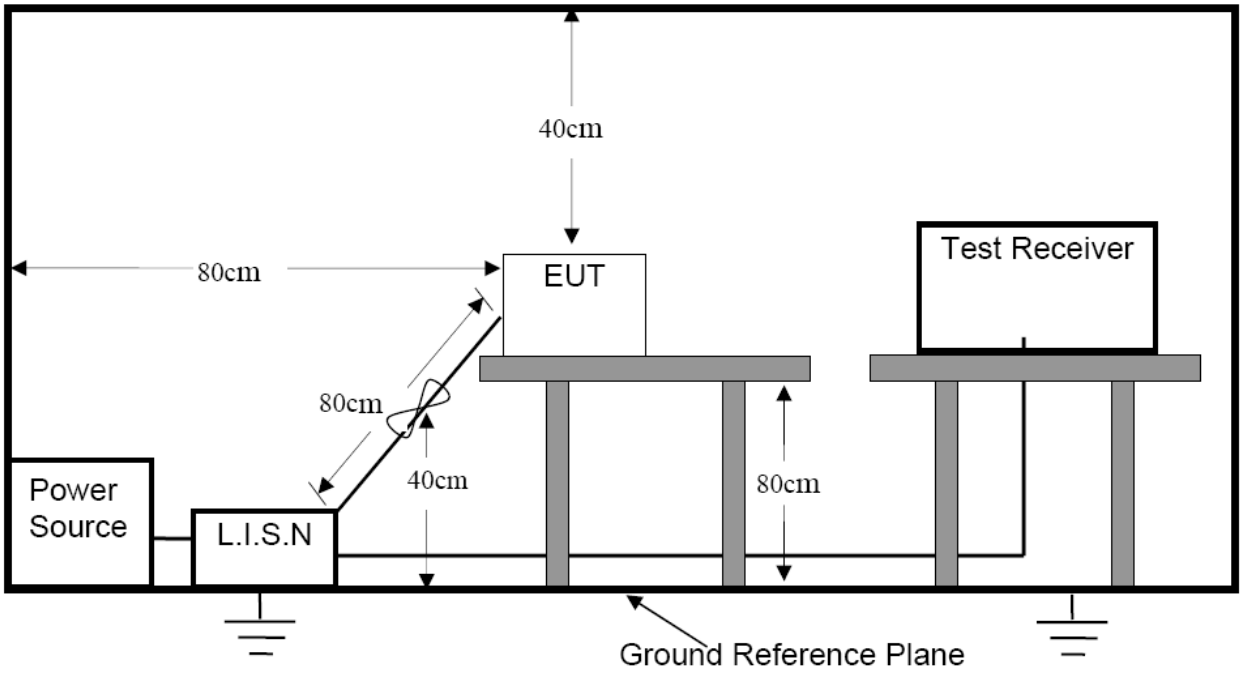
The EUT has been tested under operating condition. The Lowest, middle and highest frequencies were chosen for testing.

2.4 EUT Exercise

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

3. Conducted Emissions Test

3.1 Test SET-UP (Block Diagram of Configuration)



3.2 Test Condition

Test Requirement: FCC Part 15.207

Frequency Range: 150KHz ~ 30MHz

Detector: RBW 9KHz, VBW 30KHz

Operation Mode: TX

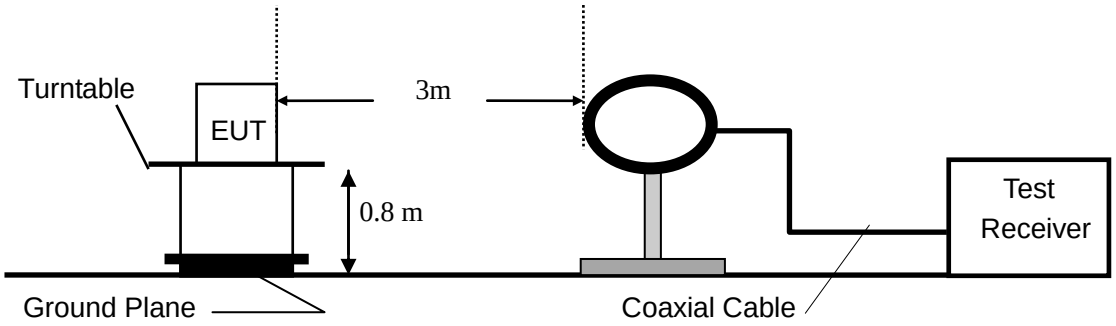
3.3 Measurement Results

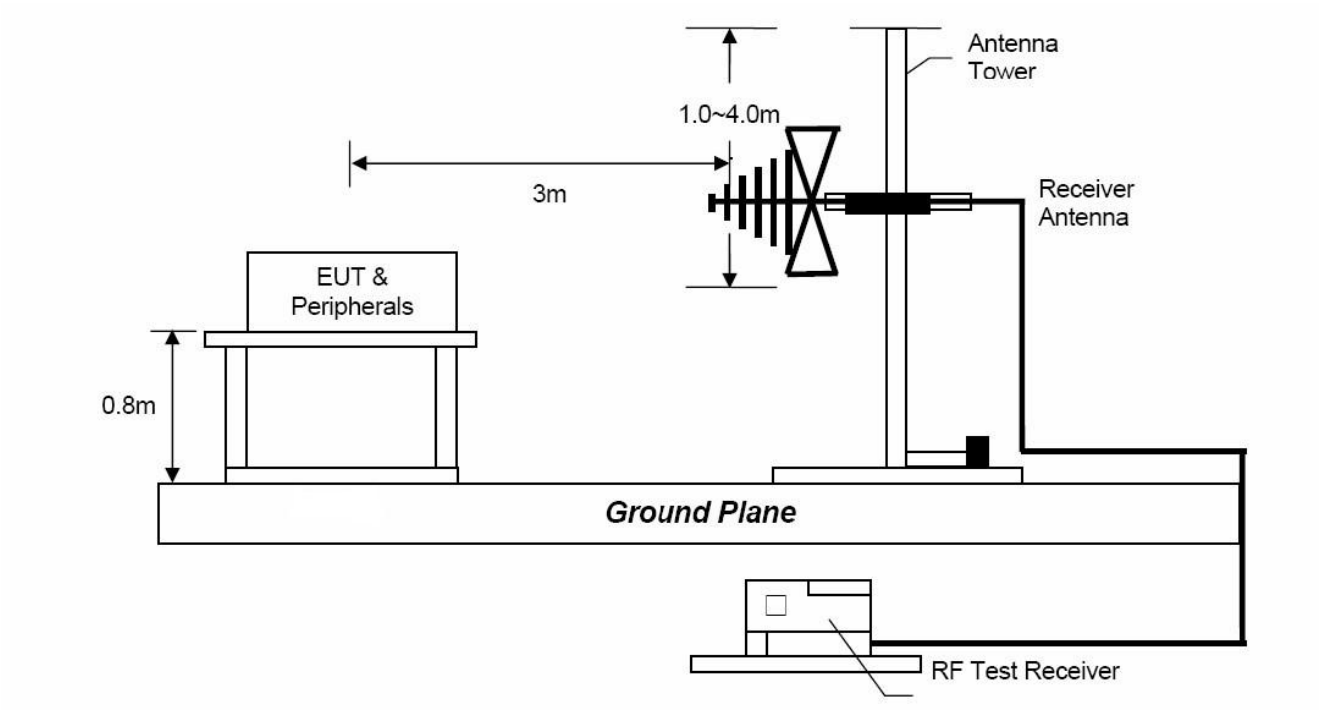
Not Applicable.

4. Radiated Emission Test

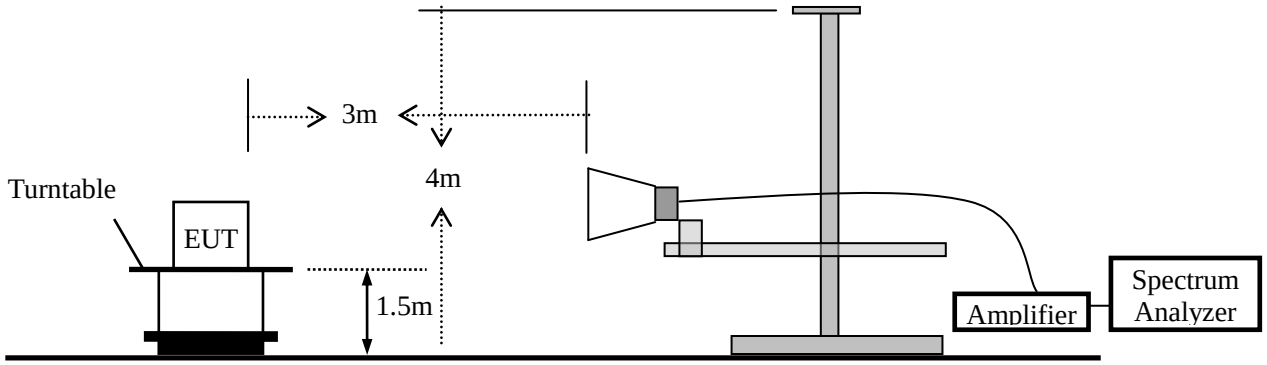
4.1 Test SET-UP (Block Diagram of Configuration)

4.1.1 Radiated Emission Test Set-Up, Frequency Below 30MHz





4.1.2 Radiated Emission Test Set-Up, Frequency above 1GHz



4.2 Measurement Procedure

a. Blow 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.
b. For the radiated emission test above 1GHz:
   The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. 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.
c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The height of antenna 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.
e. 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.
   During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Band (MHz)	Level	Resolution Bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	3 MHz
	Average	1 MHz	10 Hz

4.3 Limit

Frequency range MHz	Distance Meters	Field Strengths Limit (15.209)	
		μV/m	
0.009 ~ 0.490	300	2400/F(kHz)	
0.490 ~ 1.705	30	24000/F(kHz)	
1.705 ~ 30	30	30	
30 ~ 88	3	100	
88 ~ 216	3	150	
216 ~ 960	3	200	
Above 960	3	500	
Frequency range MHz	Distance Meters	Field Strengths Limit (15.249)	
		mV/m (Field strength of fundamental)	μV/m (Field strength of Harmonics)
902 ~ 928	3	50	500
2400 ~ 2483.5	3	50	500
5725 ~ 5875	3	50	500
24000 ~ 2425000	3	250	2500

Remark: (1) Emission level (dB)μV = 20 log Emission level μV/m

(2) The smaller limit shall apply at the cross point between two frequency bands.

(3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

(4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

(5) Sample of data calculate:

Level=Reading + Factor; Margin= Level-Limit

Factor=CF+AF+AG

Where CF=Cable attenuation factor in dB

AF= Antenna factor in dB

AG=Amplifier Gain in dB

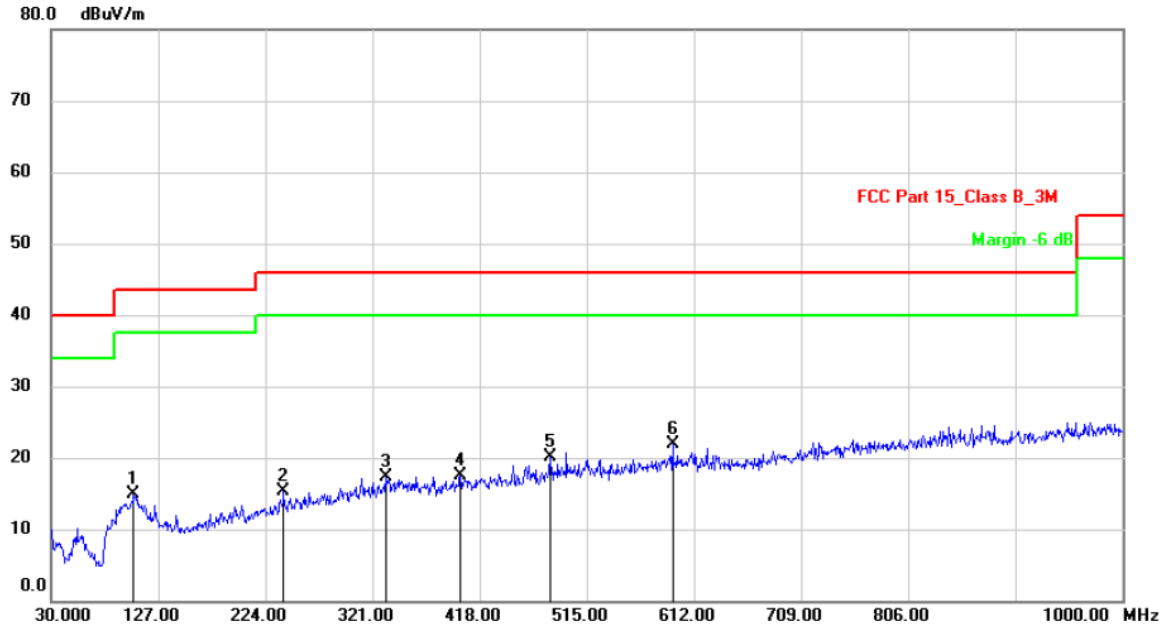
4.4 Measurement Results

Please refer to following the test plots of the worst case: Middle channel.

Dongguan NTC Co., Ltd.
Tel:+86-769-22022444 Fax:+86-769-22022799
Web: Http://www.ntc-c.com

Radiated Emission Measurement

File :RF-2 Data :#38 Date: 2019-5-8 Time: 19:24:12



Site
Limit: FCC Part 15_Class B_3M
EUT: 2.4G Modular
M/N: RF-2.4G
Mode: TX
Note:

Polarization: ***Horizontal***
Power: DC3V
Distance: 3m

Temperature: 26
Humidity: 47 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		104.6900	27.12	-12.16	14.96	43.50	-28.54	QP			
2		240.4900	27.38	-12.01	15.37	46.00	-30.63	QP			
3		332.6400	26.76	-9.52	17.24	46.00	-28.76	QP			
4		400.5400	26.59	-9.09	17.50	46.00	-28.50	QP			
5		482.0200	27.31	-7.16	20.15	46.00	-25.85	QP			
6	*	592.6000	27.03	-5.21	21.82	46.00	-24.18	QP			

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

Dongguan NTC Co., Ltd.
Tel:+86-769-22022444 Fax:+86-769-22022799
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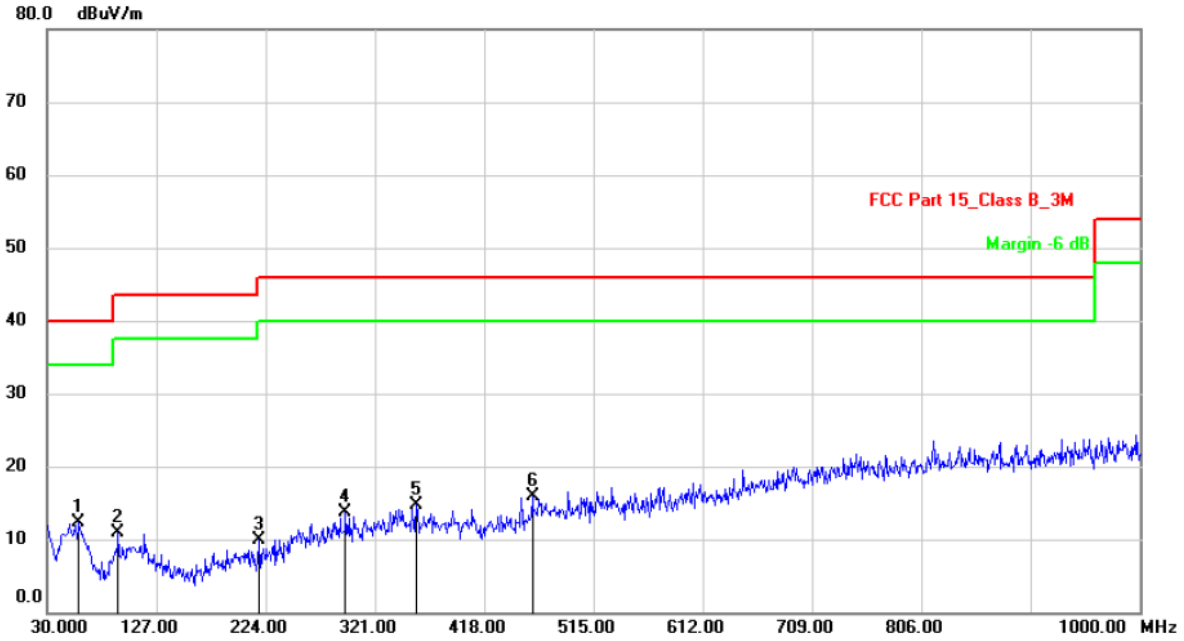
Radiated Emission Measurement

File :RF-2 Data :#39 Date: 2019-5-8 Time: 19:32:51



Site	Polarization: *Vertical*	Temperature: 26
Limit: FCC Part 15_Class B_3M	Power: DC3V	Humidity: 47 %
EUT: 2.4G Modular	Distance: 3m	
M/N: RF-2.4G		
Mode: TX		
Note:		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	58.1300	26.38	-14.11	12.27	40.00	-27.73	QP			
2		93.0500	27.13	-16.22	10.91	43.50	-32.59	QP			
3		218.1800	25.93	-16.02	9.91	46.00	-36.09	QP			
4		294.8100	26.23	-12.61	13.62	46.00	-32.38	QP			
5		357.8599	25.79	-11.13	14.66	46.00	-31.34	QP			
6		460.6800	25.71	-9.71	16.00	46.00	-30.00	QP			

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

Frequency Range:	1-25GHz	Test Date :	May 09, 2019
Test Result:	PASS	Temperature :	21 ℃
Measured Distance:	3m	Humidity :	55 %
Test By:	Sance		

Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
2406	V	64.81	37.03	0.14	64.95	37.17	114.00	94.00	-49.05	-56.83
4812	V	52.33	34.63	6.34	58.67	40.97	74.00	54.00	-15.33	-13.03
7218	V	45.00	31.29	10.46	55.46	41.75	74.00	54.00	-18.54	-12.25

2406	H	69.07	35.12	0.14	69.21	35.26	114.00	94.00	-44.79	-58.74
4812	H	54.26	35.73	6.34	60.60	42.07	74.00	54.00	-13.40	-11.93
7218	H	44.67	30.75	10.46	55.13	41.21	74.00	54.00	-18.87	-12.79

Operation Mode: TX Mode (Mid)										
2440	V	65.33	38.26	0.23	65.56	38.49	114.00	94.00	-48.44	-55.51
4880	V	50.20	33.94	6.60	56.80	40.54	74.00	54.00	-17.20	-13.46
7320	V	45.84	31.01	10.55	56.39	41.56	74.00	54.00	-17.61	-12.44

2440	H	68.34	37.85	0.23	68.57	38.08	114.00	94.00	-45.43	-55.92
4880	H	53.05	34.84	6.60	59.65	41.44	74.00	54.00	-14.35	-12.56
7320	H	46.04	31.4	10.55	56.59	41.95	74.00	54.00	-17.41	-12.05

Operation Mode: TX Mode (High)										
2472	V	65.27	33.52	0.32	65.59	33.84	114.00	94.00	-48.41	-60.16
4944	V	46.91	33.24	6.83	53.74	40.07	74.00	54.00	-20.26	-13.93
7416	V	44.49	31.15	10.59	55.08	41.74	74.00	54.00	-18.92	-12.26

2472	H	66.46	34.00	0.32	66.78	34.32	114.00	94.00	-47.22	-59.68
4944	H	34.20	43.87	6.83	41.03	50.70	74.00	54.00	-32.97	-3.30
7416	H	44.15	31.54	10.59	54.74	42.13	74.00	54.00	-19.26	-11.87

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level + Factor
(3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(4) Data of measurement within this frequency range shown " ---" in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
(5) Measurement uncertainty : ±3.7dB.
(6) Horn antenna used for the emission over 1000MHz.

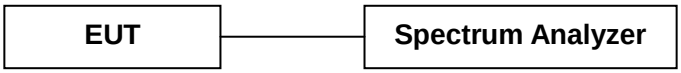
5. 20dB Bandwidth

5.1 Measurement Procedure

The 20dB bandwidth of the emission was contained within the frequency band designated which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered, FCC Rule 15.215(c):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

5.2 Test SET-UP (Block Diagram of Configuration)



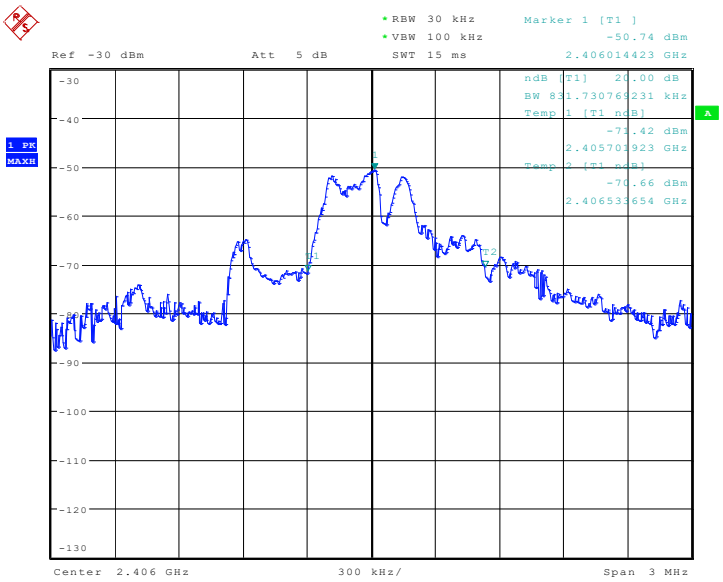
5.3 Measurement Results

Refer to attached data chart.

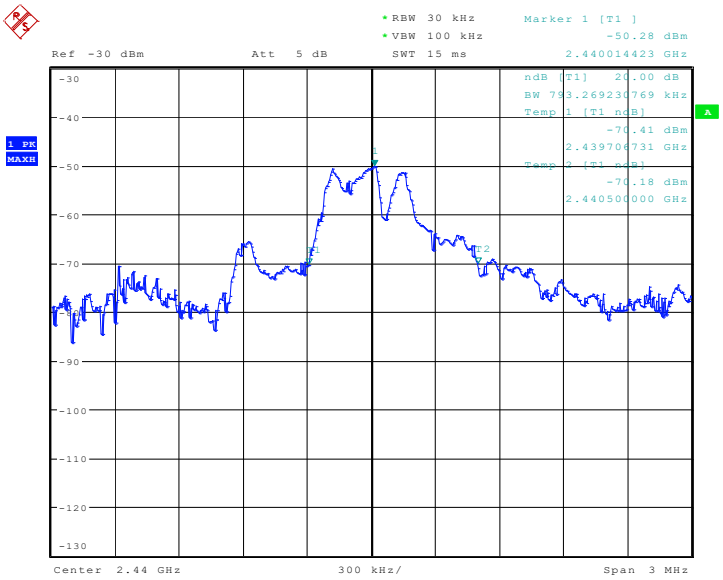
RBW:	30KHz	VBW:	100KHz
Spectrum Detector:	PK	Temperature :	22 ℃
Test By:	Sance	Humidity :	54 %
Test Result:	PASS	Test Date :	May 08, 2019

Channel frequency (MHz)	20dB Down BW(kHz)
2408	2196
2440	2131
2474	2139

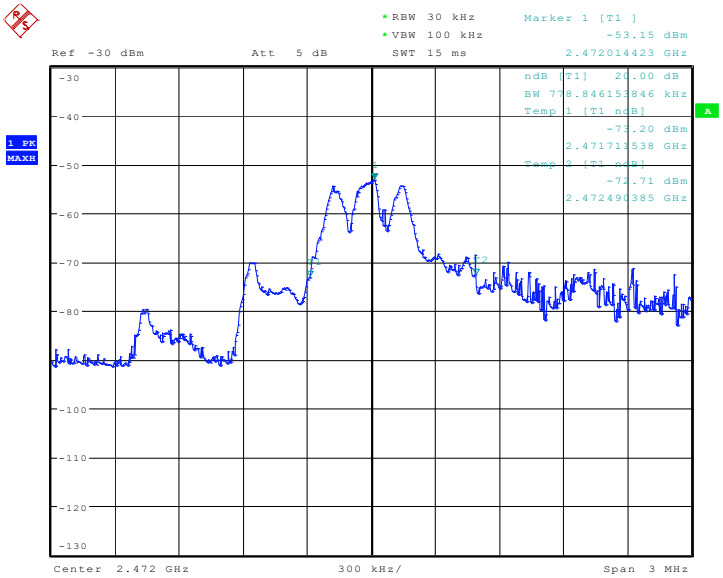
Lowest Channel



Middle Channel



Highest Channel



6. Band Edge

6.1 Measurement Procedure

Same as Radiated Emission Test.

6.2 Limit

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.

6.3 Measurement Results

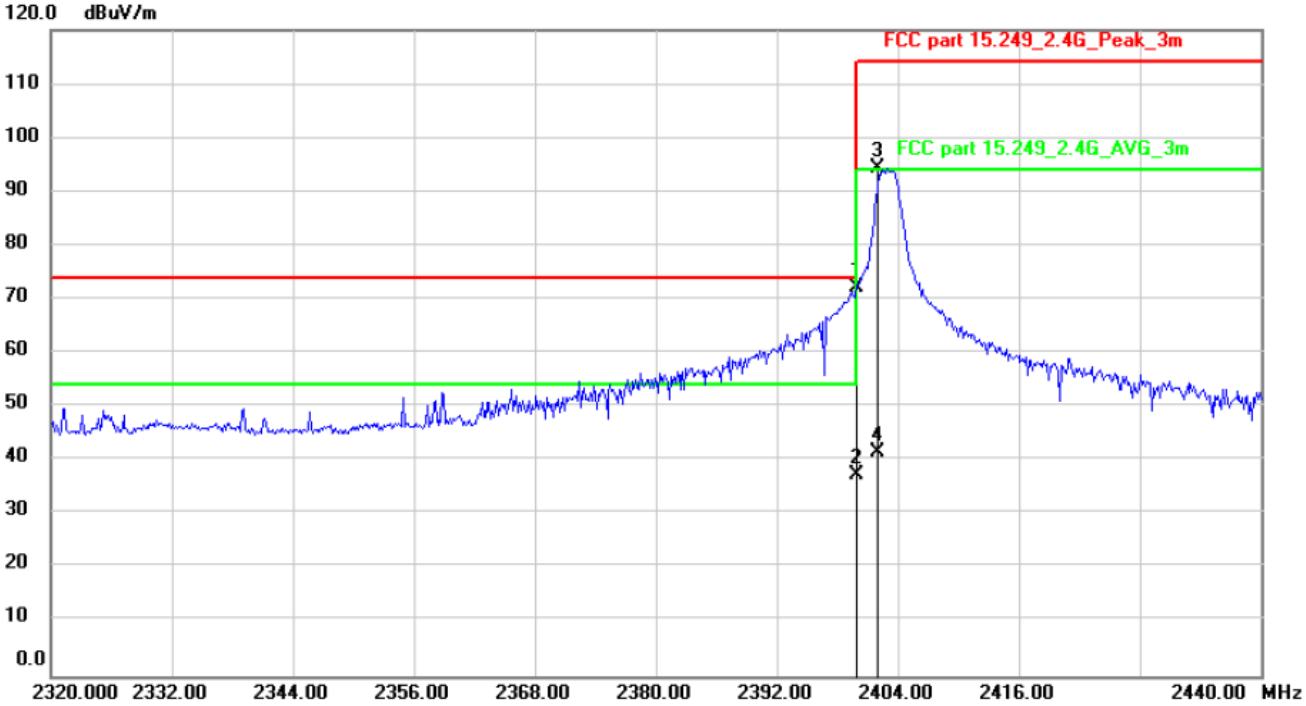
Operation Mode:	TX Mode	Test Date :	May 09, 2019
Temperature :	21 ℃	Humidity :	55 %
Test Result:	PASS	Test By:	Sance
Measured Distance:	3m		

Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
2390.000	H	51.11	32.41	0.09	51.20	32.50	74.00	54.00	-22.80	-21.50
2390.000	V	52.37	32.01	0.09	52.46	32.10	74.00	54.00	-21.54	-21.90
2483.500	H	62.44	31.68	0.35	62.79	32.03	74.00	54.00	-11.21	-21.97
2483.500	V	65.24	31.36	0.35	65.59	31.71	74.00	54.00	-8.41	-22.29

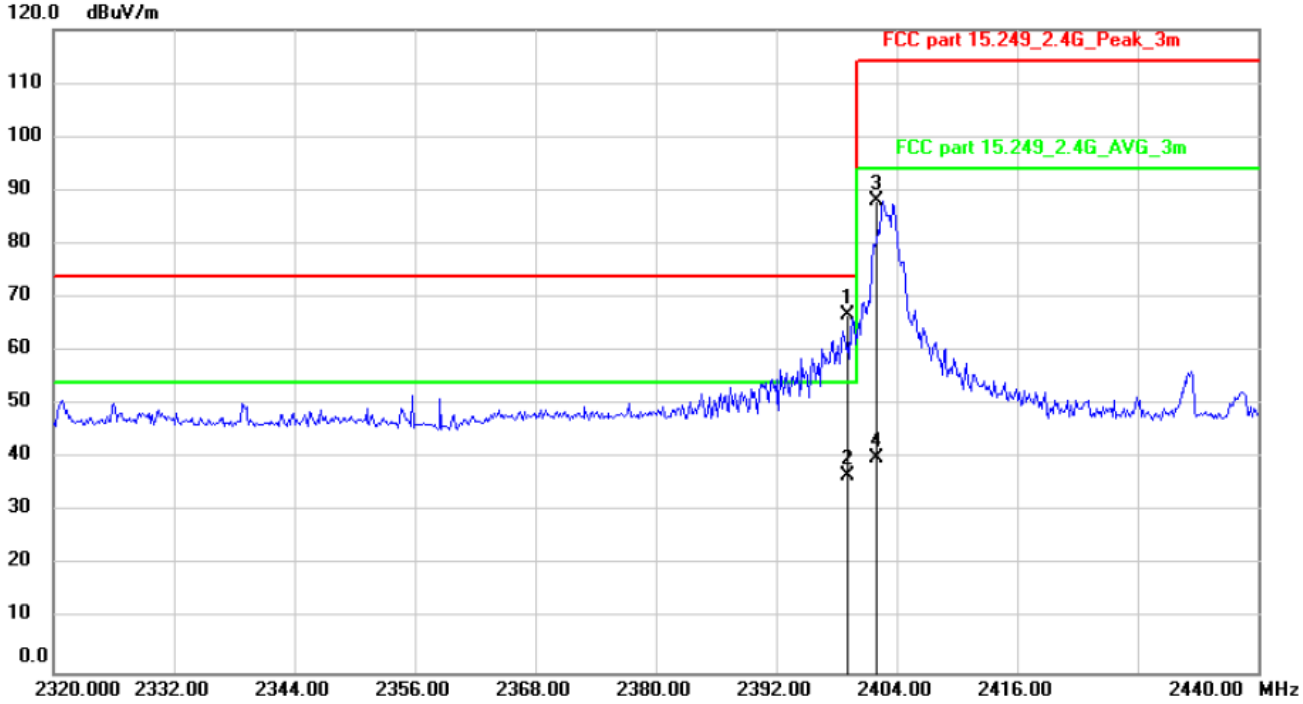
Note: (1) Emission Level= Reading Level + Factor
(2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(3) Horn antenna used for the emission over 1000MHz.

Low channel

Horizontal

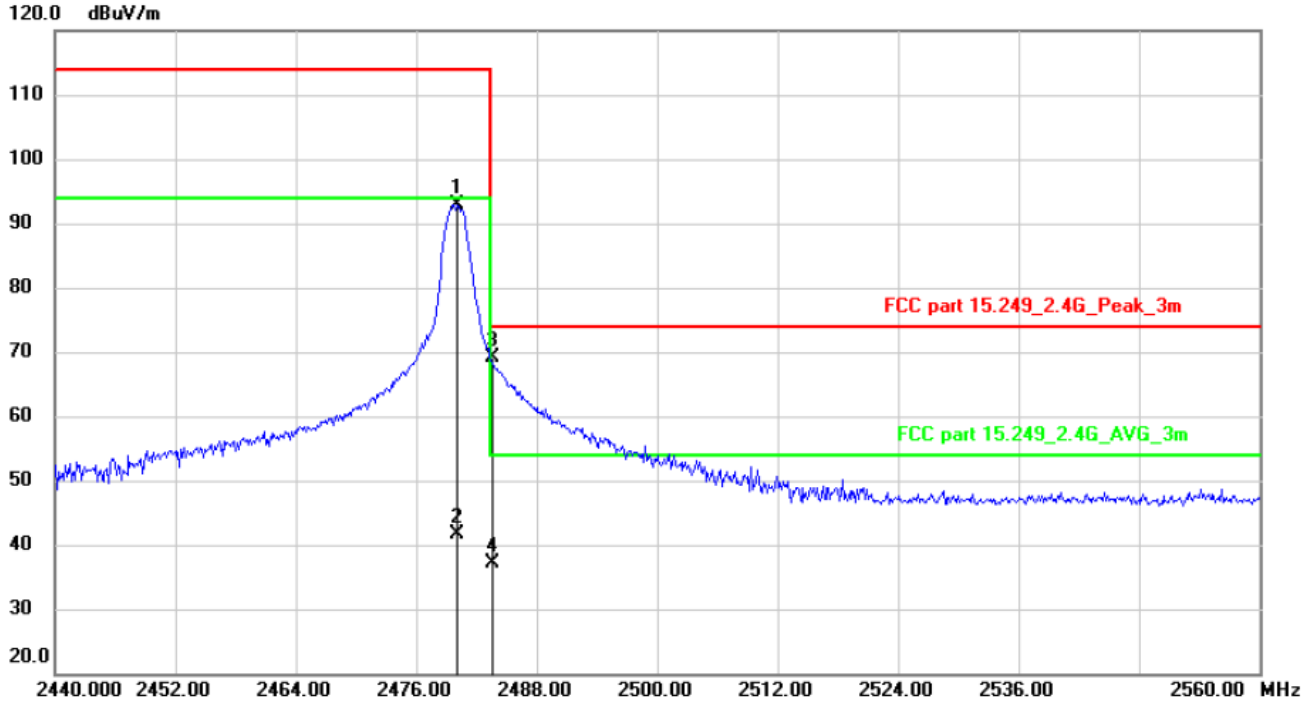


Vertical

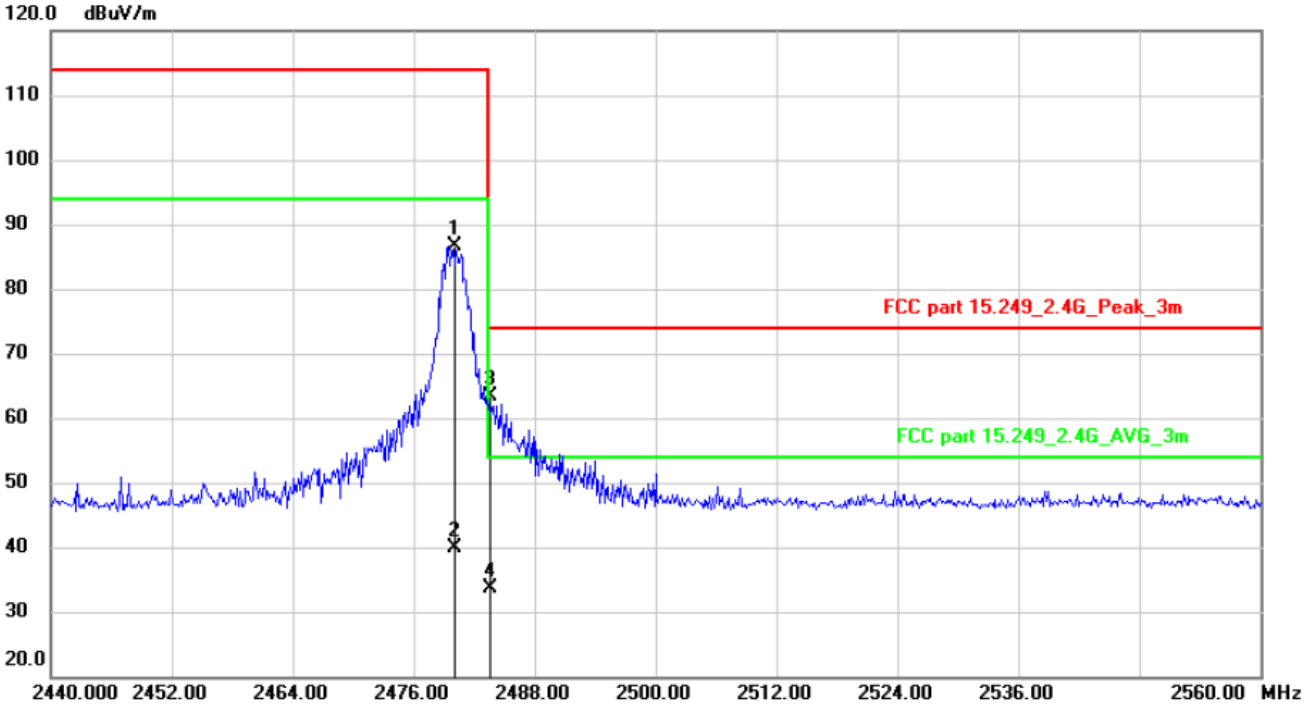


High channel

Horizontal



Vertical



7. Antenna requirement

7.1 Measurement Procedure

According to of FCC part 15C section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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.

Systems operating in the 2400-2483.5MHz band 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 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

7.2 Measurement Results

The antenna is PCB antenna and no consideration of replacement, and the best case gain of the antenna is 0 dBi. So, the antenna is consider meet the requirement.

8. Test Equipment List

No.	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	9KHz~7GHz	Mar. 13, 2019	Mar. 12, 2020
2.	Antenna	Schwarzbeck	VULB9162	9162-010	30MHz~7GHz	Mar. 22, 2019	Mar. 21, 2020
3.	Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	20Hz~26.5GHz	Mar. 13, 2019	Mar. 12, 2020
4.	Spectrum Analyzer	Keysight	N9020A	MY54200831	20Hz~26.5GHz	Apr. 23, 2019	Apr. 22, 2020
5.	Spectrum Analyzer	Rohde & Schwarz	FSV40	101003	10Hz~40GHz	Apr. 23, 2019	Apr. 22, 2020
6.	Horn Antenna	Schwarzbeck	BBHA9170	9170-372	15GHz~40GHz	Mar. 22, 2019	Mar. 21, 2020
7.	Pre-Amplifier	EMCI	EMC 184045	980102	18GHz~40GHz	Apr. 23, 2019	Apr. 22, 2020
8.	Power Sensor	DARE	RPR3006W	15I00041SNO64	100MHz~6GHz	Mar. 13, 2019	Mar. 12, 2020
9.	Communication Tester	Rohde & Schwarz	CMW500	149004	70MHz~6GHz	Mar. 13, 2019	Mar. 12, 2020
10.	Horn Antenna	COM-Power	AH-118	071078	500MHz~18GHz	Mar. 22, 2019	Mar. 21, 2020
11.	Pre-Amplifier	HP	HP 8449B	3008A00964	1GHz~26.5GHz	Mar. 13, 2019	Mar. 12, 2020
12.	Pre-Amplifier	HP	HP 8447D	1145A00203	100KHz~1.3GHz	Mar. 13, 2019	Mar. 12, 2020
13.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	9KHz~30MHz	Apr. 23, 2019	Apr. 22, 2020
14.	Temperature & Humidity Chamber	REMAFEE	SYHR225L	N/A	-40~150℃	Apr. 23, 2019	Apr. 22, 2020
15.	DC Source	MY	MY8811	N/A	0~30V	Mar. 22, 2019	Mar. 21, 2020
16.	Temporary antenna connector	TESCOM	SS402	N/A	9KHz~25GHz	N/A	N/A
17.	Test Receiver	Rohde & Schwarz	ESCI	101152	9KHz~3GHz	Mar. 13, 2019	Mar. 12, 2020
18.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	N/A	Mar. 13, 2019	Mar. 12, 2020
19.	L.I.S.N	Schwarzbeck	NNLK8129	8129212	N/A	Mar. 06, 2019	Mar. 05, 2020
20.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	N/A	Mar. 13, 2019	Mar. 12, 2020
21.	Test Software	EZ	EZ_EMC	N/A	N/A	N/A	N/A

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

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