

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 : DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD.
Address : 262 shidan Rd.,3rd industrial Area, Juzhou,Shijie Town, Dongguan city
China
Factory : DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD.
Address : 262 shidan Rd.,3rd industrial Area, Juzhou,Shijie Town, Dongguan city
China
E.U.T. : Wireless Mouse
Brand Name : N/A
Model No. : TM231, PC324A, PC324B, PC324C
(For model difference refer to section 1)
FCC ID : 2AGLG-TM231
Measurement Standard : FCC PART 15.249
Date of Receiver : August 27, 2020
Date of Test : August 31, 2020 to September 10, 2020
Date of Report : September 29, 2020

This Test Report is Issued Under the Authority of :

Prepared by



Alina Guo / Engineer

Approved & Authorized Signer



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.

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Revision History of This Test Report

Report Number	Description	Issued Date
NTC2008295FV00	Initial Issue	2020-09-29

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test

Product Name	: Wireless Mouse
Main Model Number	: TM231
Additional Model Number	: PC324A, PC324B, PC324C
Brand Name	: N/A
Power Supply	: DC 5V from USB port DC 3.7V from internal battery
Test Voltage	: AC 120V 60Hz (Adapter Input), DC 3.7V from internal battery (Only the worst case was recorded in the report)
Model Difference Description	: These models have the same circuit schematic, construction, PCB Layout and critical components. Their difference in model number due to trading purpose.
Hardware Version	: V01
Software Version	: V01
Serial number	: 20I11
Note	: N/A
Remark	: All the tests performed on model TM231.

Technical Specification:

2.4G Function:

Frequency Range	: 2403~2480MHz
Modulation Type	: GFSK
Number of Channel	: 16
Antenna Type	: PCB
Antenna Gain	: -1.78dBi (Declaration by manufacturer)

Channel List:

Channel	Frequency MHz	Channel	Frequency MHz
1	2403	9	2414
2	2426	10	2436
3	2441	11	2459
4	2463	12	2473
5	2407	13	2419
6	2422	14	2439
7	2445	15	2453
8	2466	16	2480

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

The Lowest frequency: 2403MHz

The middle frequency: 2441MHz

The Highest frequency: 2480MHz

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **2AGLG-TM231** filing to comply with Section 15.249 of the FCC Part 15, Subpart C Rule.

1.3 Test Methodology

Radiated emission measurements 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

Adapter : Manufacturer: HUWEI
Model No.: HW-050200C01
Input: AC100-240V 50/60Hz, 0.5A
Output: DC5V 2A

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, 2021
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
46405-9743A

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 Deviations and Abnormalities from Standard Conditions

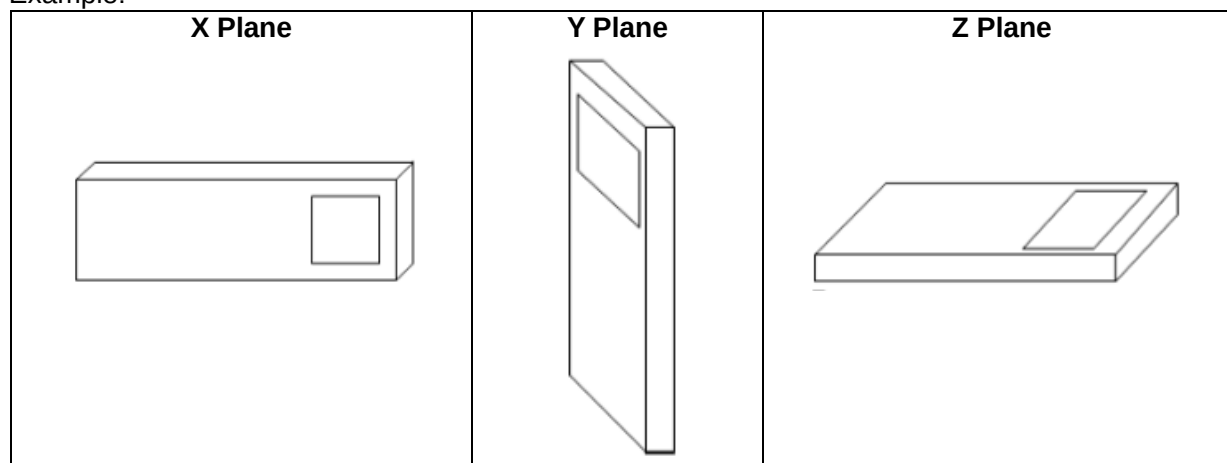
No additions, deviations and exclusions from the standard.

1.8 Summary of Test Results

FCC Rules	Description Of Test	Uncertainty	Result
§15.207(a)	AC Power Conducted Emission	±1.06dB	Compliant
§15.249(a)/ 15.209	Radiated Emissions	Below 1GHz: ±4.60 dB Above 1GHz: ±5.02 dB	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	±0.60dB	Compliant

Note: 1. The EUT has been tested as an independent unit. And continual transmitting in maximum power
 2. The EUT is a portable device and can be operated in multiple orientations, o X,Y,Z three orientations are tested during preliminary measurement. The worst case was Z.

Example:



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

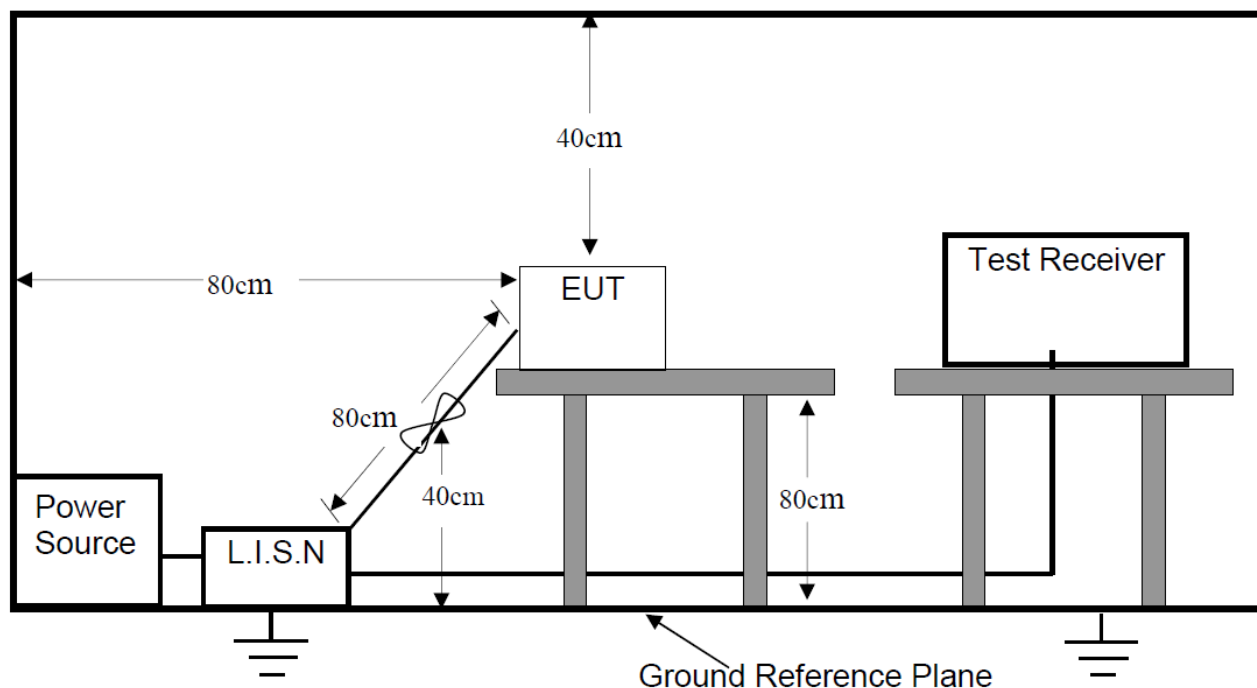
The EUT has been tested under operating condition. The Lowest, middle and highest frequencies were chosen for testing.

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

Please refer to following the test plots of the worst case: GFSK(High channel).



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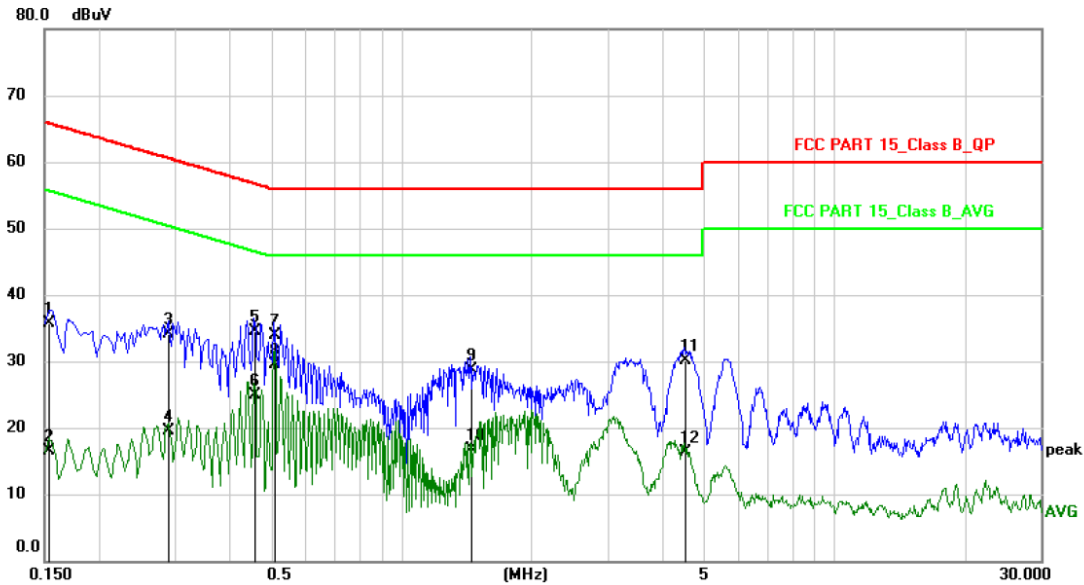
Conducted Emission Measurement

File : TM231

Data : #3

Date: 2020/9/7

Time: 9:02:54



Site

Phase: **L1**

Temperature: 26

Limit: FCC PART 15_Class B_QP

Power: AC120V/60Hz

Humidity: 50 %

EUT: Wireless Mouse

M/N: TM231

Mode: Charging+TX

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1539	25.10	10.60	35.70	65.79	-30.09	QP	
2		0.1539	5.90	10.60	16.50	55.79	-39.29	AVG	
3		0.2900	23.50	10.60	34.10	60.52	-26.42	QP	
4		0.2900	8.90	10.60	19.50	50.52	-31.02	AVG	
5		0.4580	23.98	10.62	34.60	56.73	-22.13	QP	
6		0.4580	14.28	10.62	24.90	46.73	-21.83	AVG	
7		0.5100	23.27	10.63	33.90	56.00	-22.10	QP	
8	*	0.5100	18.87	10.63	29.50	46.00	-16.50	AVG	
9		1.4460	18.00	10.70	28.70	56.00	-27.30	QP	
10		1.4460	6.10	10.70	16.80	46.00	-29.20	AVG	
11		4.5220	19.49	10.71	30.20	56.00	-25.80	QP	
12		4.5220	5.69	10.71	16.40	46.00	-29.60	AVG	



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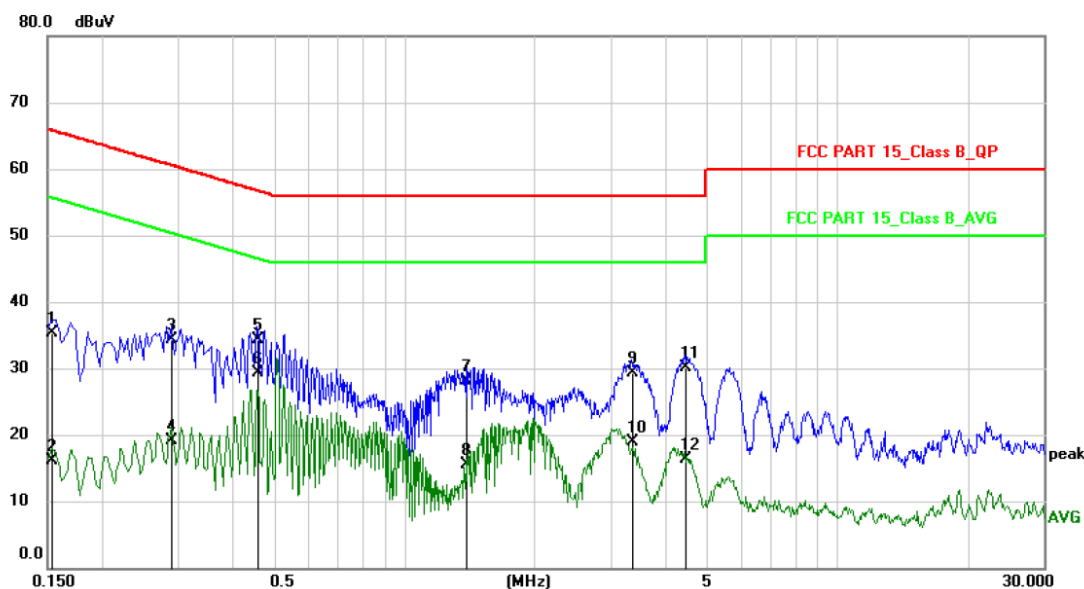
Conducted Emission Measurement

File : TM231

Data : #4

Date: 2020/9/7

Time: 9:10:42



Site

Phase: **N**

Temperature: 26

Limit: FCC PART 15_Class B_QP

Power: AC120V/60Hz

Humidity: 50 %

EUT: Wireless Mouse

M/N: TM231

Mode: Charging+TX

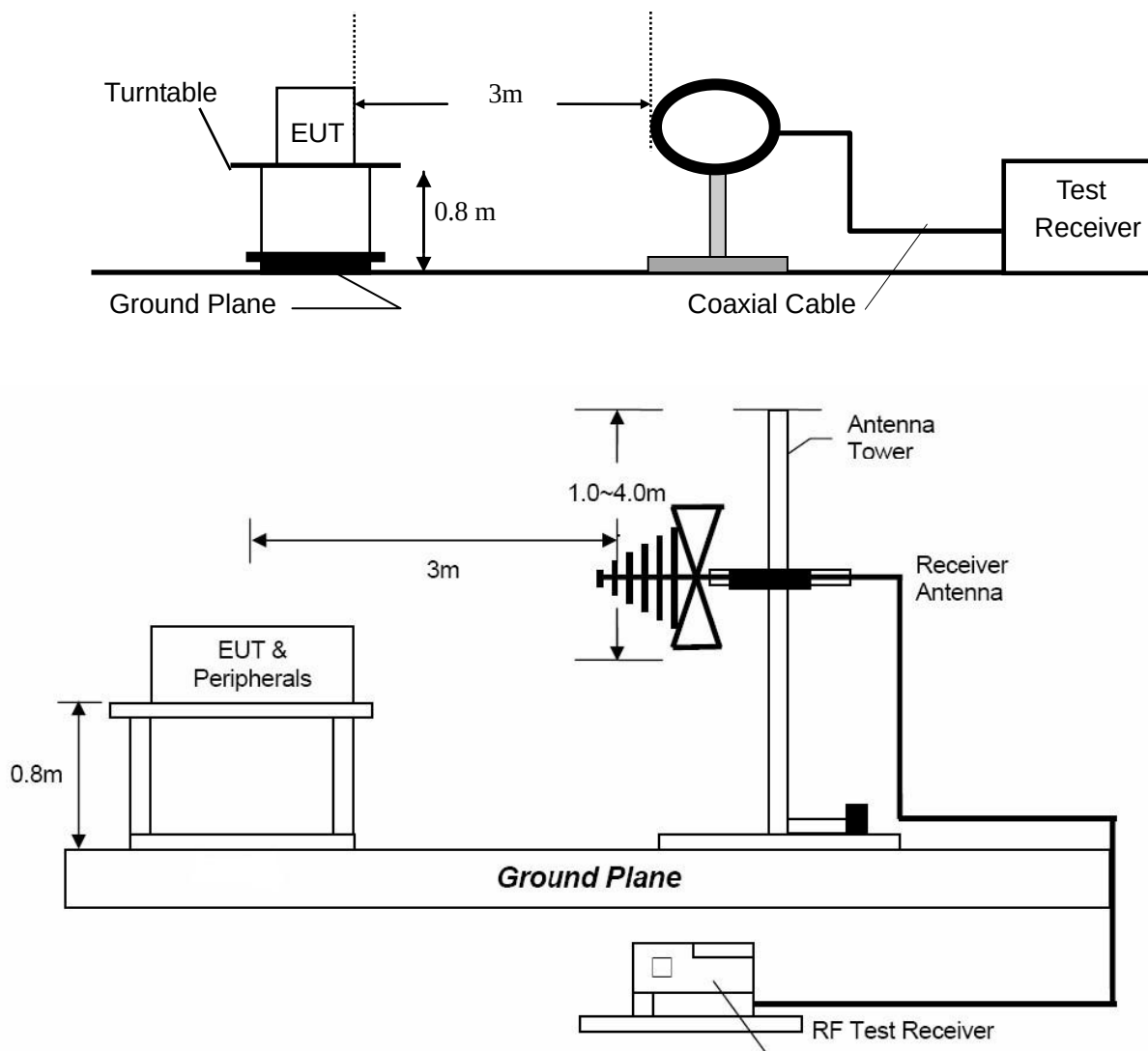
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1539	24.70	10.60	35.30	65.79	-30.49	QP	
2		0.1539	5.50	10.60	16.10	55.79	-39.69	AVG	
3		0.2900	23.80	10.60	34.40	60.52	-26.12	QP	
4		0.2900	8.60	10.60	19.20	50.52	-31.32	AVG	
5		0.4580	23.68	10.62	34.30	56.73	-22.43	QP	
6	*	0.4580	18.78	10.62	29.40	46.73	-17.33	AVG	
7		1.3940	17.50	10.70	28.20	56.00	-27.80	QP	
8		1.3940	4.90	10.70	15.60	46.00	-30.40	AVG	
9		3.3500	18.59	10.71	29.30	56.00	-26.70	QP	
10		3.3500	8.19	10.71	18.90	46.00	-27.10	AVG	
11		4.4380	19.39	10.71	30.10	56.00	-25.90	QP	
12		4.4380	5.69	10.71	16.40	46.00	-29.60	AVG	

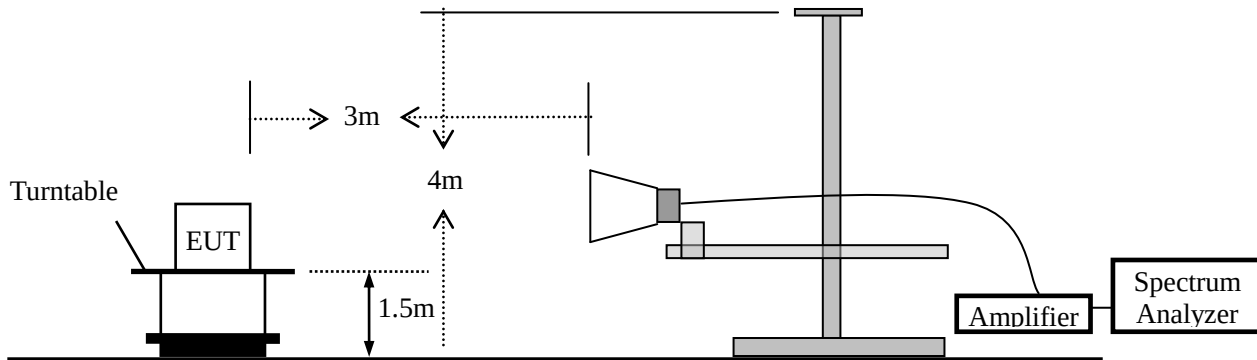
4. Radiated Emission Test

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

- 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.
- 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.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- 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)	
		$\mu\text{V/m}$	
0.009 ~ 0.490	300	$2400/F(\text{kHz})$	
0.490 ~ 1.705	30	$24000/F(\text{kHz})$	
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)	$\mu\text{V/m}$ (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 $\mu\text{V/m}$
- (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.

4.4 Measurement Results

Please refer to following the test plots of the worst case: GFSK(High channel).



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Radiated Emission Measurement

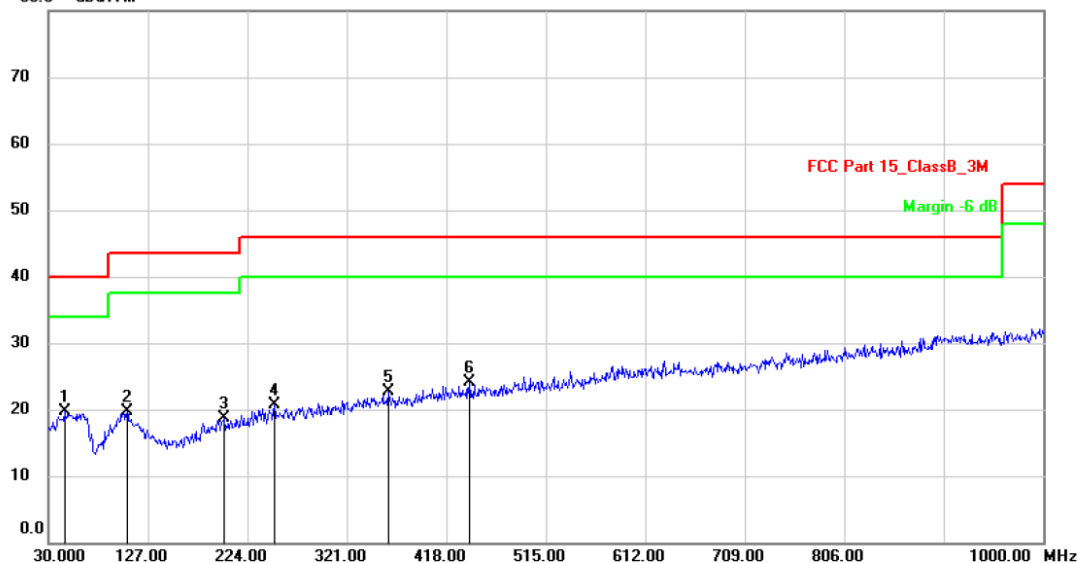
File : TM231

Data : #2

Date: 2020/9/3

Time: 19:07:47

80.0 dBuV/m



Site

Polarization: **Horizontal**

Temperature: 26

Limit: FCC Part 15_ClassB_3M

Power: DC3.7V

Humidity: 47 %

EUT: Wireless Mouse

Distance: 3m

M/N: TM231

Mode: TX

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1	*	45.5200	27.29	-7.56	19.73	40.00	-20.27	QP		
2		106.6300	27.23	-7.53	19.70	43.50	-23.80	QP		
3		201.6900	26.49	-7.70	18.79	43.50	-24.71	QP		
4		250.1900	27.06	-6.36	20.70	46.00	-25.30	QP		
5		361.7400	26.75	-3.99	22.76	46.00	-23.24	QP		
6		440.3100	26.93	-2.73	24.20	46.00	-21.80	QP		

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



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Radiated Emission Measurement

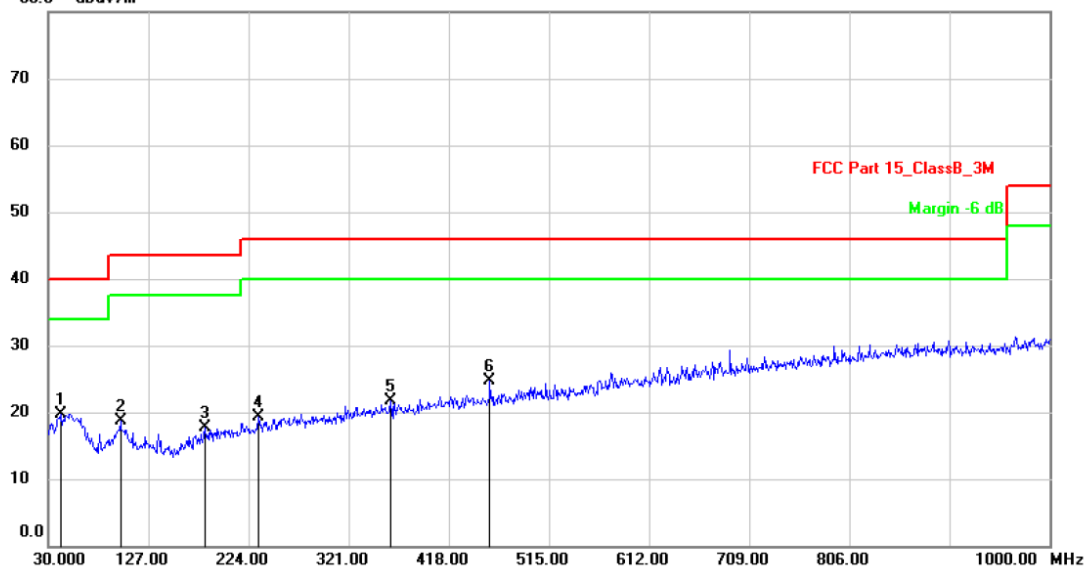
File: TM231

Data: #1

Date: 2020/9/3

Time: 19:01:28

80.0 dBuV/m



Site

Polarization: **Vertical**

Temperature: 26

Limit: FCC Part 15_ClassB_3M

Power: DC3.7V

Humidity: 47 %

EUT: Wireless Mouse

Distance: 3m

M/N: TM231

Mode: TX

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	42.6100	27.41	-7.72	19.69	40.00	-20.31	QP		
2		99.8399	27.11	-8.40	18.71	43.50	-24.79	QP		
3		181.3200	27.01	-9.35	17.66	43.50	-25.84	QP		
4		233.7000	27.15	-7.83	19.32	46.00	-26.68	QP		
5		361.7400	26.75	-4.99	21.76	46.00	-24.24	QP		
6		457.7700	28.08	-3.42	24.66	46.00	-21.34	QP		

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

Frequency Range: 1-25GHz
Test Result: PASS
Measured Distance: 3m
Test By: Lee

Test Date : September 04, 2020
Temperature : 21 °C
Humidity : 55 %

Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
2403	V	86.88	36.78	0.13	87.01	36.91	114.00	94.00	-26.99	-57.09
4806	V	46.57	36.95	6.30	52.89	43.27	74.00	54.00	-21.11	-10.73
7209	V	44.22	30.83	10.44	54.66	41.27	74.00	54.00	-19.34	-12.73

2403	H	94.28	37.08	0.13	94.41	37.21	114.00	94.00	-19.59	-56.79
4806	H	46.11	33.67	6.30	52.43	39.99	74.00	54.00	-21.57	-14.01
7209	H	44.83	30.74	10.44	55.27	41.18	74.00	54.00	-18.73	-12.82

Operation Mode: TX Mode (Mid)										
2441	V	87.12	36.30	0.24	87.36	36.54	114.00	94.00	-26.64	-57.46
4882	V	45.17	33.76	6.60	51.77	40.36	74.00	54.00	-22.23	-13.64
7323	V	44.13	30.67	10.55	54.68	41.22	74.00	54.00	-19.32	-12.78

2441	H	93.48	37.41	0.24	93.72	37.65	114.00	94.00	-20.28	-56.35
4882	H	45.75	36.17	6.60	52.35	42.77	74.00	54.00	-21.65	-11.23
7323	H	43.24	19.98	10.55	53.79	40.53	74.00	54.00	-20.21	-13.47

Operation Mode: TX Mode (High)										
2480	V	88.02	37.02	0.34	88.36	37.36	114.00	94.00	-25.64	-56.64
4960	V	45.47	35.65	6.89	52.36	42.54	74.00	54.00	-21.64	-11.46
7440	V	43.19	30.03	10.60	43.79	40.63	74.00	54.00	-20.21	-13.37

2480	H	94.08	37.18	0.34	94.42	37.52	114.00	94.00	-19.58	-56.48
4960	H	45.54	33.22	6.89	52.43	40.11	74.00	54.00	-21.57	-13.89
7440	H	44.02	29.57	10.60	54.62	40.17	74.00	54.00	-19.38	-13.83

- 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) Horn antenna used for the emission over 1000MHz.

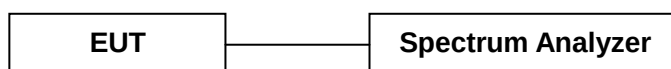
5. 20dB Bandwidth

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:	100KHz	VBW:	300KHz
Spectrum Detector:	PK	Temperature :	22 °C
Test By:	Lee	Humidity :	54 %
Test Result:	PASS	Test Date :	September 02, 2020, September 09, 2020

Channel frequency (MHz)	20dB Down BW(kHz)
2403	1239
2441	1198
2480	1187

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

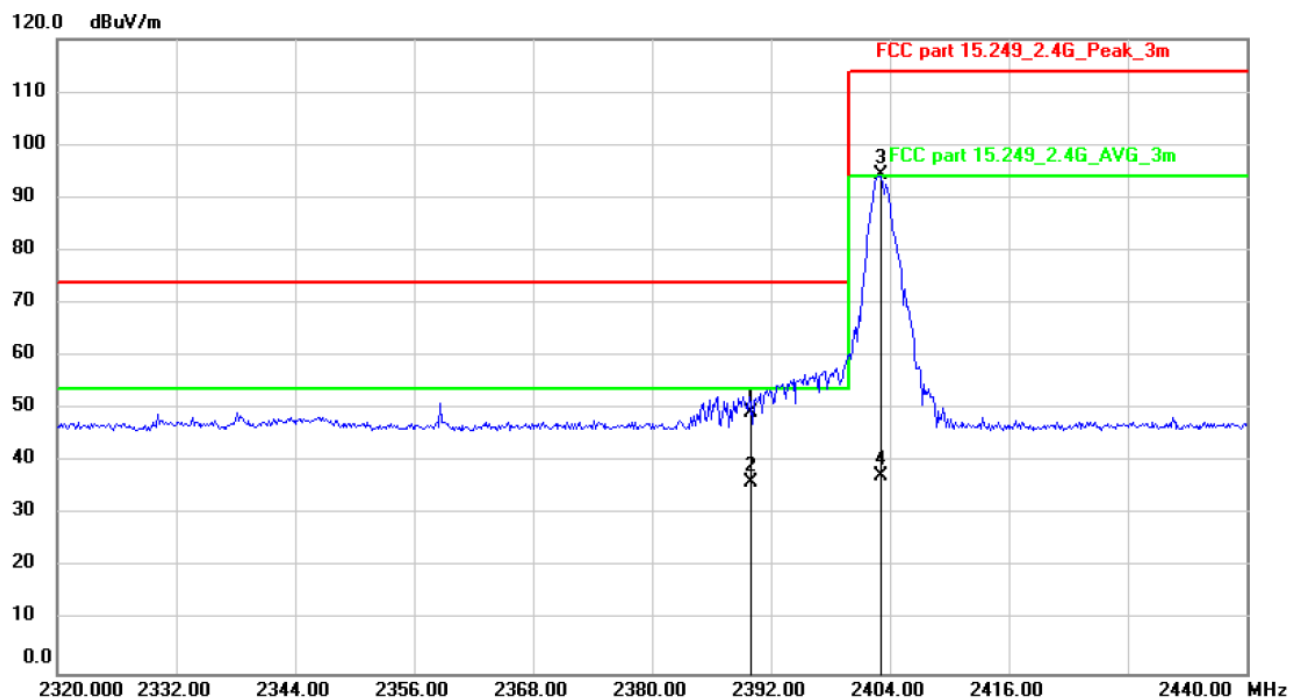
Operation Mode:	TX Mode	Test Date :	September 02, 2020
Temperature :	21 °C	Humidity :	55 %
Test Result:	PASS	Test By:	Lee
Measured Distance:	3m		

Freq. (MHz)	Ant.Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
2390.000	H	49.27	35.53	0.09	49.36	35.62	74.00	54.00	-24.64	-18.38
2390.000	V	47.67	36.48	0.09	47.76	36.57	74.00	54.00	-26.24	-17.43
2483.500	H	49.85	35.42	0.34	50.19	35.76	74.00	54.00	-23.81	-18.24
2483.500	V	52.09	36.23	0.34	52.43	36.57	74.00	54.00	-21.57	-17.43

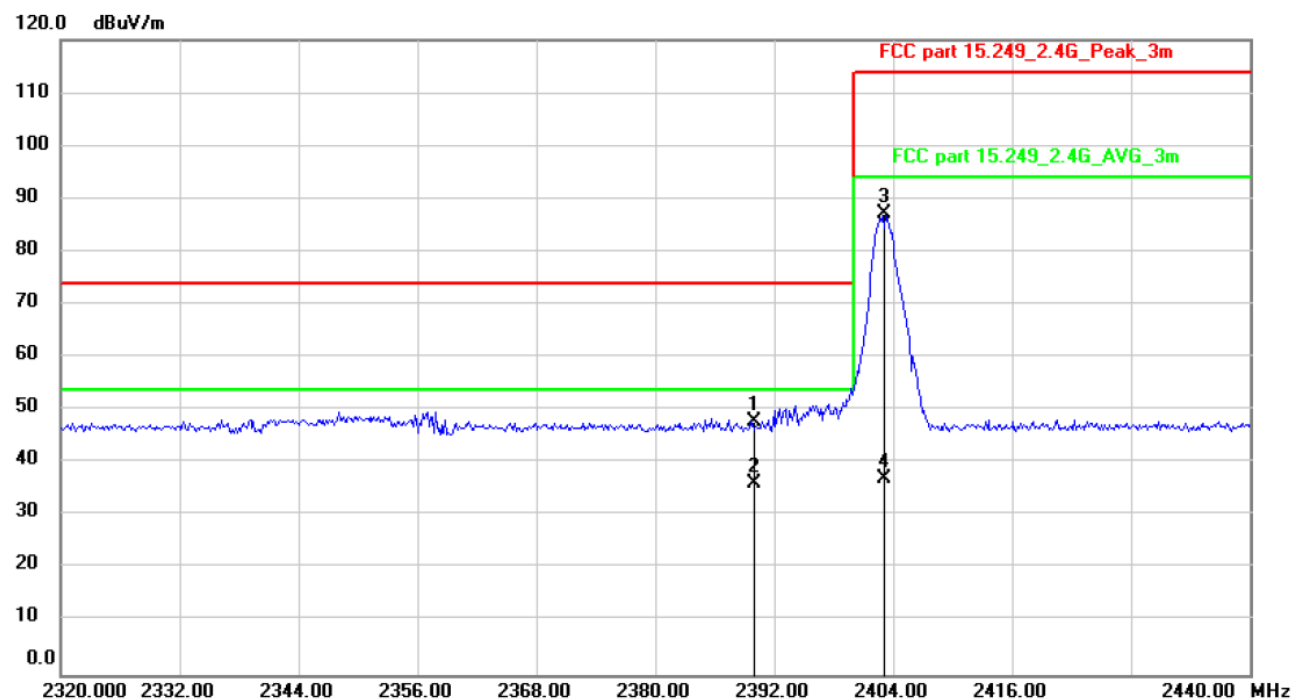
Note: (1) Emission Level= Reading Level + Factor
(2) Factor= Antenna Gain + Cable Loss – Amplifier Gain
(3) Horn antenna used for the emission over 1000MHz.

Low channel

Horizontal

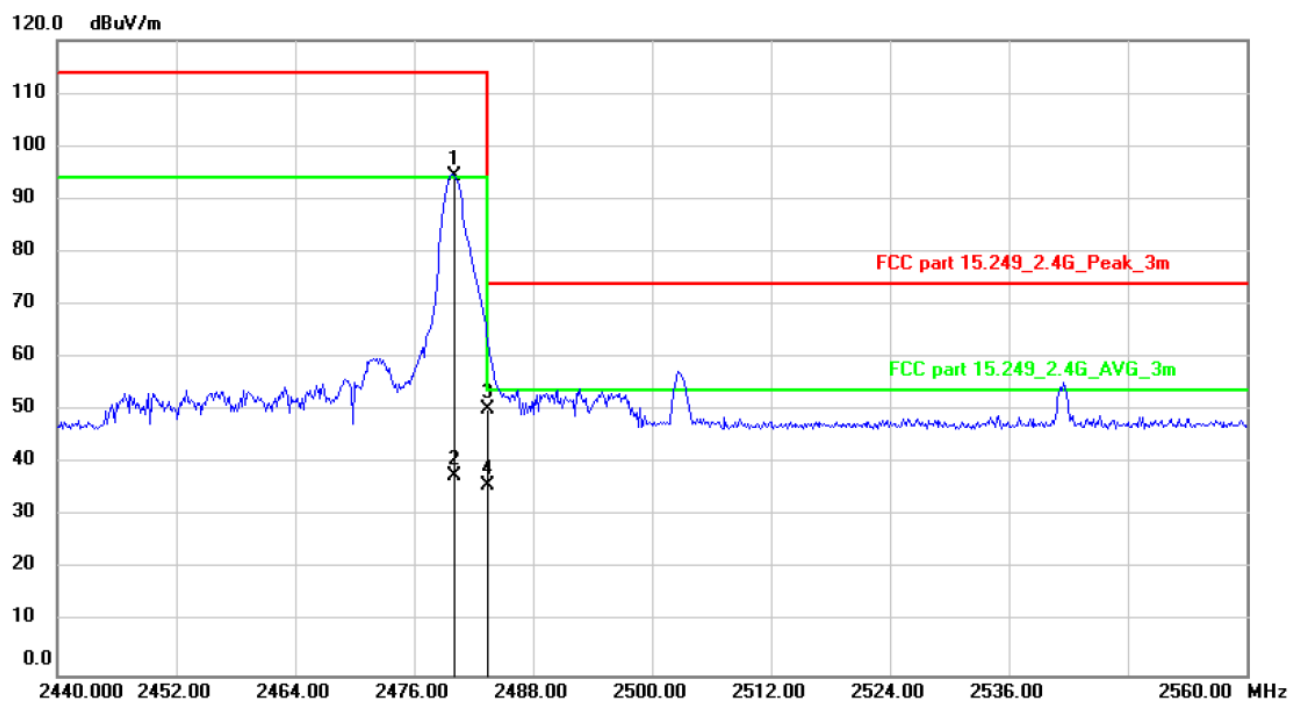


Vertical

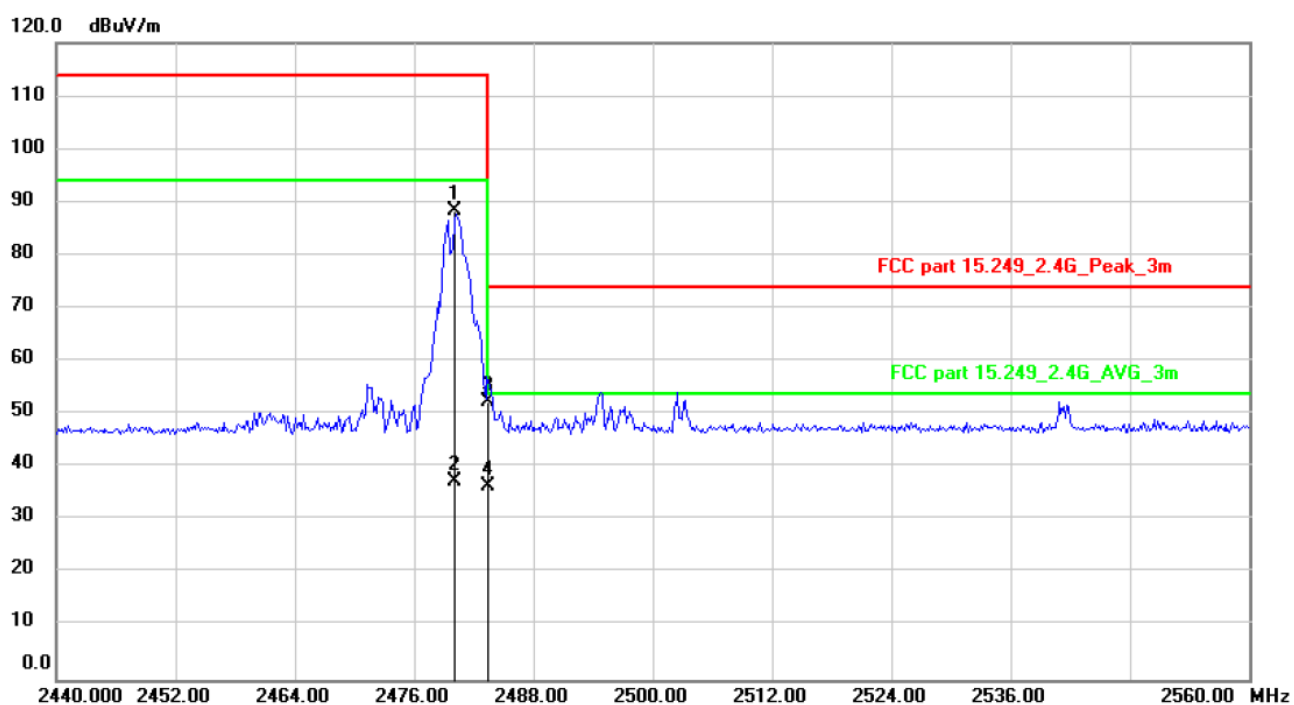


High channel

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 -1.78dBi. So, the antenna is consider meet the requirement.

8. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2020	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 23, 2020	1 Year
3.	Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2020	1 Year
4.	Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2020	1 Year
5.	Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2020	1 Year
6.	Horn Antenna	Schwarzbeck	BBHA9170	9170-172	Mar. 22, 2019	2 Year
7.	Power Sensor	DARE	RPR3006W	15100041SNO 64	Mar. 13, 2020	1 Year
8.	Communication Tester	Rohde & Schwarz	CMW500	149004	Mar. 13, 2020	1 Year
9.	Horn Antenna	COM-Power	AH-118	071078	Mar. 23, 2020	1 Year
10.	Pre-Amplifier	HP	HP 8449B	3008A00964	Mar. 13, 2020	1 Year
11.	Pre-Amplifier	HP	HP 8447D	1145A00203	Mar. 13, 2020	1 Year
12.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	Mar. 23, 2020	1 Year
13.	Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 14, 2020	1 Year
14.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 13, 2020	1 Year
15.	L.I.S.N	Rohde & Schwarz	ESH2-Z5	893606/014	Mar. 13, 2020	1 Year
16.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2020	1 Year
17.	Temperature & Humidity Chamber	REMAFEE	SYHR225L	N/A	Mar. 13, 2020	1 Year
18.	DC Source	Maynuo	MY8811	N/A	Mar. 13, 2020	1 Year
19.	Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
20.	Chamber	SAEMC	9*7*7m	N/A	Jun. 20, 2019	2 Year
21.	Test Software	EZ	EZ_EM C	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.

---End---