



FCC PART 15.249 TEST REPORT

For

SAILSKY ELECTRONIC LIMITED

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FCC ID: 2AYB6MU21012

Report Type: Original Report	Product Type: Slim Wireless Mouse
Report Number: RSZ201125830-00	
Report Date: 2020-12-17	
Reviewed By: RF Engineer	Jacob Kong 
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Slim Wireless Mouse
Tested Model	MU21008
Frequency Range	2405~2475 MHz
Maximum Field Strength	81.70dBuV/m@3m
Modulation Technique	GFSK
Antenna Specification*	-2 dBi (It is provided by the applicant)
Voltage Range	DC 1.5V*2 from battery
Date of Test	2020-12-04 to 2020-12-17
Sample serial number	RSZ201125830-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-11-25
Sample/EUT Status	Good condition

Objective

This type approval report is in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.249 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1°C
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing by manufacturer.

Frequency List

Channel	Frequency	Channel	Frequency
1	2405 MHz	2	2411 MHz
3	2417 MHz	4	2451 MHz
5	2457 MHz	6	2463 MHz
7	2469 MHz	8	2475 MHz

Channel 1, Channel 4 and Channel 8 were selected for testing.

EUT Exercise Software

No software was used to the EUT tested.

Equipment Modifications

No modifications were made to the unit tested.

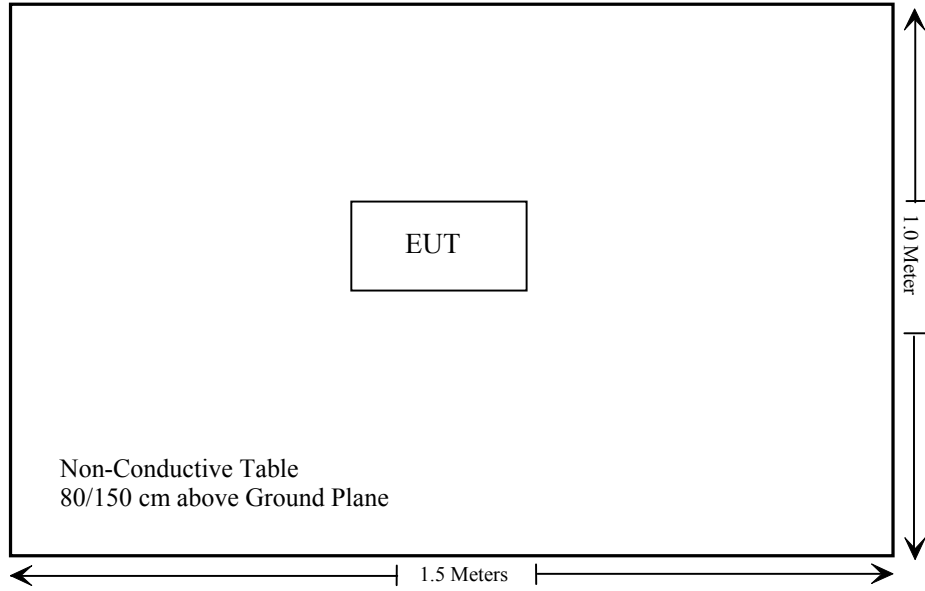
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

Support Cable Descriptions

Cable Description	Length (m)	From/Port	To
/	/	/	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Not appliance
15.205, §15.209, §15.249(a)(c)(d)	Radiated Emissions& Outside of Band Emission	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

Note: EUT powered by battery only.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/29	2021/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/19
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 shall be considered sufficient to comply with the provisions of this Section. 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.

Antenna Connector Construction

The EUT has one PCB antenna which was permanently attached and the antenna gain is -2dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC§15.205, §15.209 & §15.249(a)(c)(d) - RADIATED EMISSIONS

Applicable Standard

As per FCC§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)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

As per FCC§15.249 (d), 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.

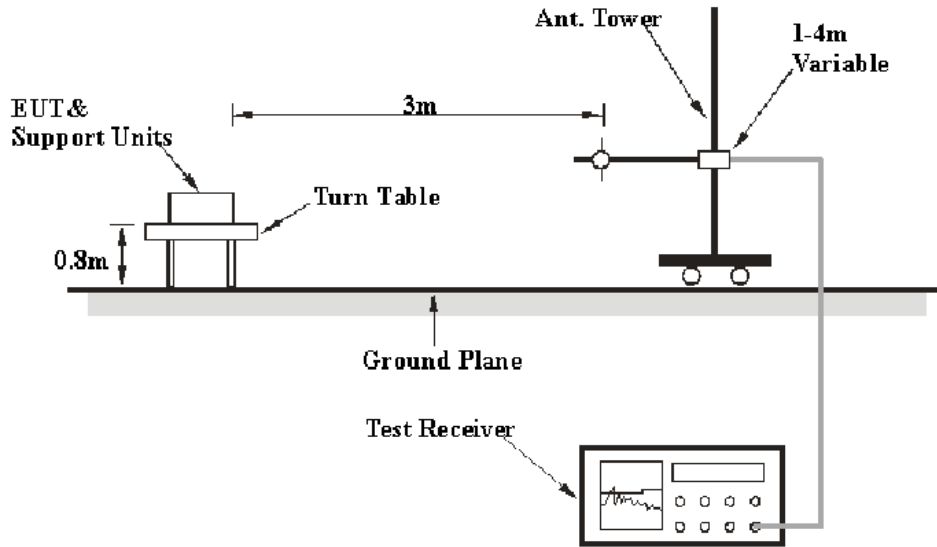
Test Equipment Setup

The system was investigated from 30 MHz to 25 GHz.

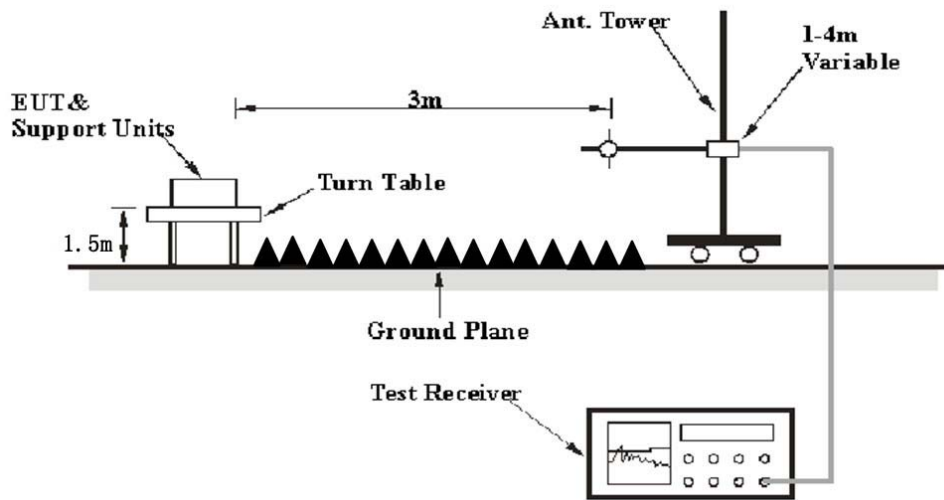
Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane for below 1GHz or 1.5 meter for above 1GHz, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

Corrected Amplitude & Margin Calculation

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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 limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

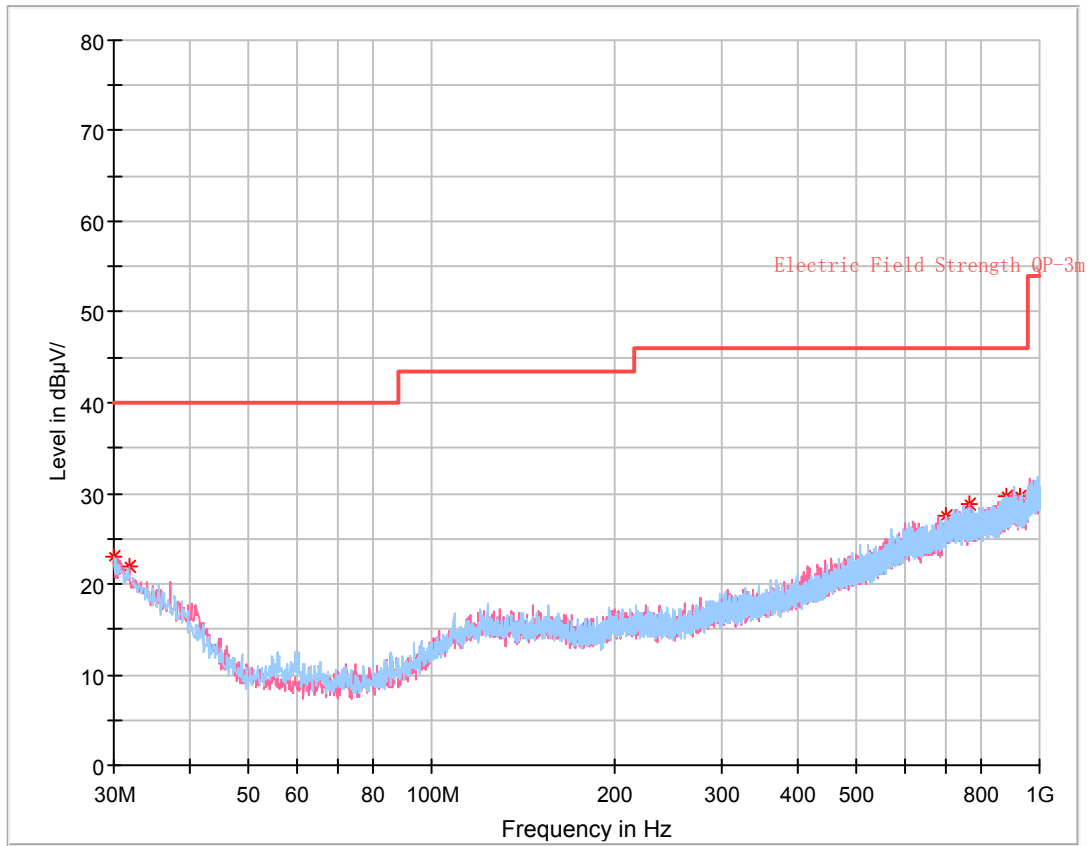
Environmental Conditions

Temperature:	26~28.4 °C
Relative Humidity:	45~51 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Holland Yang on 2020-12-04 for below 1GHz and Alan He on 2020-12-17 for above 1GHz.

Test Mode: Transmitting

30MHz – 1 GHz (worst case is Low channel):



Critical_Freqs

Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.000000	23.08	40.00	16.92	100.0	H	165.0	-4.4
31.818750	22.01	40.00	17.99	300.0	V	307.0	-5.6
704.150000	27.62	46.00	18.38	200.0	H	0.0	-1.1
766.108750	28.76	46.00	17.24	100.0	V	0.0	-0.2
878.992500	29.61	46.00	16.39	200.0	H	303.0	1.1
928.220000	29.74	46.00	16.26	300.0	V	0.0	1.8

1 GHz - 25 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dB μ V/m)	FCC Part 15.249&15.209	
	Reading (dB μ V)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dB μ V/m)	Margin (dB)
Low Channel (2405 MHz)									
2405.00	49.83	PK	227	1.4	H	31.87	81.70	94	12.30
2405.00	42.59	PK	201	1.6	V	31.87	74.46	94	19.54
2363.66	33.58	PK	279	2.2	H	31.87	65.45	74	8.55
2399.99	33.76	PK	157	1.8	H	31.87	65.63	74	8.37
2499.13	29.33	PK	138	1.6	H	32.13	61.46	74	12.54
4810.00	53.36	PK	321	1.0	H	6.28	59.64	74	14.36
7215.00	52.59	PK	162	1.0	H	11.93	64.52	74	9.48
Middle Channel (2451 MHz)									
2451.00	49.39	PK	162	1.5	H	32.03	81.42	94	12.58
2451.00	41.74	PK	121	1.9	V	32.03	73.77	94	20.23
4902.00	52.00	PK	120	1.0	H	6.76	58.76	74	15.24
7353.00	52.31	PK	156	1.1	H	12.29	64.60	74	9.40
High Channel (2475 MHz)									
2475.00	48.61	PK	157	2.4	H	32.13	80.74	94	13.26
2475.00	42.26	PK	50	1.4	V	32.13	74.39	94	19.61
2358.34	28.91	PK	330	1.9	H	31.77	60.68	74	13.32
2498.34	30.30	PK	291	1.5	H	32.13	62.43	74	11.57
4950.00	52.63	PK	167	1.0	H	6.80	59.43	74	14.57
7425.00	51.97	PK	246	1.8	H	12.39	64.36	74	9.64

Note: For the fundamental test, peak value meet the average limit.

Frequency (MHz)	Peak value@3m	Rx Antenna	Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part15.249	
		Polar (H / V)			Limit (dBµV/m)	Margin (dB)
Average						
Low Channel(2405MHz)						
2363.66	65.45	H	-36.21	29.24	54	24.76
2399.99	65.63	H	-36.21	29.42	54	24.58
2499.13	61.46	H	-36.21	25.25	54	28.75
4810.00	59.64	H	-36.21	23.43	54	30.57
7215.00	64.52	H	-36.21	28.31	54	25.69
Middle Channel(2451MHz)						
4902.00	58.76	H	-36.21	22.55	54	31.45
7353.00	64.60	H	-36.21	28.39	54	25.61
High Channel(2475MHz)						
2358.34	60.68	H	-36.21	24.47	54	29.53
2498.34	62.43	H	-36.21	26.22	54	27.78
4950.00	59.43	H	-36.21	23.22	54	30.78
7425.00	64.36	H	-36.21	28.15	54	25.85

Note:

Corrected Amplitude = Corrected Factor + Reading

Corrected Factor=Antenna factor (RX) +cable loss - amplifier factor

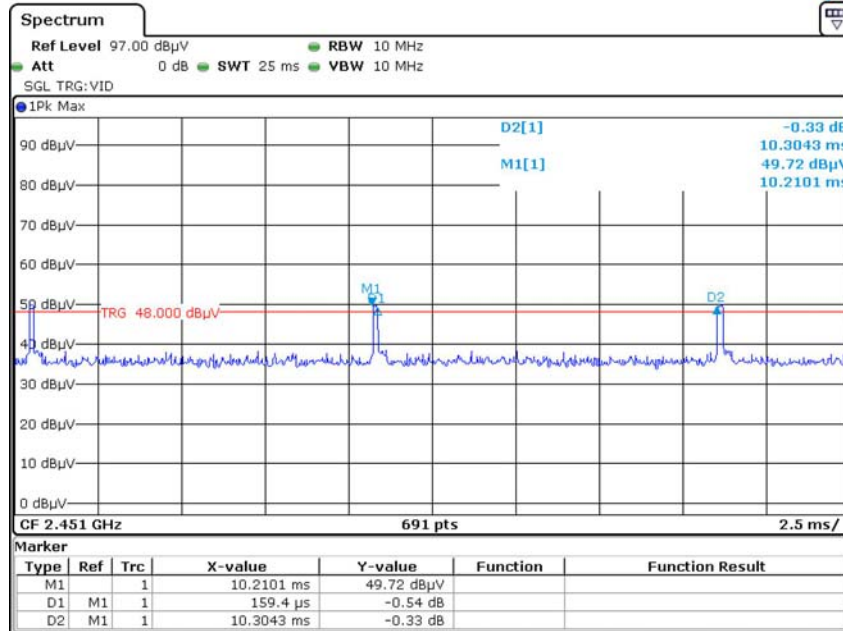
Margin = Limit- Corr. Amplitude

Duty Cycle = Ton/Tp*100%, Ton =159.40µs, Tp= 10.30ms

Duty Cycle Factor = 20lg(Duty Cycle) = -36.21

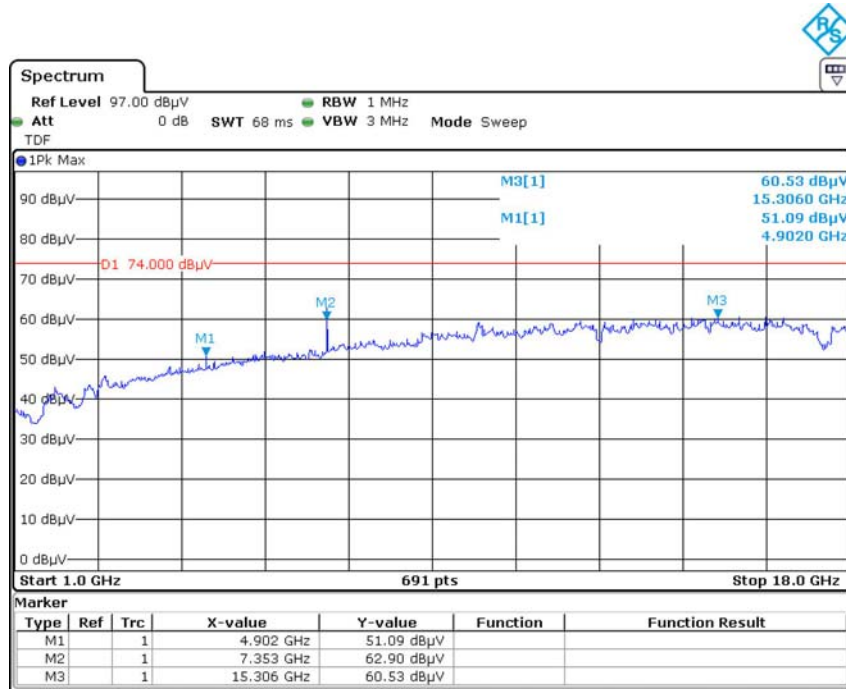
AV=PK+20*Ig(Duty Cycle)

Duty Cycle

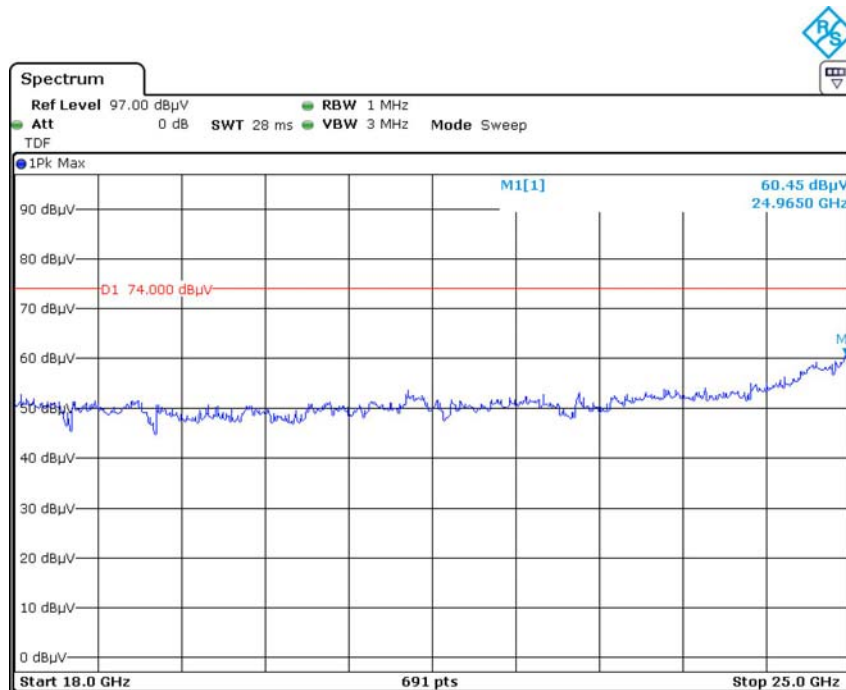


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Pre-scan with middle channel Peak Horizontal

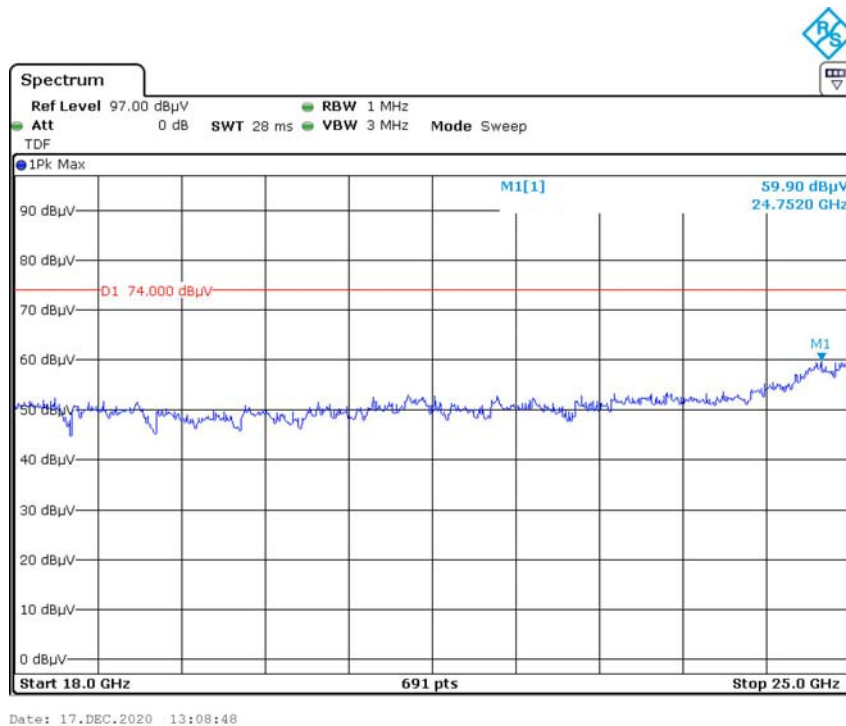
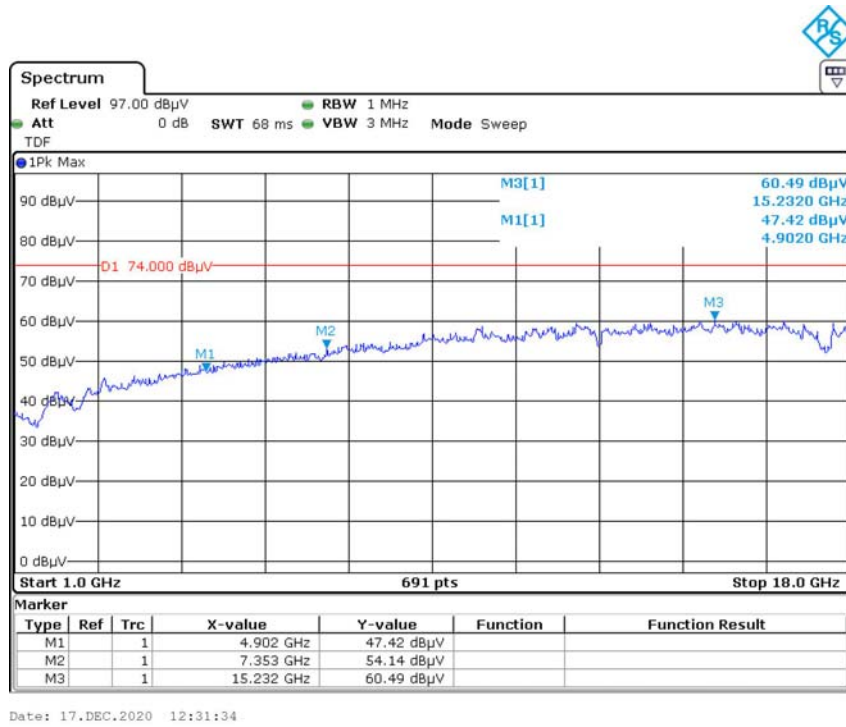


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Vertical



FCC§15.215(c) - 20dB EMISSION BANDWIDTH

Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that indicated 20dB bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

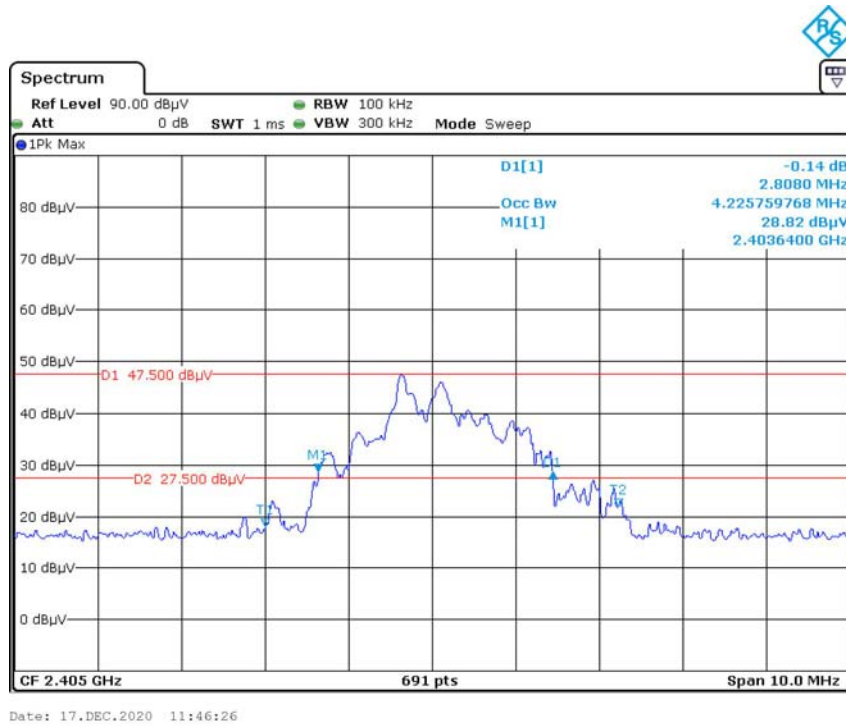
The testing was performed by Thea Xiao on 2020-12-17.

Test Mode: Transmitting

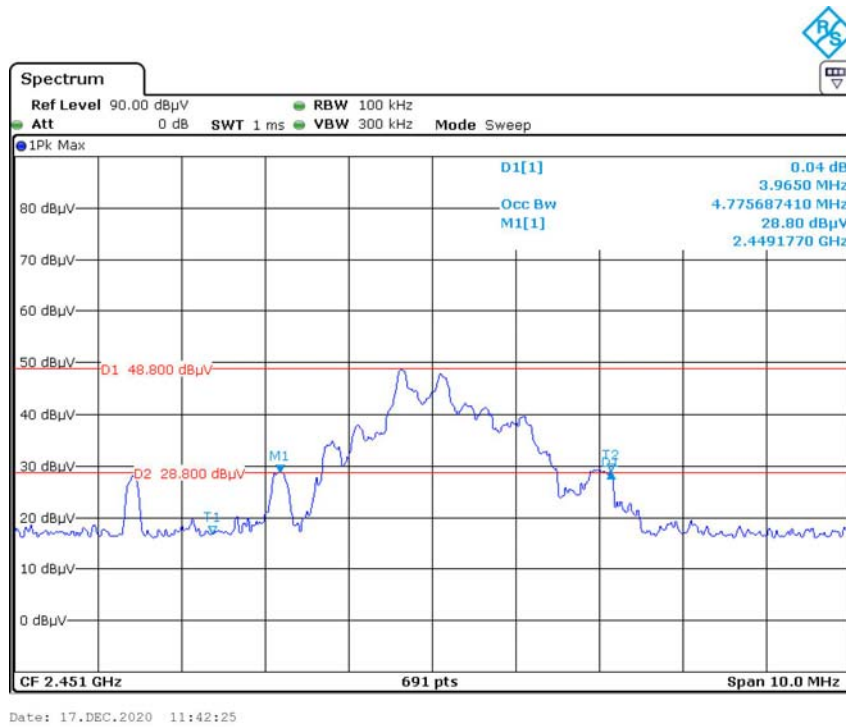
Please refer to the following table and plots.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2405	2.808
Middle	2451	3.965
High	2475	2.562

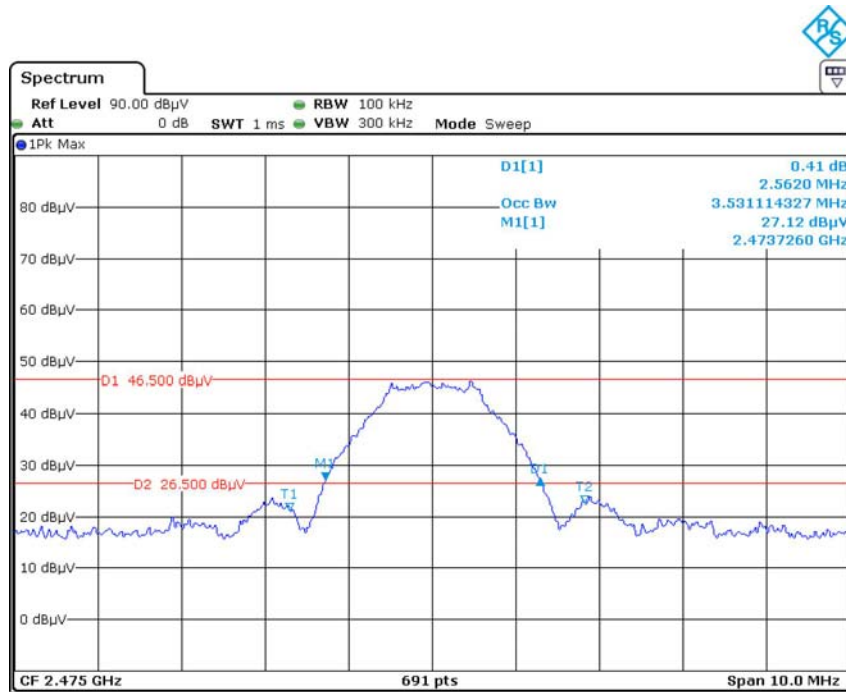
Low Channel



Middle Channel



High Channel



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