

FCC PART 15.249

TEST REPORT

For

STAR WAVE TECHNOLOGY CO., LTD.

UNIT 04 7/F BRIGHT WAY TOWER33 MONG KOK, RDKL, Hong Kong

FCC ID: 2AA8MIMAC-K131S

Report Type: Original Report	Product Name: Wireless keyboard
Report Number: RDG200624010-00	
Report Date: 2020-07-15	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Wireless keyboard
EUT Model:	IMAC-K131S
Multiple Models:	SW-CM1000, SW-CM2000, SW-CM3000, SW-CM4000, SW-CM5000, SW-CM6000, SW-CM7000, SW-CM8000, SW-GMK3000
Operation Frequency:	2405-2470MHz
Modulation Type:	GFSK
Rated Input Voltage:	DC 3V from Battery
Serial Number:	RDG200624010 -RF-S1
EUT Received Date:	2020.7.1
EUT Received Status:	Good

Note: Model IMAC-K131S was selected for fully testing, the detailed information about the difference among SW-CM1000, SW-CM2000, SW-CM3000, SW-CM4000, SW-CM5000, SW-CM6000, SW-CM7000, SW-CM8000, SW-GMK3000 and model IMAC-K131S can be referred to the declaration letter which was stated and guaranteed by the manufacturer.

Objective

This type approval report is prepared on behalf of **STAR WAVE TECHNOLOGY CO., LTD.** 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 Rules Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

No related submittal(s)/grant(s).

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 emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

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

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “△”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Justification

The EUT was configured in operating mode for testing which was provided by the manufacturer.

The device employs total 8 channels as below:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405	5	2457
2	2410	6	2463
3	2420	7	2469
4	2430	8	2470

2405MHz, 2430MHz, 2470MHz was tested.

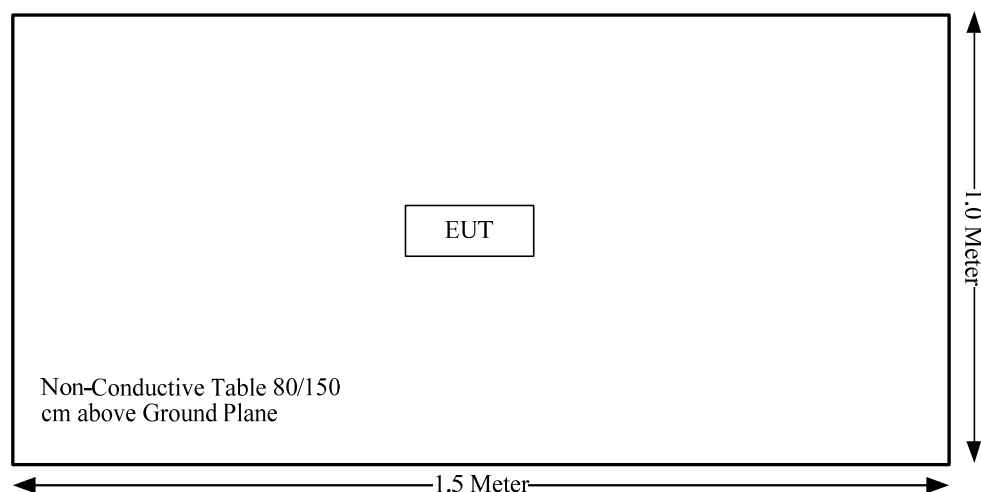
EUT Exercise Software

The software “BkNewTolol.exe” was used for testing, which was provided by manufacturer. The maximum power was configured as default setting.

Equipment Modifications

No modifications were made to the EUT.

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 Applicable
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

Note: the device was powered by battery.

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Antenna Connector Construction

The EUT has one internal antenna arrangement, and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC§15.205, §15.209&§15.249- 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:

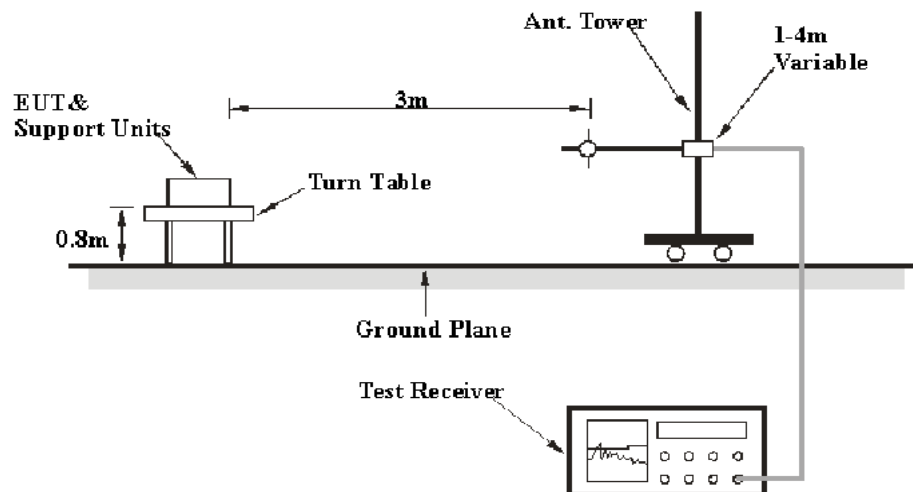
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

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

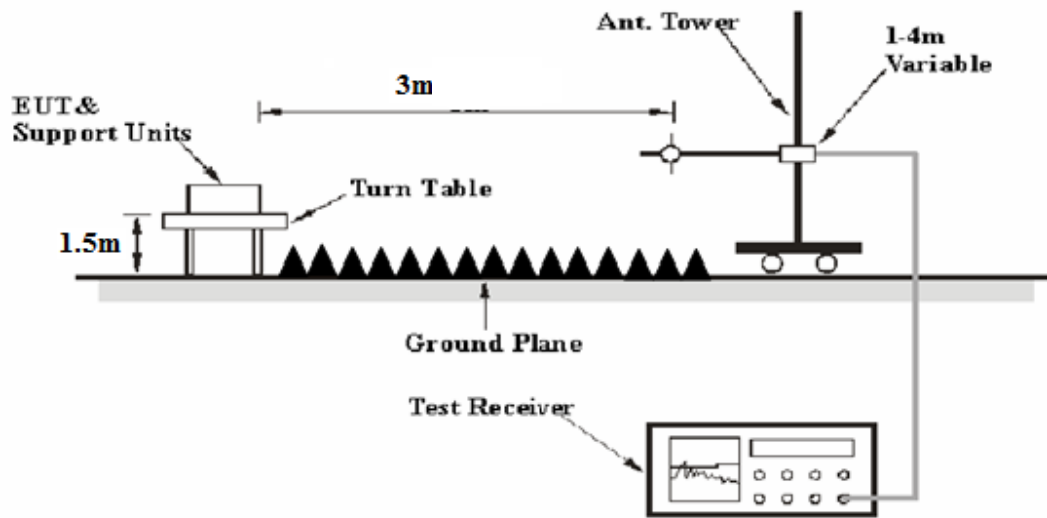
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission below 1GHz tests were performed in the 3 meters chamber test site A, above 1GHz tests were performed in the 3 meters chamber test site B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.249 limits.

Test Equipment Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

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

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

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

All data was recorded in the Quasi-peak detection mode from 30 MHz to 1GHz, peak and average detection mode above 1 GHz.

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
R&S	EMI Test Receiver	ESR3	102453	2019-09-12	2020-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2020-05-06	2021-05-06
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2017-12-06	2020-12-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2020-05-09	2021-05-09
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2020-06-27	2021-06-27
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2019-09-05	2020-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2020-06-27	2021-06-27
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2020-06-16	2021-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2020-06-16	2021-06-16

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

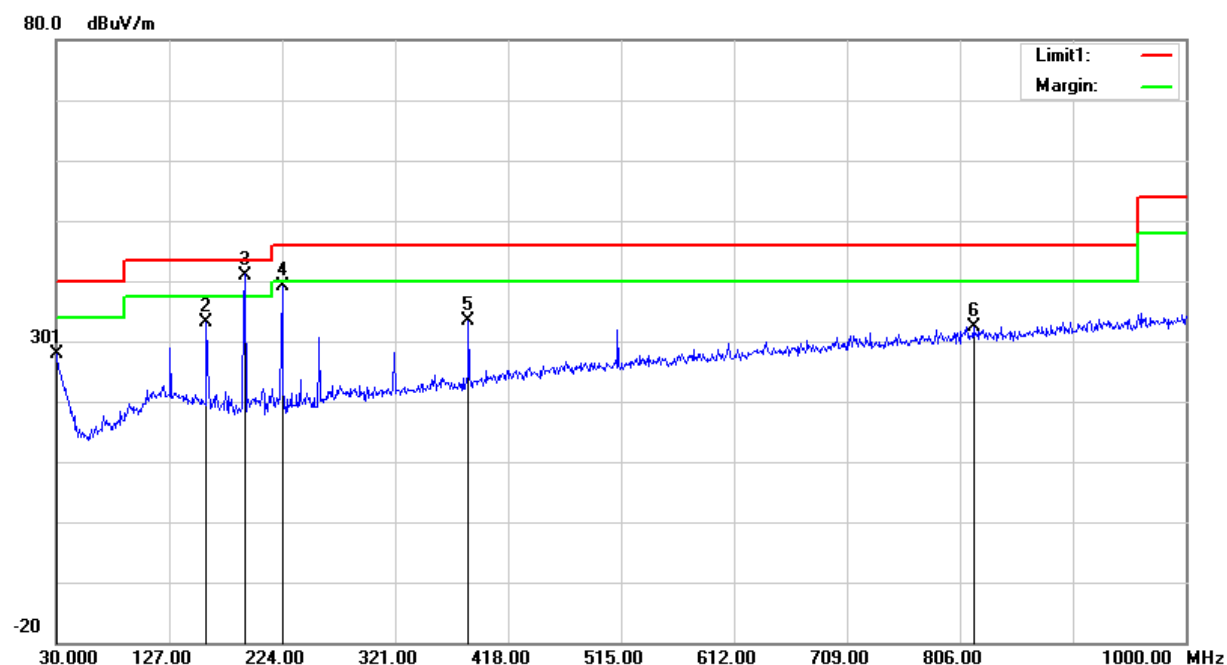
Test Data**Environmental Conditions**

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	28.1°C	28.0°C
Relative Humidity:	46%	55%
ATM Pressure:	100.3 kPa	100.3 kPa
Tester:	Bond Qin	Joker Chen
Test Date:	2020-07-12	2020-07-12

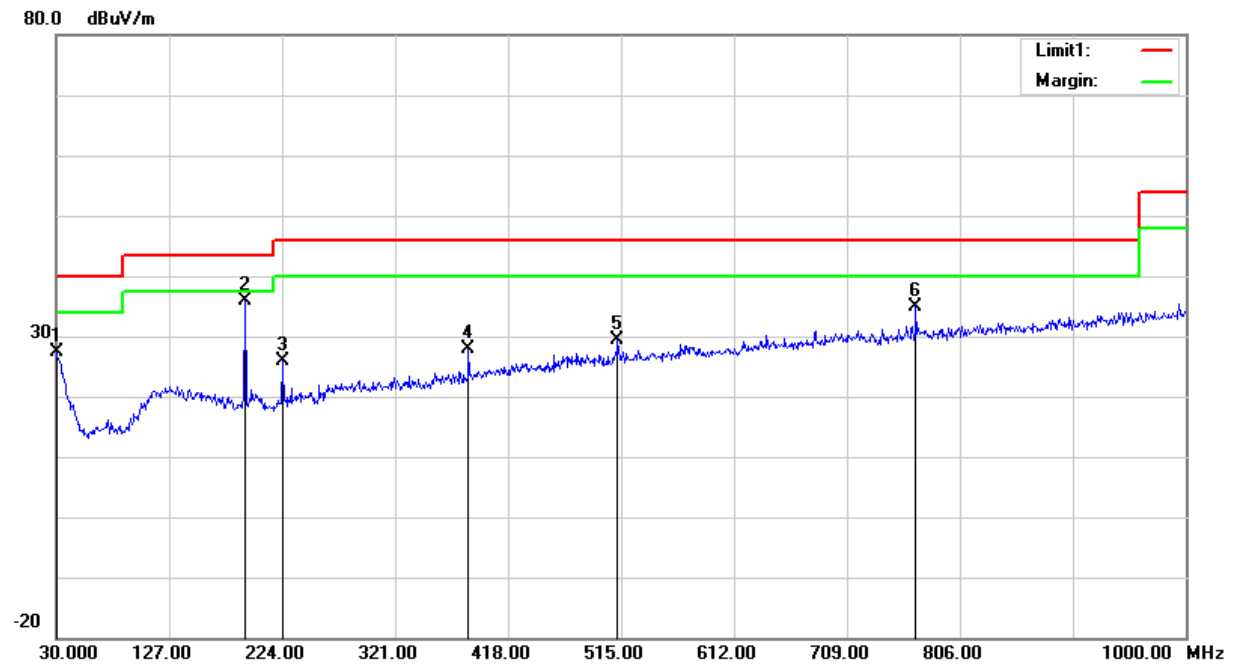
Test Mode: Transmitting

1) 30MHz-1GHz(Middle channel is the worst):

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	26.11	peak	1.72	27.83	40.00	12.17
159.0100	39.06	peak	-5.81	33.25	43.50	10.25
191.9900	47.90	QP	-7.01	40.89	43.50	2.61
224.0000	45.91	peak	-6.79	39.12	46.00	6.88
384.0500	35.80	peak	-2.43	33.37	46.00	12.63
817.6400	27.63	peak	4.85	32.48	46.00	13.52

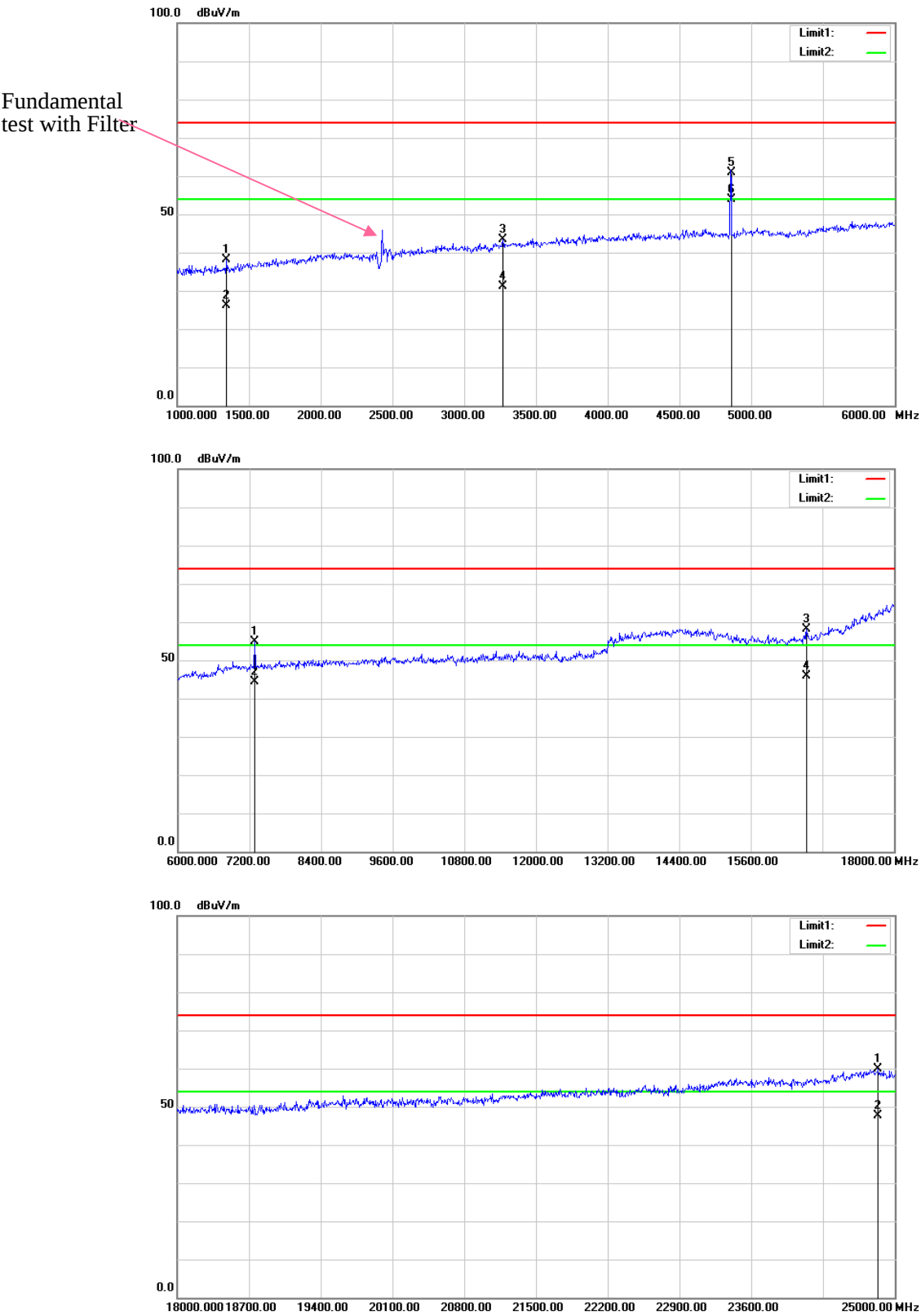
Vertical:

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	25.57	peak	1.72	27.29	40.00	12.71
191.9900	42.90	peak	-7.01	35.89	43.50	7.61
224.0000	32.59	peak	-6.79	25.80	46.00	20.20
384.0500	30.32	peak	-2.43	27.89	46.00	18.11
512.0900	29.55	peak	-0.24	29.31	46.00	16.69
768.1700	30.51	peak	4.26	34.77	46.00	11.23

2) 1GHz-25GHz

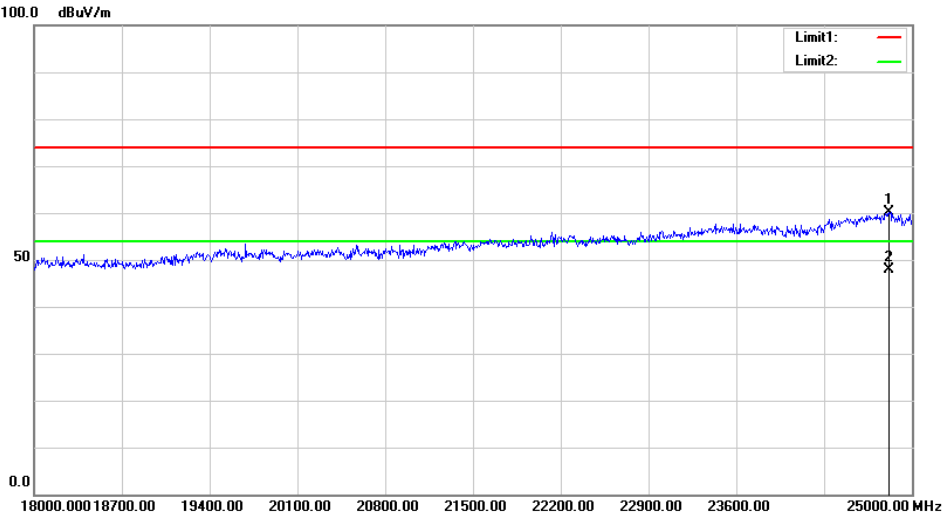
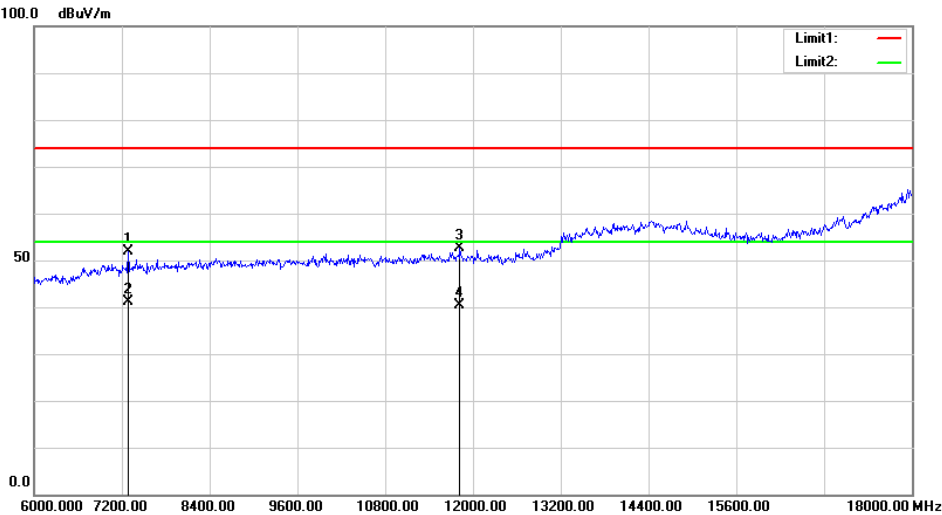
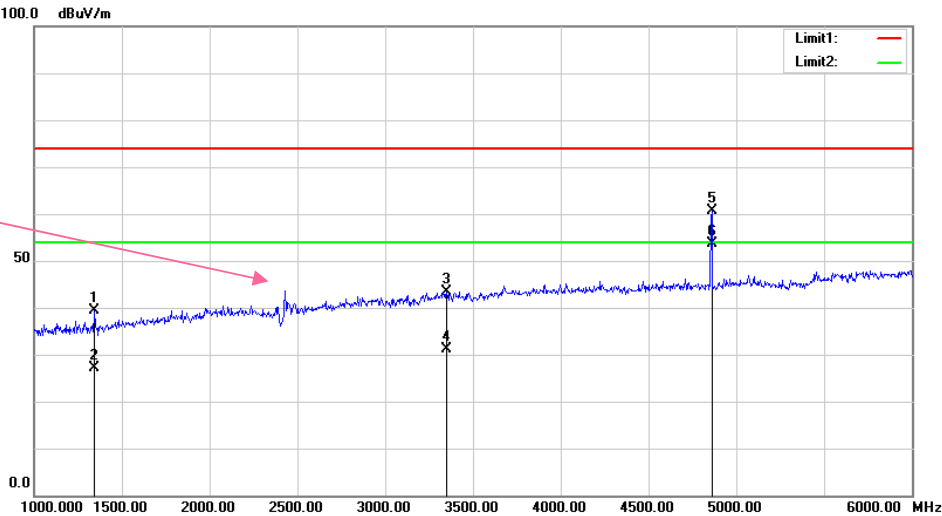
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2405 MHz									
2405.00	49.68	PK	H	28.11	1.80	0.00	79.59	113.98	34.39
2405.00	46.84	AV	H	28.11	1.80	0.00	76.75	93.98	17.23
2405.00	44.57	PK	V	28.11	1.80	0.00	74.48	113.98	39.50
2405.00	41.93	AV	V	28.11	1.80	0.00	71.84	93.98	22.14
2400.00	25.62	PK	H	28.10	1.80	0.00	55.52	74.00	18.48
2400.00	13.62	AV	H	28.10	1.80	0.00	43.52	54.00	10.48
4810.00	49.71	PK	H	32.92	3.17	25.61	60.19	74.00	13.81
4810.00	43.13	AV	H	32.92	3.17	25.61	53.61	54.00	0.39
7215.00	40.77	PK	H	35.76	4.81	25.61	55.73	74.00	18.27
7215.00	30.75	AV	H	35.76	4.81	25.61	45.71	54.00	8.29
Middle Channel: 2430 MHz									
2430.00	48.27	PK	H	28.16	1.82	0.00	78.25	113.98	35.73
2430.00	45.80	AV	H	28.16	1.82	0.00	75.78	93.98	18.20
2430.00	45.44	PK	V	28.16	1.82	0.00	75.42	113.98	38.56
2430.00	42.89	AV	V	28.16	1.82	0.00	72.87	93.98	21.11
4860.00	50.22	PK	H	33.02	3.24	25.64	60.84	74.00	13.16
4860.00	43.32	AV	H	33.02	3.24	25.64	53.94	54.00	0.06
7290.00	39.95	PK	H	35.95	4.68	25.69	54.89	74.00	19.11
7290.00	29.50	AV	H	35.95	4.68	25.69	44.44	54.00	9.56
High Channel: 2470 MHz									
2470.00	47.93	PK	H	28.24	1.84	0.00	78.01	113.98	35.97
2470.00	45.81	AV	H	28.24	1.84	0.00	75.89	93.98	18.09
2470.00	46.16	PK	V	28.24	1.84	0.00	76.24	113.98	37.74
2470.00	43.02	AV	V	28.24	1.84	0.00	73.10	93.98	20.88
2483.50	26.36	PK	H	28.27	1.84	0.00	56.47	74.00	17.53
2483.50	13.90	AV	H	28.27	1.84	0.00	44.01	54.00	9.99
4940.00	49.36	PK	H	33.18	3.25	25.64	60.15	74.00	13.85
4940.00	42.83	AV	H	33.18	3.25	25.64	53.62	54.00	0.38
7410.00	39.04	PK	H	36.27	4.47	25.82	53.96	74.00	20.04
7410.00	28.94	AV	H	36.27	4.47	25.82	43.86	54.00	10.14

Worst mode Test plots(Middle channel)
Horizontal



Vertical

Fundamental
test with Filter



FCC §15.215(c) – 20 dB BANDWIDTH TESTING**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. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
3. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2020-01-09	2021-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data**Environmental Conditions**

Temperature:	27.7 °C
Relative Humidity:	50 %
ATM Pressure:	100.3 kPa
Tester:	Vern Shen
Test Date:	2020-07-12

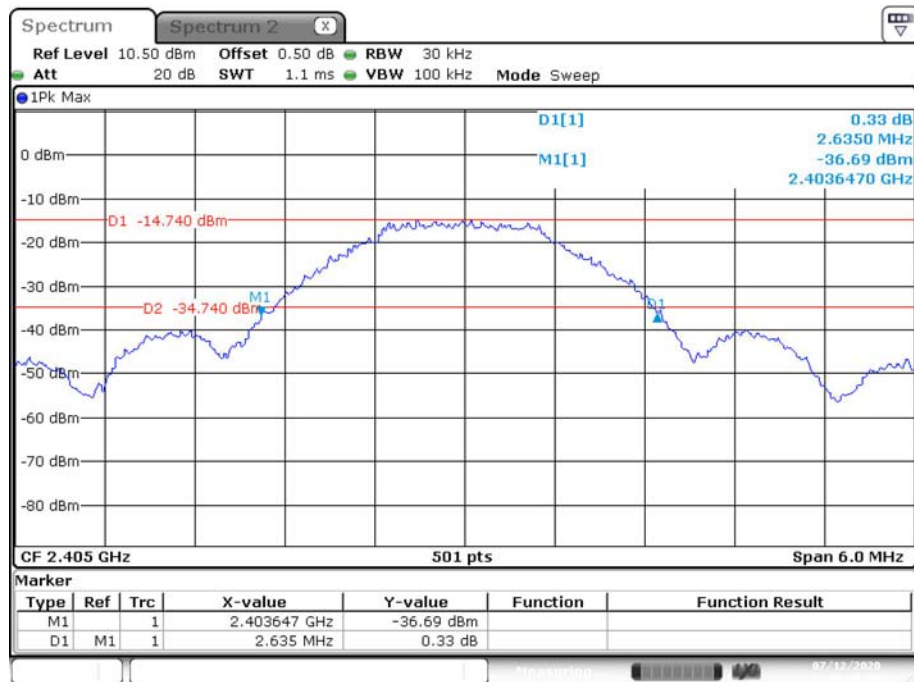
Test Result: Compliant.

Please refer to following tables and plots

Test Mode: Transmitting

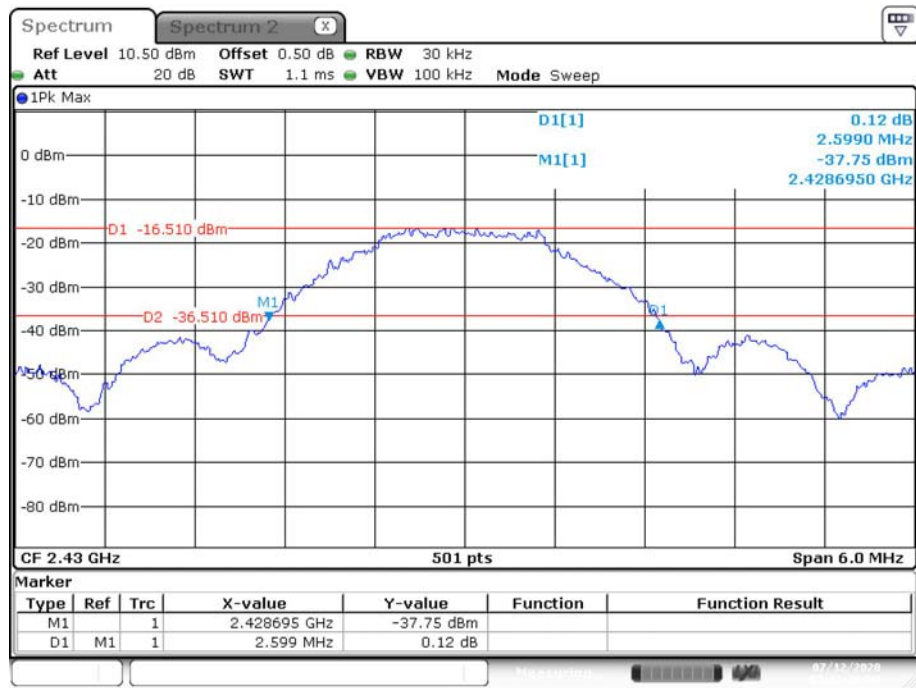
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2405	2.635
Middle	2430	2.599
High	2470	2.599

Low Channel



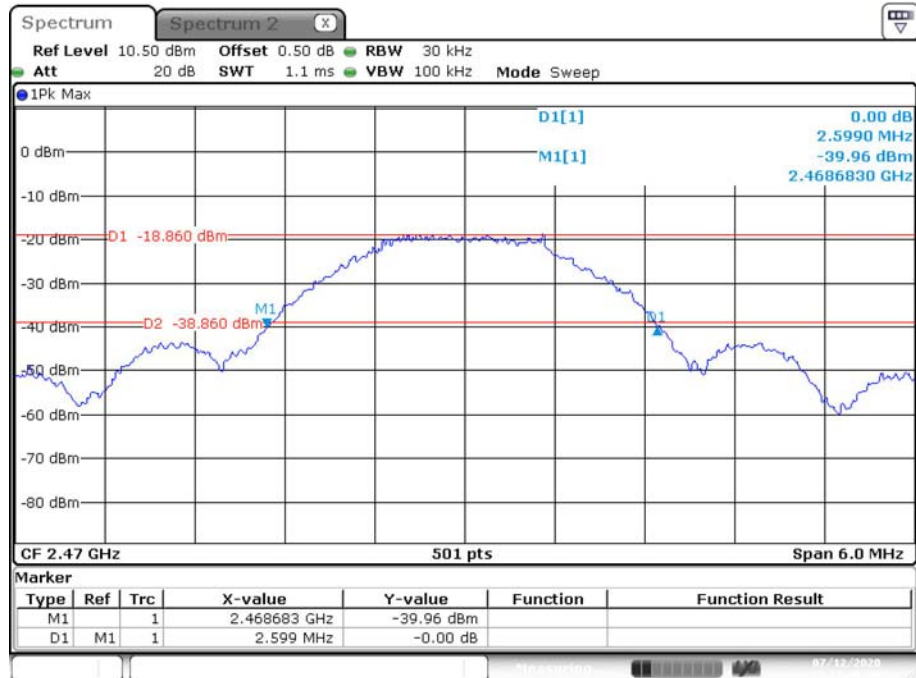
Date: 12.JUL.2020 15:08:20

Middle Channel



Date: 12.JUL.2020 15:12:39

High Channel



Date: 12.JUL.2020 15:17:20

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