

TEST REPORT

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Product Name: Mechanical keyboard
FCC ID: 2BBA6-I75
IC: 31424-I75
HVIN: I75, 661, I75Pro
47 CFR Part 15, Subpart C(15.249)
RSS-210 Issue 10, December 2019,
Standard(s): Amendment (April 2020)
RSS-Gen, Issue 5, February 2021 Amendment 2
ANSI C63.10-2013
Report Number: 2402W59393E-RF-00D
Report Date: 2024/9/11

The above device has been tested and found compliant with the requirement of the relative standards by Bay Area Compliance Laboratories Corp. (Dongguan).

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	2402W59393E-RF-00D	Original Report	2024/9/11

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Mechanical keyboard
EUT Model:	I75
Multiple Model:	661, I75Pro
Operation Frequency:	2405-2475 MHz
Modulation Type:	GFSK
Rated Input Voltage:	DC 3.7V From Battery or DC 5V From USB
Serial Number:	2PRW-1(Radiated Spurious Emission) 2PRW-7(RF conducted)
EUT Received Date:	2024/8/10
EUT Received Status:	Good

1.2 Accessory Information

Accessory Description	Manufacturer	Model	Parameters
/	/	/	/

1.3 Antenna Information Detail ▲:

Antenna Manufacturer	Antenna Type	input impedance (Ohm)	Frequency Range	Antenna Gain
Dingnan JinPeng Electronics Co.,Ltd.	PCB	50	2.4-2.5GHz	2.34dBi
The design of compliance with §15.203:				
☒ Unit uses a permanently attached antenna.				
☐ Unit uses a unique coupling to the intentional radiator.				
☐ Unit was professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.				

1.4 Equipment Modifications

No modifications are made to the EUT during all test items.

2. SUMMARY OF TEST RESULTS

Standard(s)/Rule(s)	Description of Test	Result
§15.203 RSS-GEN Clause 6.8	Antenna Requirement	Compliant
§15.207(a) RSS-Gen Clause 8.8	Conduction Emissions	Not applicable*
15.205, §15.209, §15.249 RSS-Gen Clause 8.10 RSS-210 Annex B B.10	Radiated Emissions	Compliant
§15.215 (c)	20 dB Bandwidth	Compliant
RSS-Gen Clause 6.7	99% Occupied Bandwidth	Compliant
Note 1: Not applicable for AC line conducted emissions, The device was powered by battery when operating. Note 2: For Radiated Spurious Emissions 9kHz~ 1GHz, the maximum output power mode and channel was tested.		

3. DESCRIPTION OF TEST CONFIGURATION

3.1 Operation Frequency Detail

Channel Number	1	2	3	4	5	6	7	8
Frequency (MHz)	2405	2463	2441	2426	2408	2466	2445	2422
Channel Number	9	10	11	12	13	14	15	16
Frequency (MHz)	2414	2471	2459	2436	2419	2475	2453	2439

3.2 EUT Operation Condition

The EUT was configured for testing in Engineering Mode, which was provided by the manufacturer. The EUT configuration as below:

EUT Exercise Software: BK32xx RF Test V1.9.1_en			
The software was provided by manufacturer. The maximum power was configured as below, that was provided by the manufacturer ▲ :			
Test Modes	Power Level Setting		
	Lowest Channel	Middle Channel	Highest Channel
GFSK	1	1	1

3.3 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

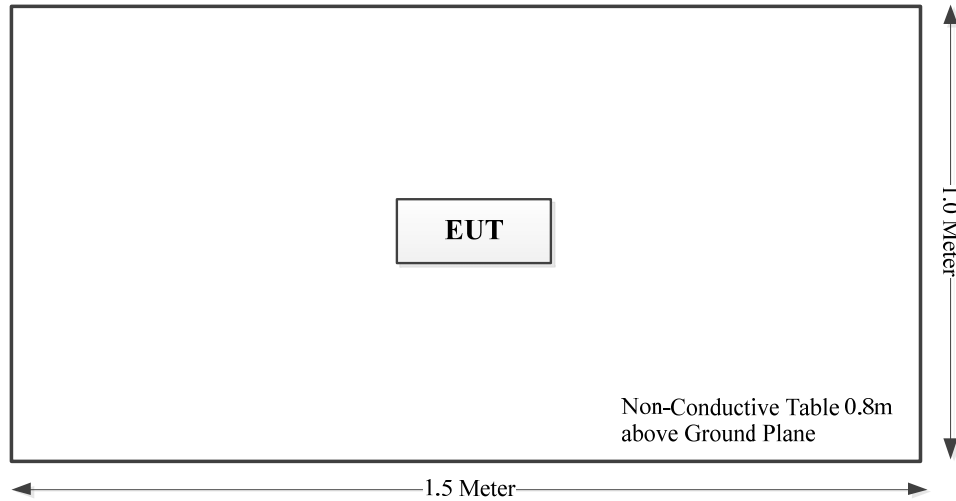
3.4 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

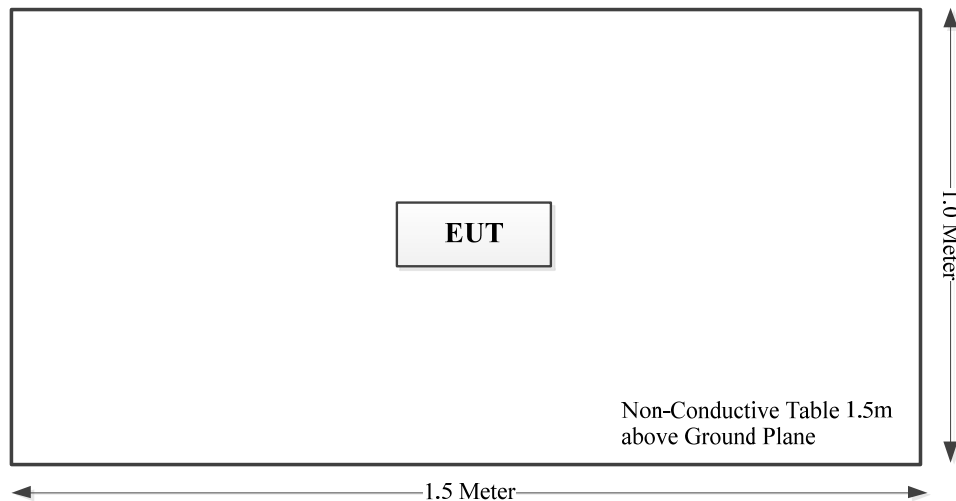
3.5 Block Diagram of Test Setup

Radiated Spurious Emissions:

Below 1GHz:



Above 1GHz:



3.6 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, 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. : 829273, the FCC Designation No. : CN5044.

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

3.7 Measurement Uncertainty

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.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	9kHz~30MHz: 3.3dB, 30MHz~200MHz: 4.55 dB, 200MHz~1GHz: 5.92 dB, 1GHz~6GHz: 4.98 dB, 6GHz~18GHz: 5.89 dB, 18GHz~26.5GHz: 5.47 dB, 26.5GHz~40GHz: 5.63 dB, 40~60G: 4.83dB, 60G~90G: 4.94dB, 90G-140G: 5.46dB, 140G-220G: 6.00dB, 220G-325G: 7.35dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
AC Power Lines Conducted Emission	3.11 dB (150 kHz to 30 MHz)

4. REQUIREMENTS AND TEST RESULTS

4.1 AC Line Conducted Emissions

Not Applicable, the device was power by battery.

4.2 Radiated Emissions

4.2.1 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.

RSS-210, Annex B, B.10

Devices shall comply with the following requirements:

(a) The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2.

Table B2 — Field strength limits at various frequencies

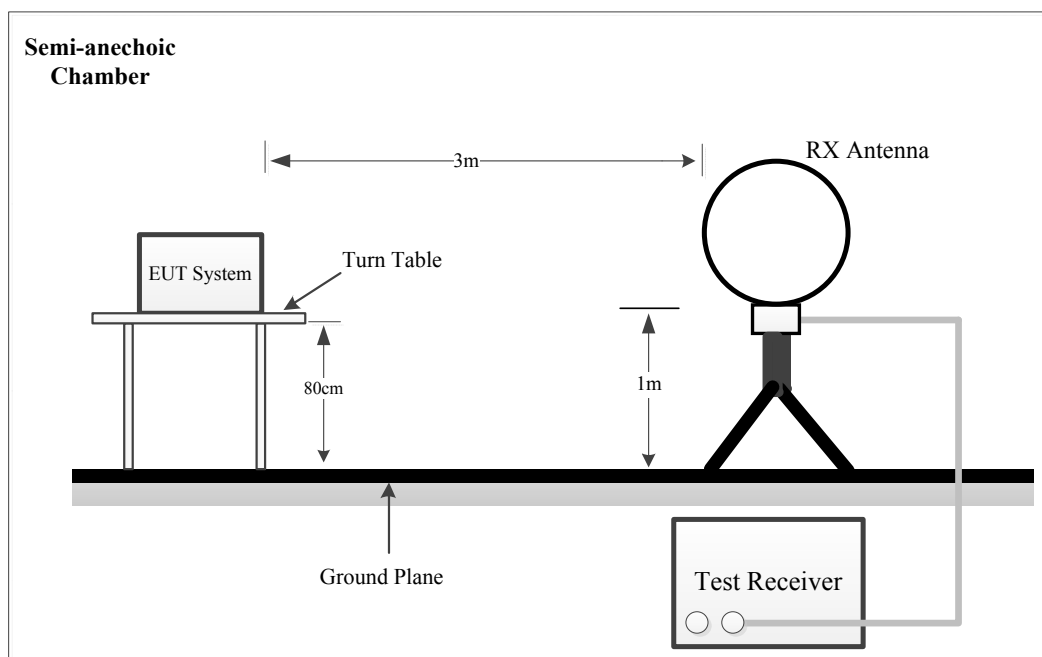
Frequency bands (MHz)	Field strength (mV/m)	
	Fundamental emissions	Harmonic emissions
902-928	50	0.5
2400-2483.5	50	0.5
5725-5875	50	0.5
24000-24250	250	2.5

The field strength shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

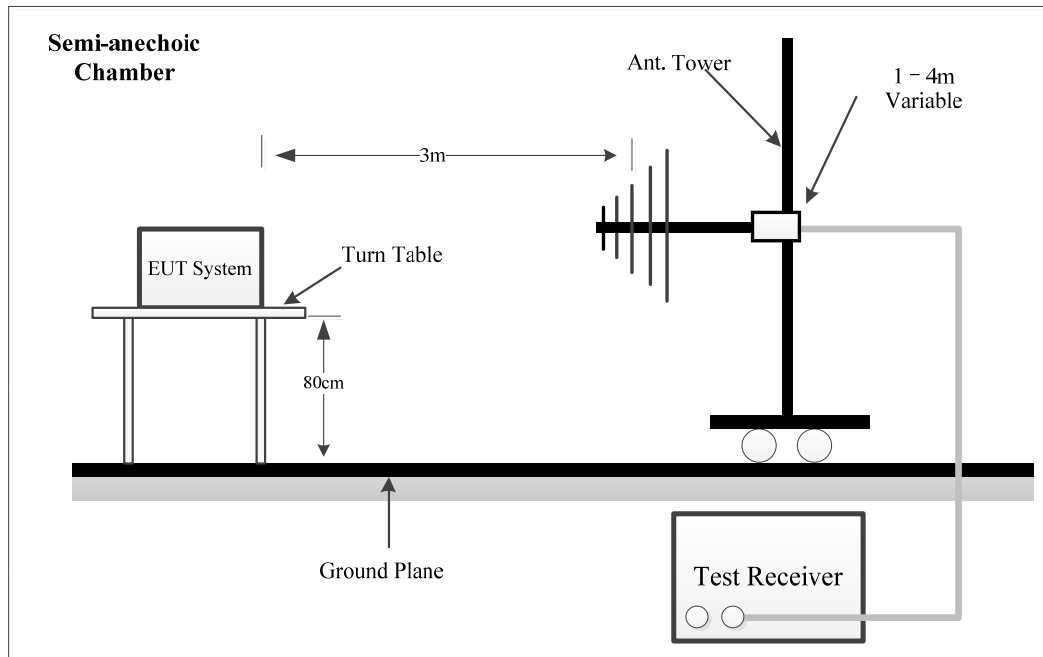
- (b) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in [RSS-Gen](#), whichever is less stringent

4.2.2 EUT Setup

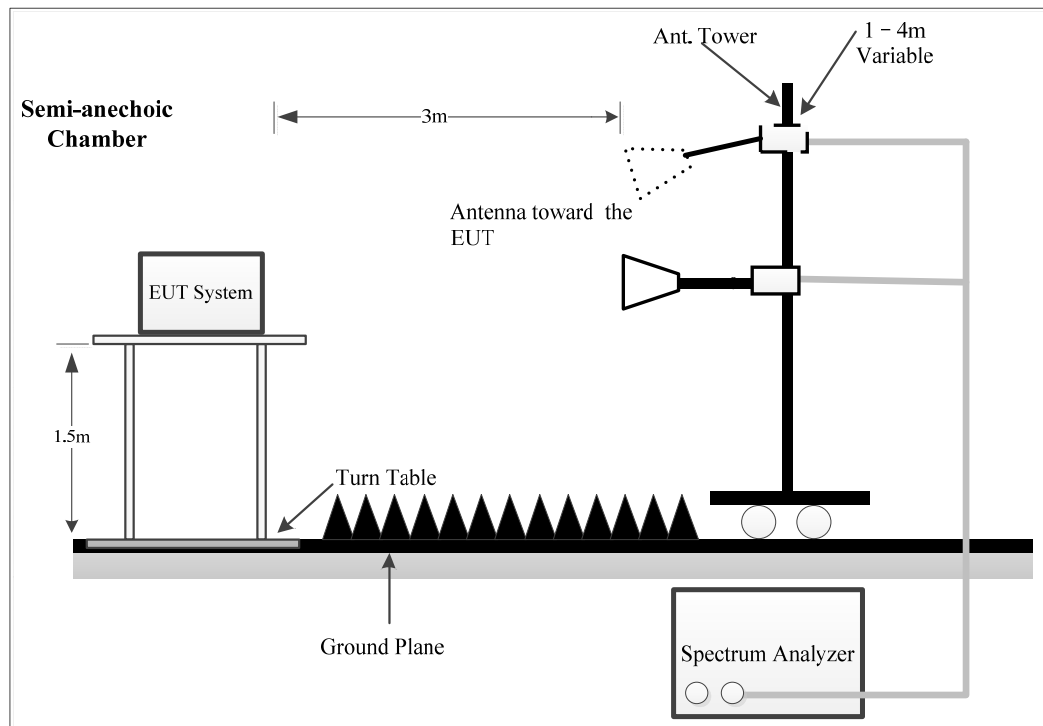
9kHz~30MHz:



Below 1GHz:



1GHz-25 GHz:



For 9kHz-30MHz test, the lowest height of the magnetic antenna shall be 1 m above the ground and three antenna orientations (parallel, perpendicular, and ground-parallel) shall be measured.

The radiated emission test was performed in the 3 meters chamber, 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.

4.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 25 GHz.

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

9kHz-100GHz:

Frequency Range	Measurement	RBW	Video B/W	IF B/W
9 kHz – 150 kHz	QP/AV	200 Hz	1 kHz	200 Hz
150 kHz – 30 MHz	QP/AV	9 kHz	30 kHz	9 kHz
30 MHz – 1000 MHz	PK	100 kHz	300 kHz	/
	QP	/	/	120 kHz
Above 1 GHz	PK	1MHz	3 MHz	
	AV	/	/	1MHz

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.

4.2.4 Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 9 kHz -1 GHz, except 9-90 kHz, 110-490 kHz, employing an average detector, peak and Average detection modes for frequencies above 1 GHz.

4.2.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$\text{Result} = \text{Reading} + \text{Factor}$$

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

Note: the antenna JB3 was calibrated with 6dB Attenuator, the antenna factor includes the insertion loss of the Attenuator.

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Result}$$

4.2.6 Test Result

Serial Number:	2PRW-1	Test Date:	Below 1GHz: 2024/8/19 Above 1GHz: 2024/9/4
Test Site:	Chamber 10m, Chamber B	Test Mode:	Transmitting
Tester:	Zoo Zou, Leo Xiao	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	26.6~28	Relative Humidity: (%)	44~59	ATM Pressure: (kPa)	100.3~100.5
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
9kHz~1000MHz					
EMCO	Passive Loop Antenna	6512	9706-1206	2023/10/21	2026/10/20
Sunol Sciences	Hybrid Antenna	JB3	A060611-1	2023/9/6	2026/9/5
Narda	Coaxial Attenuator	779-6dB	04269	2023/9/6	2026/9/5
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2024/8/1	2025/7/31
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-04	2024/8/1	2025/7/31
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2024/8/1	2025/7/31
Sonoma	Amplifier	310N	185914	2024/8/1	2025/7/31
R&S	EMI Test Receiver	ESCI	101121	2023/10/18	2024/10/17
Audix	Test Software	E3	191218 V9	N/A	N/A
Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2023/9/7	2026/9/6
R&S	Spectrum Analyzer	FSV40	101944	2023/10/18	2024/10/17
Xinhang Macrowave	Coaxial Cable	XH750A-N/J-SMA/J-10M	20231117004 #0001	2023/11/17	2024/11/16
Audix	Test Software	E3	191218 (V9)	N/A	N/A
AH	Preamplifier	PAM-0118P	469	2024/4/15	2025/4/15
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-03 1304	2023/2/22	2026/2/21
Xinhang Macrowave	Coaxial Cable	XH360A-2.92/J-2.92/J-6M-A	20231208001 #0001	2023/12/11	2024/12/10
AH	Preamplifier	PAM-1840VH	191	2023/9/7	2024/9/6
E-Microwave	Band Rejection Filter	OBSF-2400-2483.5-S	OE01601525	2024/2/21	2025/2/20
Micro-tronics	High Pass Filter	HPM50111	G217	2023/12/1	2024/11/30

* 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:

Please refer to the below table and plots.

After pre-scan in the X, Y and Z axes of orientation, the worst case is below:

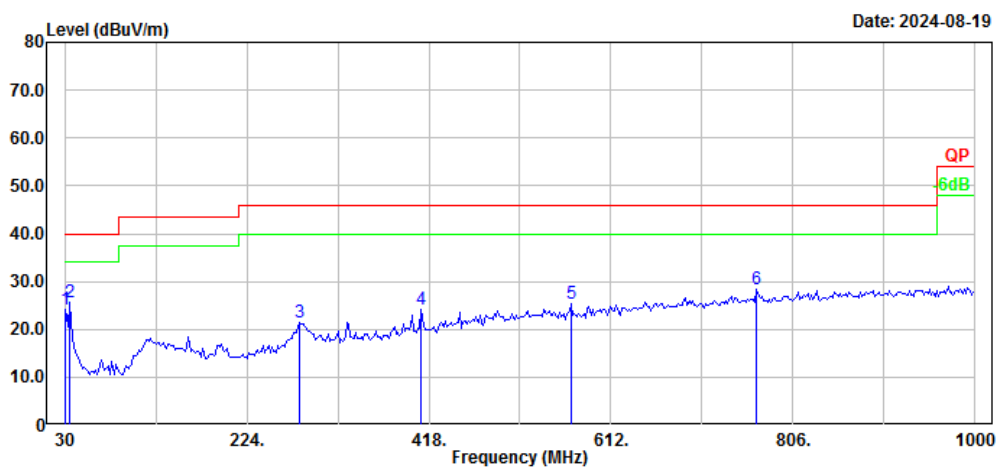
1) 9kHz-30MHz:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

2) 30MHz-1GHz

Project No.: 2402W59393E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

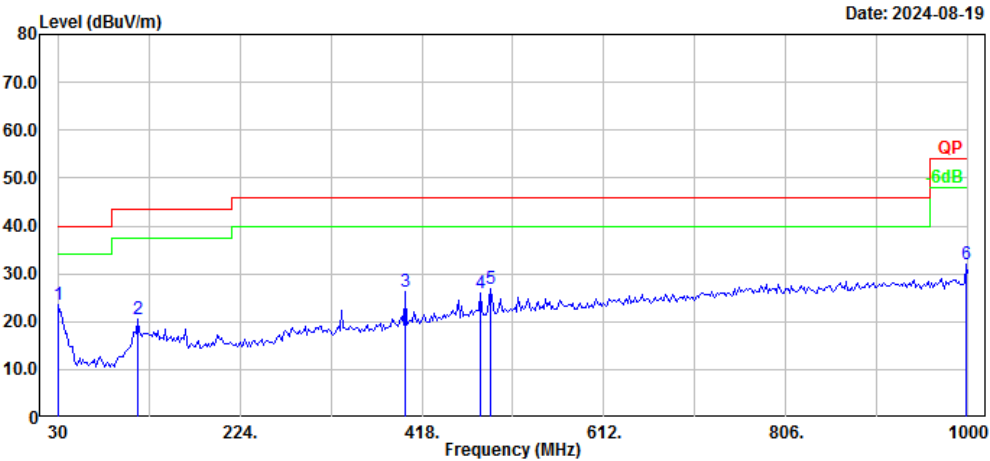
Serial No.: 2PRW-1
Tester: Zoo Zou



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	30.00	28.03	-3.80	24.23	40.00	15.77	Peak
2	35.82	33.69	-8.01	25.68	40.00	14.32	Peak
3	280.26	31.19	-9.73	21.46	46.00	24.54	Peak
4	410.24	30.99	-6.71	24.28	46.00	21.72	Peak
5	569.32	28.64	-3.23	25.41	46.00	20.59	Peak
6	767.20	28.28	-0.05	28.23	46.00	17.77	Peak

Project No.: 2402W59393E-RF
Polarization: Vertical
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Zoo Zou



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	30.00	27.34	-3.80	23.54	40.00	16.46	Peak
2	115.36	31.15	-10.60	20.55	43.50	22.95	Peak
3	400.54	33.13	-6.96	26.17	46.00	19.83	Peak
4	480.08	30.73	-4.71	26.02	46.00	19.98	Peak
5	491.72	31.34	-4.46	26.88	46.00	19.12	Peak
6	998.06	29.20	2.80	32.00	54.00	22.00	Peak

3) 1-25GHz:

Frequency (GHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
Low Channel: 2405MHz							
2404.41	54.48	PK	H	28.63	83.11	114.00	30.89
2404.41	52.68	AV	H	28.63	81.31	94.00	12.69
2404.35	47.29	PK	V	28.63	75.92	114.00	38.08
2404.35	46.46	AV	V	28.63	75.09	94.00	18.91
2400.00	27.13	PK	H	28.61	55.74	74.00	18.26
2400.00	17.50	AV	H	28.61	46.11	54.00	7.89
2400.00	26.33	PK	V	28.61	54.94	74.00	19.06
2400.00	16.37	AV	V	28.61	44.98	54.00	9.02
4810.00	49.28	PK	H	-10.1	39.18	74.00	34.82
4810.00	41.27	AV	H	-10.1	31.17	54.00	22.83
4810.00	48.73	PK	V	-10.1	38.63	74.00	35.37
4810.00	40.38	AV	V	-10.1	30.28	54.00	23.72
7215.00	51.99	PK	H	-5.46	46.53	74.00	27.47
7215.00	47.12	AV	H	-5.46	41.66	54.00	12.34
7215.00	56.48	PK	V	-5.46	51.02	74.00	22.98
7215.00	53.43	AV	V	-5.46	47.97	54.00	6.03
Middle Channel: 2441MHz							
2441.00	52.45	PK	H	28.78	81.23	114.00	32.77
2441.00	51.57	AV	H	28.78	80.35	94.00	13.65
2441.00	46.76	PK	V	28.78	75.54	114.00	38.46
2441.00	45.47	AV	V	28.78	74.25	94.00	19.75
4882.00	48.53	PK	H	-10	38.53	74.00	35.47
4882.00	40.49	AV	H	-10	30.49	54.00	23.51
4882.00	50.01	PK	V	-10	40.01	74.00	33.99
4882.00	41.91	AV	V	-10	31.91	54.00	22.09
7323.00	52.35	PK	H	-5.01	47.34	74.00	26.66
7323.00	46.96	AV	H	-5.01	41.95	54.00	12.05
7323.00	56.28	PK	V	-5.01	51.27	74.00	22.73
7323.00	53.21	AV	V	-5.01	48.20	54.00	5.80
2072.00	76.42	PK	H	-15.91	60.51	74.00	13.49
2072.00	54.47	AV	H	-15.91	38.56	54.00	15.44
2072.00	67.18	PK	V	-15.91	51.27	74.00	22.73
2072.00	45.43	AV	V	-15.91	29.52	54.00	24.48
2809.00	70.49	PK	H	-13.3	57.19	74.00	16.81
2809.00	48.16	AV	H	-13.3	34.86	54.00	19.14
2809.00	61.34	PK	V	-13.3	48.04	74.00	25.96
2809.00	40.19	AV	V	-13.3	26.89	54.00	27.11

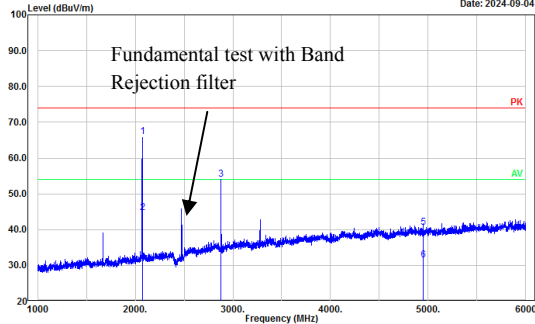
Frequency (GHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
High Channel: 2475 MHz							
2474.84	52.93	PK	H	28.91	81.84	114.00	32.16
2474.84	51.62	AV	H	28.91	80.53	94.00	13.47
2474.38	46.22	PK	V	28.91	75.13	114.00	38.87
2474.38	45.42	AV	V	28.91	74.33	94.00	19.67
2483.50	26.90	PK	H	28.95	55.85	74.00	18.15
2483.50	16.41	AV	H	28.95	45.36	54.00	8.64
2483.50	26.44	PK	V	28.95	55.39	74.00	18.61
2483.50	16.93	AV	V	28.95	45.88	54.00	8.12
4950.00	50.53	PK	H	-9.98	40.55	74.00	33.45
4950.00	41.49	AV	H	-9.98	31.51	54.00	22.49
4950.00	48.53	PK	V	-9.98	38.55	74.00	35.45
4950.00	40.59	AV	V	-9.98	30.61	54.00	23.39
7425.00	52.36	PK	H	-4.58	47.78	74.00	26.22
7425.00	46.07	AV	H	-4.58	41.49	54.00	12.51
7425.00	56.20	PK	V	-4.58	51.62	74.00	22.38
7425.00	52.87	AV	V	-4.58	48.29	54.00	5.71
2072.00	81.82	PK	H	-15.91	65.91	74.00	8.09
2072.00	60.64	AV	H	-15.91	44.73	54.00	9.27
2072.00	82.81	PK	V	-15.91	66.90	74.00	7.10
2072.00	60.94	AV	V	-15.91	45.03	54.00	8.97
2876.00	67.01	PK	H	-12.98	54.03	74.00	19.97
2876.00	45.53	AV	H	-12.98	32.55	54.00	21.45
2877.00	59.79	PK	V	-12.97	46.82	74.00	27.18
2877.00	39.41	AV	V	-12.97	26.44	54.00	27.56

Horizontal

Project No.: 2402W59393E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Leo Xiao

Date: 2024-09-04



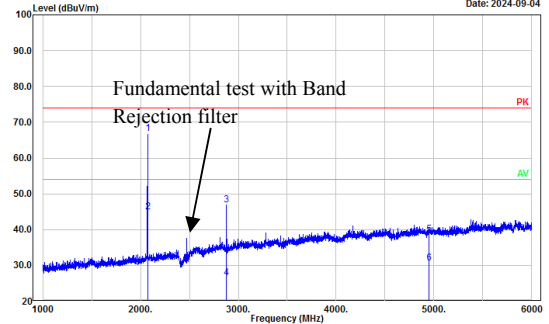
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2872.00	81.82	-15.91	65.91	74.00	8.09	Peak
2	2872.00	60.64	-15.91	44.73	54.00	9.27	Average
3	2876.00	67.01	-12.98	54.03	74.00	19.97	Peak
4	2876.00	45.53	-12.98	32.55	54.00	21.45	Average
5	4950.00	50.53	-9.98	40.55	74.00	33.45	Peak
6	4950.00	41.49	-9.98	31.51	54.00	22.49	Average

Vertical

Project No.: 2402W59393E-RF
Polarization: Vertical
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Leo Xiao

Date: 2024-09-04

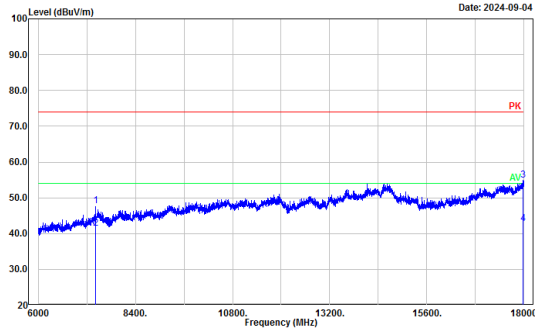


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2872.00	82.81	-15.91	66.90	74.00	7.10	Peak
2	2872.00	60.94	-15.91	45.03	54.00	8.97	Average
3	2877.00	59.79	-12.97	46.82	74.00	27.18	Peak
4	2877.00	39.41	-12.97	26.44	54.00	27.56	Average
5	4950.00	48.53	-9.98	38.55	74.00	35.45	Peak
6	4950.00	40.59	-9.98	30.61	54.00	23.39	Average

Project No.: 2402W59393E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Leo Xiao

Date: 2024-09-04

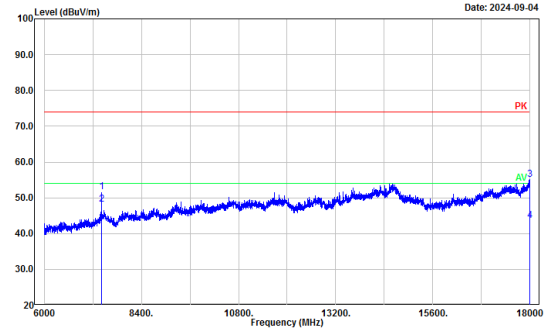


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	7425.00	52.36	-4.58	47.78	74.00	26.22	Peak
2	7425.00	46.07	-4.58	41.49	54.00	12.51	Average
3	17971.20	46.95	7.92	54.87	74.00	19.13	Peak
4	17971.20	34.82	7.92	42.74	54.00	11.26	Average

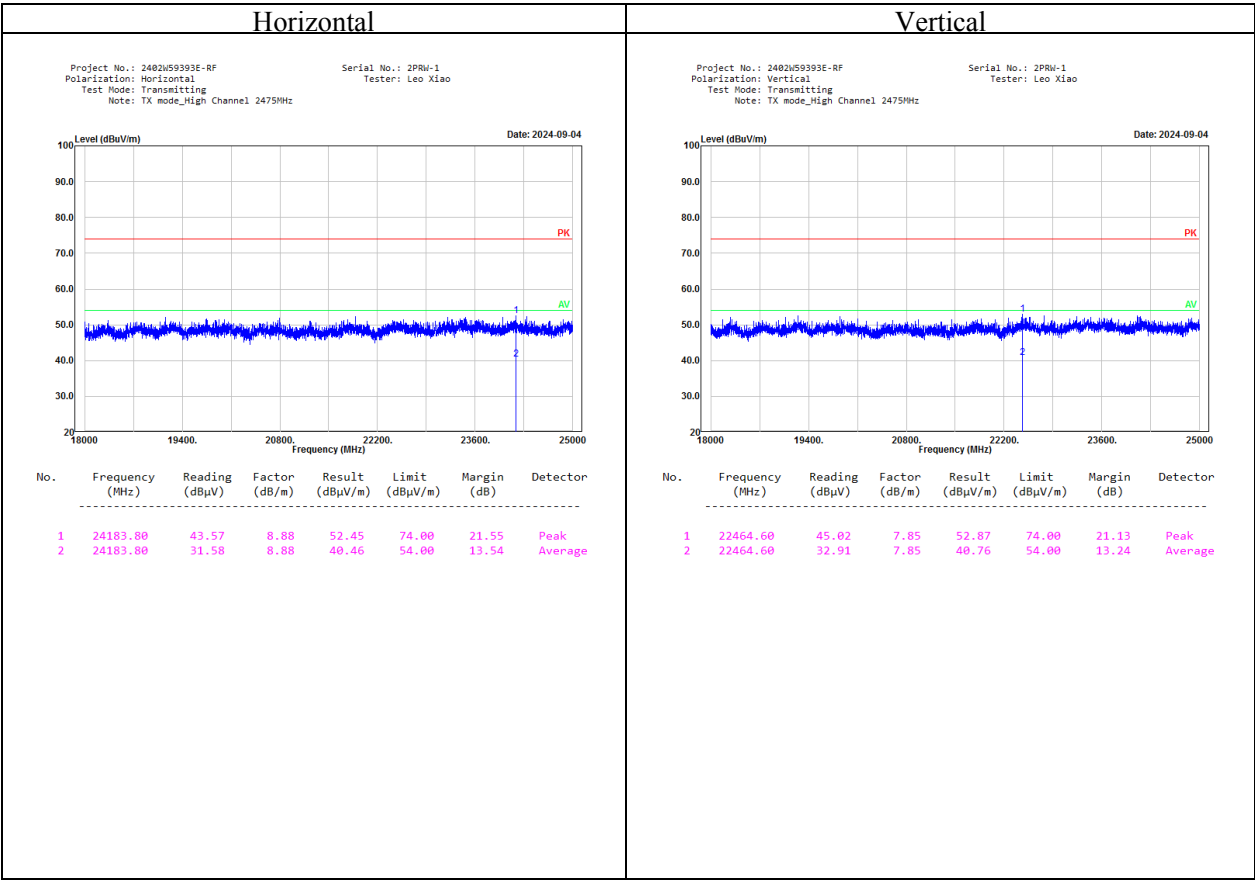
Project No.: 2402W59393E-RF
Polarization: Vertical
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Leo Xiao

Date: 2024-09-04



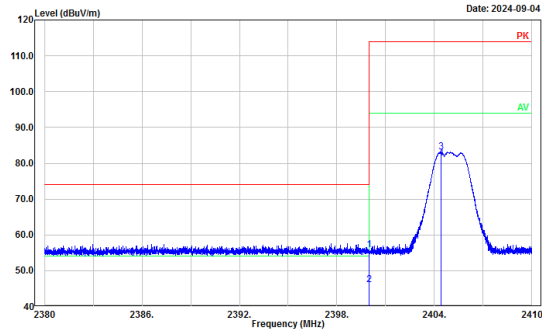
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	7425.00	56.20	-4.58	51.62	74.00	22.38	Peak
2	7425.00	52.87	-4.58	48.29	54.00	5.71	Average
3	17997.60	47.07	8.12	55.19	74.00	18.81	Peak
4	17997.60	35.55	8.12	43.67	54.00	10.33	Average



Bandedge. Horizontal

Project No.: 2402W59393E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note: TX mode_Low Channel 2405MHz

Serial No.: 2PRW-1
Tester: Leo Xiao

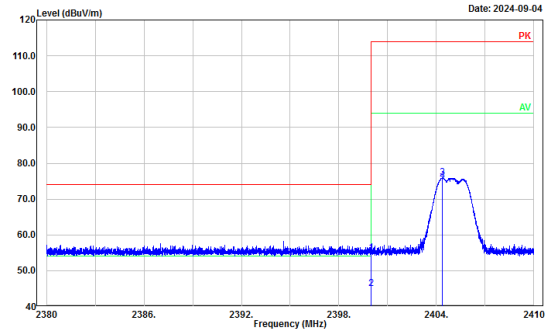


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2400.00	27.13	28.61	55.74	74.00	18.26	Peak
2	2400.00	17.50	28.61	46.11	54.00	7.89	Average
3	2404.41	54.48	28.63	83.11	114.00	30.89	Peak
4	2404.41	52.68	28.63	81.31	94.00	12.69	Average

Bandedge. Vertical

Project No.: 2402W59393E-RF
Polarization: Vertical
Test Mode: Transmitting
Note: TX mode_Low Channel 2405MHz

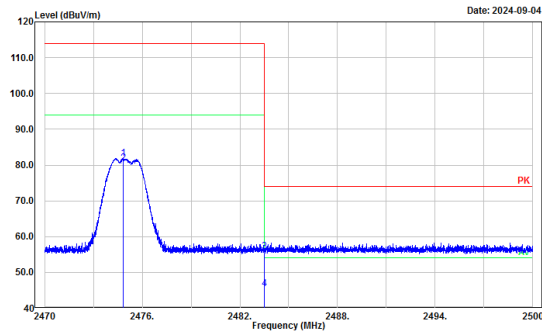
Serial No.: 2PRW-1
Tester: Leo Xiao



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2400.00	26.33	28.61	54.94	74.00	19.06	Peak
2	2400.00	16.37	28.61	44.98	54.00	9.02	Average
3	2404.35	47.29	28.63	75.92	114.00	38.08	Peak
4	2404.35	46.46	28.63	75.09	94.00	18.91	Average

Project No.: 2402W59393E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

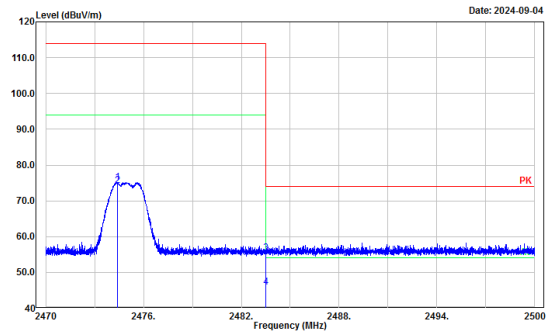
Serial No.: 2PRW-1
Tester: Leo Xiao



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2474.84	52.93	28.91	81.84	114.00	32.16	Peak
2	2474.84	51.62	28.91	80.53	94.00	13.47	Average
3	2483.50	26.90	28.95	55.85	74.00	18.15	Peak
4	2483.50	16.41	28.95	45.36	54.00	8.64	Average

Project No.: 2402W59393E-RF
Polarization: Vertical
Test Mode: Transmitting
Note: TX mode_High Channel 2475MHz

Serial No.: 2PRW-1
Tester: Leo Xiao



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2474.38	46.22	28.91	75.13	114.00	38.87	Peak
2	2474.38	45.42	28.91	74.33	94.00	19.67	Average
3	2483.50	26.44	28.95	55.39	74.00	18.61	Peak
4	2483.50	16.93	28.95	45.88	54.00	8.12	Average

4.3 20 dB Emission Bandwidth and 99% Occupied Bandwidth

4.3.1 Applicable Standard

FCC §15.215

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.

RSS-Gen Clause 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth: The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

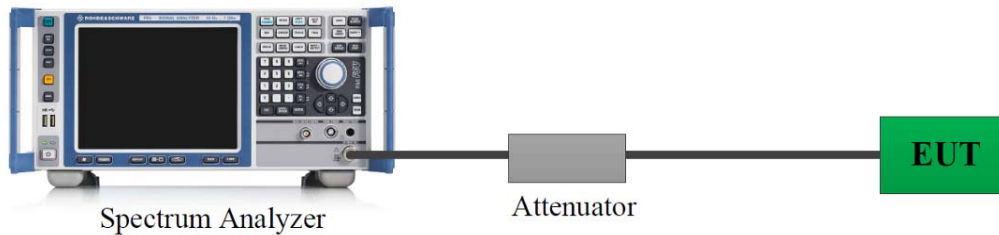
The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

4.3.2 EUT Setup



A short RF cable with low cable loss connected to the EUT antenna port, which was provided by manufacturer.

4.3.3 Test Procedure

According to ANSI C63.10-2013 Section 6.9.2

- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, unless otherwise specified by the applicable requirement.
- Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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 20 dB relative to the maximum level measured in the fundamental emission.

According to ANSI C63.10-2013 Section 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

4.3.4 Test Result

Serial No.:	2PRW-7	Test Date:	2024/8/21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Roy Xiao	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.8	Relative Humidity: (%)	49	ATM Pressure: (kPa)	100.9
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101589	2023/10/18	2024/10/17
Eastsheep	Coaxial Attenuator	5W-N-JK-6G-10dB	F-08-EM503	2024/6/7	2025/6/7

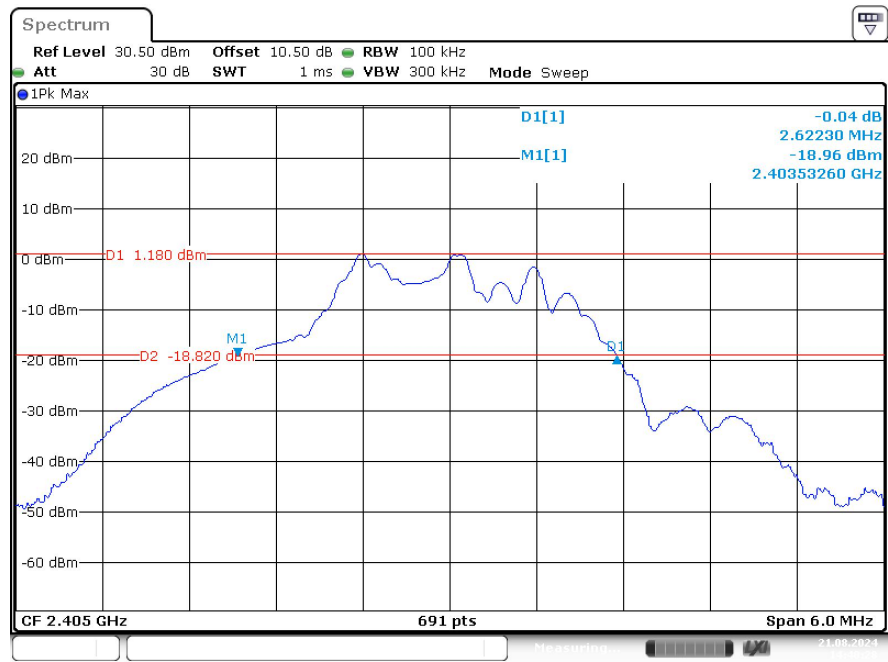
* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test Channel	Test Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	2405	2.622	2.466
Middle	2441	2.544	2.318
Highest	2475	2.449	2.179

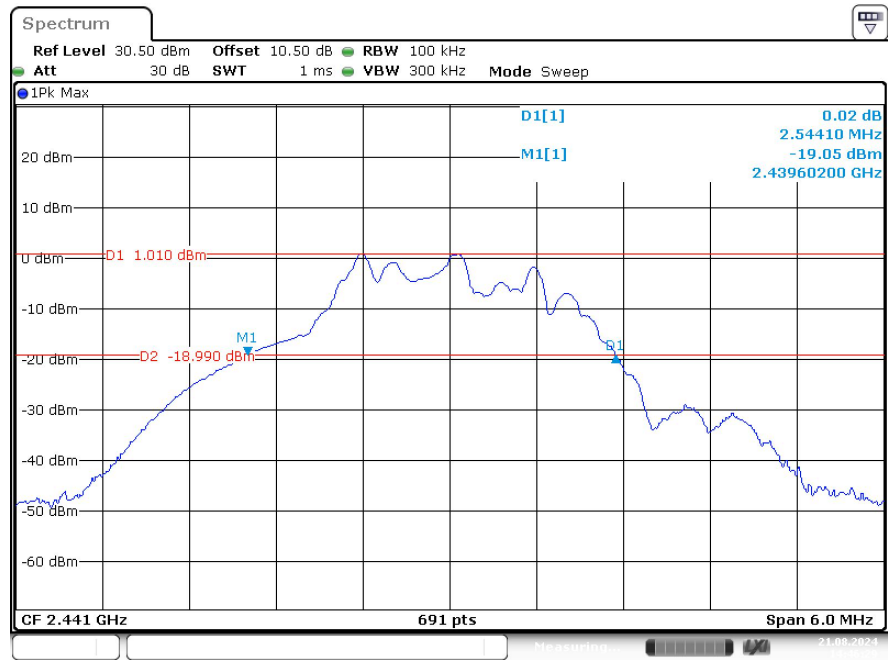
20 dB Bandwidth:

2405MHz



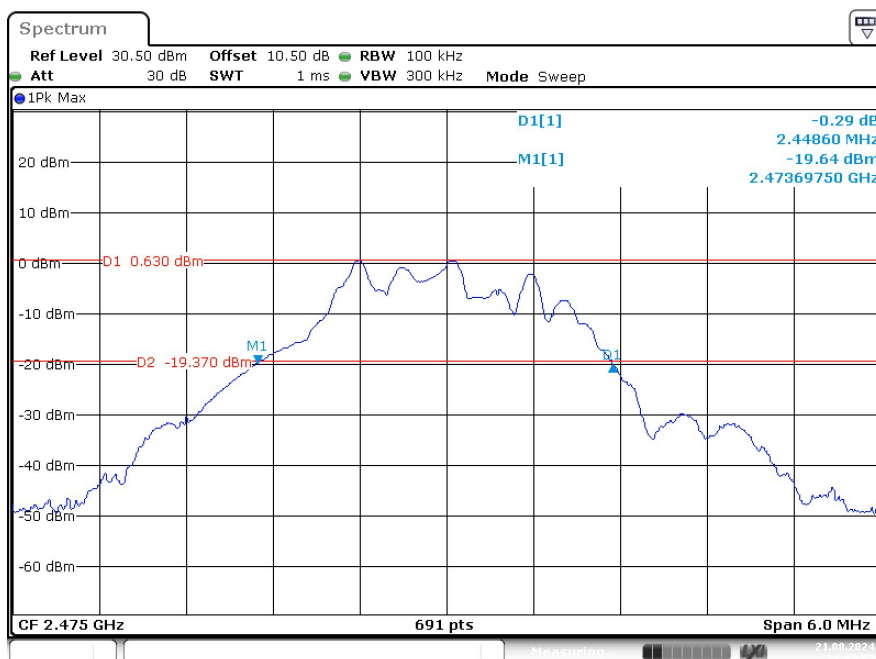
ProjectNo.:2402W59393E Tester:Roy xiao
Date: 21.AUG.2024 14:40:28

2441MHz



ProjectNo.:2402W59393E Tester:Roy xiao
Date: 21.AUG.2024 14:46:29

2475MHz

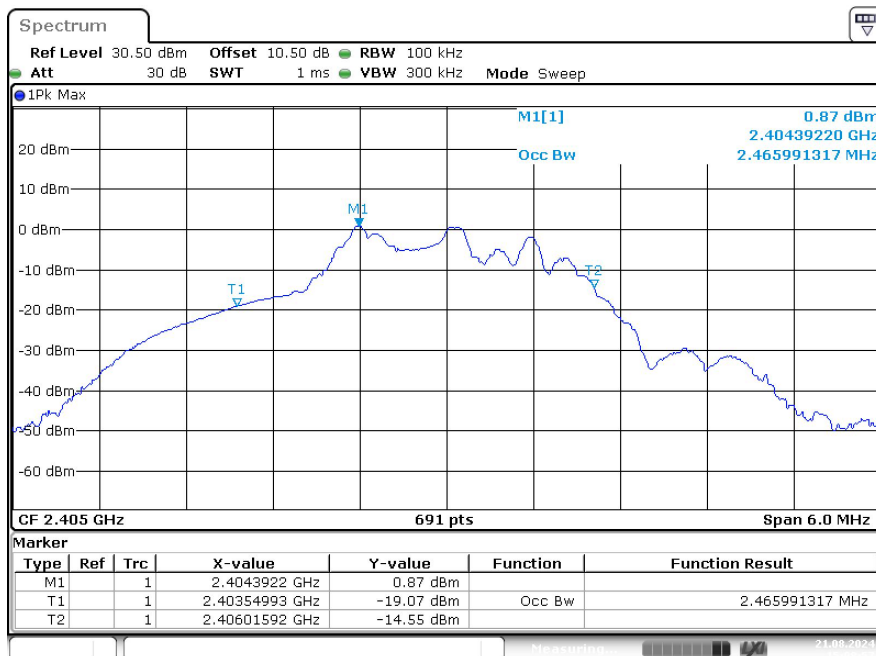


ProjectNo.:2402W59393E Tester:Roy xiao

Date: 21.AUG.2024 14:43:57

99% Occupied Bandwidth:

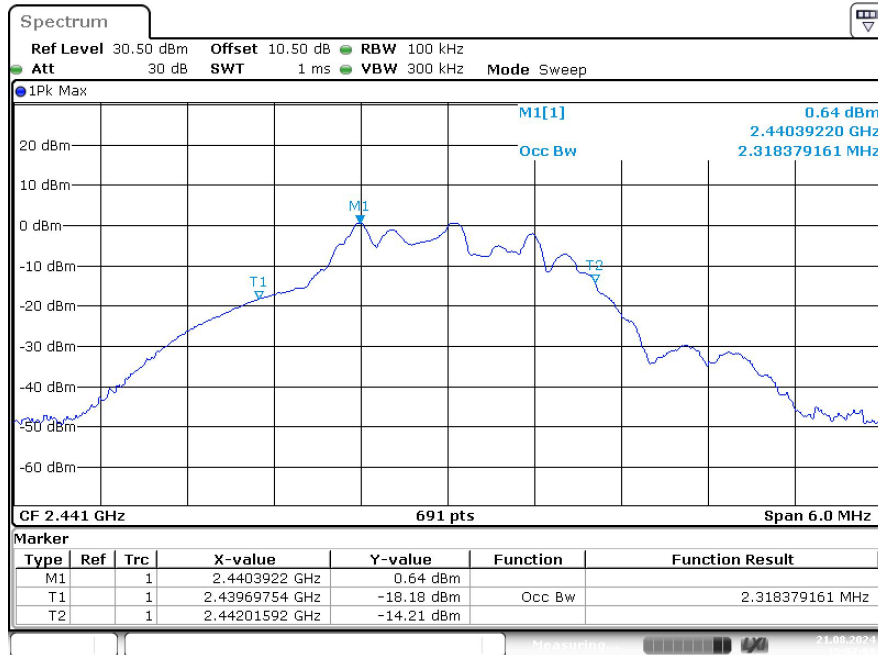
2405MHz



ProjectNo.:2402W59393E Tester:Roy Xiao

Date: 21.AUG.2024 15:08:57

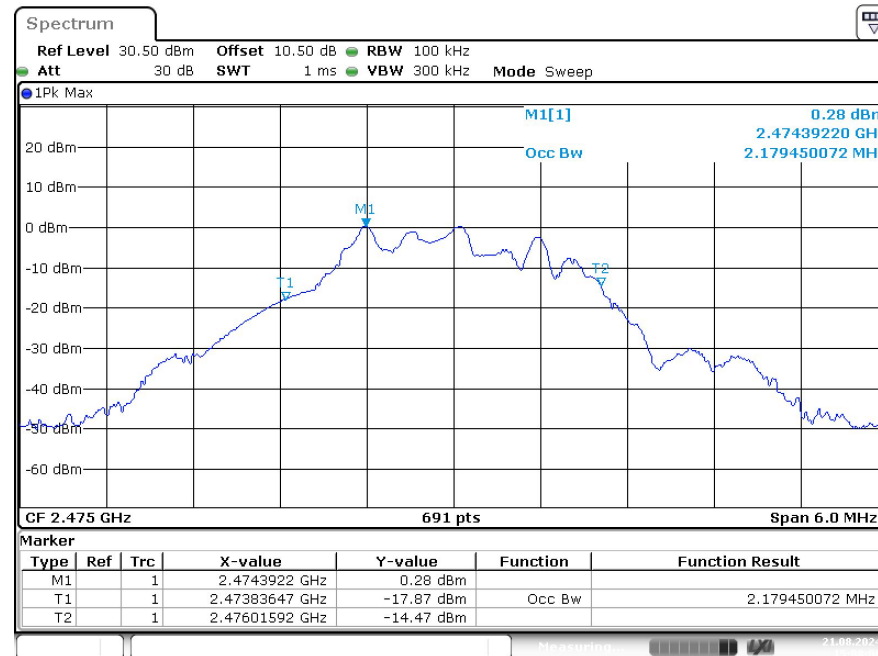
2441MHz



ProjectNo.:2402W59393E Tester:Roy Xiao

Date: 21.AUG.2024 15:07:09

2475MHz



ProjectNo.:2402W59393E Tester:Roy Xiao

Date: 21.AUG.2024 15:08:06

4.4 Antenna Requirement

4.4.1 Applicable Standard

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen Clause 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISSED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

4.4.2 Judgment

Compliant. Please refer to the Antenna Information detail in Section 1.3.

EXHIBIT A - EUT PHOTOGRAPHS

Please refer to the attachment 2402W59393E-RF-EXP EUT EXTERNAL PHOTOGRAPHS and 2402W59393E-RF-INP EUT INTERNAL PHOTOGRAPHS

EXHIBIT B - TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2402W59393E-RF-00D-TSP TEST SETUP PHOTOGRAPHS.

EXHIBIT C - RF EXPOSURE EVALUATION

SAR EVALUATION

Applicable Standard

According to §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Measurement Result

The max conducted power including tune-up tolerance is -14 dBm (0.04 mW).

$$[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$$
$$= 0.04/5 \cdot (\sqrt{2.480}) = 0.1 < 3.0$$

Note: the max conducted power including tune-up tolerance was declared by manufacturer. The Bluetooth and SRD can't transmit simultaneously. The maximum E-Field strength is [83.11dBuV/m@3m](#), the EIRP= -12.09 dBm

Result: Compliant. The stand-alone SAR evaluation is not necessary.

EXEMPTION LIMITS FOR ROUTINE EVALUATION – SAR EVALUATION

Applicable Standard

RSS-102, Issue 5, Clause 2.5.1:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance⁴⁵

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Measurement Result:

The max tune-up conducted power is -14dBm, Antenna Gain: 2.34dBi,
Tune-up EIRP is -11.66dBm(0.07mW)

The exemption power(P) limits for routine evaluation in 2402-2480MHz is:

$$(2480-2450)/(3500-2450)=(P-4)/(2-4)$$

$$\Rightarrow P=3.94 \text{ mW}@2480 \text{ MHz}$$

$$> 0.07\text{mW}$$

Note: the max conducted power including tune-up tolerance was declared by manufacturer. The Bluetooth and SRD can't transmit simultaneously. The maximum E-Field strength is [83.11dBuV/m@3m](#), the EIRP=-12.09 dBm.

So the stand-alone SAR evaluation can be exempted.

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