TEST REPORT

Applicant Name :	SHENZHEN ACTTO ELECTRONICS TECHNOLOGY CO.,LTD
Address :	1206I, Bld4, Huanggang Center, Century of Excellence Center, Fushan Community, Futian, Shenzhen, China
Report Number:	RA230504-23421E-RF
FCC ID:	2BA6I-B603R

Test Standard (s)

FCC PART 15.249

Sample Description

Product Type:	Actto Curved Mini Bluetooth Keyboard receiver
Model No.:	B603R
Trade Mark:	ACTTO
Date Received:	2023-05-04
Date of Test:	2023-06-07 to 2023-06-19
Report Date:	2023-06-19

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Dave Liang

EMC Engineer

Approved By:

Candy Li

EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

Shenzhen Accurate Technology Co., Ltd. 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 an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230504-23421E-RF	Original Report	2023-06-19

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Actto Curved Mini Bluetooth Keyboard receiver
Tested Model	B603R
Frequency Range	SRD: 2402-2480MHz
Maximum E-Field Strength	87.31dBuV/m@3m
Modulation Technique	GFSK
Antenna Specification*	Internal Antenna (It is provided by the applicant)
Voltage Range	DC 5V from USB port
Sample number	25D7-2 (CE&RE); 25D7-3 (RF Conducted Test) (Assigned by ATC, Shenzhen)
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, 15.207, 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 Compliant Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.74dB
Emissions, Radiated	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
Temperature		1℃
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 Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, 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.: 708358, the FCC Designation No.: CN1189.

Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 4297.01.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing by manufacturer.

Frequency list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
…	…	…	…
…	…	…	…
…	…	…	…
18	2438	38	2478
19	2440	39	2480

Channel 0, Channel 19 and Channel 39 were selected for testing.

EUT Exercise Software

Software “BEKEN_FREQUEN_TEST”* was used during testing and the power level was default *.

Special Accessories

No special accessory.

Equipment Modifications

No modifications were made to the unit tested.

Support Equipment List and Details

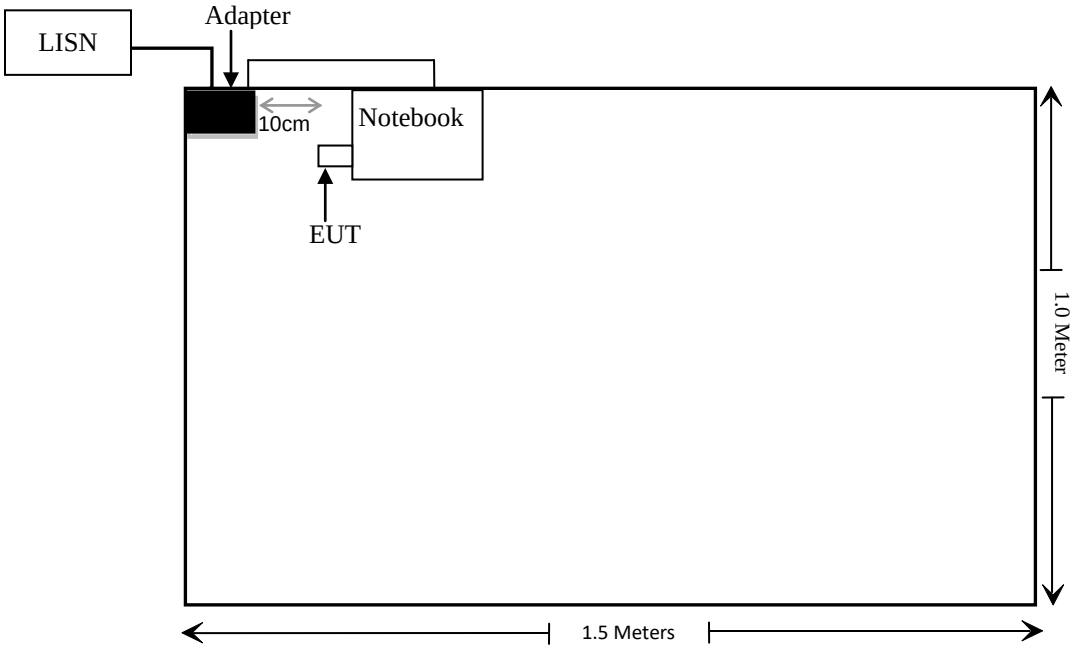
Manufacturer	Description	Model	Serial Number
LENOVO	Notebook	ThinkPad X240	SL10F31638JS
Unknown	Adapter	ADLX65NDC3A	Unknown

Support Cable Descriptions

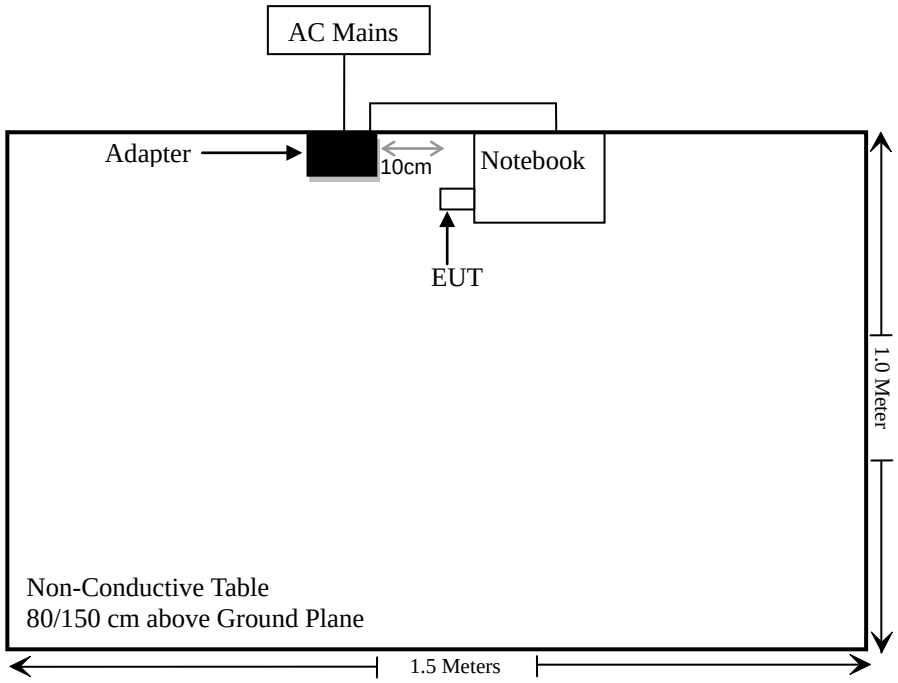
Cable Description	Length (m)	From/Port	To
Un-shielding Detachable AC Cable	1.15	Adapter	LISN
Un-shielding Detachable DC Cable	1.5	Adapter	Notebook

Block Diagram of Test Setup

For Conducted Emission:



For Radiated Emission:



Note: The support table edge was flush with the center of turntable.

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1) , §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	Conduction Emissions	Compliant
§15.205, §15.209, §15.249(d)	Radiated Emissions& Outside of Band Emission	Compliant
§15.215 (c)	20dB Bandwidth	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
R & S	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50Ω Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 191218 (V9)					
Radiated Emissions Test					
Rohde & Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-184055 36-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.15	N600	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.16	N650	2022/11/25	2023/11/24
Radiated Emission Test Software:e3 191218 (V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.33	RF-03	Each time	

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), 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 KDB 447498 D01 General RF Exposure Guidance

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:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Test Result:

For worst case:

Mode	Frequency (MHz)	Maximum power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
		(dBm)	(mW)				
SRD	2402-2480	-7.89	0.16	5	0.05	3.0	Yes

Note: Use the highest e-field strength (87.31dBuV/m@3m) for the evaluation
E(dBuV/m)=EIRP(dBm)-95.2 for distance 3m
so the EIRP=87.31dBuV/m-95.2=-7.89dBm

Result: No Standalone SAR test is required

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 internal antenna which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

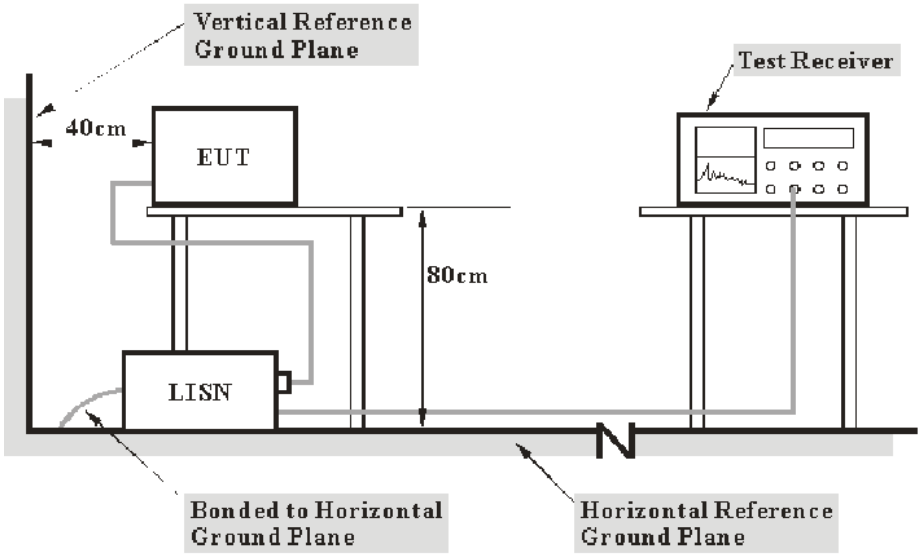
Result: Compliant.

FCC §15.207 (a)-AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Factor = LISN VDF + Cable Loss

The "**Over Limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

Environmental Conditions

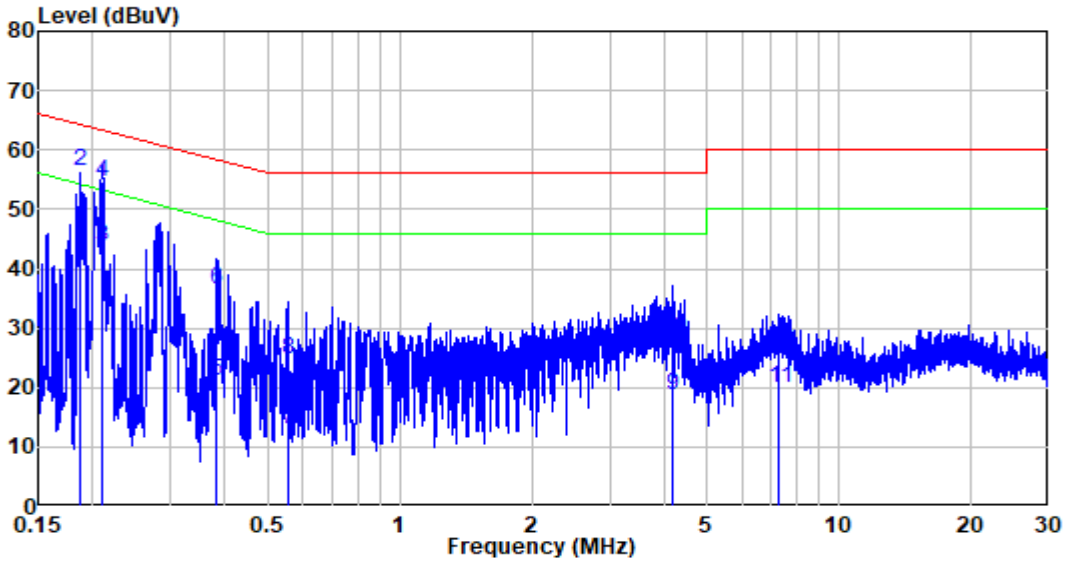
Temperature:	23℃
Relative Humidity:	49 %
ATM Pressure:	101.0 kPa

The testing was performed by Jerry Wu on 2023-06-13.

EUT operation mode: Transmitting (worst case is low channel)

Please refer the below plots.

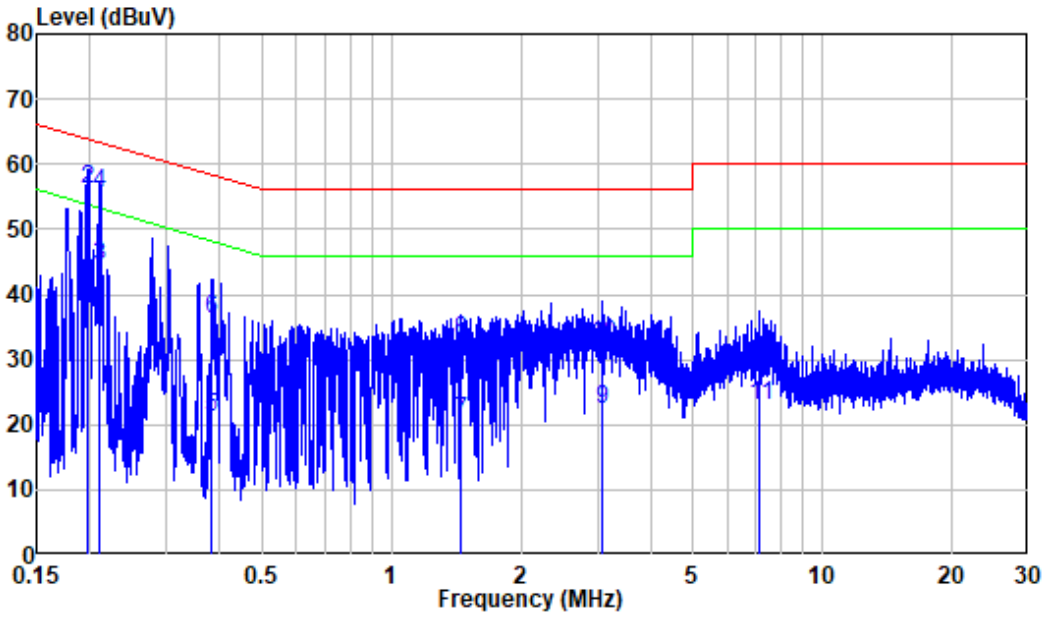
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA230504-23421E-RF
Mode : 2.4G Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.188	10.28	32.76	43.04	54.15	-11.11	Average
2	0.188	10.28	46.15	56.43	64.15	-7.72	QP
3	0.210	10.29	33.63	43.92	53.20	-9.28	Average
4	0.210	10.29	44.40	54.69	63.20	-8.51	QP
5	0.382	10.34	10.92	21.26	48.24	-26.98	Average
6	0.382	10.34	26.10	36.44	58.24	-21.80	QP
7	0.558	10.43	2.58	13.01	46.00	-32.99	Average
8	0.558	10.43	14.32	24.75	56.00	-31.25	QP
9	4.166	10.53	8.09	18.62	46.00	-27.38	Average
10	4.166	10.53	18.00	28.53	56.00	-27.47	QP
11	7.295	10.45	9.44	19.89	50.00	-30.11	Average
12	7.295	10.45	15.86	26.31	60.00	-33.69	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230504-23421E-RF
Mode : 2.4G Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.198	10.39	31.49	41.88	53.70	-11.82	Average
2	0.198	10.39	45.73	56.12	63.70	-7.58	QP
3	0.211	10.38	34.04	44.42	53.18	-8.76	Average
4	0.211	10.38	45.06	55.44	63.18	-7.74	QP
5	0.382	10.37	10.67	21.04	48.24	-27.20	Average
6	0.382	10.37	25.89	36.26	58.24	-21.98	QP
7	1.447	10.49	9.99	20.48	46.00	-25.52	Average
8	1.447	10.49	22.40	32.89	56.00	-23.11	QP
9	3.094	10.50	11.89	22.39	46.00	-23.61	Average
10	3.094	10.50	21.84	32.34	56.00	-23.66	QP
11	7.152	10.53	12.36	22.89	50.00	-27.11	Average
12	7.152	10.53	17.35	27.88	60.00	-32.12	QP

FCC§15.205, §15.209 & §15.249(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 spectrum analyzer or receiver is set as:

Below 1000MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

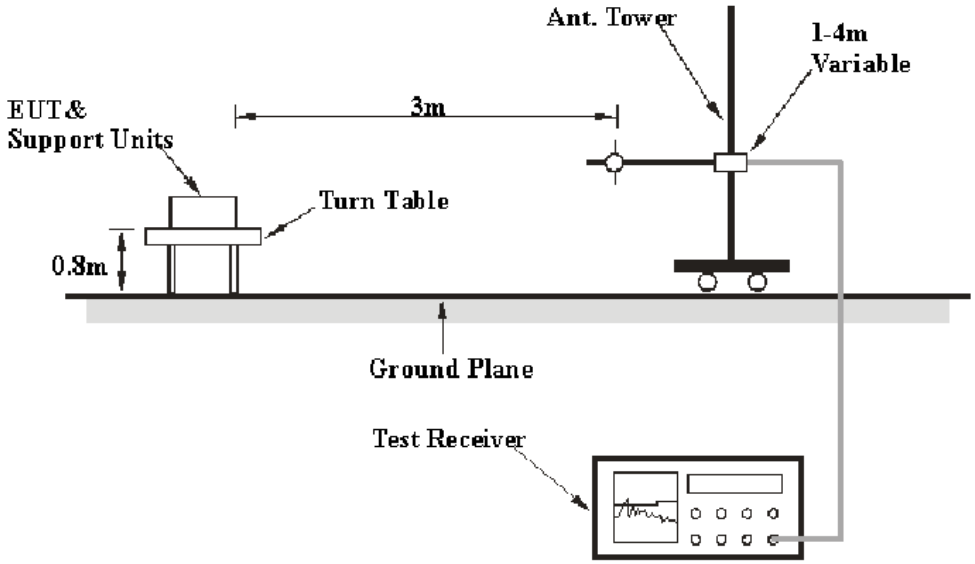
Above 1000MHz:

Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

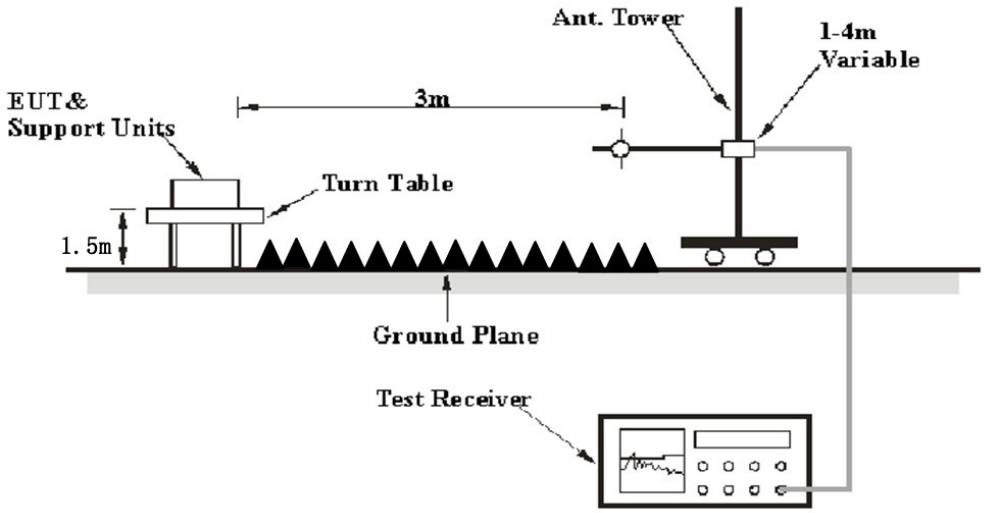
If the maximized peak measured value complies with the limit, then it is unnecessary to perform QP/Average measurement.

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission and out of band emission tests were performed in the 3meters 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 meter, 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 Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Results Summary

According to the EUT complied with the FCC Part 15.205, 15.209 & §15.249

Test Data

Environmental Conditions

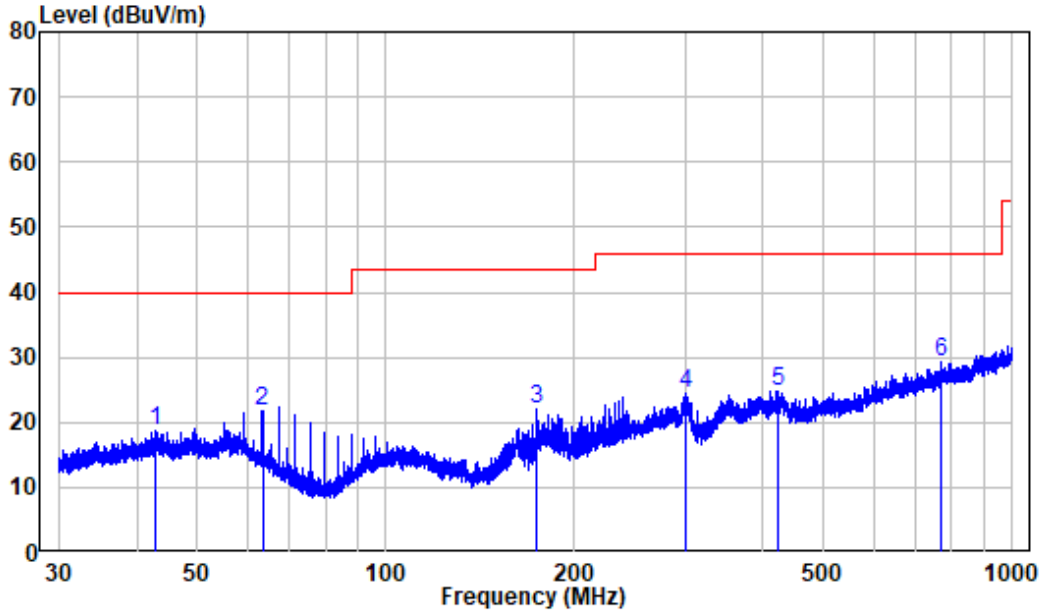
Temperature:	22-24 ℃
Relative Humidity:	54-56 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason Liu on 2023-06-13 for below 1G.
The testing was performed by Jeef Huang on 2023-06-07 for above 1G.

Test Mode: Transmitting
(Pre-scan in the X, Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

Below 1GHz: (worst case is low channel)

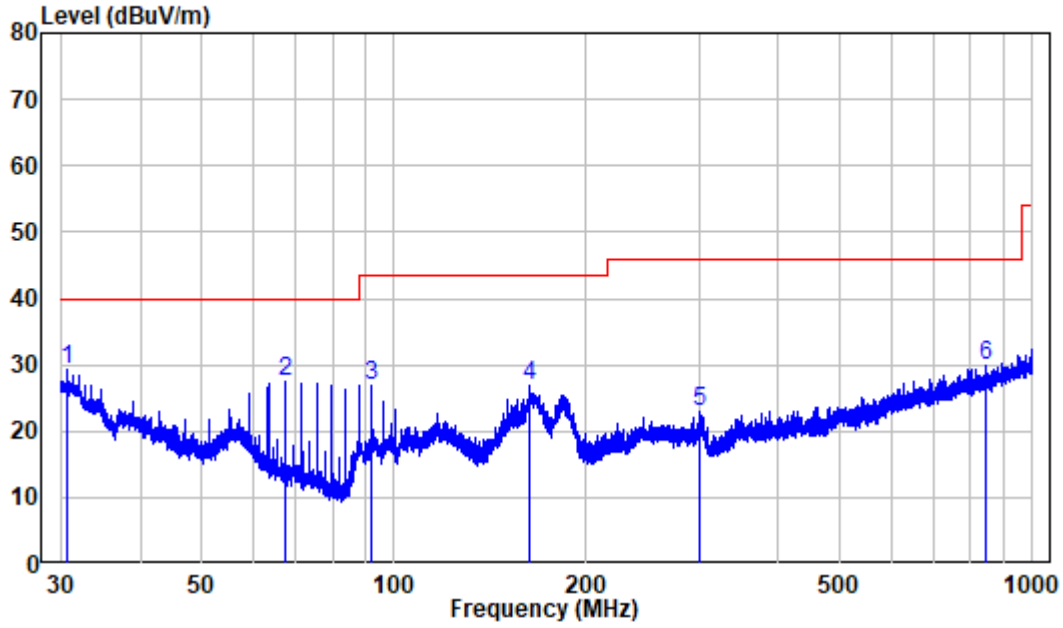
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230504-23421E-RF
Test Mode: 2.4G Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	42.843	-9.97	28.55	18.58	40.00	-21.42	Peak
2	63.480	-11.96	33.84	21.88	40.00	-18.12	Peak
3	173.509	-13.23	35.18	21.95	43.50	-21.55	Peak
4	301.026	-9.19	33.54	24.35	46.00	-21.65	Peak
5	423.540	-5.94	30.64	24.70	46.00	-21.30	Peak
6	767.065	-0.32	29.52	29.20	46.00	-16.80	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230504-23421E-RF
Test Mode: 2.4G Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	30.732	-12.32	41.67	29.35	40.00	-10.65	Peak
2	67.586	-13.64	41.25	27.61	40.00	-12.39	Peak
3	92.139	-13.26	40.15	26.89	43.50	-16.61	Peak
4	162.397	-14.29	41.28	26.99	43.50	-16.51	Peak
5	301.422	-9.18	32.24	23.06	46.00	-22.94	Peak
6	845.829	0.40	29.53	29.93	46.00	-16.07	Peak

Above 1 GHz

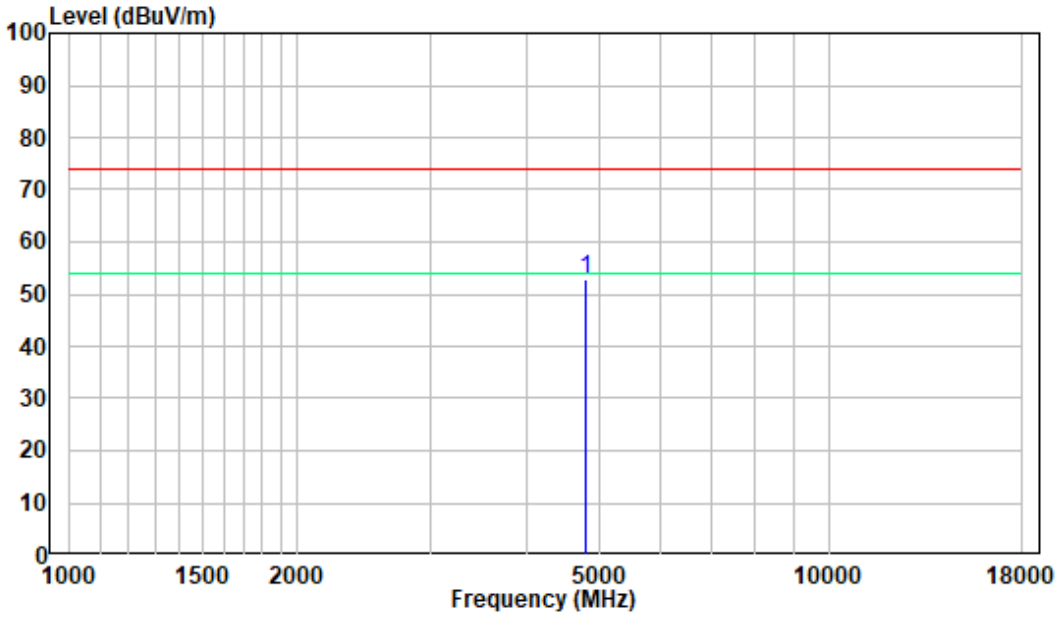
Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel									
2402	96.64	PK	286	2.1	H	-10.69	85.95	114	-28.05
2402	87.58	PK	259	1.9	V	-10.69	76.89	114	-37.11
2310	60.78	PK	145	1.3	H	-10.36	50.42	74	-23.58
2310	56.92	PK	61	2.0	V	-10.36	46.56	74	-27.44
2390	60.46	PK	266	1.1	H	-10.71	49.75	74	-24.25
2390	56.86	PK	201	1.3	V	-10.71	46.15	74	-27.85
2400	68.4	PK	194	1.6	H	-10.68	57.72	74	-16.28
2400	55.51	AV	194	1.6	H	-10.68	44.83	54	-9.17
2400	64.53	PK	210	2.0	V	-10.68	53.85	74	-20.15
4804	58.79	PK	253	1.2	H	-6.11	52.68	74	-21.32
4804	53.69	PK	41	1.8	V	-6.11	47.58	74	-26.42
Middle Channel									
2440	97.42	PK	317	2.0	H	-10.78	86.64	114	-27.36
2440	88.23	PK	41	1.2	V	-10.78	77.45	114	-36.55
4880	58.04	PK	159	1.2	H	-5.9	52.14	74	-21.86
4880	52.75	PK	243	1.5	V	-5.9	46.85	74	-27.15
High Channel									
2480	97.89	PK	261	1.6	H	-10.58	**87.31**	114	-26.69
2480	88.75	PK	62	1.6	V	-10.58	78.17	114	-35.83
2483.5	64.47	PK	82	2.1	H	-10.55	53.92	74	-20.08
2483.5	62.92	PK	38	1.6	V	-10.55	52.37	74	-21.63
2500	57.27	PK	289	1.9	H	-10.42	46.85	74	-27.15
2500	53.25	PK	171	1.8	V	-10.42	42.83	74	-31.17
4960	58.01	PK	67	1.5	H	-5.47	52.54	74	-21.46
4960	53.78	PK	167	1.3	V	-5.47	48.31	74	-25.69

Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Factor + Reading
Margin = Corrected Amplitude – Limit
The other spurious emission which is in the noise floor level was not recorded.
For above 1GHz, when the test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, just peak value was recorded.

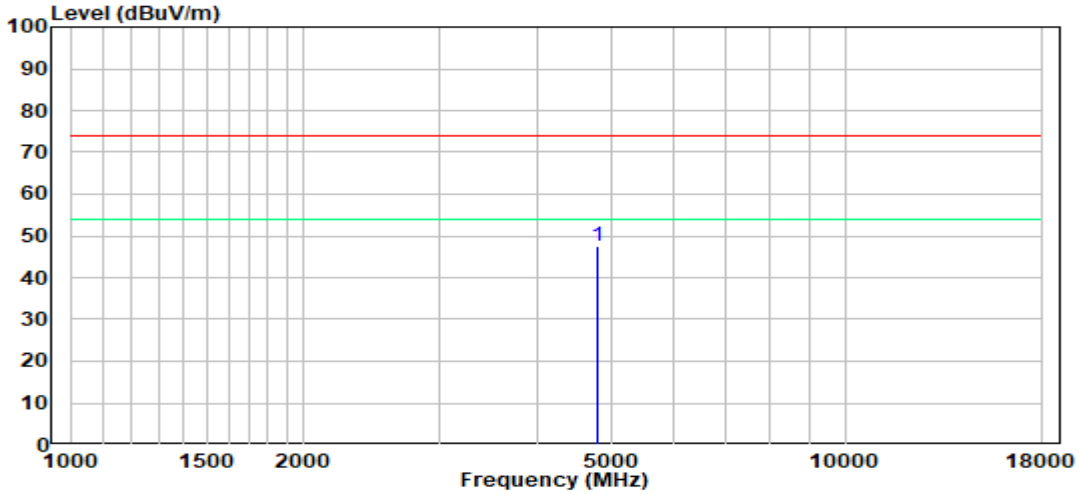
Pre-scan plots:

1-18GHz: (worst case is Low channel)

Horizontal

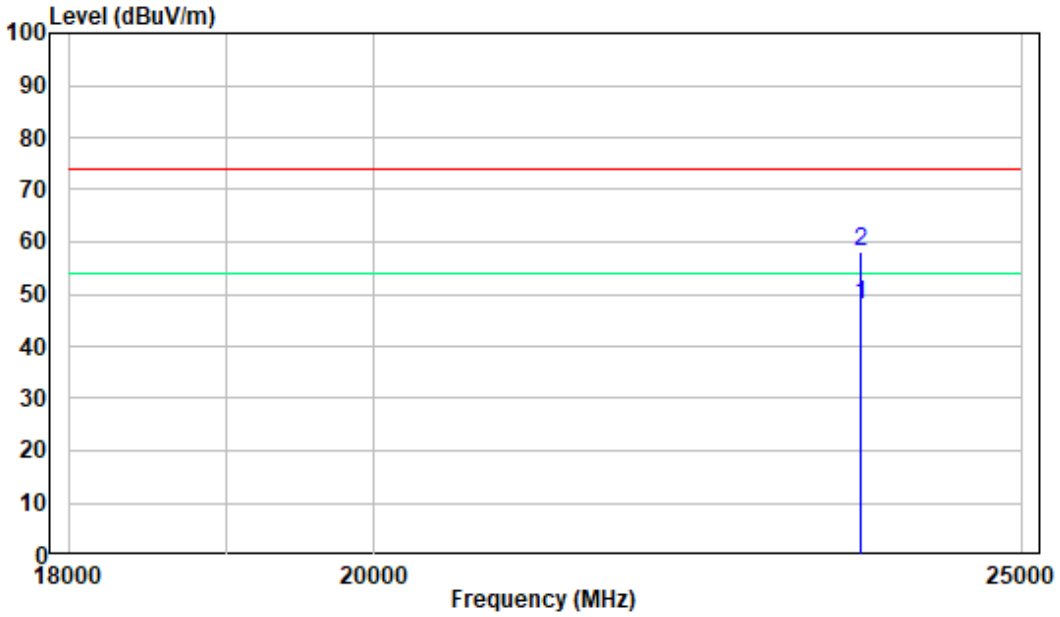


Vertical

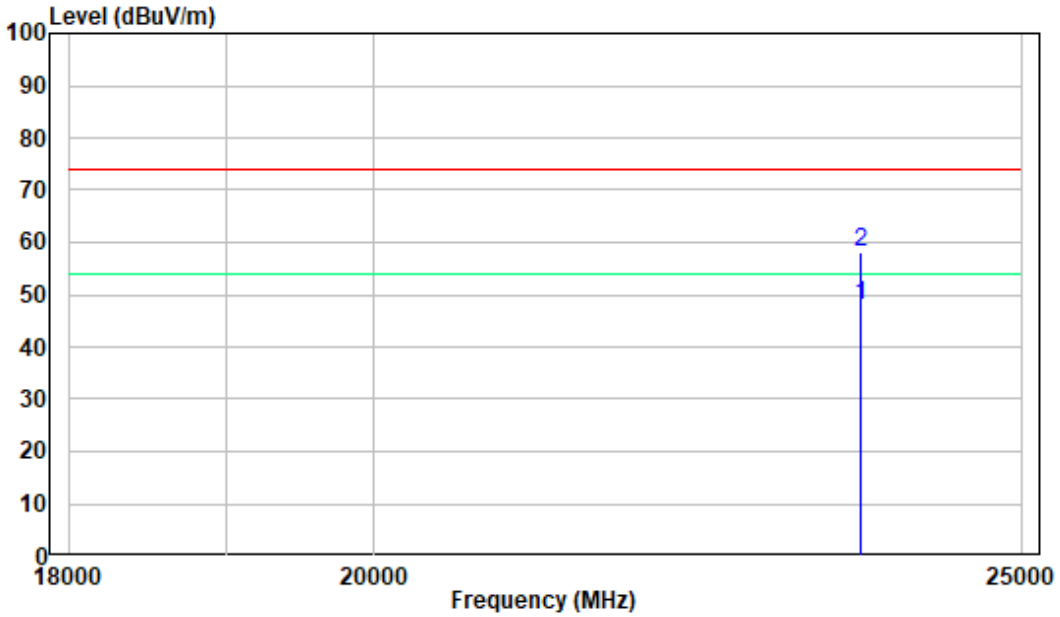


18-25GHz: (worst case is low channel)

Horizontal



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

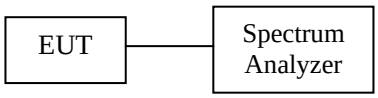
According to ANSI C63.10-2013, section 6.9.

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 20dBbandwidth.

4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	24℃
Relative Humidity:	47%
ATM Pressure:	101.0 kPa

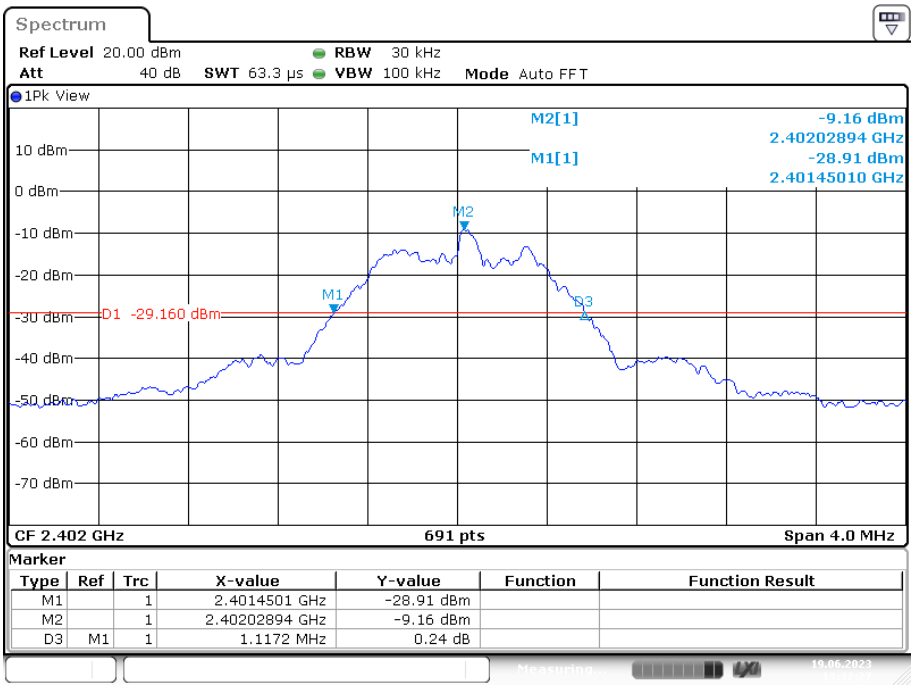
The testing was performed by Matt Liang on 2023-06-19.

Test Mode: Transmitting

Test Result: Please refer to the following table and plots.

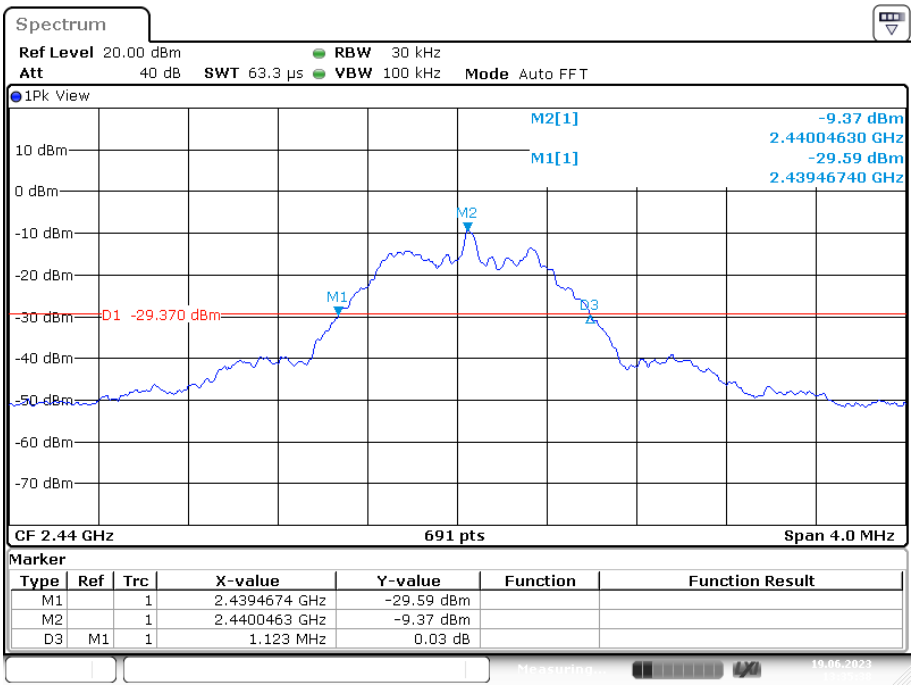
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.117
Middle	2440	1.123
High	2480	1.111

Low Channel



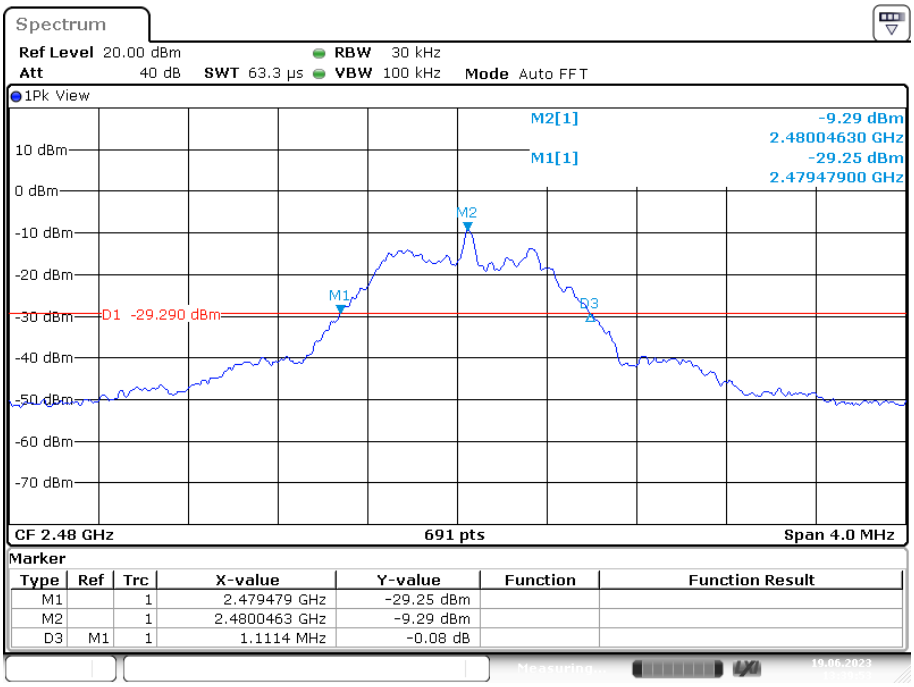
Date: 19.JUN.2023 13:32:27

Middle Channel



Date: 19.JUN.2023 13:35:38

High Channel



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