

FCC PART 15.249

TEST REPORT

For

Shenzhen GreyShark Technology Co. LTD

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FCC ID: 2A2JO-BSM00

Report Type: Original Report	Product Type: Gaming Mouse Dongle
Report Number: SZ1210715-29286E-RF-00	
Report Date: 2021-08-02	
Reviewed By: RF Engineer	Jacob Kong 
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Gaming Mouse Dongle
Tested Model	BS-M1-R
Frequency Range	2402-2480MHz
Transmit Power	82.74dBuV/m@3m
Modulation Technique	GFSK
Antenna Specification*	0 dBi (It is provided by the applicant)
Voltage Range	DC 5V
Date of Test	2021-07-20 to 2021-07-29
Sample serial number	SZ1210715-29286E-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2021-07-15
Sample/EUT Status	Good condition

Objective

This test 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, 15.215 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.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
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 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, 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

16 channels are provided to testing:

Channel	Frequency(GHz)	Channel	Frequency(GHz)
1	2.402	9	2.414
2	2.426	10	2.436
3	2.441	11	2.459
4	2.463	12	2.473
5	2.407	13	2.419
6	2.422	14	2.439
7	2.445	15	2.453
8	2.466	16	2.480

EUT was tested with Channel 1, 3 and 16.

EUT Exercise Software

“MouseTester-20191024”* software was use to the EUT tested and power level is default*. The software and power level was provided by the applicant.

Equipment Modifications

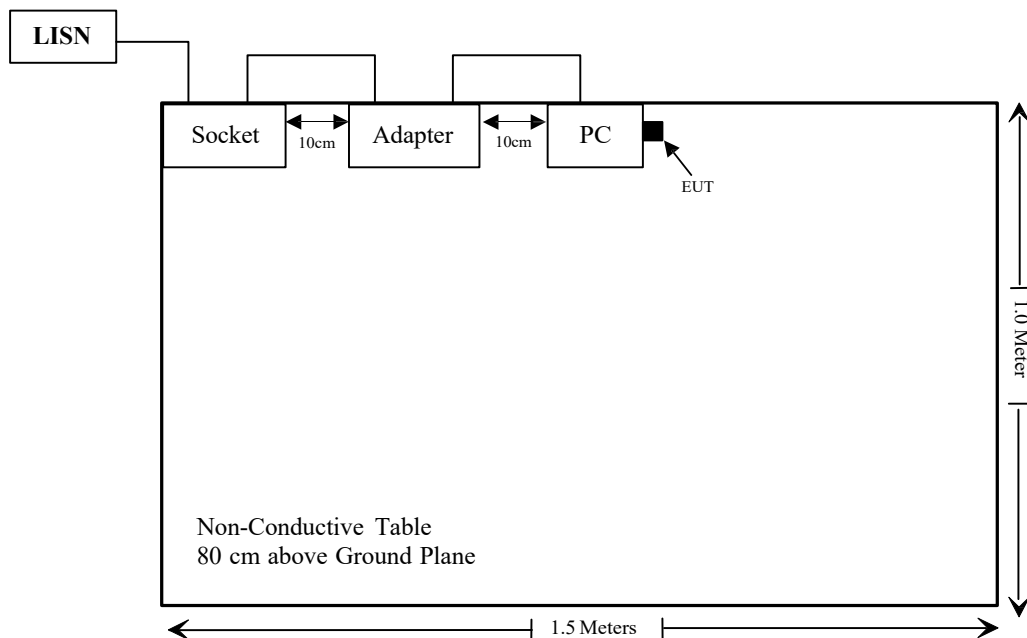
No modifications were made to the unit tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	PC	Latitude E6520	DL0ZCS1
DELL	Adapter	EA90PM111	Unknown

Support Cable Descriptions

Cable Description	Length (m)	From/Port	To
Un-shield Detach able AC Cable	1.0	Socket	Adapter
Un-shield Detach able DC Cable	1.0	Adapter	PC

Block Diagram of Test Setup

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§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)	20 dB Bandwidth	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2021/07/07	2022/07/06
Rohde & Schwarz	LISN	ENV216	101613	2021/07/07	2022/07/06
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2021/07/06	2022/07/05
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 4	EC-007	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10.00	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2021/07/06	2022/07/05
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	3115	9107-3694	2021/01/15	2024/01/14
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	2021/04/20	2022/04/20
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 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

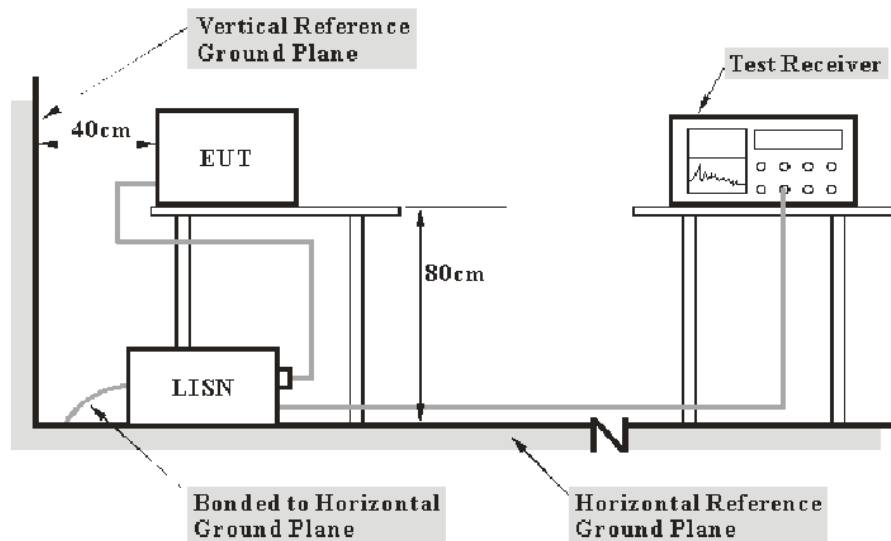
Result: Compliance.

FCC §15.207 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

According to FCC §15.207

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 per ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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

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.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

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

Test Results Summary

According to the EUT complied with the FCC Part 15.207,

Test Data

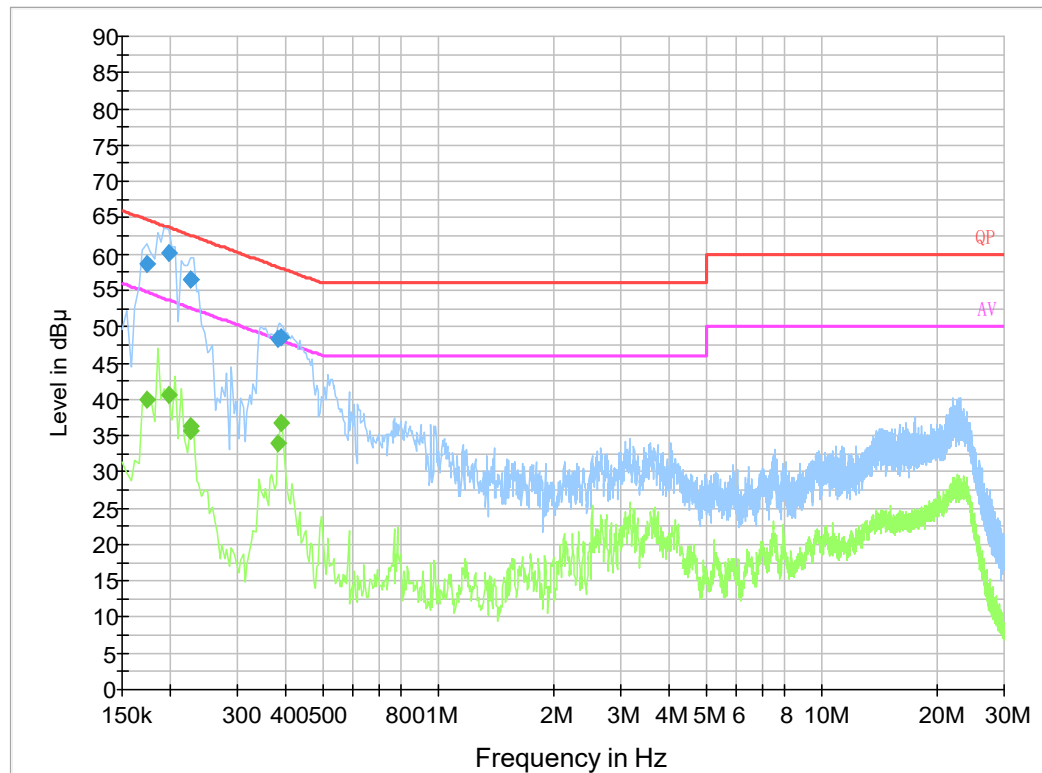
Environmental Conditions

Temperature:	26 °C
Relative Humidity:	70 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2021-07-21.

EUT Operation Mode: Transmitting

AC 120V/60 Hz, Line

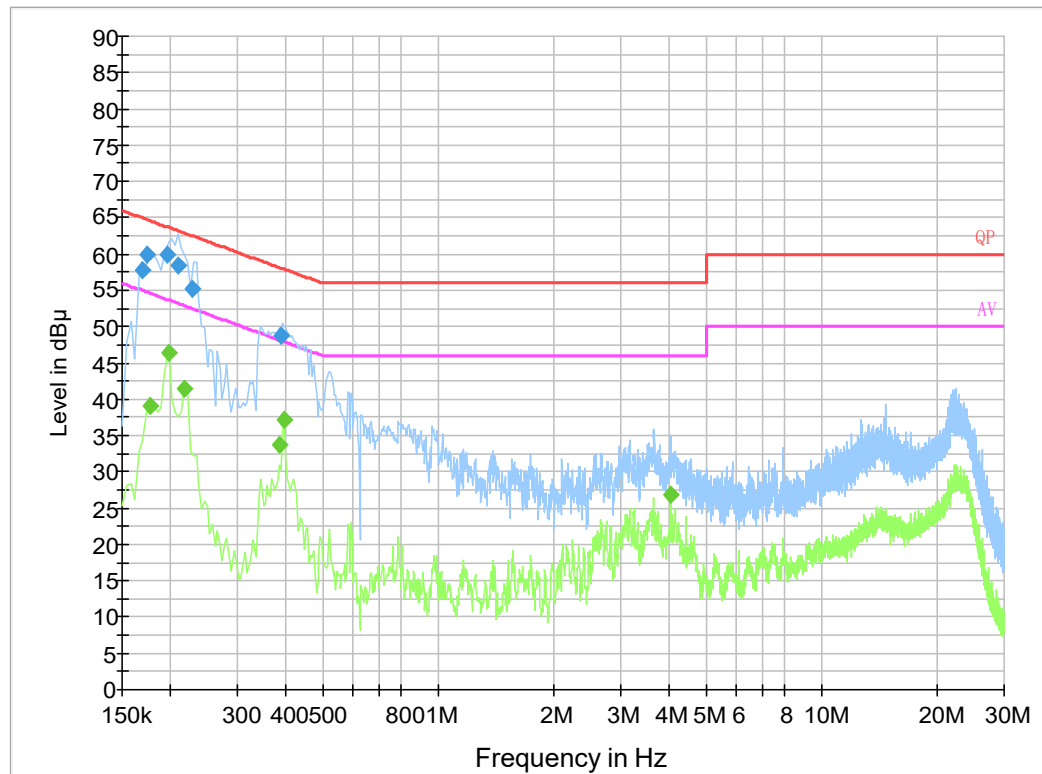


Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.173500	58.7	9.000	L1	19.9	6.1	64.8
0.198500	60.2	9.000	L1	19.8	3.5	63.7
0.225500	56.4	9.000	L1	19.8	6.2	62.6
0.225500	56.4	9.000	L1	19.8	6.2	62.6
0.384150	48.4	9.000	L1	19.9	9.8	58.2
0.388210	48.5	9.000	L1	19.9	9.6	58.1

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.173500	39.9	9.000	L1	19.9	14.9	54.8
0.198500	40.6	9.000	L1	19.8	13.1	53.7
0.225500	35.6	9.000	L1	19.8	17.0	52.6
0.225500	36.3	9.000	L1	19.8	16.3	52.6
0.384150	33.9	9.000	L1	19.9	14.3	48.2
0.388210	36.7	9.000	L1	19.9	11.4	48.1

AC 120V/60 Hz, Neutral**Final Result 1**

Frequency (MHz)	QuasiPeak (dB µV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µV)
0.169500	57.8	9.000	N	19.8	7.2	65.0
0.173500	60.0	9.000	N	19.8	4.8	64.8
0.197500	59.9	9.000	N	19.8	3.8	63.7
0.209500	58.4	9.000	N	19.8	4.8	63.2
0.229500	55.3	9.000	N	19.8	7.2	62.5
0.388090	48.8	9.000	N	19.8	9.3	58.1

Final Result 2

Frequency (MHz)	Average (dB µV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µV)
0.178000	39.1	9.000	N	19.8	15.5	54.6
0.198000	46.3	9.000	N	19.8	7.4	53.7
0.218000	41.5	9.000	N	19.8	11.4	52.9
0.386000	33.7	9.000	N	19.8	14.4	48.1
0.398000	37.1	9.000	N	19.8	10.8	47.9
4.050000	27.0	9.000	N	19.9	19.0	46.0

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

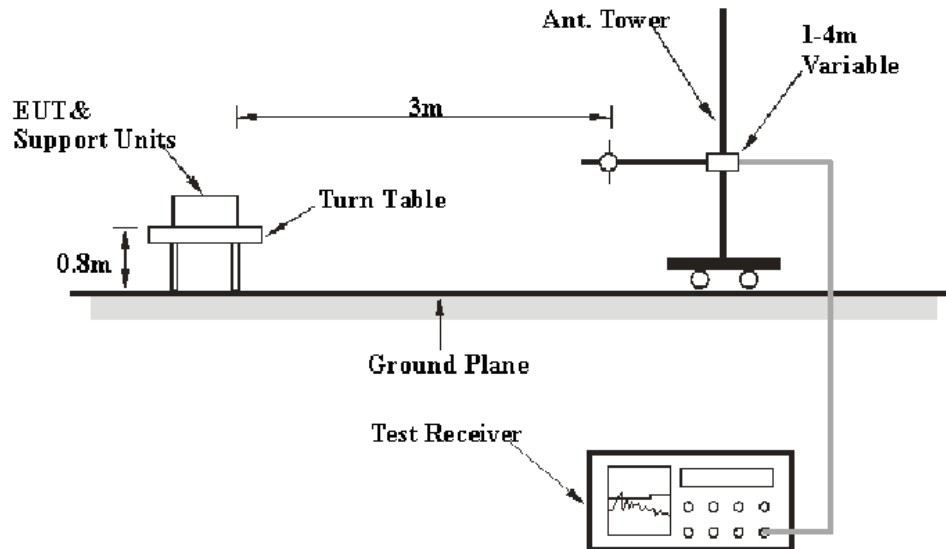
Above 1000MHz:

Peak: RBW = 1MHz / VBW = 3MHz / Sweep = Auto

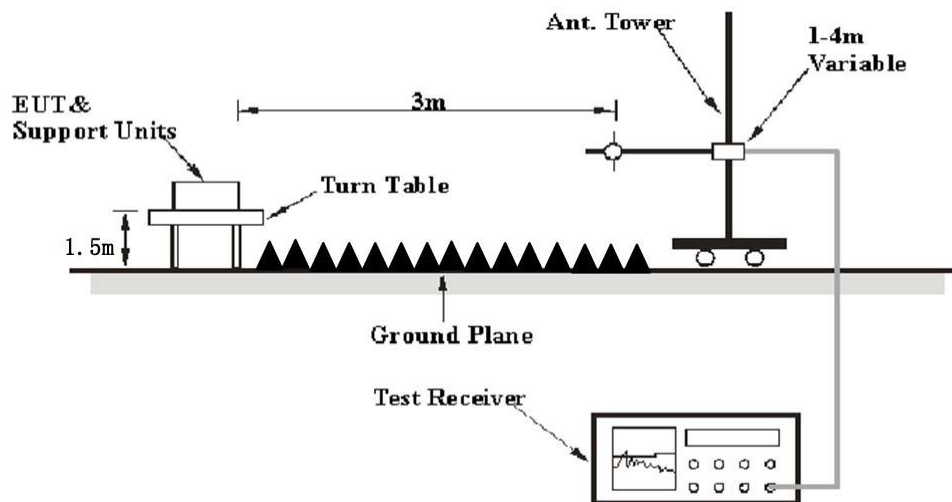
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

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 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 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 Results Summary

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

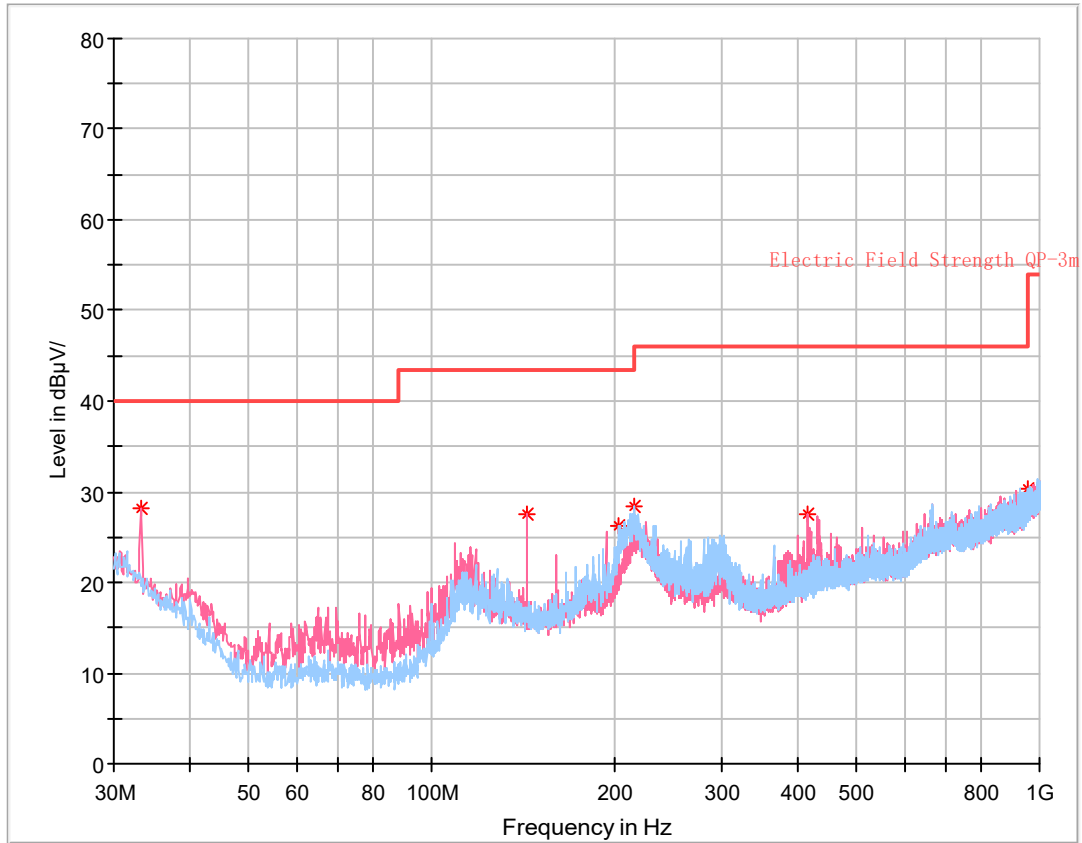
Test Data

Environmental Conditions

Temperature:	27.4~ 30 °C
Relative Humidity:	45~ 55 %
ATM Pressure:	101.0kPa

The testing was performed by Willia Wang on 2021-07-20 for below 1GHz and Bruce Lin on 2021-07-29 for above 1GHz.

Test Mode: Transmitting

30MHz – 1 GHz: (worst case is high channel)**Critical_Freqs**

Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.152500	28.10	40.00	11.90	100.0	V	260.0	-6.0
143.368750	27.55	43.50	15.95	100.0	V	302.0	-10.9
203.630000	26.30	43.50	17.20	100.0	H	85.0	-11.1
215.997500	28.30	43.50	15.20	100.0	H	49.0	-11.3
416.666250	27.49	46.00	18.51	100.0	V	20.0	-6.8
955.986250	30.40	46.00	15.60	300.0	H	228.0	1.8

1 GHz - 25 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.249&15.209	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel(2402MHz)									
2402.00	49.56	PK	212	1.8	H	31.87	81.43	114	32.57
2402.00	40.12	Ave.	212	1.8	H	31.87	71.99	94	22.01
2402.00	43.35	PK	54	1.1	V	31.87	75.22	114	38.78
2402.00	33.86	Ave.	54	1.1	V	31.87	65.73	94	28.27
2389.28	29.66	PK	209	1.1	H	31.87	61.53	74	12.47
2389.28	15.42	Ave.	209	1.1	H	31.87	47.29	54	6.71
2484.09	29.37	PK	220	1.0	H	32.13	61.50	74	12.50
2484.09	15.03	Ave.	220	1.0	H	32.13	47.16	54	6.84
2400.00	33.33	PK	35	2.2	H	31.87	65.20	74	8.80
2400.00	16.01	Ave.	35	2.2	H	31.87	47.88	54	6.12
4804.00	44.57	PK	34	2.1	H	6.28	50.85	74	23.15
4804.00	32.87	Ave.	297	1.0	V	6.28	39.15	54	14.85
Middle Channel(2441MHz)									
2441.00	50.14	PK	47	1.8	H	31.97	82.11	114	31.89
2441.00	40.76	Ave.	47	1.8	H	31.97	72.73	94	21.27
2441.00	43.86	PK	34	1.9	V	31.97	75.83	114	38.17
2441.00	33.27	Ave.	34	1.9	V	31.97	65.24	94	28.76
4882.00	44.37	PK	278	1.1	H	6.76	51.13	74	22.87
4882.00	31.84	Ave.	278	1.1	H	6.76	38.60	54	15.40
High Channel(2480 MHz)									
2480.00	50.61	PK	260	2.4	H	32.13	82.74	114	31.26
2480.00	40.99	Ave.	260	2.4	H	32.13	73.12	94	20.88
2480.00	42.69	PK	207	2.5	V	32.13	74.82	114	39.18
2480.00	33.85	Ave.	207	2.5	V	32.13	65.98	94	28.02
2389.16	29.35	PK	213	1.2	H	31.87	61.22	74	12.78
2389.16	15.01	Ave.	213	1.2	H	31.87	46.88	54	7.12
2484.10	29.45	PK	195	1.2	H	32.13	61.58	74	12.42
2484.10	15.13	Ave.	195	1.2	H	32.13	47.26	54	6.74
2400.00	30.47	PK	248	1.7	H	31.87	62.34	74	11.66
2400.00	15.45	Ave.	248	1.7	H	31.87	47.32	54	6.68
4960.00	44.72	PK	50	1.5	H	6.80	51.52	74	22.48
4960.00	32.11	Ave.	50	1.5	H	6.80	38.91	54	15.09

Note:

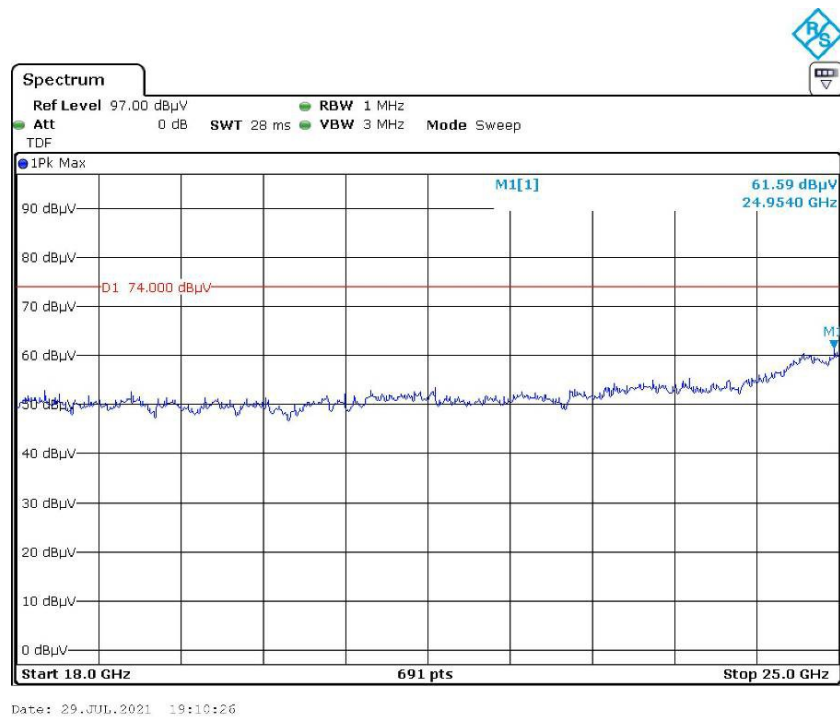
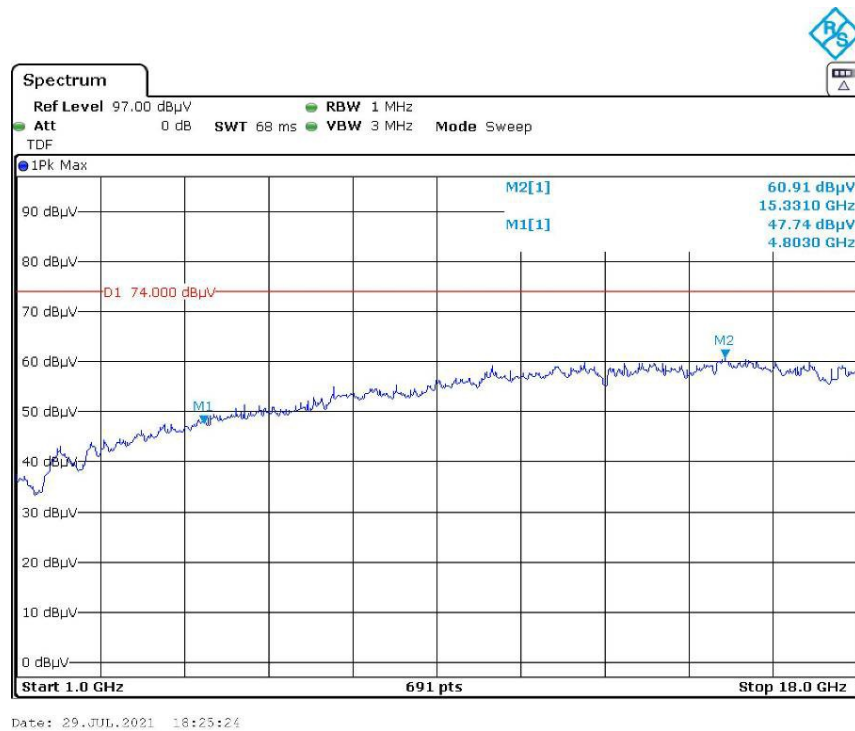
Corrected Amplitude = Corrected Factor + Reading

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

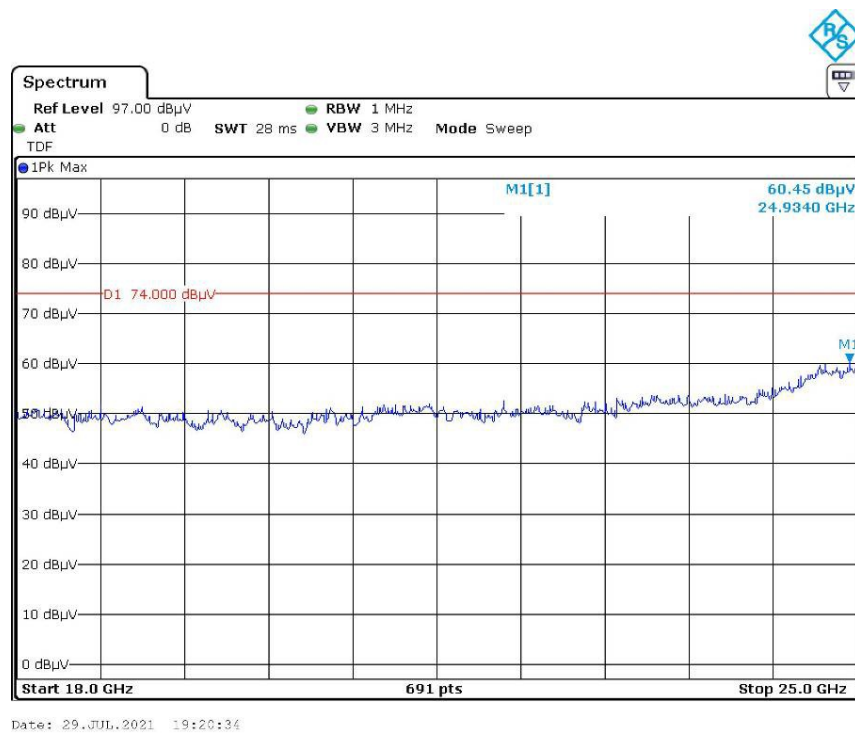
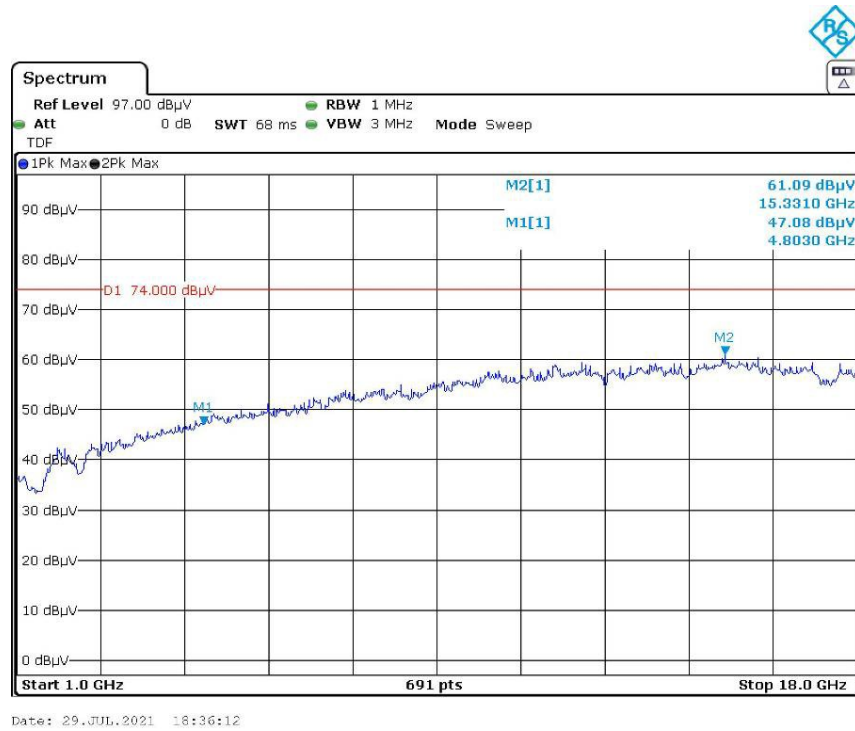
Margin = Limit- Corr. Amplitude

The emission more than20dB below the limit was not required to be recorded.

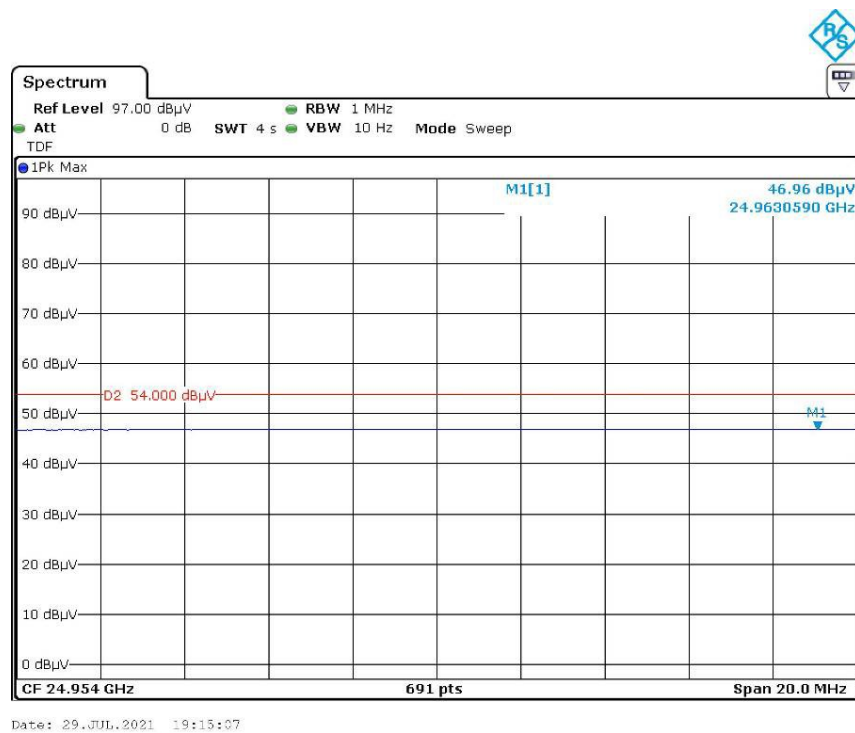
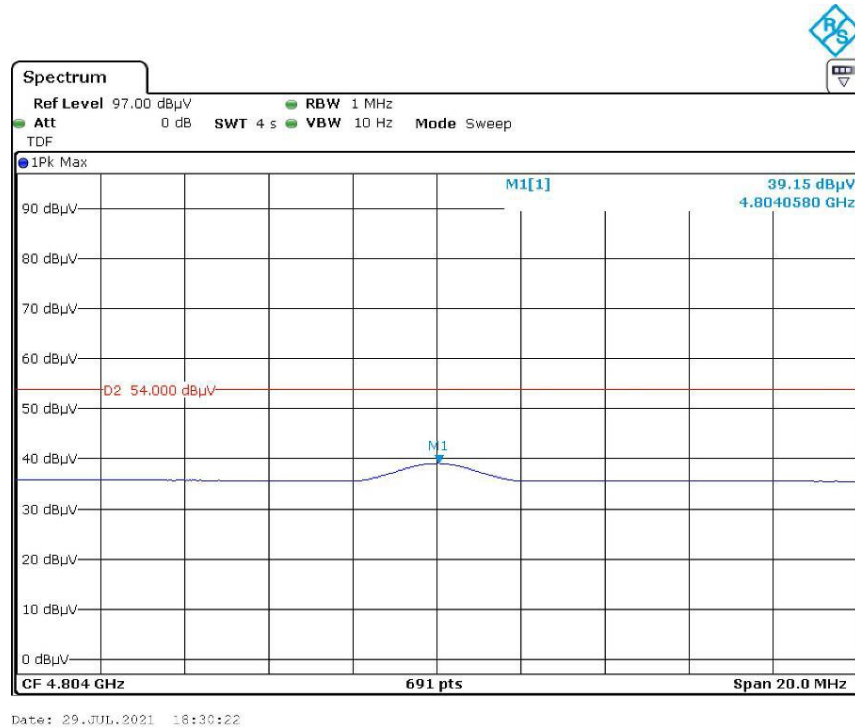
Pre-scan with low channel Peak
Horizontal



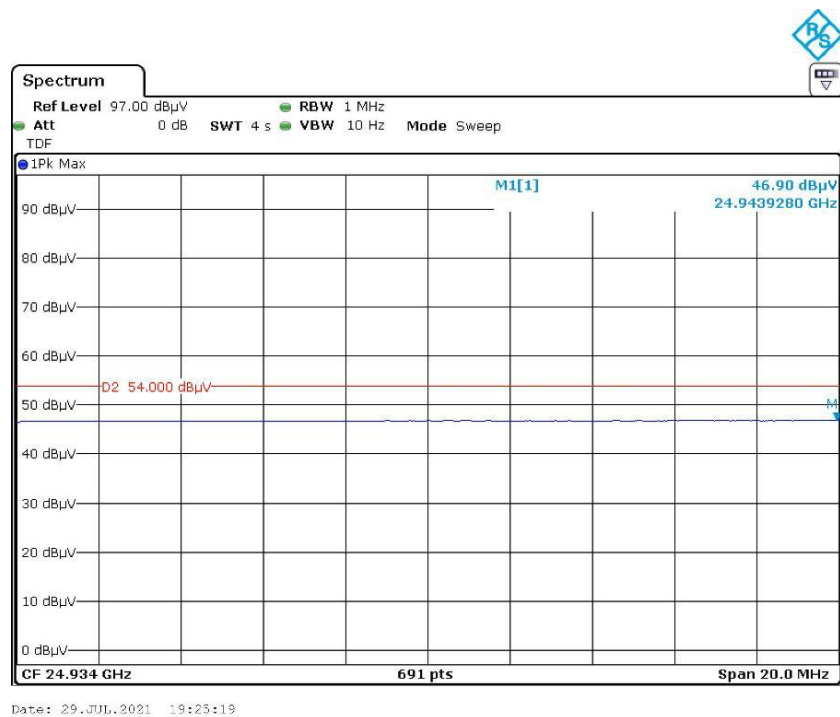
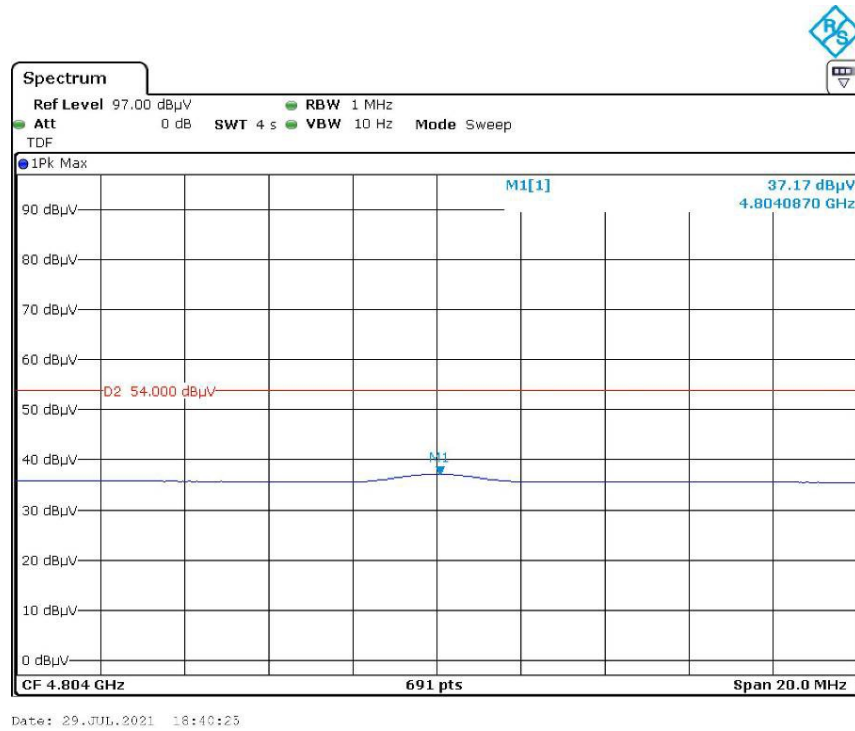
Vertical



Average value for the peak point at pre-scan 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

1. Set the SA to any one convenient frequency EUT operate.
2. 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 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission.
3. Set a reference level on the measuring instrument equal to the highest peak value.
4. Measure the frequency difference of two frequencies that indicated 20dB bandwidth.
5. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	27 °C
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

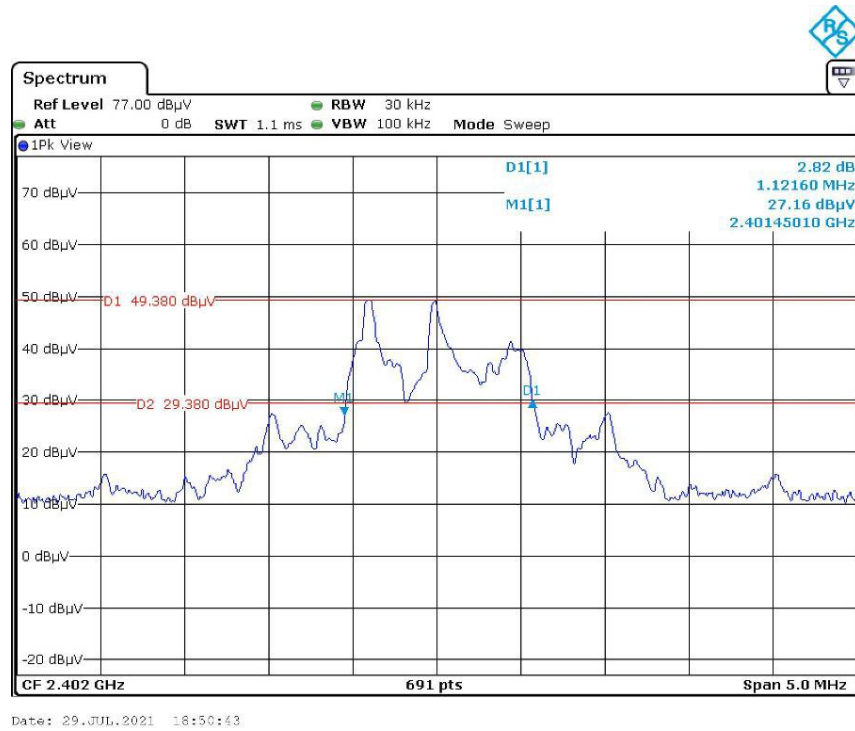
The testing was performed by Bravos Zhao on 2021-07-29

Test Mode: Transmitting

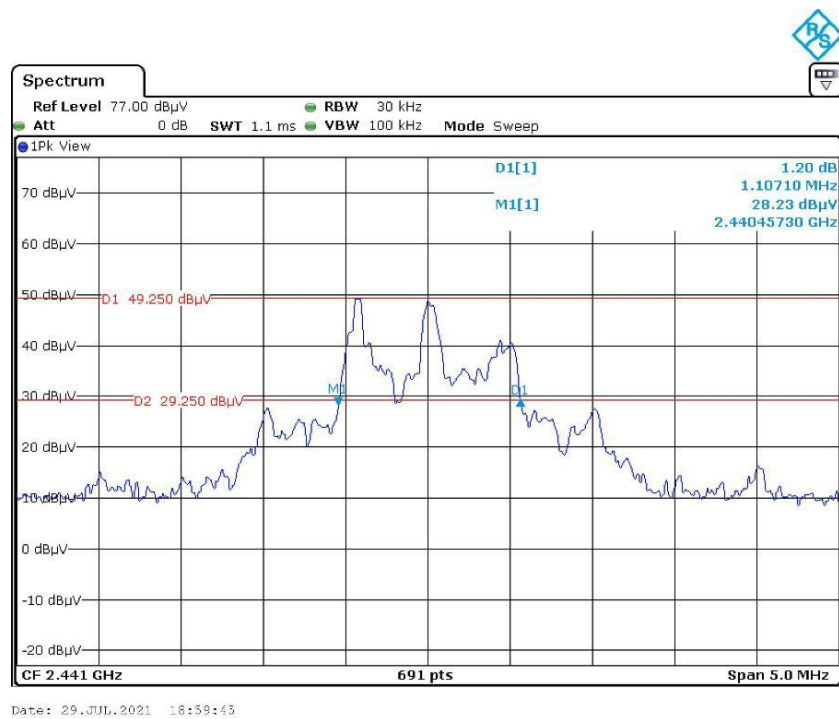
Please refer to the following table and plots.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.122
Middle	2441	1.107
High	2480	1.158

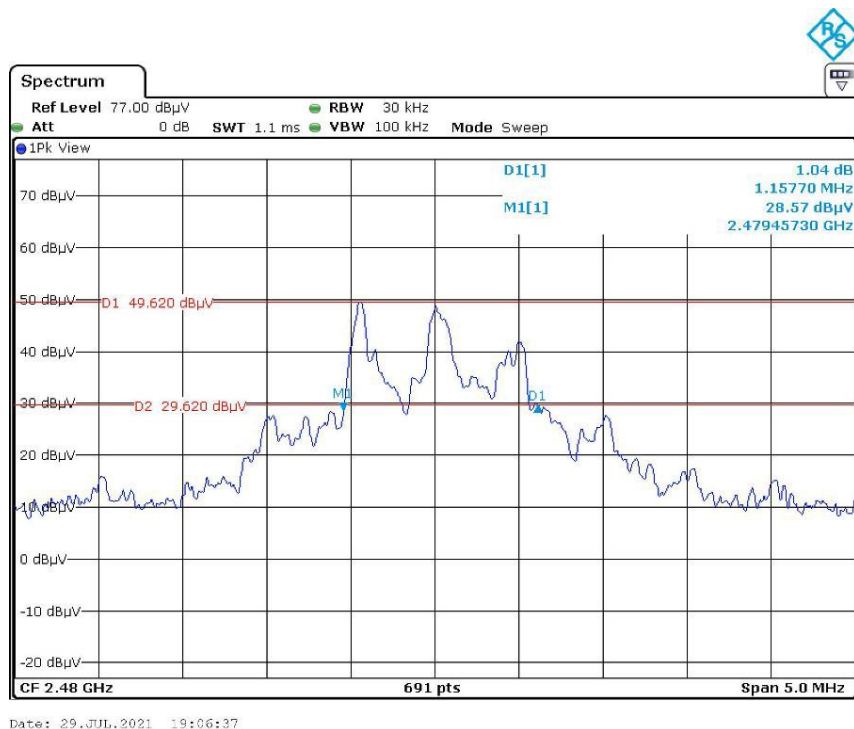
Low Channel



Middle Channel



High Channel



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