FCC Part 15.249

TEST REPORT

For

PENPOWER TECHNOLOGY LTD.

7F, NO.47, Lane 2, Sec.2, Kuang-Fu Rd.,, Hsinchu City, 300 Taiwan

FCC ID: QIC-JLMT001

Report Type:	**Product Type:**
Original Report	PenPower EZGoRF Jr.DONGLE

Report Producer : Coco Lin

Report Number : RXZ231003013RF04

Report Date : 2024-04-22

Reviewed By: Andy Shih

Andy.Shih

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ231003013	RXZ231003013RF04	2024-04-22	Original Report	Coco Lin

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	PENPOWER TECHNOLOGY LTD.
	7F, NO.47, Lane 2, Sec.2, Kuang-Fu Rd.,, Hsinchu City, **300 Taiwan**
Brand(Trade) Name	PenPower
Product (Equipment)	PenPower EZGoRF Jr.DONGLE
Main Model Name	JLMT-001
Frequency Range	2408~2474 MHz
Modulation Technique	GFSK
Power Operation (Voltage Range)	☐ AC ☐ Adapter ☐ By AC Power Cord ☐ PoE
	☒ DC Type 5V ☐ Battery ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	2023/10/04
Date of Test	2023/10/11 ~ 2024/04/20

*All measurement and test data in this report was gathered from production sample serial number: RXZ231003013-11 (Assigned by BACL, New Taipei Laboratory).

1.2 Objective

This report is prepared on behalf of *PENPOWER TECHNOLOGY LTD.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

1.3 Related Submittal(s)/Grant(s)

N/A.

1.4 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.

1.5 Statement

Decision Rule: No, (The test results do not include MU judgment)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.
Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 2.53 dB
Emissions Bandwidth		+/- 0.09 %
Emissions, radiated	9 kHz~30 MHz	+/- 3.54 dB
	30 MHz~1 GHz	+/- 4.99 dB
	1 GHz~18 GHz	+/- 7.56 dB
	18 GHz~40 GHz	+/- 5.06 dB
Temperature		+/- 0.79 °C
Humidity		+/- 0.44 %

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

1.7 Environmental Conditions

Test Site	Test Date	Temperature (℃)	Relative Humidity (%)	Test Engineer
AC Line Conducted Emissions	2023/10/11	24.8	64	Jing Chang
Radiation Spurious Emissions	2024/01/19~2024/04/20	21.7~23.8	66~68	Jim Chen
20 dB Emission Bandwidth	2024/01/12	20.7	49	Jim Chen

1.8 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

2 System Test Configuration

2.1 Description of Test Configuration

Channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2408	12	2432	24	2456
1	2410	13	2434	25	2458
2	2412	14	2436	26	2460
3	2414	15	2438	27	2462
4	2416	16	2440	28	2464
5	2418	17	2442	29	2466
6	2420	18	2444	30	2468
7	2422	19	2446	31	2470
8	2424	20	2448	32	2472
9	2426	21	2450	33	2474
10	2428	22	2452	/	/
11	2430	23	2454	/	/

Tested with channel 0, 16 and 33.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The test software was used “RF TEST & EMI MODE V1.0.0.3”

The system was configured for testing in engineering mode, which was provided by manufacturer.

Test Frequency	Low	Middle	High
Power Level Setting	Default	Default	Default

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number
NB	DELL	E6410
Writing Pad	PenPower	EZGoW01

2.5 External Cable List and Details

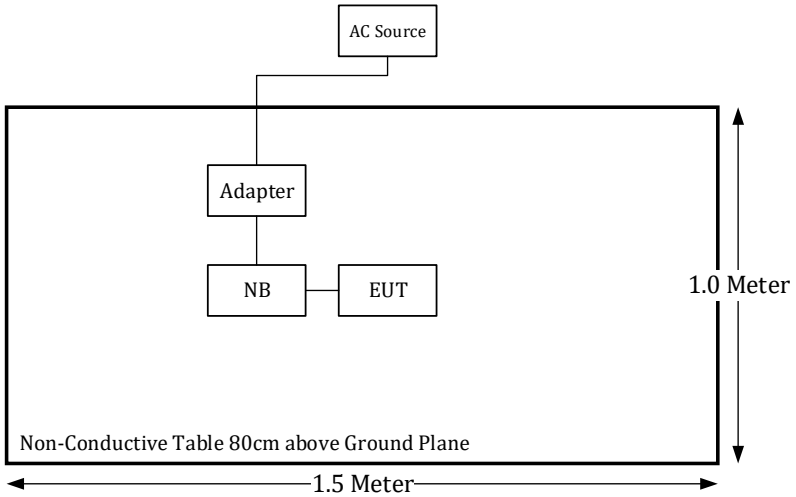
Cable Description	Length (cm)	From	To
USB Cable	25	NB	EUT

2.6 Block Diagram of Test Setup

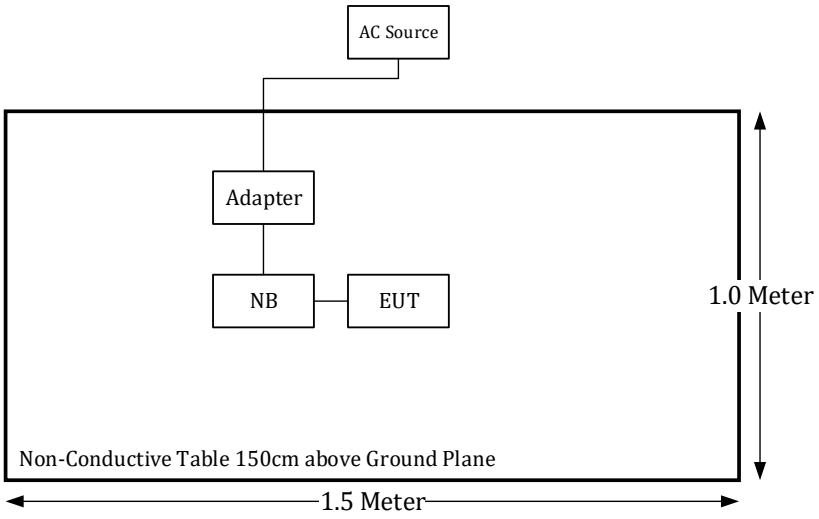
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

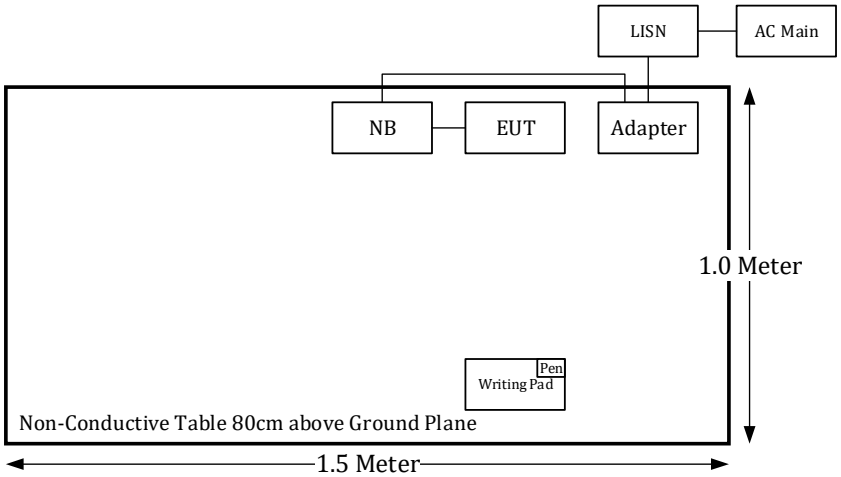
Below 1GHz:



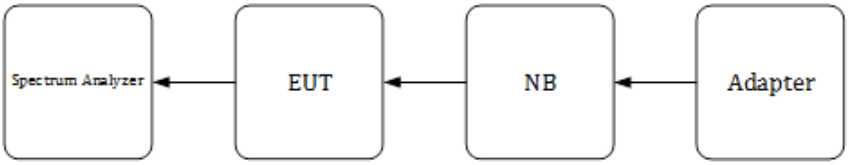
Above 1GHz:



Conduction



Conducted



3 Summary of Test Results

FCC Rules	Description of Test	Results
§1.1307(b)(3)(i)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209,§15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Emission Bandwidth	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2023/2/2	2024/2/1
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2023/5/22	2024/5/20
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2023/5/18	2024/5/16
RF Cable	EMEC	EM-CB5D	1	2023/6/6	2024/6/4
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	35796	2024/3/27	2025/3/26
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2023/1/31	2024/1/30
Horn Antenna	EMCO	SAS-571	1020	2023/5/18	2024/5/17
Horn Antenna	ETS-Lindgren	3116	62638	2023/8/25	2024/8/24
Preamplifier	Sonoma	310N	130602	2023/6/16	2024/6/15
Preamplifier	Channel	ERA-100M-18G-01D1748	EC2300051	2023/4/1	2024/3/31
Preamplifier	A.H. Systems	PAM-1840VH	174	2023/3/24	2024/3/23
Spectrum Analyzer	Rohde & Schwarz	FSV40	101939	2024/3/23	2024/3/23
				2024/3/27	2025/3/27
EMI Test Receiver	Rohde & Schwarz	ESR3	102099	2023/6/16	2024/6/15
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2023/1/24	2024/1/23
				2024/1/23	2025/1/23
Coaxial Cable	COMMATE	PEWC	8Dr	2023/12/23	2024/12/22
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2023/1/24	2024/1/23
				2024/1/23	2025/1/23
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2023/12/23	2024/12/22
Cable	EMC	EMC105-SM-SM-10000	201003	2023/1/24	2024/1/23
				2024/1/23	2025/1/23
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2023/1/24	2024/1/23
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-50CM	15120-1	2023/2/1	2024/1/31
Software	AUDIX	E3	18621a	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2023/2/9	2024/2/8
Cable	UTIFLEX	UFA210A	9435	2023/10/2	2024/10/1

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

5 FCC §1.1307(b)(3)(i) – RF EXPOSURE

5.1 Applicable Standard

According to subpart 15.249 and subpart §1.1307(b)(3)(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (*i.e.,* any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). *Pth* is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

5.2 RF Exposure Evaluation Result

Calculate the ERP from the radiated field strength in the far field using Equation

EIRP= E_{Meas} + 20log(d_{Meas})-104.7

EIRP= 82.81 dBμV/m -95.2 = −12.39 dBm

ERP = EIRP – 2.15 dB

Project info

Freq (MHz)	EIRP (dBm)	ERP (dBm)	ERP (mW)
2408~2474	-12.39	-14.54	0.04

§ 1.1307(b)(3)(i)(A)

The available maximum time-averaged power is no more than 1 mW

Result: The device meets the exemption requirement.

6 FCC §15.203 – Antenna Requirements

6.1 Applicable Standard

An intentional radiator shall be designed to ensure that no antenna other than that furnished by theresponsible 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.

6.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain
MOSART	PCB(Dongle)	PCB	-1.5532 dBi

The antenna is permanently attached to the device.

Result: Compliance.

7 FCC §15.207(a) – AC Line Conducted Emissions

7.1 Applicable Standard

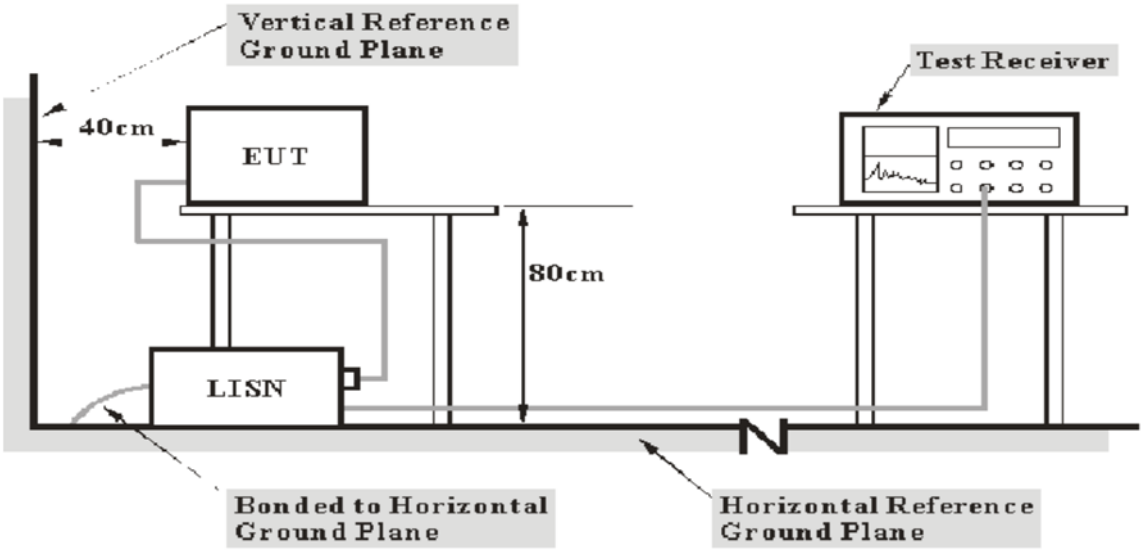
According to §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 1
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

7.2 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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.3 EMI Test Receiver Setup

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

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

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

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

7.5 Factor & Over Limit

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

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

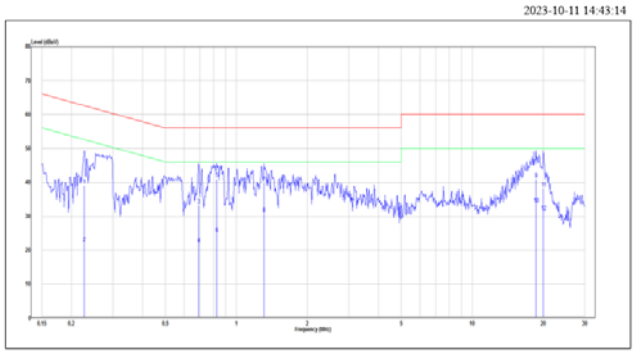
Over Limit = Result – Limit Line

7.6 Test Results

Test Mode: Transmitting

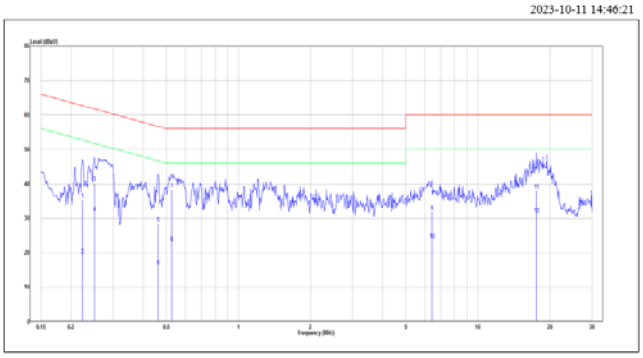
Main: AC120 V, 60 Hz

Line



No.	Frequency (MHz)	Reading dBuV	Correct Factor(dB)	Result dBuV	Limit dBuV	Over limit (dB)	Remark	Phase
1	0.227	19.53	19.50	39.03	62.57	-23.53	QP	Line
2	0.227	2.57	19.50	22.07	52.57	-30.50	Average	Line
3	0.694	13.47	19.72	33.19	56.00	-22.81	QP	Line
4	0.694	2.00	19.72	21.72	46.00	-24.28	Average	Line
5	0.826	21.18	19.78	40.96	56.00	-15.04	QP	Line
6	0.826	5.12	19.78	24.90	46.00	-21.10	Average	Line
7	1.310	19.88	19.93	39.81	56.00	-16.19	QP	Line
8	1.310	10.70	19.93	30.63	46.00	-15.37	Average	Line
9	18.622	20.39	20.42	40.81	60.00	-19.19	QP	Line
10	18.622	13.10	20.42	33.51	50.00	-16.49	Average	Line
11	20.056	17.69	20.47	38.17	60.00	-21.83	QP	Line
12	20.056	10.83	20.47	31.30	50.00	-18.70	Average	Line

Neutral



No.	Frequency (MHz)	Reading dBuV	Correct Factor(dB)	Result dBuV	Limit dBuV	Over limit (dB)	Remark	Phase
1	0.223	15.75	19.51	35.26	62.70	-27.44	QP	Neutral
2	0.223	-0.32	19.51	19.19	52.70	-33.51	Average	Neutral
3	0.251	20.76	19.52	40.28	61.73	-21.45	QP	Neutral
4	0.251	12.10	19.52	31.62	51.73	-20.11	Average	Neutral
5	0.461	8.77	19.61	28.38	56.67	-28.29	QP	Neutral
6	0.461	-3.58	19.61	16.03	46.67	-30.64	Average	Neutral
7	0.527	18.68	19.64	38.32	56.00	-17.68	QP	Neutral
8	0.527	3.08	19.64	22.72	46.00	-23.28	Average	Neutral
9	6.420	11.66	20.15	31.82	60.00	-28.18	QP	Neutral
10	6.420	3.49	20.15	23.64	50.00	-26.36	Average	Neutral
11	17.568	17.60	20.43	38.03	60.00	-21.97	QP	Neutral
12	17.568	10.67	20.43	31.10	50.00	-18.90	Average	Neutral

Note:

Result = Read Level + Factor

Over Limit = Result – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8 FCC §15.209, §15.205 , §15.249 - Radiated Emissions

8.1 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 (millivolts/meter)
920-928 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.

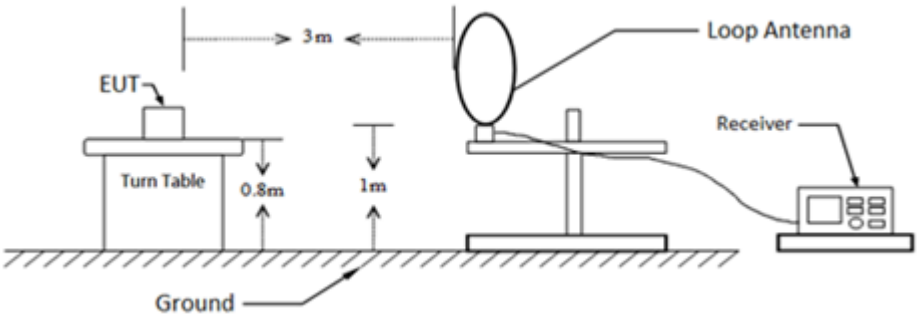
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to ANSI C63.10-2013, section 5.3.3

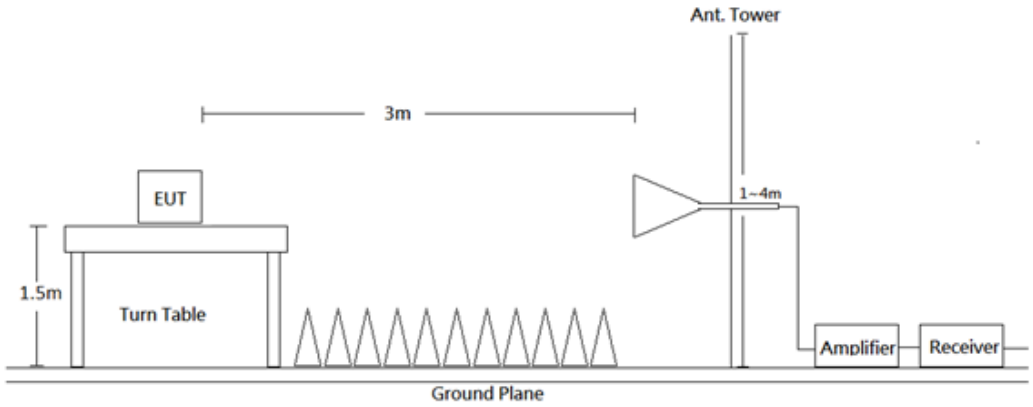
Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field, and the emissions to be measured can be detected by the measurement equipment (see 4.3.4). Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

8.2 EUT Setup

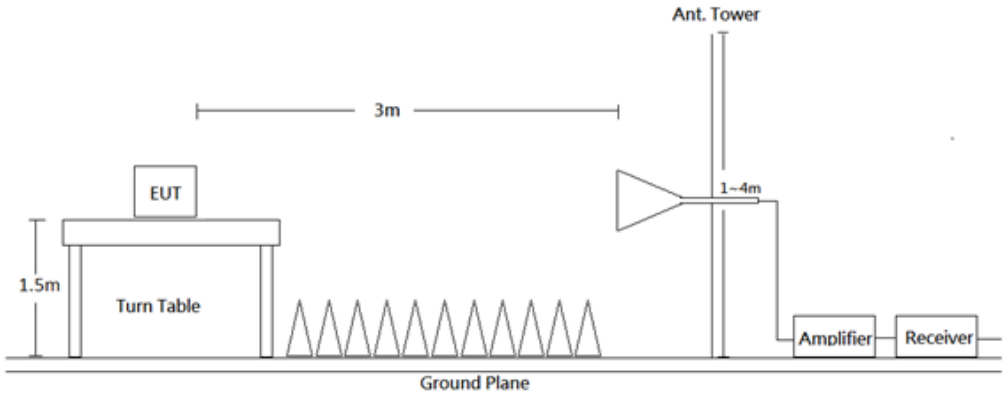
9kHz-30MHz:



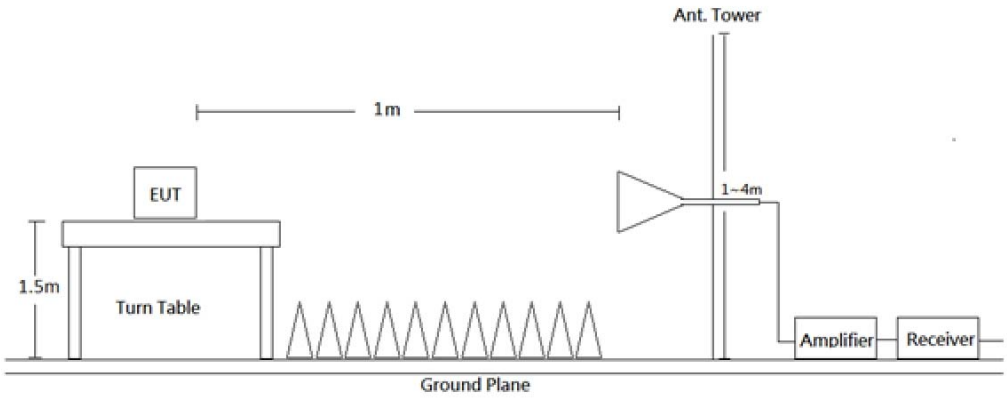
30MHz-1GHz:



1-18 GHz:



18-26.5 GHz:



Radiated 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, and FCC 15.249 limits.

8.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	VBW	Measurement method
9 kHz - 150 kHz	300 Hz	1 kHz	QP/AV
150 kHz - 30 MHz	10 kHz	30 kHz	QP/AV
30-1000 MHz	120 kHz	300 kHz	QP
Above 1 GHz	1 MHz	3 MHz	PK
Above 1 GHz	1 MHz	10 Hz	AVG

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.

8.4 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 Quasi-peak and average detector mode from 9 kHz to 30 MHz, Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5 Factor & Over Limit

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

Factor = Antenna Factor + Cable Loss + Amplifier Gain

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

Margin = Level – Limit

8.6 Test Results

Test Mode: Transmitting

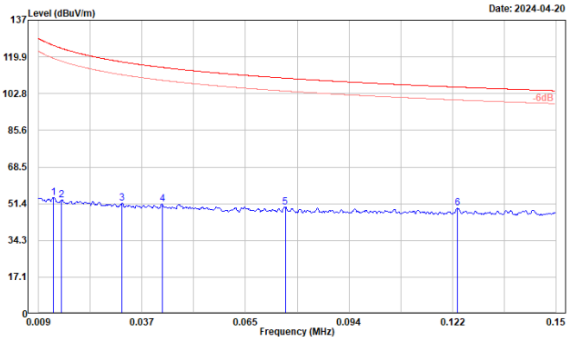
(Pre-scan with three orthogonal axis, and worse case as Z axis.)

9kHz-30MHz:

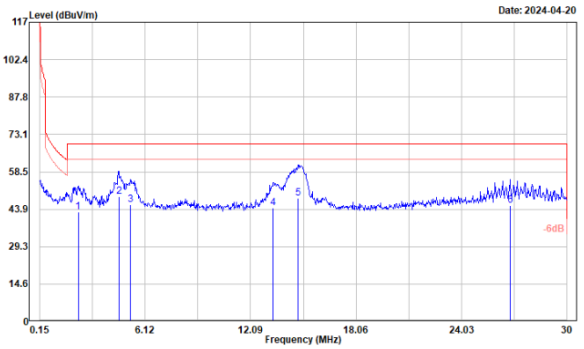
(worst case is low channel)

(Prescan using three directional polarities, worst case parallel.)

9kHz-150kHz	150kHz-30MHz



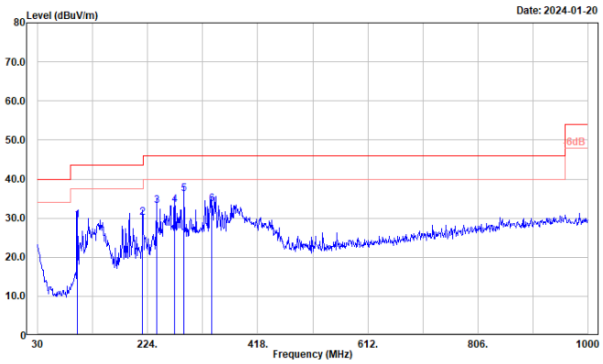
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
0.013	38.15	16.22	54.37	125.27	-70.90	100	257	Average
0.015	37.39	15.79	53.18	123.88	-70.70	100	228	Average
0.032	38.15	13.53	51.68	117.55	-65.87	100	109	Average
0.043	38.39	12.69	51.08	115.00	-63.92	100	10	Average
0.076	38.51	11.39	49.90	109.96	-60.06	100	0	Average
0.123	37.87	11.34	49.21	105.79	-56.58	100	308	Average



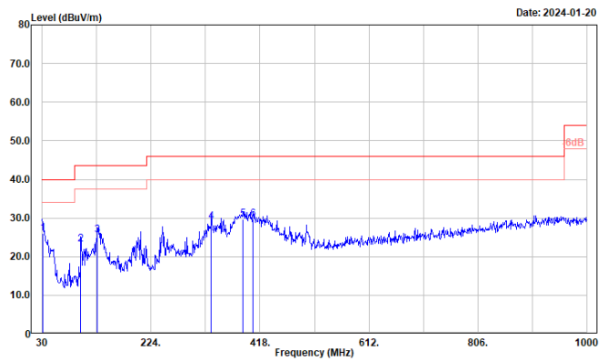
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2.329	32.16	10.65	42.81	69.54	-26.73	100	152	QP
4.628	38.08	10.65	48.73	69.54	-20.81	100	331	QP
5.284	34.59	11.01	45.60	69.54	-23.94	100	200	QP
13.374	32.83	11.47	44.30	69.54	-25.24	100	52	QP
14.777	36.60	11.51	48.11	69.54	-21.43	100	107	QP
26.776	33.71	11.72	45.43	69.54	-24.11	100	174	QP

30MHz-1GHz:

Low channel	
Horizontal	**Vertical**



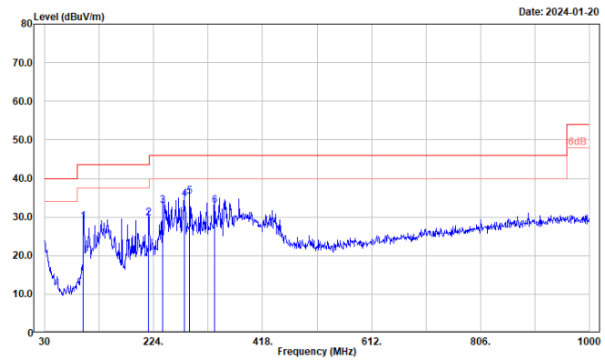
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
99.840	42.95	-13.36	29.59	43.50	-13.91	100	307	QP
215.270	42.47	-12.42	30.05	43.50	-13.45	100	206	QP
239.520	44.41	-11.32	33.09	46.00	-12.91	100	331	QP
271.530	42.98	-9.60	33.38	46.00	-12.62	100	299	QP
288.020	45.35	-9.15	36.20	46.00	-9.80	100	354	QP
337.490	42.08	-8.55	33.53	46.00	-12.47	100	217	QP



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	30.45	-4.45	26.00	40.00	-14.00	100	360	QP
98.870	36.81	-13.57	23.24	43.50	-20.26	100	121	QP
128.940	35.19	-9.57	25.62	43.50	-17.88	100	307	QP
331.670	37.66	-8.55	29.11	46.00	-16.89	100	214	QP
387.930	36.93	-7.30	29.63	46.00	-16.37	100	13	QP
405.390	36.55	-6.90	29.65	46.00	-16.35	100	17	QP

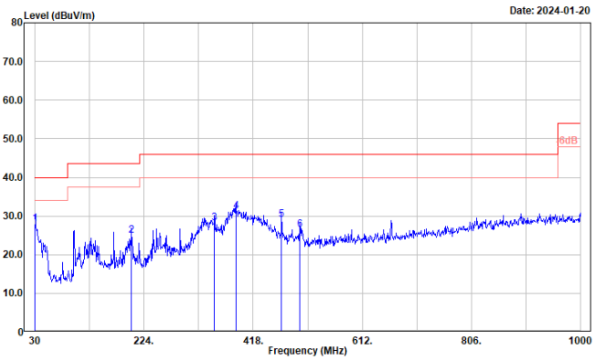
Middle channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
98.870	42.40	-13.57	28.83	43.50	-14.67	100	298	QP
215.270	42.13	-12.42	29.71	43.50	-13.79	100	206	QP
239.520	44.20	-11.32	32.88	46.00	-13.12	100	4	QP
278.320	44.27	-9.51	34.76	46.00	-11.24	100	289	QP
288.020	44.50	-9.15	35.35	46.00	-10.65	100	225	QP
332.640	41.54	-8.55	32.99	46.00	-13.01	100	244	QP

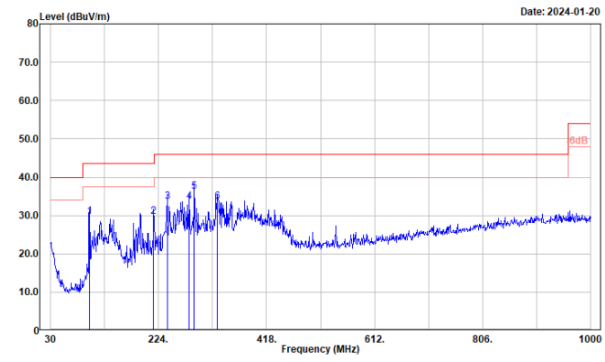
Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
30.000	31.07	-3.01	28.06	40.00	-11.94	100	285	QP
201.690	35.70	-10.79	24.91	43.50	-18.59	100	309	QP
349.130	36.52	-8.37	28.15	46.00	-17.85	100	359	QP
386.960	38.66	-7.34	31.32	46.00	-14.68	100	59	QP
468.440	34.36	-5.35	29.01	46.00	-16.99	100	21	QP
501.420	31.10	-4.70	26.40	46.00	-19.60	100	344	QP

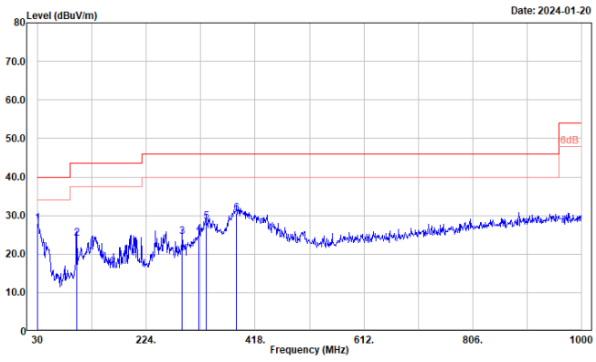
High channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
99.840	42.96	-13.36	29.60	43.50	-13.90	100	301	QP
215.270	42.02	-12.42	29.60	43.50	-13.90	100	202	QP
239.520	44.98	-11.32	33.66	46.00	-12.34	100	214	QP
279.290	43.15	-9.50	33.65	46.00	-12.35	100	290	QP
288.020	45.45	-9.15	36.30	46.00	-9.70	100	357	QP
329.730	42.13	-8.55	33.58	46.00	-12.42	100	164	QP

Vertical

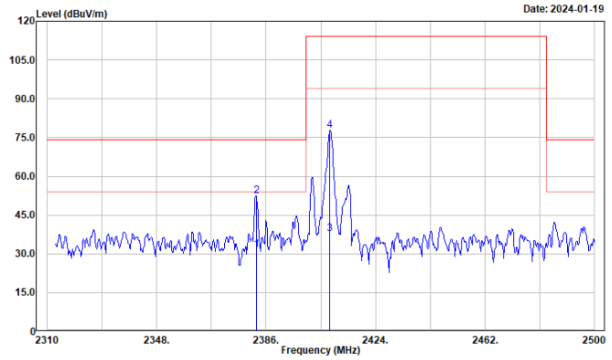


Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
30.000	31.06	-3.01	28.05	40.00	-11.95	100	44	QP
99.840	37.43	-13.36	24.07	43.50	-19.43	100	125	QP
288.020	33.69	-9.15	24.54	46.00	-21.46	100	240	QP
318.090	34.11	-8.94	25.17	46.00	-20.83	100	358	QP
330.700	36.87	-8.54	28.33	46.00	-17.67	100	360	QP
385.020	38.07	-7.42	30.65	46.00	-15.35	100	10	QP

Band-Edge:

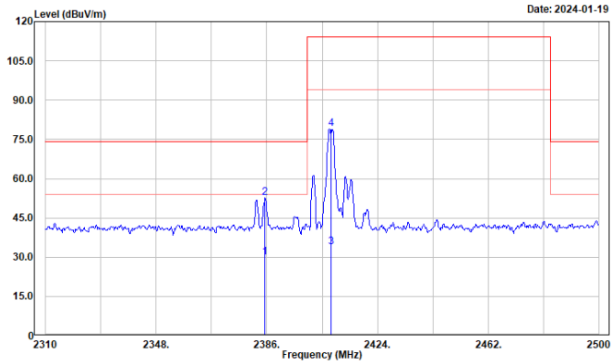
Low channel

Horizontal



Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Height (cm)	Degree (°)	Remark
2382.540	42.68	-11.19	31.49	54.00	-22.51	132	183	Average
2382.540	63.65	-11.19	52.46	74.00	-21.54	132	183	Peak
2408.000	48.75	-11.10	37.65	94.00	-56.35	132	183	Average
2408.000	88.74	-11.10	77.64	114.00	-36.36	132	183	Peak

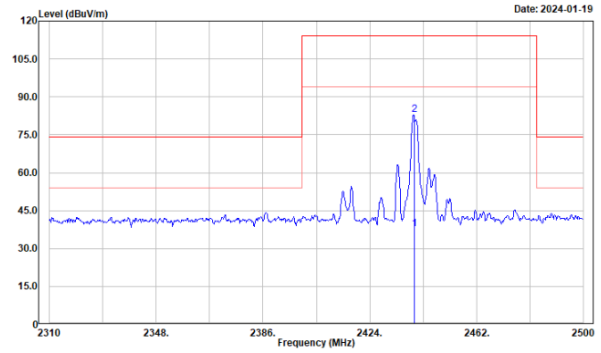
Vertical



Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Height (cm)	Degree (°)	Remark
2385.430	41.16	-11.18	29.98	54.00	-24.02	148	294	Average
2385.430	63.76	-11.18	52.58	74.00	-21.42	148	294	Peak
2408.000	45.03	-11.10	33.93	94.00	-60.07	148	294	Average
2408.000	89.99	-11.10	78.89	114.00	-35.11	148	294	Peak

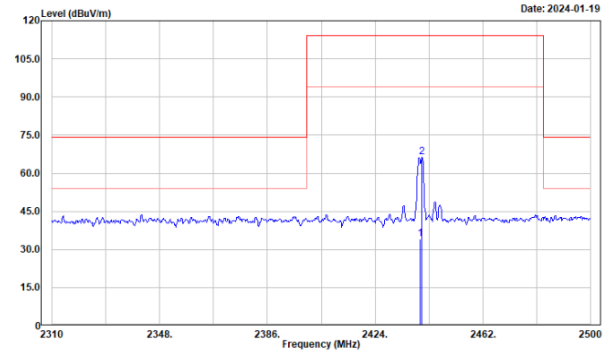
Middle channel

Horizontal



Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Height (cm)	Degree (°)	Remark
2440.000	48.92	-11.06	37.86	94.00	-56.14	133	187	Average
2440.000	93.87	-11.06	82.81	114.00	-31.19	133	187	Peak

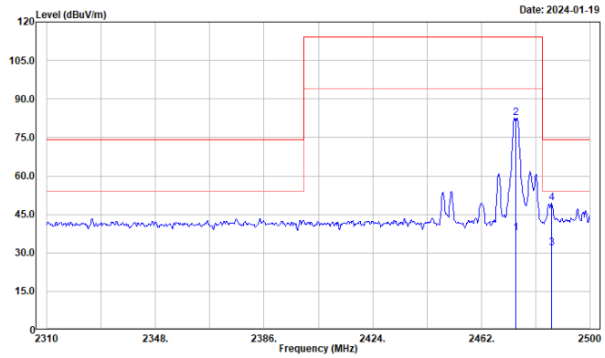
Vertical



Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Height (cm)	Degree (°)	Remark
2440.000	45.06	-11.06	34.00	94.00	-60.00	145	289	Average
2440.530	77.48	-11.06	66.42	114.00	-47.58	145	289	Peak

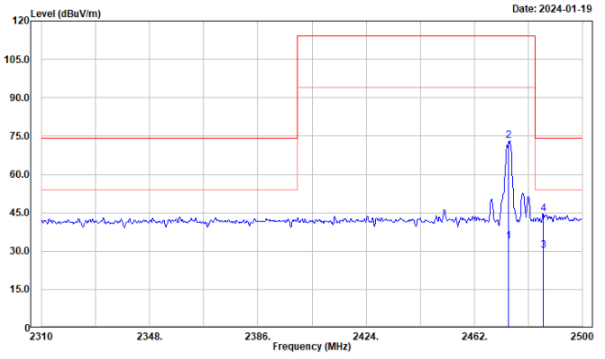
High channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2474.000	48.42	-10.72	37.70	94.00	-56.30	135	234	Average
2474.000	93.32	-10.72	82.60	114.00	-31.40	135	234	Peak
2486.510	42.48	-10.55	31.93	54.00	-22.07	135	234	Average
2486.510	59.99	-10.55	49.44	74.00	-24.56	135	234	Peak

Vertical

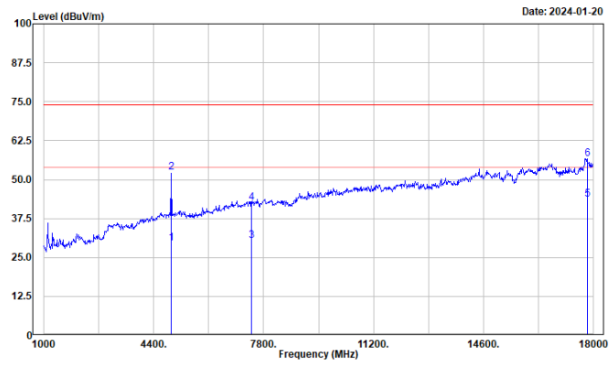


Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2474.000	44.61	-10.72	33.89	94.00	-60.11	142	290	Average
2474.000	83.77	-10.72	73.05	114.00	-40.95	142	290	Peak
2486.320	40.92	-10.55	30.37	54.00	-23.63	142	290	Average
2486.320	55.13	-10.55	44.58	74.00	-29.42	142	290	Peak

(Worst case mode is high channel)

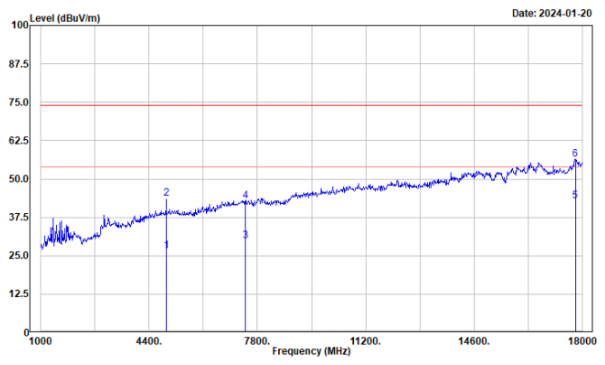
1GHz-18GHz:

Horizontal



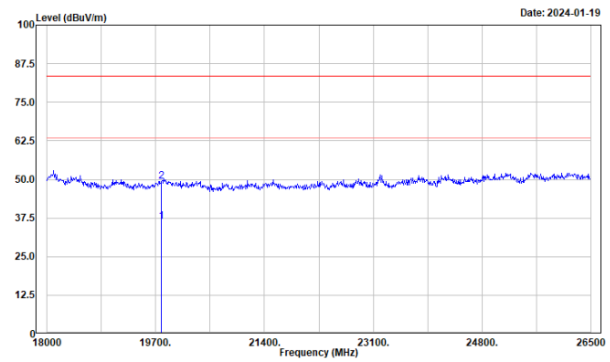
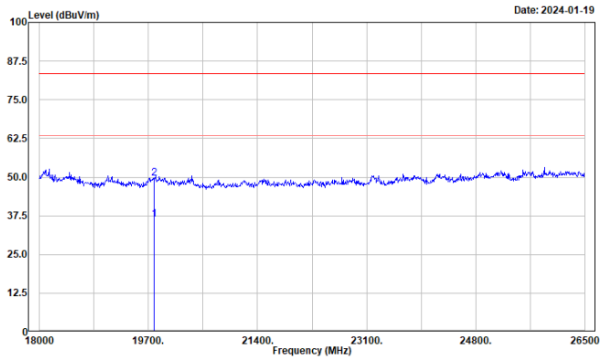
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4948.000	34.10	-4.63	29.47	54.00	-24.53	142	14	Average
4948.000	57.00	-4.63	52.37	74.00	-21.63	142	14	Peak
7422.000	30.01	0.37	30.38	54.00	-23.62	149	229	Average
7422.000	42.23	0.37	42.60	74.00	-31.40	149	229	Peak
17813.000	30.51	13.01	43.52	54.00	-10.48	150	236	Average
17813.000	43.70	13.01	56.71	74.00	-17.29	150	236	Peak

Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4948.000	31.21	-4.66	26.55	54.00	-27.45	151	150	Average
4948.000	48.27	-4.66	43.61	74.00	-30.39	151	150	Peak
7422.000	29.50	0.37	29.87	54.00	-24.13	145	346	Average
7422.000	42.40	0.37	42.77	74.00	-31.23	145	346	Peak
17779.000	29.92	12.86	42.78	54.00	-11.22	150	197	Average
17779.000	43.62	12.86	56.48	74.00	-17.52	150	197	Peak

18GHz-26.5GHz:

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19792.000	18.79	17.49	36.28	63.50	-27.22	150	354	Average
19792.000	31.72	17.49	49.21	83.50	-34.29	150	354	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19792.000	18.76	17.49	36.25	63.50	-27.25	150	170	Average
19792.000	32.08	17.49	49.57	83.50	-33.93	150	170	Peak

Note:

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

For 18-26.5GHz Convert the test distance limit of 3 meters to a limit of 1 meter:

Conversion factor = 20 log (1m/3m) = 9.5 dB , Limit = 54+9.5 = 63.50 dBuV/m @ 1m

Above 1GHz

Low channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2382.540	42.68	-11.19	31.49	54.00	-22.51	132	183	Average
2382.540	63.65	-11.19	52.46	74.00	-21.54	132	183	Peak
2408.000	48.75	-11.10	37.65	94.00	-56.35	132	183	Average
2408.000	88.74	-11.10	77.64	114.00	-36.36	132	183	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4816.000	32.43	-4.97	27.46	54.00	-26.54	100	293	Average
4816.000	57.24	-4.97	52.27	74.00	-21.73	100	293	Peak
7224.000	29.54	0.04	29.58	54.00	-24.42	152	56	Average
7224.000	42.29	0.04	42.33	74.00	-31.67	152	56	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2385.430	41.16	-11.18	29.98	54.00	-24.02	148	294	Average
2385.430	63.76	-11.18	52.58	74.00	-21.42	148	294	Peak
2408.000	45.03	-11.10	33.93	94.00	-60.07	148	294	Average
2408.000	89.99	-11.10	78.89	114.00	-35.11	148	294	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4816.000	32.73	-4.97	27.76	54.00	-26.24	109	250	Average
4816.000	51.19	-4.97	46.22	74.00	-27.78	109	250	Peak
7224.000	29.47	0.04	29.51	54.00	-24.49	152	95	Average
7224.000	43.28	0.04	43.32	74.00	-30.68	152	95	Peak

Middle channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	48.92	-11.06	37.86	94.00	-56.14	133	187	Average
2440.000	93.87	-11.06	82.81	114.00	-31.19	133	187	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	32.83	-4.89	27.94	54.00	-26.06	125	298	Average
4880.000	55.15	-4.89	50.26	74.00	-23.74	125	298	Peak
7320.000	29.53	0.02	29.55	54.00	-24.45	154	0	Average
7320.000	42.54	0.02	42.56	74.00	-31.44	154	0	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	45.06	-11.06	34.00	94.00	-60.00	145	289	Average
2440.530	77.48	-11.06	66.42	114.00	-47.58	145	289	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	31.51	-4.89	26.62	54.00	-27.38	124	259	Average
4880.000	49.27	-4.89	44.38	74.00	-29.62	124	259	Peak
7320.000	29.61	0.02	29.63	54.00	-24.37	152	243	Average
7320.000	42.87	0.02	42.89	74.00	-31.11	152	243	Peak

High channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2474.000	48.42	-10.72	37.70	94.00	-56.30	135	234	Average
2474.000	93.32	-10.72	82.60	114.00	-31.40	135	234	Peak
2486.510	42.48	-10.55	31.93	54.00	-22.07	135	234	Average
2486.510	59.99	-10.55	49.44	74.00	-24.56	135	234	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4948.000	34.10	-4.63	29.47	54.00	-24.53	142	14	Average
4948.000	57.00	-4.63	52.37	74.00	-21.63	142	14	Peak
7422.000	30.01	0.37	30.38	54.00	-23.62	149	229	Average
7422.000	42.23	0.37	42.60	74.00	-31.40	149	229	Peak
17813.000	30.51	13.01	43.52	54.00	-10.48	150	236	Average
17813.000	43.70	13.01	56.71	74.00	-17.29	150	236	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2474.000	44.61	-10.72	33.89	94.00	-60.11	142	290	Average
2474.000	83.77	-10.72	73.05	114.00	-40.95	142	290	Peak
2486.320	40.92	-10.55	30.37	54.00	-23.63	142	290	Average
2486.320	55.13	-10.55	44.58	74.00	-29.42	142	290	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4948.000	31.21	-4.66	26.55	54.00	-27.45	151	150	Average
4948.000	48.27	-4.66	43.61	74.00	-30.39	151	150	Peak
7422.000	29.50	0.37	29.87	54.00	-24.13	145	346	Average
7422.000	42.40	0.37	42.77	74.00	-31.23	145	346	Peak
17779.000	29.92	12.86	42.78	54.00	-11.22	150	197	Average
17779.000	43.62	12.86	56.48	74.00	-17.52	150	197	Peak

Note:

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

9 FCC §15.215(c) –20 dB Bandwidth Testing

9.1 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.

9.2 Test Procedure

According to ANSI C63.10-2013 Section 6.9.2

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. 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 were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

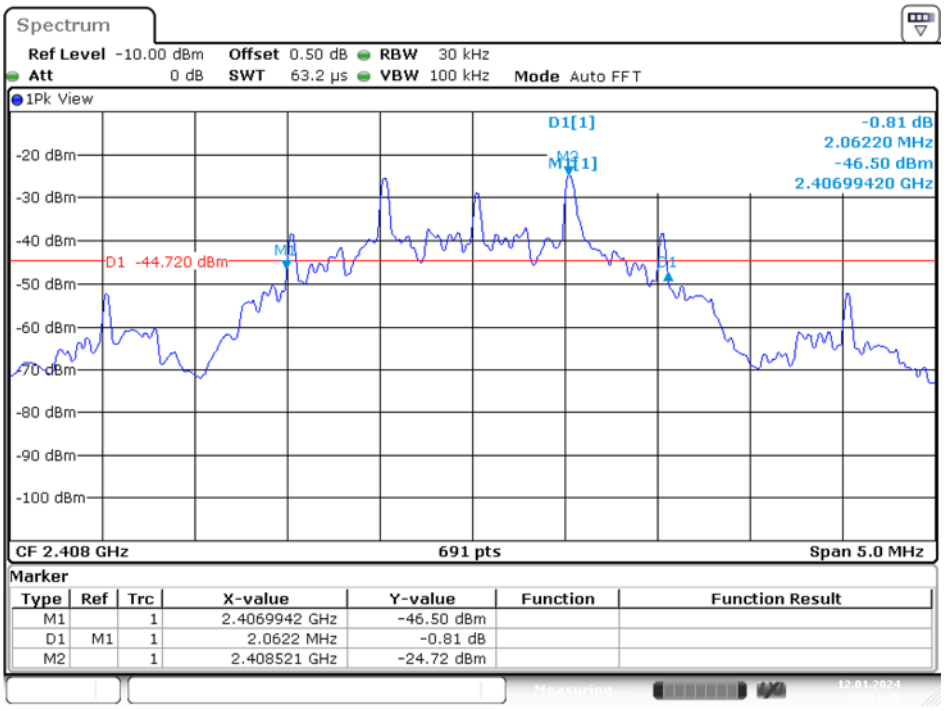
9.3 Test Results

Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
Low	2408	2.06
Middle	2440	2.06
High	2474	2.06

Please refer to the following plots

20 dB Emission Bandwidth

Low Channel



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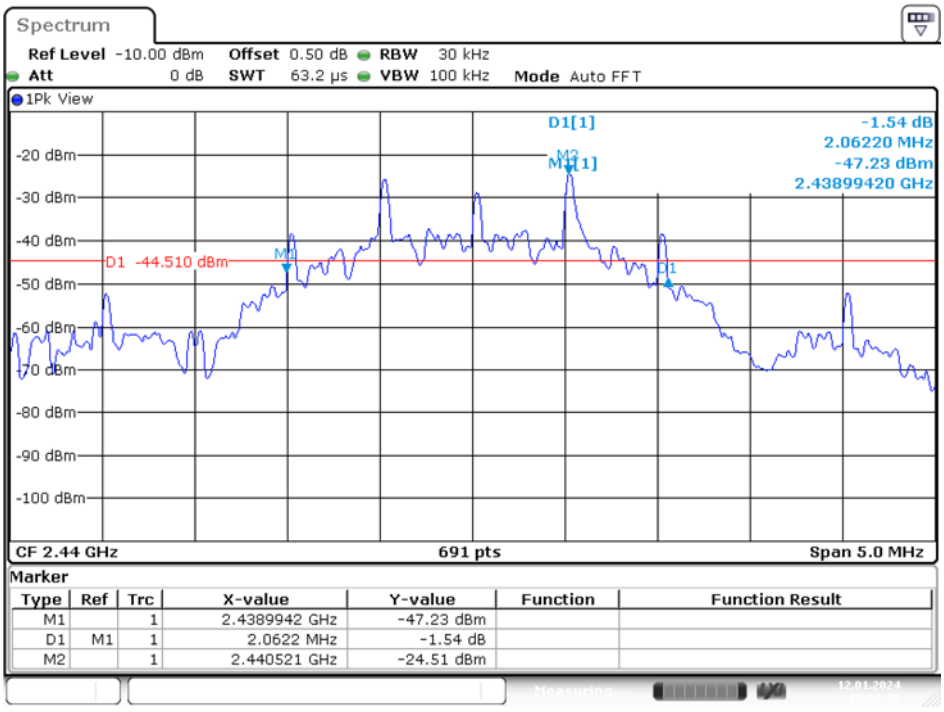
Middle Channel



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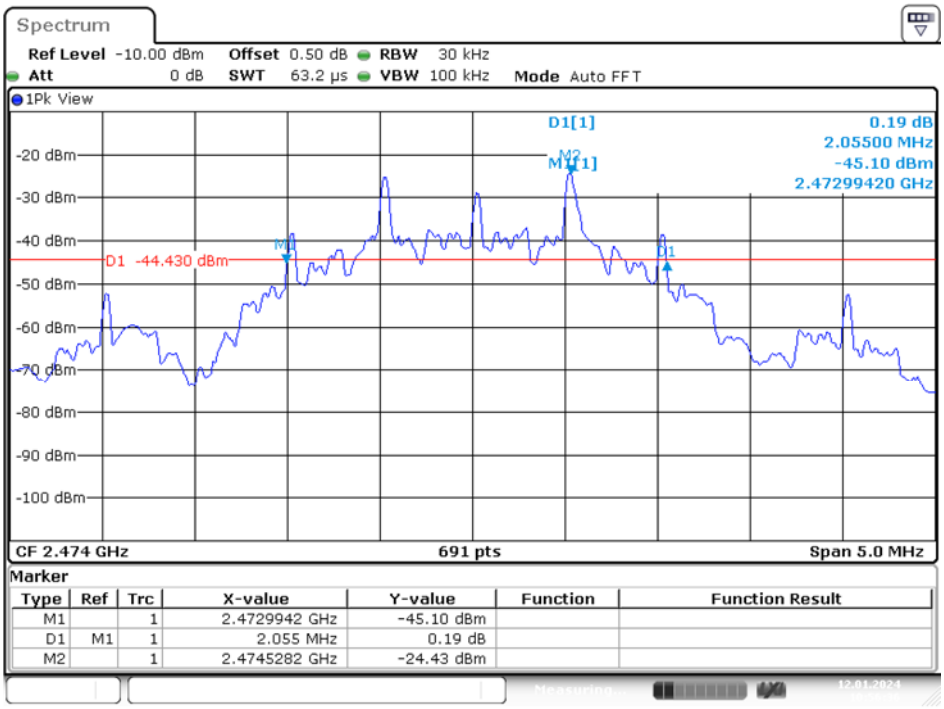
High Channel



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