

# Test Report

**Report No.:** MTi241213015-02E2

**Date of issue:** 2024-12-25

**Applicant:** ShenZhen ZhiHaiHe Tech Co.,Ltd

**Product name:** Varmilo Mechanical Keyboard

**Model(s):** APV108, APV109, APV113

**FCC ID:** 2AF8O-APV108

Shenzhen Microtest Co., Ltd.

<http://www.mtitest.cn>

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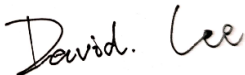

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Test Result Certification	
<b>Applicant:</b>	ShenZhen ZhiHaiHe Tech Co.,Ltd
<b>Address:</b>	5th Floor, Block 2, 10th Industrial Zone, Tian Liao Community, Yu Tang Area, Guang Ming District, Shenzhen, China
<b>Manufacturer:</b>	ShenZhen ZhiHaiHe Tech Co.,Ltd
<b>Address:</b>	5th Floor, Block 2, 10th Industrial Zone, Tian Liao Community, Yu Tang Area, Guang Ming District, Shenzhen, China
<b>Product description</b>	
<b>Product name:</b>	Varmilo Mechanical Keyboard
<b>Trademark:</b>	Varmilo
<b>Model name:</b>	APV108
<b>Series Model(s):</b>	APV109, APV113
<b>Standards:</b>	47 CFR Part 15.249
<b>Test Method:</b>	ANSI C63.10-2020
<b>Date of Test</b>	
<b>Date of test:</b>	2024-12-19 to 2024-12-23
<b>Test result:</b>	Pass

<b>Test Engineer</b>	:	
		(Maleah Deng)
<b>Reviewed By</b>	:	
		(David Lee)
<b>Approved By</b>	:	
		(Leon Chen)

## 1 General Description

### 1.1 Description of the EUT

Product name:	Varmilo Mechanical Keyboard
Model name:	APV108
Series Model(s):	APV109, APV113
Model difference:	All the models are the same circuit and module, except the model name.
Electrical rating:	Input: DC 5V, 500mA Battery: DC 3.7V, 2500mAh
Accessories:	Cable: USB-A to Type-C cable (1.8m)*1 Dongle*1
Hardware version:	APV108-V2.0(D)
Software version:	CAP_APV108_V20241116
Test sample(s) number:	MTi241213015-02S1001
<b>RF specification</b>	
Operating frequency range:	2404-2478MHz
Channel number:	38
Modulation type:	GFSK
Antenna(s) type:	PCB Antenna
Antenna(s) gain:	2dBi

### 1.2 Description of test modes

No.	Emission test modes
Mode1	TX-GFSK

#### 1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	/	/
10	2422	20	2442	30	2462	/	/

**Test Channel List**

Lowest Channel (LCH) (MHz)	Middle Channel (MCH) (MHz)	Highest Channel (HCH) (MHz)
2404	2440	2478

Note: The test software provided by manufacturer is used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

**Test Software:**

For power setting, refer to below table.

Test Software:	RF Test Tool		
Mode	2404MHz	2440MHz	2478MHz
GFSK	0*04	0*04	0*04

### 1.3 Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15°C ~ 35°C
Humidity:	20% RH ~ 75% RH
Atmospheric pressure:	101 kPa ~ 101 kPa

### 1.4 Description of support units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Support equipment list			
Description	Model	Serial No.	Manufacturer
HUAWEI CHARGE	HW-050200C02	K95212KA103561	HUAWEI
Support cable list			
Description	Length (m)	From	To
/	/	/	/

### 1.5 Measurement uncertainty

Measurement	Uncertainty
Conducted emissions (AMN 150kHz~30MHz)	±3.1dB
Occupied channel bandwidth	±3 %
Radiated spurious emissions (above 1GHz)	±5.3dB
Radiated spurious emissions (9kHz~30MHz)	±4.3dB
Radiated spurious emissions (30MHz~1GHz)	±4.7dB
Temperature	±1 °C
Humidity	± 5 %

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 2 Summary of Test Result

No.	Item	Standard	Requirement	Result
1	Antenna requirement	47 CFR Part 15.249	47 CFR Part 15.203	Pass
2	Conducted Emission at AC power line	47 CFR Part 15.249	47 CFR 15.207(a)	Pass
3	Occupied Bandwidth	47 CFR Part 15.249	47 CFR 15.215(c)	Pass
4	Field strength of fundamental	47 CFR Part 15.249	47 CFR 15.249(a) 47 CFR 15.249(b)(1)	Pass
5	Band edge emissions (Radiated)	47 CFR Part 15.249	47 CFR 15.249(d)	Pass
6	Emissions in frequency bands (below 1GHz)	47 CFR Part 15.249	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)	Pass
7	Emissions in frequency bands (above 1GHz)	47 CFR Part 15.249	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)	Pass



### 3 Test Facilities and accreditations

#### 3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No.7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573
IC Registration No.:	21760
CABID:	CN0093

#### 4 List of test equipment

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
Conducted Emission at AC power line						
1	EMI Test Receiver	Rohde&schwarz	ESCI3	101368	2024-03-20	2025-03-19
2	Artificial mains network	Schwarzbeck	NSLK 8127	183	2024-03-21	2025-03-20
3	Artificial Mains Network	Rohde & Schwarz	ESH2-Z5	100263	2024-03-20	2025-03-19
Occupied Bandwidth						
1	Wideband Radio Communication Tester	Rohde&schwarz	CMW500	149155	2024-03-20	2025-03-19
2	ESG Series Analog Ssignal Generator	Agilent	E4421B	GB40051240	2024-03-21	2025-03-20
3	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2024-03-21	2025-03-20
4	Synthesized Sweeper	Agilent	83752A	3610A01957	2024-03-21	2025-03-20
5	MXA Signal Analyzer	Agilent	N9020A	MY50143483	2024-03-21	2025-03-20
6	RF Control Unit	Tonscend	JS0806-1	19D8060152	2024-03-21	2025-03-20
7	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2024-03-21	2025-03-20
8	ESG Vector Signal Generator	Agilent	N5182A	MY50143762	2024-03-20	2025-03-19
9	DC Power Supply	Agilent	E3632A	MY40027695	2024-03-21	2025-03-20
Field strength of fundamental Band edge emissions (Radiated) Emissions in frequency bands (above 1GHz)						
1	EMI Test Receiver	Rohde&schwarz	ESCI7	101166	2024-03-20	2025-03-19
2	Double Ridged Broadband Horn Antenna	schwarabeck	BBHA 9120 D	2278	2023-06-17	2025-06-16
3	Amplifier	Agilent	8449B	3008A01120	2024-03-20	2025-03-19
4	MXA signal analyzer	Agilent	N9020A	MY54440859	2024-03-21	2025-03-20
5	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2024-03-21	2025-03-20
6	Horn antenna	Schwarzbeck	BBHA 9170	00987	2023-06-17	2025-06-16
7	Pre-amplifier	Space-Dtronics	EWLAN1840 G	210405001	2024-03-21	2025-03-20
Emissions in frequency bands (below 1GHz)						
1	EMI Test Receiver	Rohde&schwarz	ESCI7	101166	2024-03-20	2025-03-19
2	TRILOG Broadband Antenna	schwarabeck	VULB 9163	9163-1338	2023-06-11	2025-06-10
3	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00066	2024-03-23	2025-03-22
4	Amplifier	Hewlett-Packard	8447F	3113A06184	2024-03-20	2025-03-19

## 5 Evaluation Results (Evaluation)

### 5.1 Antenna requirement

Test Requirement:	Refer to 47 CFR Part 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.
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## 6 Radio Spectrum Matter Test Results (RF)

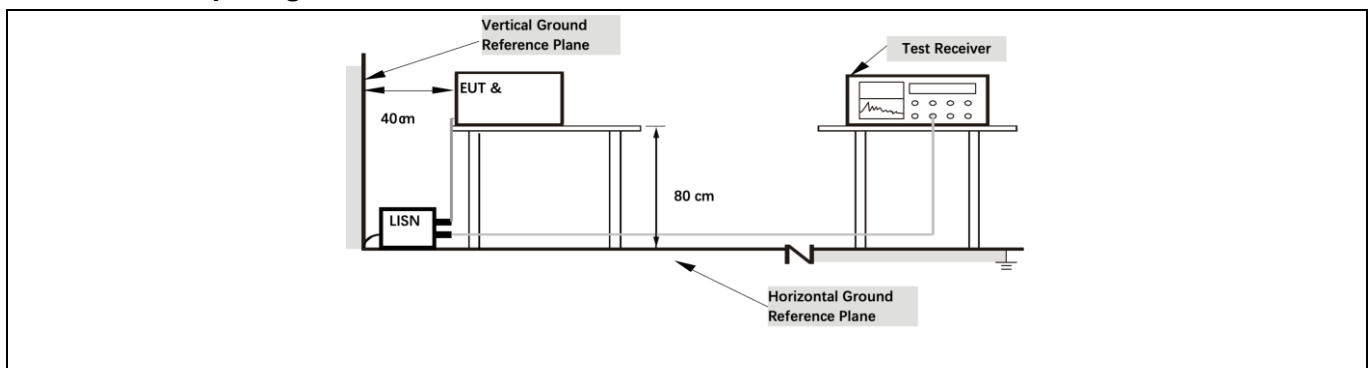
### 6.1 Conducted Emission at AC power line

Test Requirement:	Except as shown in paragraphs (b) and (c) of this section, 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 $\mu$ H/50 ohms line impedance stabilization network (LISN).		
Test Limit:	Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
	*Decreases with the logarithm of the frequency.		
Test Method:	ANSI C63.10-2020 section 6.2		
Procedure:	Refer to ANSI C63.10-2020 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices		

#### 6.1.1 E.U.T. Operation:

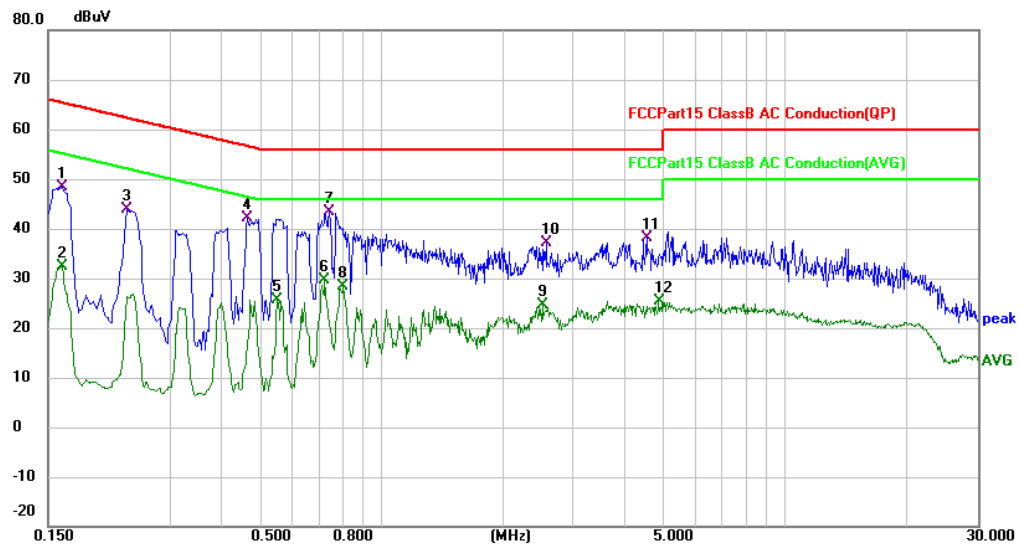
Operating Environment:					
Temperature:	21.3 °C	Humidity:	33 %	Atmospheric Pressure:	101 kPa
Pre test mode:	Mode1				
Final test mode:	Mode1				

#### 6.1.2 Test Setup Diagram:



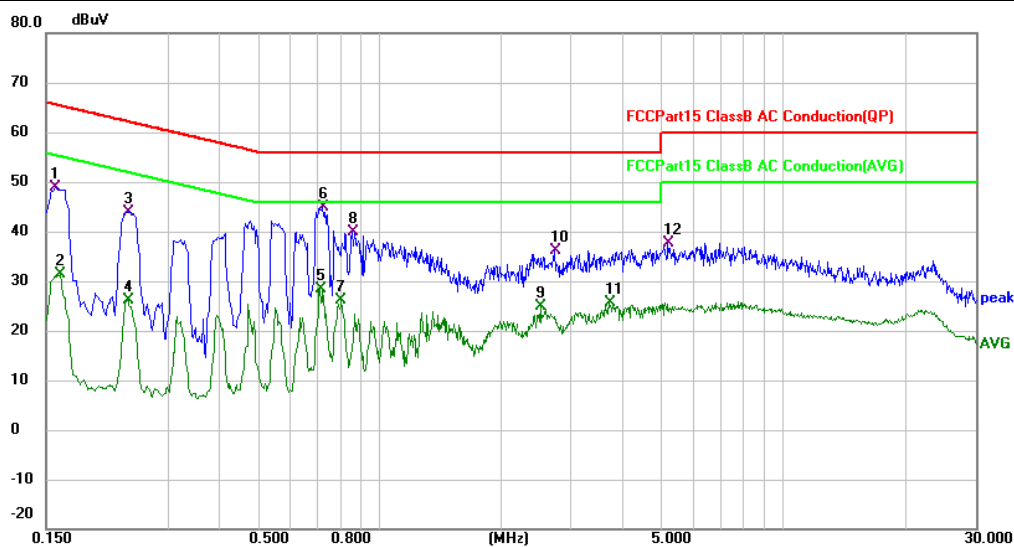
### 6.1.3 Test Data:

Mode1 / Line: Line / CH: H



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1620	38.03	10.30	48.33	65.36	-17.03	QP	
2		0.1620	22.08	10.30	32.38	55.36	-22.98	AVG	
3		0.2340	33.48	10.32	43.80	62.31	-18.51	QP	
4		0.4660	31.66	10.42	42.08	56.58	-14.50	QP	
5		0.5540	15.26	10.44	25.70	46.00	-20.30	AVG	
6		0.7260	19.20	10.48	29.68	46.00	-16.32	AVG	
7	*	0.7460	32.77	10.49	43.26	56.00	-12.74	QP	
8		0.8059	17.83	10.49	28.32	46.00	-17.68	AVG	
9		2.5220	14.12	10.56	24.68	46.00	-21.32	AVG	
10		2.5700	26.50	10.56	37.06	56.00	-18.94	QP	
11		4.5620	27.68	10.57	38.25	56.00	-17.75	QP	
12		4.8780	14.87	10.57	25.44	46.00	-20.56	AVG	

Mode1 / Line: Neutral / CH: H



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1580	38.48	10.30	48.78	65.57	-16.79	QP	
2		0.1620	20.96	10.30	31.26	55.36	-24.10	AVG	
3		0.2380	33.59	10.32	43.91	62.17	-18.26	QP	
4		0.2380	15.86	10.32	26.18	52.17	-25.99	AVG	
5		0.7140	17.87	10.48	28.35	46.00	-17.65	AVG	
6	*	0.7260	34.39	10.48	44.87	56.00	-11.13	QP	
7		0.8059	15.54	10.49	26.03	46.00	-19.97	AVG	
8		0.8580	29.28	10.51	39.79	56.00	-16.21	QP	
9		2.5180	14.36	10.56	24.92	46.00	-21.08	AVG	
10		2.7340	25.45	10.56	36.01	56.00	-19.99	QP	
11		3.7380	15.15	10.56	25.71	46.00	-20.29	AVG	
12		5.1979	27.02	10.58	37.60	60.00	-22.40	QP	

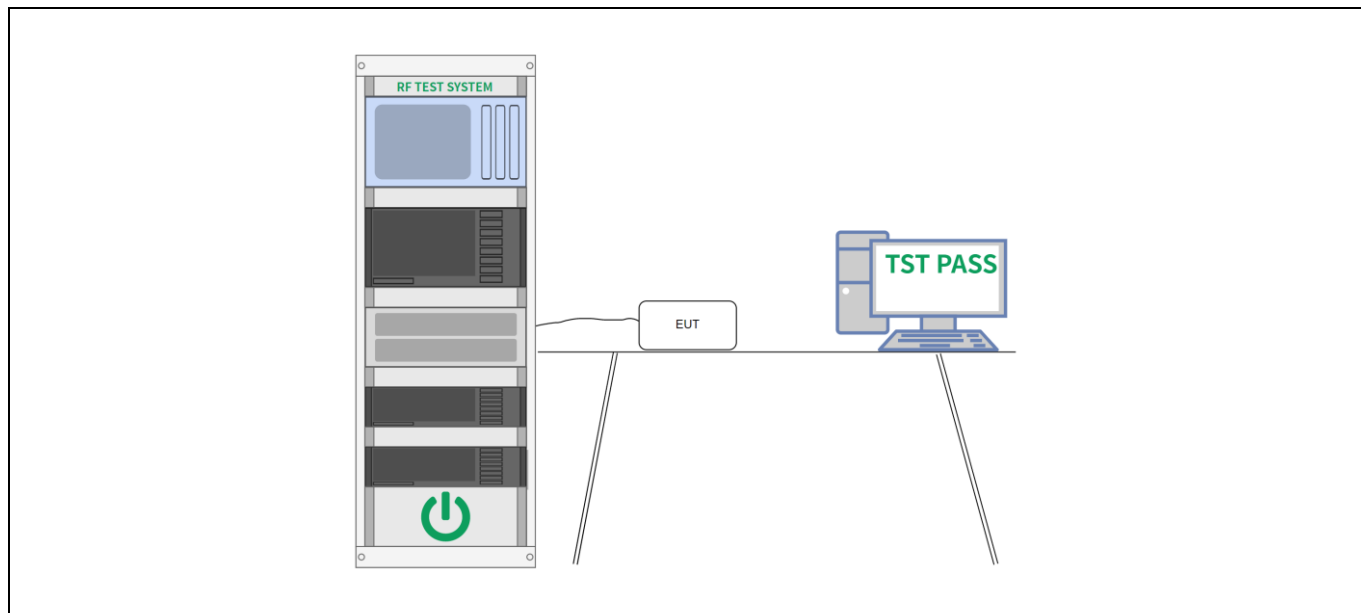
## 6.2 Occupied Bandwidth

Test Requirement:	47 CFR 15.215(c)
Test Limit:	Refer to 47 CFR 15.215(c), 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 Method:	ANSI C63.10-2020, section 6.9.2
Procedure:	<p>a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.</p> <p>b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.</p> <p>c) 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 <math>[10 \log (OBW/RBW)]</math> below the reference level. Specific guidance is given in 4.1.5.2.</p> <p>d) Steps a) through c) might require iteration to adjust within the specified tolerances.</p> <p>e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.</p> <p>f) Set detection mode to peak and trace mode to max hold.</p> <p>g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).</p> <p>h) Determine the “-xx dB down amplitude” using <math>[(\text{reference value}) - \text{xx}]</math>. Alternatively, this calculation may be made by using the marker-delta function of the instrument.</p> <p>i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).</p> <p>j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.</p> <p>k) 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).</p>

### 6.2.1 E.U.T. Operation:

Operating Environment:					
Temperature:	23.4 °C	Humidity:	44 %	Atmospheric Pressure:	101 kPa
Pre test mode:	Mode1				
Final test mode:	Mode1				

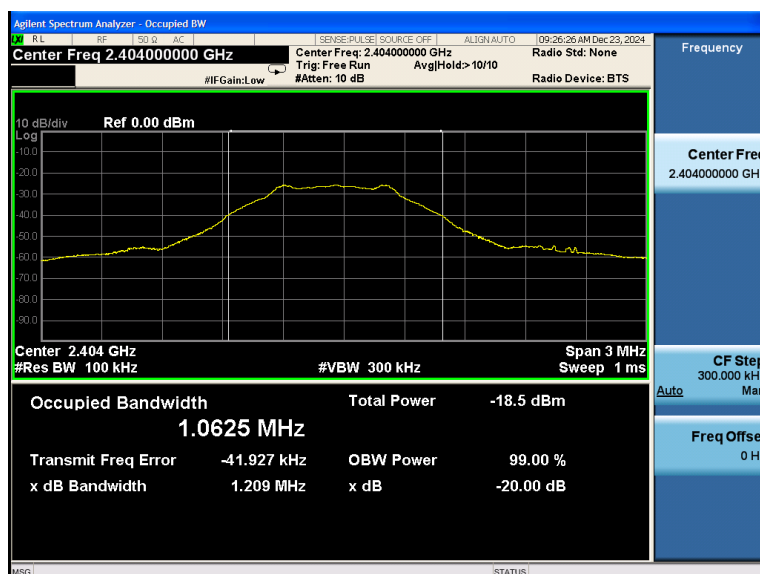
### 6.2.2 Test Setup Diagram:



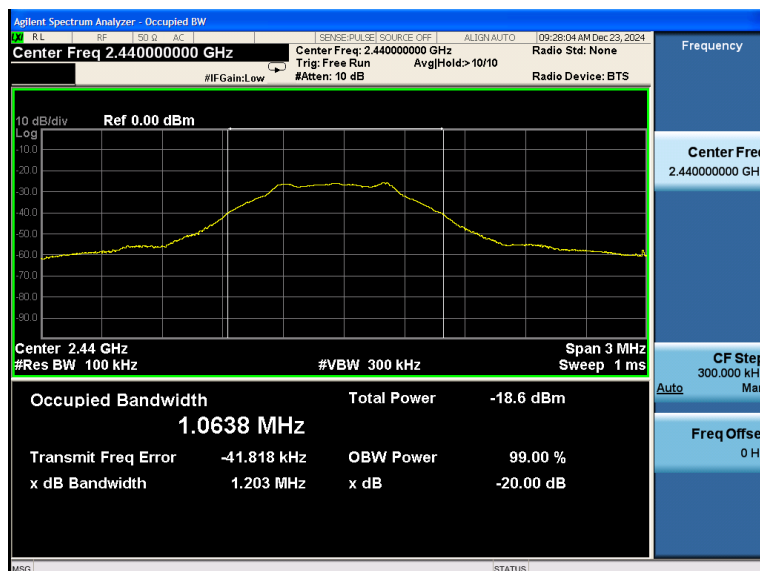
### 6.2.3 Test Data:

Test channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
CH1	2404	1.209	1.0625
CH19	2440	1.203	1.0638
CH38	2478	1.225	1.0608

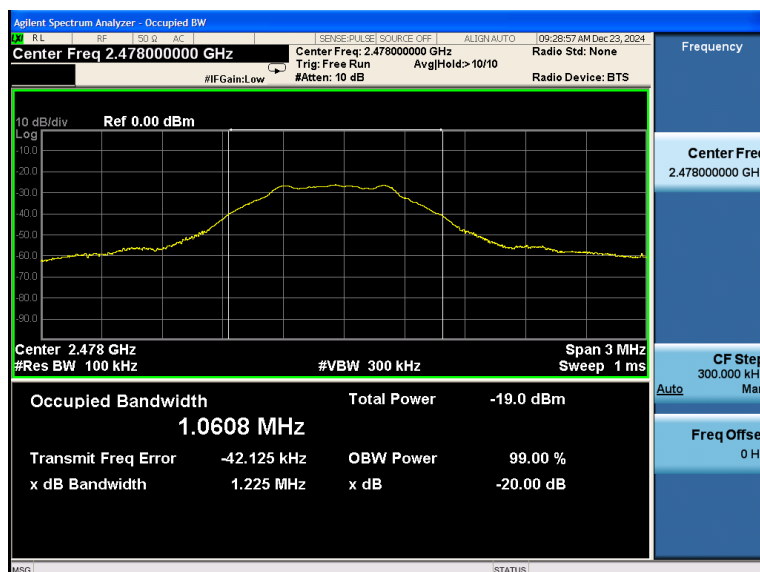
### CH1



### CH19



### CH38





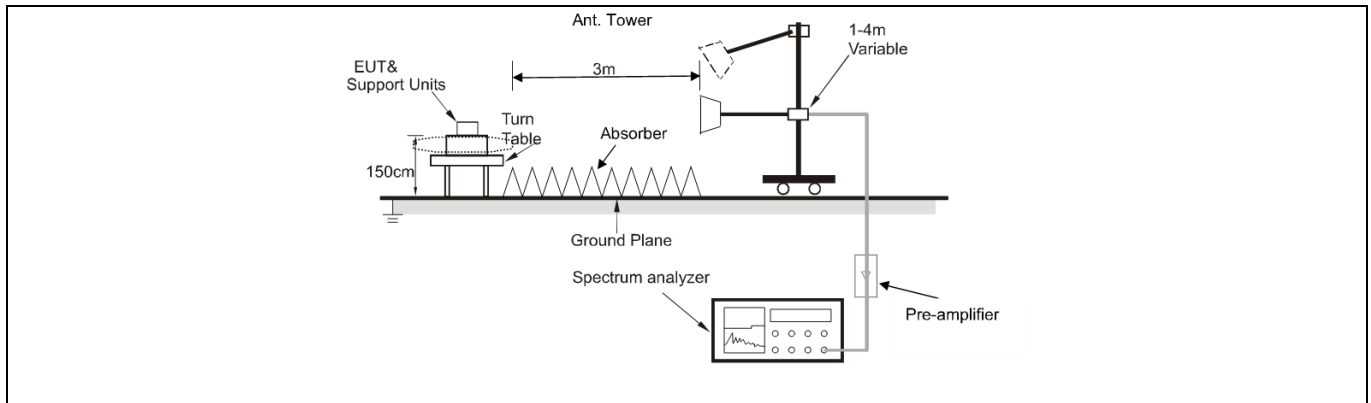
### 6.3 Field strength of fundamental

Test Requirement:	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
The field strength of emissions in this band shall not exceed 2500 millivolts/meter.			
Test Method:	ANSI C63.10-2020 section 6.6		
Procedure:	ANSI C63.10-2020 section 6.6		

#### 6.3.1 E.U.T. Operation:

Operating Environment:			
Temperature:	24.1 °C	Humidity:	32.2 %
Atmospheric Pressure:	101 kPa		
Pre test mode:	Mode1		
Final test mode:	Mode1		

#### 6.3.2 Test Setup Diagram:



**6.3.3 Test Data:**

Mode1 / Polarization: Horizontal / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2404.000	68.70	-4.27	64.43	114.00	-49.57	peak
2	*	2404.000	67.61	-4.27	63.34	94.00	-30.66	AVG

Mode1 / Polarization: Vertical / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2404.000	69.90	-4.27	65.63	114.00	-48.37	peak
2	*	2404.000	68.86	-4.27	64.59	94.00	-29.41	AVG

Mode1 / Polarization: Horizontal / CH: M

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2440.000	73.38	-4.38	69.00	114.00	-45.00	peak
2	*	2440.000	72.61	-4.38	68.23	94.00	-25.77	AVG

Mode1 / Polarization: Vertical / CH: M

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2440.000	74.25	-4.38	69.87	114.00	-44.13	peak
2	*	2440.000	73.57	-4.38	69.19	94.00	-24.81	AVG

Mode1 / Polarization: Horizontal / CH: H

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2478.000	78.36	-4.24	74.12	114.00	-39.88	peak
2	*	2478.000	77.78	-4.24	73.54	94.00	-20.46	AVG

Mode1 / Polarization: Vertical / CH: H

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2478.000	78.58	-4.24	74.34	114.00	-39.66	peak
2	*	2478.000	78.01	-4.24	73.77	94.00	-20.23	AVG

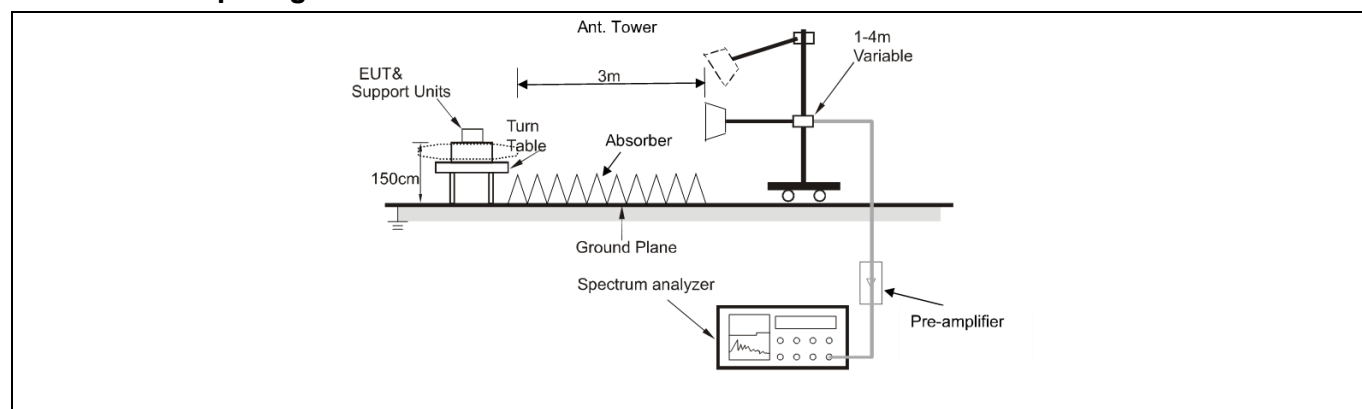
#### 6.4 Band edge emissions (Radiated)

Test Requirement:	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 Limit:	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.		
	Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
	0.009-0.490	2400/F(kHz)	300
	0.490-1.705	24000/F(kHz)	30
	1.705-30.0	30	30
	30-88	100 **	3
	88-216	150 **	3
	216-960	200 **	3
	Above 960	500	3
	<p>** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.</p> <p>In the emission table above, the tighter limit applies at the band edges. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.</p>		
Test Method:	ANSI C63.10-2020 section 6.6.4		
Procedure:	ANSI C63.10-2020 section 6.6.4		

### 6.4.1 E.U.T. Operation:

Operating Environment:					
Temperature:	25 °C	Humidity:	56 %	Atmospheric Pressure:	101 kPa
Pre test mode:	Mode1				
Final test mode:	Mode1				

#### 6.4.2 Test Setup Diagram:



**6.4.3 Test Data:**

Mode1 / Polarization: Horizontal / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2310.000	48.14	-4.83	43.31	74.00	-30.69	peak
2		2310.000	37.60	-4.83	32.77	54.00	-21.23	AVG
3		2390.000	47.14	-4.31	42.83	74.00	-31.17	peak
4		2390.000	37.57	-4.31	33.26	54.00	-20.74	AVG
5		2400.000	47.02	-4.25	42.77	74.00	-31.23	peak
6	*	2400.000	37.59	-4.25	33.34	54.00	-20.66	AVG

Mode1 / Polarization: Vertical / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2310.000	47.87	-4.83	43.04	74.00	-30.96	peak
2		2310.000	37.57	-4.83	32.74	54.00	-21.26	AVG
3		2390.000	47.29	-4.31	42.98	74.00	-31.02	peak
4		2390.000	37.76	-4.31	33.45	54.00	-20.55	AVG
5		2400.000	48.32	-4.25	44.07	74.00	-29.93	peak
6	*	2400.000	37.75	-4.25	33.50	54.00	-20.50	AVG

Mode1 / Polarization: Horizontal / CH: H

No. Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	2483.500	50.48	-4.21	46.27	74.00	-27.73	peak
2	2483.500	37.79	-4.21	33.58	54.00	-20.42	AVG
3	2500.000	46.89	-4.10	42.79	74.00	-31.21	peak
4 *	2500.000	37.79	-4.10	33.69	54.00	-20.31	AVG

Mode1 / Polarization: Vertical / CH: H

No. Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	2483.500	50.17	-4.21	45.96	74.00	-28.04	peak
2	2483.500	37.68	-4.21	33.47	54.00	-20.53	AVG
3	2500.000	47.54	-4.10	43.44	74.00	-30.56	peak
4 *	2500.000	37.87	-4.10	33.77	54.00	-20.23	AVG

## 6.5 Emissions in frequency bands (below 1GHz)

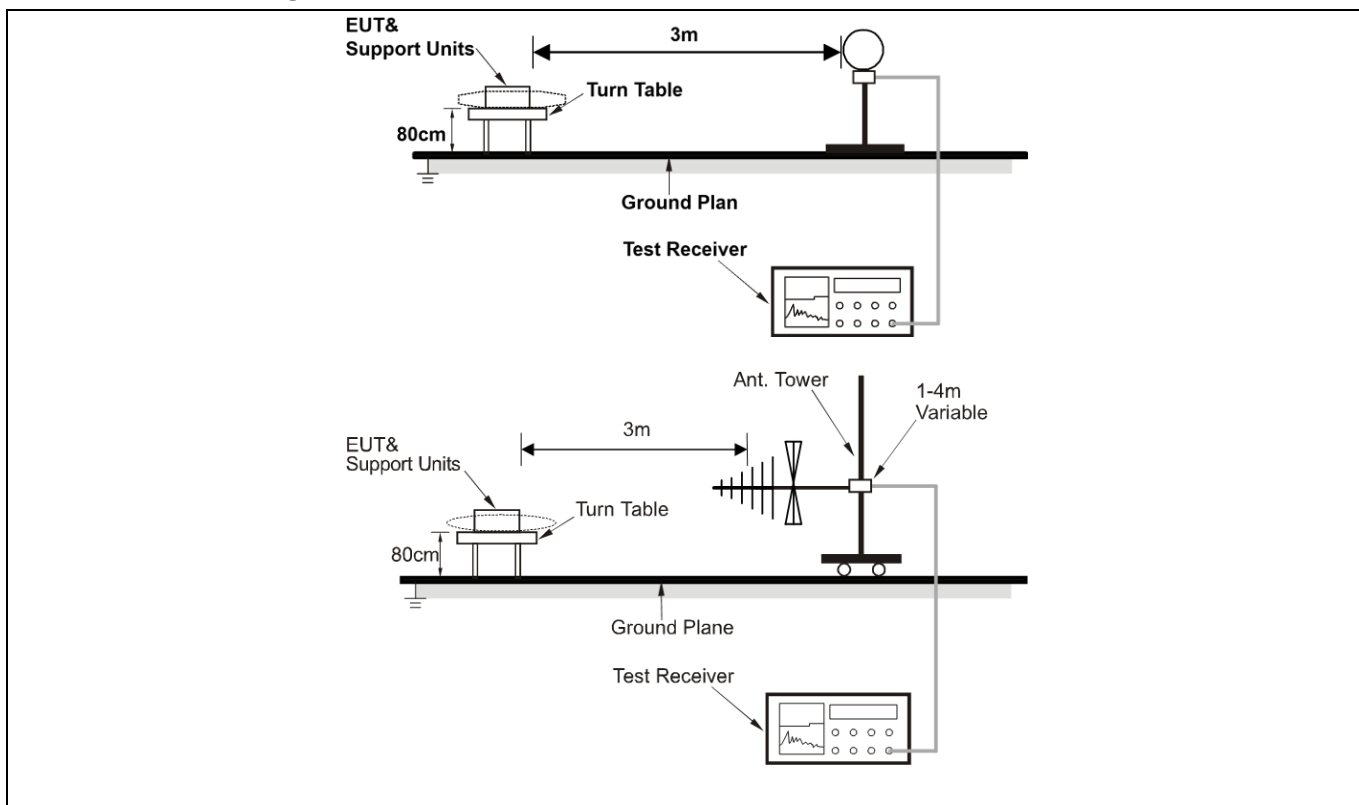
Test Requirement:	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)																																									
Test Limit:	<p>Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:</p> <table><tr><th>Fundamental frequency</th><th>Field strength of fundamental (millivolts/meter)</th><th>Field strength of harmonics (microvolts/meter)</th></tr><tr><td>902-928 MHz</td><td>50</td><td>500</td></tr><tr><td>2400-2483.5 MHz</td><td>50</td><td>500</td></tr><tr><td>5725-5875 MHz</td><td>50</td><td>500</td></tr><tr><td>24.0-24.25 GHz</td><td>250</td><td>2500</td></tr></table> <p>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.</p> <table><tr><th>Frequency (MHz)</th><th>Field strength (microvolts/meter)</th><th>Measurement distance (meters)</th></tr><tr><td>0.009-0.490</td><td>2400/F(kHz)</td><td>300</td></tr><tr><td>0.490-1.705</td><td>24000/F(kHz)</td><td>30</td></tr><tr><td>1.705-30.0</td><td>30</td><td>30</td></tr><tr><td>30-88</td><td>100 **</td><td>3</td></tr><tr><td>88-216</td><td>150 **</td><td>3</td></tr><tr><td>216-960</td><td>200 **</td><td>3</td></tr><tr><td>Above 960</td><td>500</td><td>3</td></tr></table> <p>** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.</p> <p>In the emission table above, the tighter limit applies at the band edges. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.</p>			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	Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	0.009-0.490	2400/F(kHz)	300	0.490-1.705	24000/F(kHz)	30	1.705-30.0	30	30	30-88	100 **	3	88-216	150 **	3	216-960	200 **	3	Above 960	500	3
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																																								
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)																																								
0.009-0.490	2400/F(kHz)	300																																								
0.490-1.705	24000/F(kHz)	30																																								
1.705-30.0	30	30																																								
30-88	100 **	3																																								
88-216	150 **	3																																								
216-960	200 **	3																																								
Above 960	500	3																																								
Test Method:	ANSI C63.10-2020 section 6.5																																									
Procedure:	ANSI C63.10-2020 section 6.5																																									

### 6.5.1 E.U.T. Operation:

Operating Environment:					
Temperature:	25 °C	Humidity:	56 %	Atmospheric Pressure:	101 kPa

Pre test mode:	Mode1
Final test mode:	Mode1

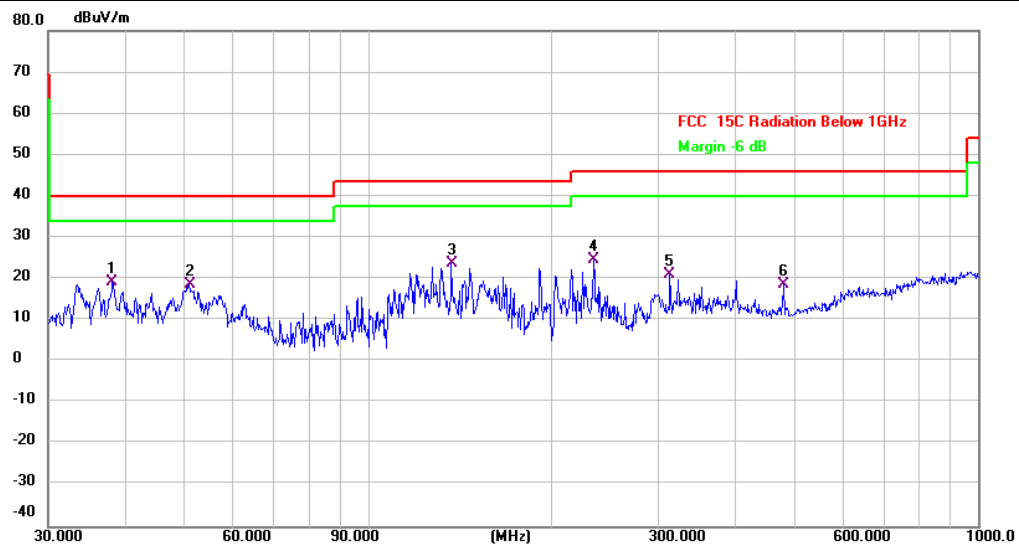
### 6.5.2 Test Setup Diagram:





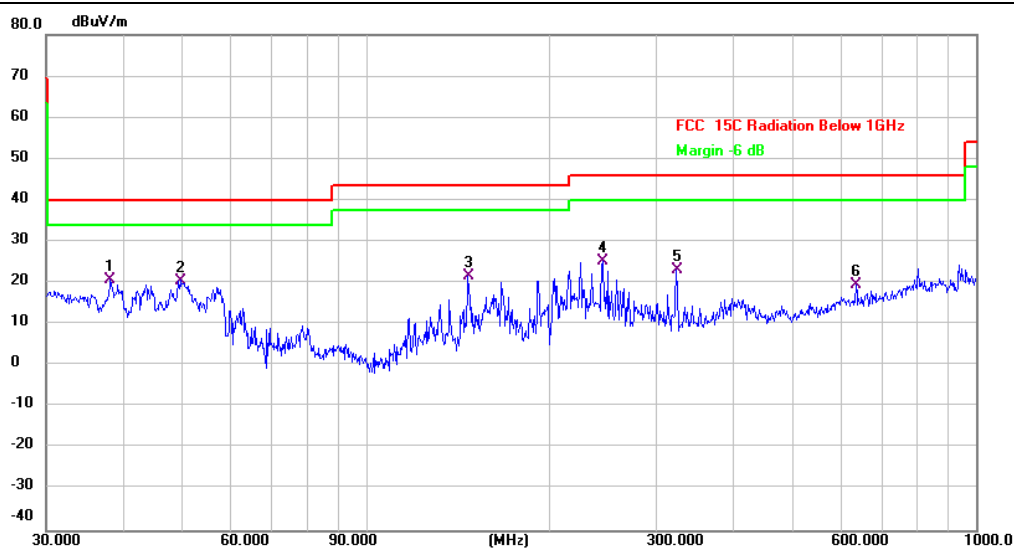
### 6.5.3 Test Data:

Mode1 / Polarization: Horizontal / CH: H



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		38.2120	33.43	-14.13	19.30	40.00	-20.70	QP	
2		50.9420	34.38	-15.61	18.77	40.00	-21.23	QP	
3	*	136.9391	46.19	-22.36	23.83	43.50	-19.67	QP	
4		234.9909	39.13	-14.57	24.56	46.00	-21.44	QP	
5		313.2760	37.71	-16.65	21.06	46.00	-24.94	QP	
6		480.5276	32.92	-14.28	18.64	46.00	-27.36	QP	

Mode1 / Polarization: Vertical / CH: H



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	38.2120	45.91	-25.28	20.63	40.00	-19.37	QP	
2		49.7068	42.89	-22.29	20.60	40.00	-19.40	QP	
3		146.8877	37.25	-15.68	21.57	43.50	-21.93	QP	
4		245.0900	43.94	-18.62	25.32	46.00	-20.68	QP	
5		323.3204	37.37	-14.25	23.12	46.00	-22.88	QP	
6		636.1340	31.13	-11.53	19.60	46.00	-26.40	QP	

## 6.6 Emissions in frequency bands (above 1GHz)

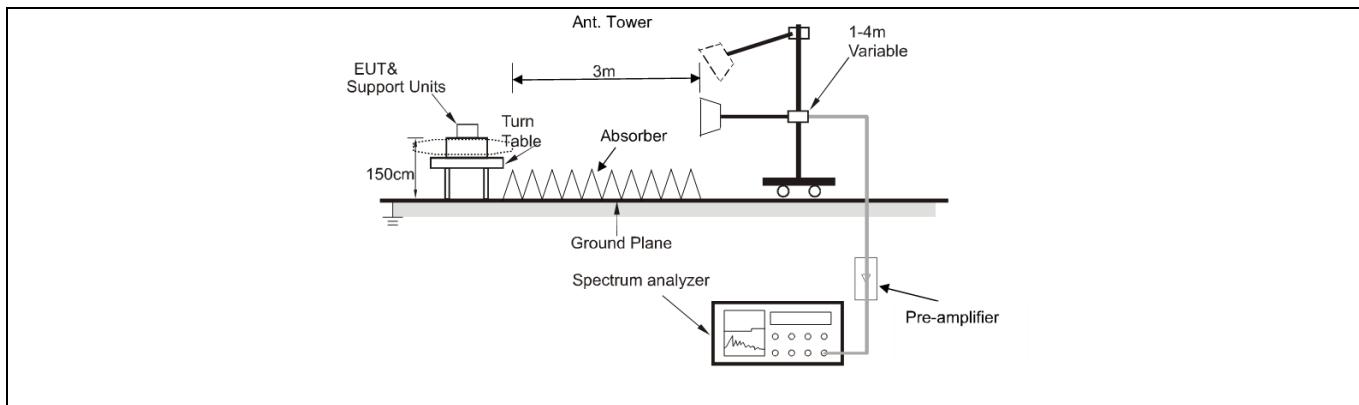
Test Requirement:	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)																																									
Test Limit:	<p>Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:</p> <table><tr><th>Fundamental frequency</th><th>Field strength of fundamental (millivolts/meter)</th><th>Field strength of harmonics (microvolts/meter)</th></tr><tr><td>902-928 MHz</td><td>50</td><td>500</td></tr><tr><td>2400-2483.5 MHz</td><td>50</td><td>500</td></tr><tr><td>5725-5875 MHz</td><td>50</td><td>500</td></tr><tr><td>24.0-24.25 GHz</td><td>250</td><td>2500</td></tr></table> <p>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.</p> <table><tr><th>Frequency (MHz)</th><th>Field strength (microvolts/meter)</th><th>Measurement distance (meters)</th></tr><tr><td>0.009-0.490</td><td>2400/F(kHz)</td><td>300</td></tr><tr><td>0.490-1.705</td><td>24000/F(kHz)</td><td>30</td></tr><tr><td>1.705-30.0</td><td>30</td><td>30</td></tr><tr><td>30-88</td><td>100 **</td><td>3</td></tr><tr><td>88-216</td><td>150 **</td><td>3</td></tr><tr><td>216-960</td><td>200 **</td><td>3</td></tr><tr><td>Above 960</td><td>500</td><td>3</td></tr></table> <p>** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.</p> <p>In the emission table above, the tighter limit applies at the band edges. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.</p>			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	Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	0.009-0.490	2400/F(kHz)	300	0.490-1.705	24000/F(kHz)	30	1.705-30.0	30	30	30-88	100 **	3	88-216	150 **	3	216-960	200 **	3	Above 960	500	3
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																																								
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)																																								
0.009-0.490	2400/F(kHz)	300																																								
0.490-1.705	24000/F(kHz)	30																																								
1.705-30.0	30	30																																								
30-88	100 **	3																																								
88-216	150 **	3																																								
216-960	200 **	3																																								
Above 960	500	3																																								
Test Method:	ANSI C63.10-2020 section 6.6																																									
Procedure:	ANSI C63.10-2020 section 6.6																																									

### 6.6.1 E.U.T. Operation:

Operating Environment:					
Temperature:	25 °C	Humidity:	56 %	Atmospheric Pressure:	101 kPa

Pre test mode:	Mode1
Final test mode:	Mode1

### 6.6.2 Test Setup Diagram:



**6.6.3 Test Data:**

Mode1 / Polarization: Horizontal / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4808.000	42.95	0.53	43.48	74.00	-30.52	peak
2		4808.000	37.03	0.53	37.56	54.00	-16.44	AVG
3		7212.000	44.99	7.84	52.83	74.00	-21.17	peak
4		7212.000	38.73	7.84	46.57	54.00	-7.43	AVG
5		9616.000	45.06	8.88	53.94	74.00	-20.06	peak
6	*	9616.000	38.71	8.88	47.59	54.00	-6.41	AVG

Mode1 / Polarization: Vertical / CH: L

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4808.000	43.04	0.53	43.57	74.00	-30.43	peak
2		4808.000	36.73	0.53	37.26	54.00	-16.74	AVG
3		7212.000	45.05	7.84	52.89	74.00	-21.11	peak
4		7212.000	38.70	7.84	46.54	54.00	-7.46	AVG
5		9616.000	44.90	8.88	53.78	74.00	-20.22	peak
6	*	9616.000	38.81	8.88	47.69	54.00	-6.31	AVG

Mode1 / Polarization: Horizontal / CH: M

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4880.000	43.60	0.56	44.16	74.00	-29.84	peak
2		4880.000	38.06	0.56	38.62	54.00	-15.38	AVG
3		7320.000	46.52	7.54	54.06	74.00	-19.94	peak
4		7320.000	40.58	7.54	48.12	54.00	-5.88	AVG
5		9760.000	44.86	9.33	54.19	74.00	-19.81	peak
6	*	9760.000	39.05	9.33	48.38	54.00	-5.62	AVG

Mode1 / Polarization: Vertical / CH: M

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4880.000	44.42	0.56	44.98	74.00	-29.02	peak
2		4880.000	38.00	0.56	38.56	54.00	-15.44	AVG
3		7320.000	44.70	7.54	52.24	74.00	-21.76	peak
4		7320.000	39.03	7.54	46.57	54.00	-7.43	AVG
5		9760.000	45.18	9.33	54.51	74.00	-19.49	peak
6	*	9760.000	39.16	9.33	48.49	54.00	-5.51	AVG

Mode1 / Polarization: Horizontal / CH: H

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4956.0000	44.04	0.63	44.67	74	-29.33	peak
2		4956.0000	37.6	0.63	38.23	54	-15.77	AVG
3		7434.0000	45.54	7.95	53.49	74	-20.51	peak
4		7434.0000	39.74	7.95	47.69	54	-6.31	AVG
5		9912.0000	44.23	9.67	53.9	74	-20.1	peak
6		9912.0000	38.15	9.67	47.82	54	-6.18	AVG

Mode1 / Polarization: Vertical / CH: H

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4956.0000	44.22	0.63	44.85	74	-29.15	peak
2		4956.0000	37.91	0.63	38.54	54	-15.46	AVG
3		7434.0000	44.73	7.95	52.68	74	-21.32	peak
4		7434.0000	38.65	7.95	46.6	54	-7.4	AVG
5		9912.0000	44.42	9.67	54.09	74	-19.91	peak
6		9912.0000	38.54	9.67	48.21	54	-5.79	AVG

## Photographs of the test setup

Refer to Appendix - Test Setup Photos



## Photographs of the EUT

Refer to Appendix - EUT Photos

**----End of Report----**