

Test Report

Report No.: MTi240220005-07E2
Date of issue: 2024-03-26
Applicant: ShenZhen ZhiHaiHe Tech Co.,Ltd
Product: Varmilo Mechanical Keyboard
Model(s): VPT108, VPT109, VPT113
FCC ID: 2AF8O-VPT108

Shenzhen Microtest Co., Ltd.

<http://www.mtitest.com>

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Test Result Certification	
Applicant:	ShenZhen ZhiHaiHe Tech Co.,Ltd
Address:	Unit B, 2nd Floor, Block 3, 10th Industrial Zone, Tian Liao Community, Gong Ming Area, Guang Ming New District, Shen Zhen, China.
Manufacturer:	ShenZhen ZhiHaiHe Tech Co.,Ltd
Address:	Unit B, 2nd Floor, Block 3, 10th Industrial Zone, Tian Liao Community, Gong Ming Area, Guang Ming New District, Shen Zhen, China.
Product description	
Product name:	Varmilo Mechanical Keyboard
Trademark:	Varmilo
Model name:	VPT108
Series Model(s):	VPT109, VPT113
Standards:	47 CFR Part 15.249
Test Method:	ANSI C63.10-2013
Date of Test	
Date of test:	2024-03-19 to 2024-03-26
Test result:	Pass

Test Engineer	:	<i>Letter Lan.</i>
		(Letter Lan)
Reviewed By	:	<i>Leon Chen</i>
		(Leon Chen)
Approved By	:	<i>Tom Xue</i>
		(Tom Xue)

1 General Description

1.1 Description of the EUT

Product name:	Varmilo Mechanical Keyboard
Model name:	VPT108
Series Model(s):	VPT109, VPT113
Model difference:	All the models are the same circuit and module, except the model name.
Electrical rating:	Input: 5V/500mA Battery: 3.7V/2500mAh
Accessories:	Cable: Cable: USB-A to USB-C cable 1.8m Dongle*1
Hardware version:	VPT109-V1.1(H)
Software version:	KB01_VPT108_VPT109_3M_V20240126_1633
Test sample(s) number:	MTi240220005-07S1001
RF specification	
Operating frequency range:	2404MHz to 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

1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2404	10	2424	20	2444	30	2464
1	2406	11	2426	21	2446	31	2466
2	2408	12	2428	22	2448	32	2468
3	2410	13	2430	23	2450	33	2470
4	2412	14	2432	24	2452	34	2472
5	2414	15	2434	25	2454	35	2474
6	2416	16	2436	26	2456	36	2476
7	2418	17	2438	27	2458	37	2478
8	2420	18	2440	28	2460	/	/
9	2422	19	2442	29	2462	/	/

Test Channel List

Operation Band: 2.4G

Bandwidth (MHz)	Lowest Channel (LCH) (MHz)	Middle Channel (MCH) (MHz)	Highest Channel (HCH) (MHz)
1	2404	2452	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: RF Test

For power setting, refer to below table.

Mode	2404MHz	2452MHz	2478MHz
1M	-8	-8	-8

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:	98 kPa ~ 101 kPa

1.4 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
/	/	/	/
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	2023-04-26	2024-04-25
2	Artificial mains network	Schwarzbeck	NSLK 8127	183	2023-05-05	2024-05-04
3	Artificial Mains Network	Rohde & Schwarz	ESH2-Z5	100263	2023-06-03	2024-06-02
Occupied Bandwidth Band edge emissions (Radiated)						
Emissions in frequency bands (below 1GHz)						
1	EMI Test Receiver	Rohde&schwarz	ESCI7	101166	2023-04-26	2024-04-25
2	TRILOG Broadband Antenna	schwarabeck	VULB 9163	9163-1338	2023-06-11	2025-06-10
3	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00066	2023-06-11	2025-06-10
4	Amplifier	Hewlett-Packard	8447F	3113A06184	2023-04-25	2024-04-24
5	Multi-device Controller	TuoPu	TPMDC	/	2023-05-04	2024-05-03
Emissions in frequency bands (above 1GHz)						
1	EMI Test Receiver	Rohde&schwarz	ESCI7	101166	2023-04-26	2024-04-25
2	Double Ridged Broadband Horn Antenna	schwarabeck	BBHA 9120 D	2278	2023-06-17	2025-06-16
3	Amplifier	Agilent	8449B	3008A01120	2023-06-26	2024-06-25
4	Multi-device Controller	TuoPu	TPMDC	/	2023-05-04	2024-05-03
5	MXA signal analyzer	Agilent	N9020A	MY54440859	2023-06-01	2024-05-31

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)

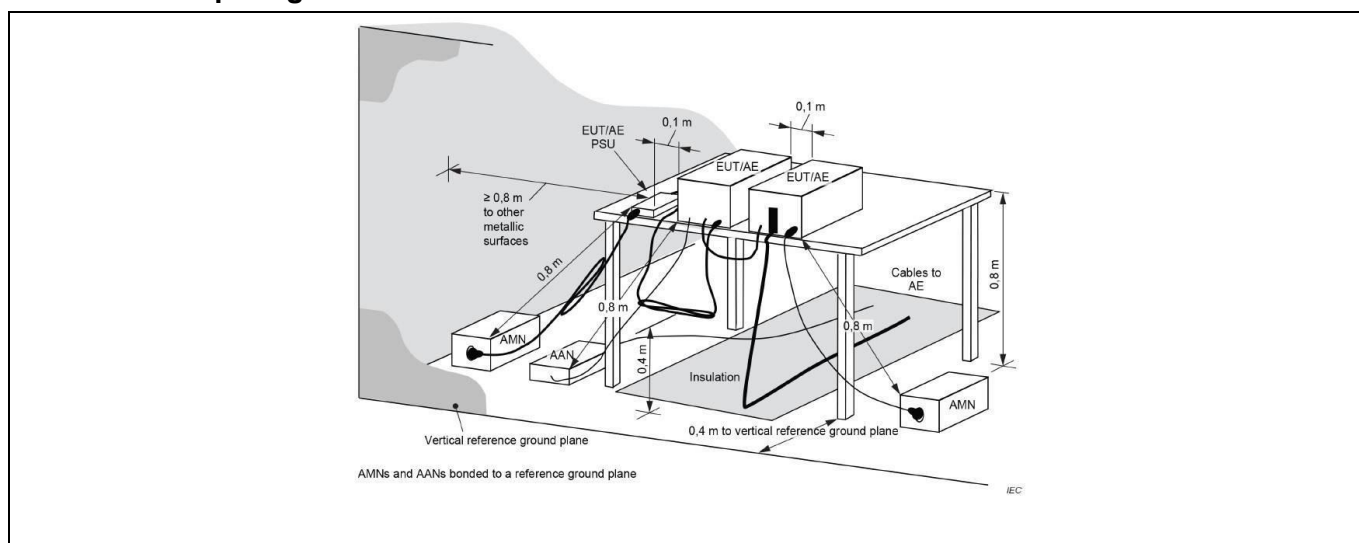
6.1 Conducted Emission at AC power line

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 μ H/50 ohms line impedance stabilization network (LISN).		
Test Limit:	Frequency of emission (MHz)	Conducted limit (dB μ 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 C63.10-2013 section 6.2		
Procedure:	Refer to ANSI C63.10-2013 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices		

6.1.1 E.U.T. Operation:

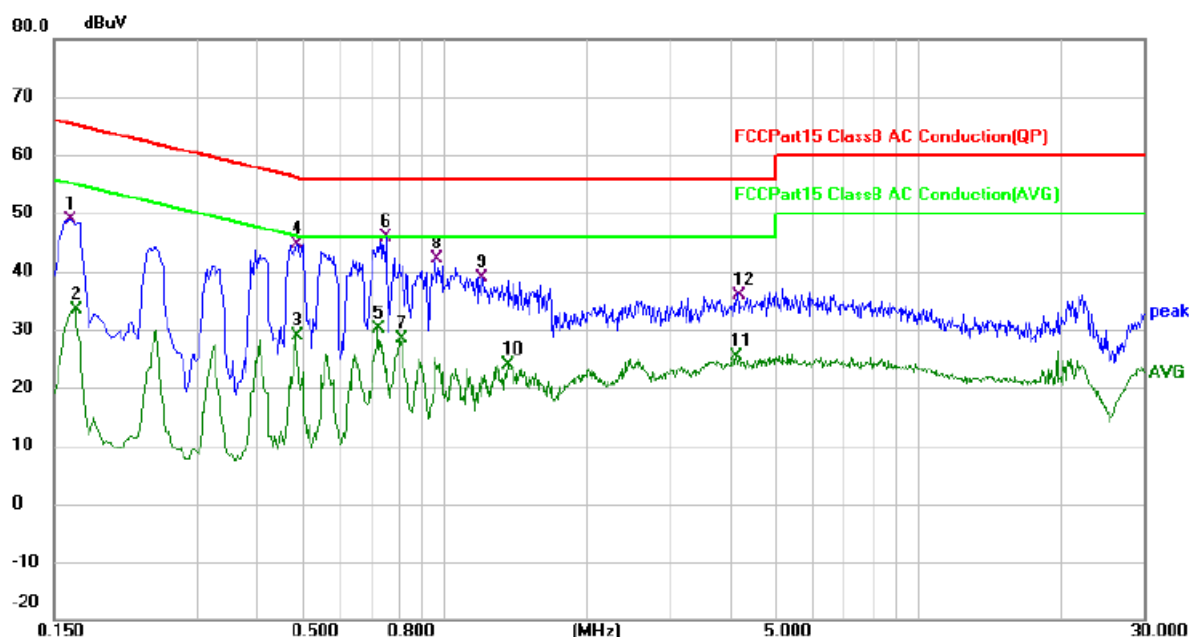
Operating Environment:					
Temperature:	16.5 °C	Humidity:	40.5 %	Atmospheric Pressure:	99 kPa
Pre test mode:	Mode1				
Final test mode:	Mode1				

6.1.2 Test Setup Diagram:



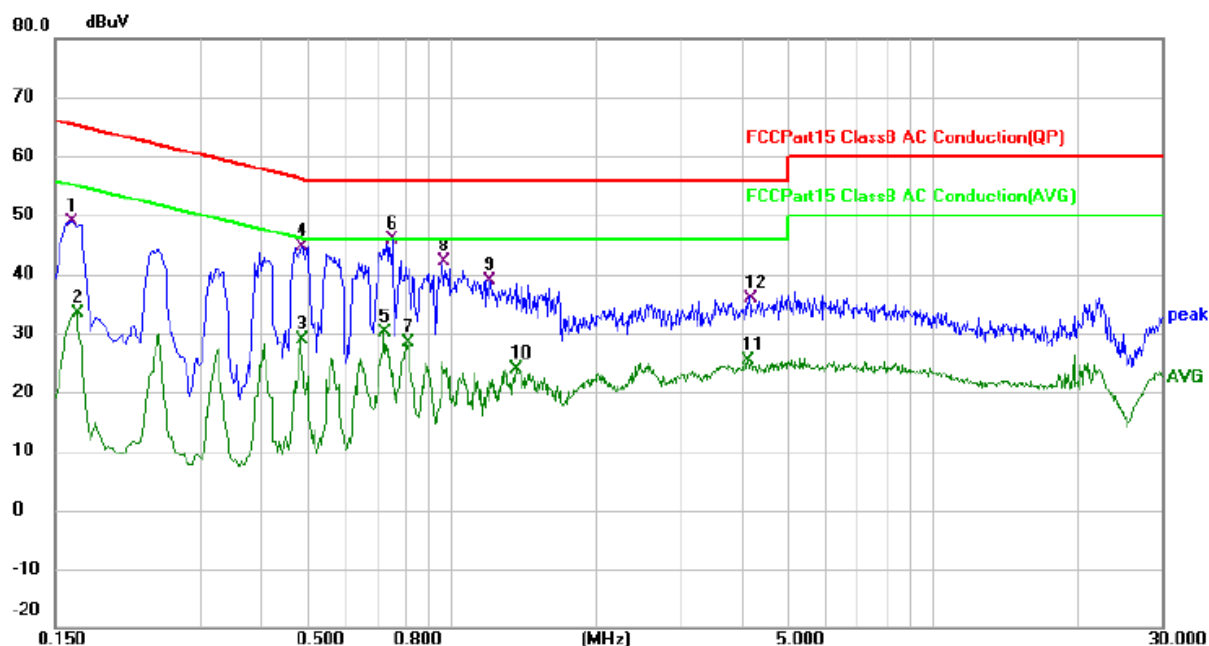
6.1.3 Test Data:

Mode1 / Line: Line



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over		
		MHz	Level	Factor	ment			Detector	Comment
			dBuV		dBuV	dBuV	dB		
1		0.1620	38.48	10.38	48.86	65.36	-16.50	QP	
2		0.1660	22.97	10.38	33.35	55.16	-21.81	AVG	
3		0.4860	17.50	11.49	28.99	46.24	-17.25	AVG	
4		0.4900	33.20	11.49	44.69	56.17	-11.48	QP	
5		0.7260	17.99	12.02	30.01	46.00	-15.99	AVG	
6	*	0.7580	33.73	12.09	45.82	56.00	-10.18	QP	
7		0.8139	16.09	12.20	28.29	46.00	-17.71	AVG	
8		0.9620	29.69	12.53	42.22	56.00	-13.78	QP	
9		1.2020	25.85	13.02	38.87	56.00	-17.13	QP	
10		1.3619	10.61	13.35	23.96	46.00	-22.04	AVG	
11		4.1500	14.77	10.64	25.41	46.00	-20.59	AVG	
12		4.1740	25.36	10.64	36.00	56.00	-20.00	QP	

Mode1 / Line: Neutral



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1620	38.48	10.38	48.86	65.36	-16.50	QP	
2		0.1660	22.97	10.38	33.35	55.16	-21.81	AVG	
3		0.4860	17.50	11.49	28.99	46.24	-17.25	AVG	
4		0.4900	33.20	11.49	44.69	56.17	-11.48	QP	
5		0.7260	17.99	12.02	30.01	46.00	-15.99	AVG	
6	*	0.7580	33.73	12.09	45.82	56.00	-10.18	QP	
7		0.8139	16.09	12.20	28.29	46.00	-17.71	AVG	
8		0.9620	29.69	12.53	42.22	56.00	-13.78	QP	
9		1.2020	25.85	13.02	38.87	56.00	-17.13	QP	
10		1.3619	10.61	13.35	23.96	46.00	-22.04	AVG	
11		4.1500	14.77	10.64	25.41	46.00	-20.59	AVG	
12		4.1740	25.36	10.64	36.00	56.00	-20.00	QP	

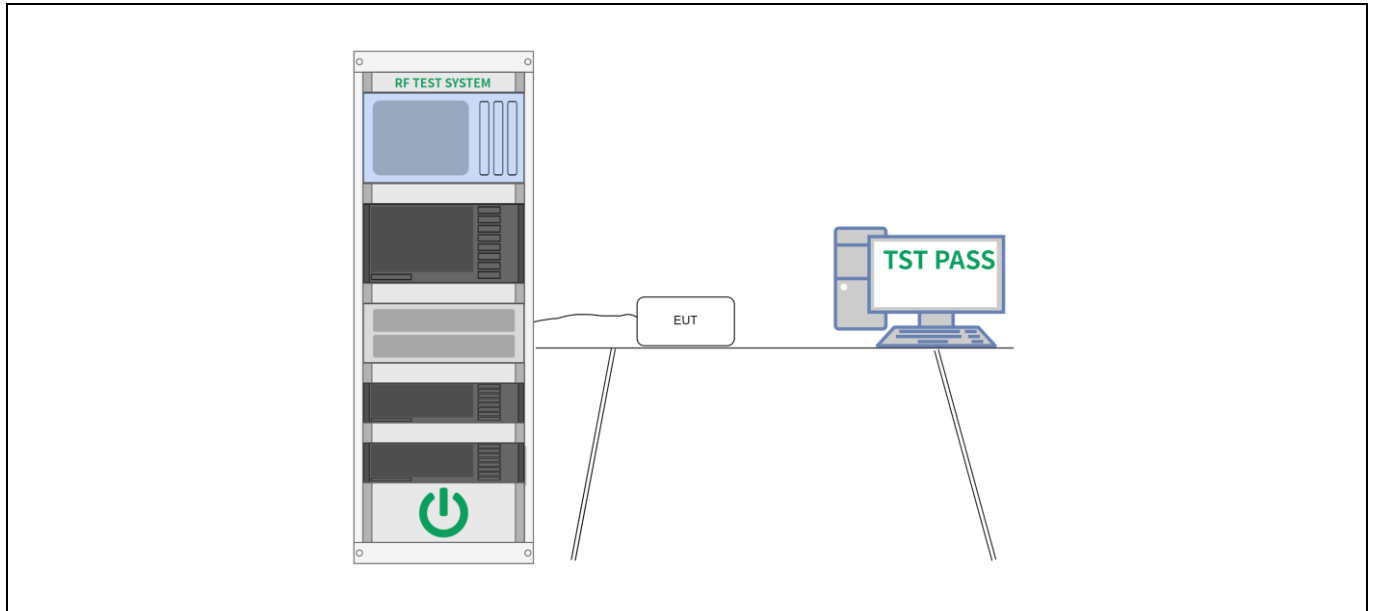
6.2 Occupied Bandwidth

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 C63.10-2013, 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 $[10 \log (OBW/RBW)]$ 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 $[(\text{reference value}) - \text{xx}]$. 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:	25 °C	Humidity:	59 %	Atmospheric Pressure:	98 kPa
Pre test mode:	Mode1				
Final test mode:	Mode1				

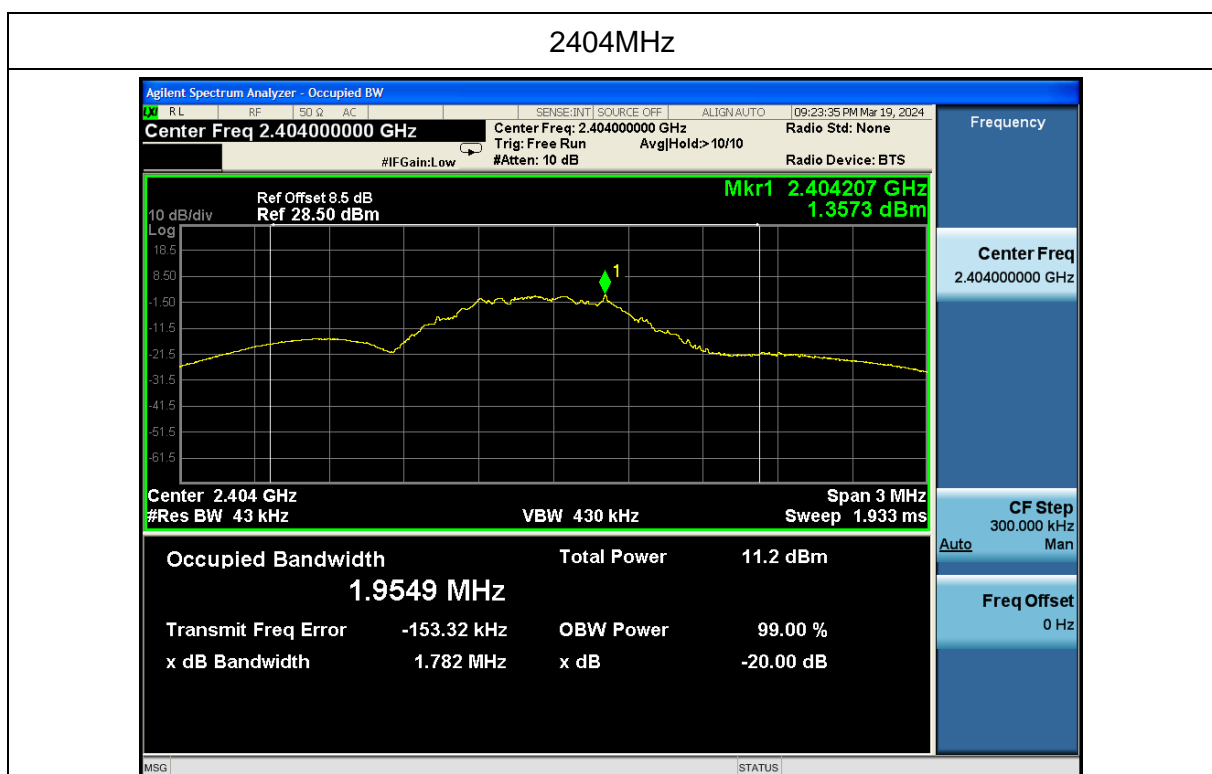
6.2.2 Test Setup Diagram:



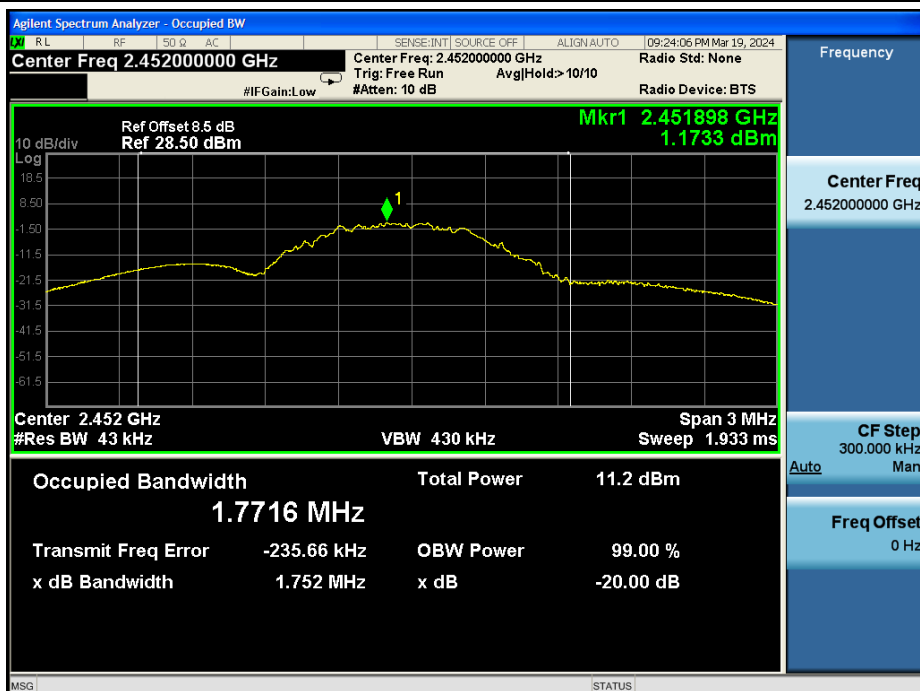
6.2.3 Test Data:

Frequency (MHz)	20dB bandwidth (MHz)	99% bandwidth (MHz)
2404	1.782	1.9549
2452	1.752	1.7716
2478	1.765	1.6919

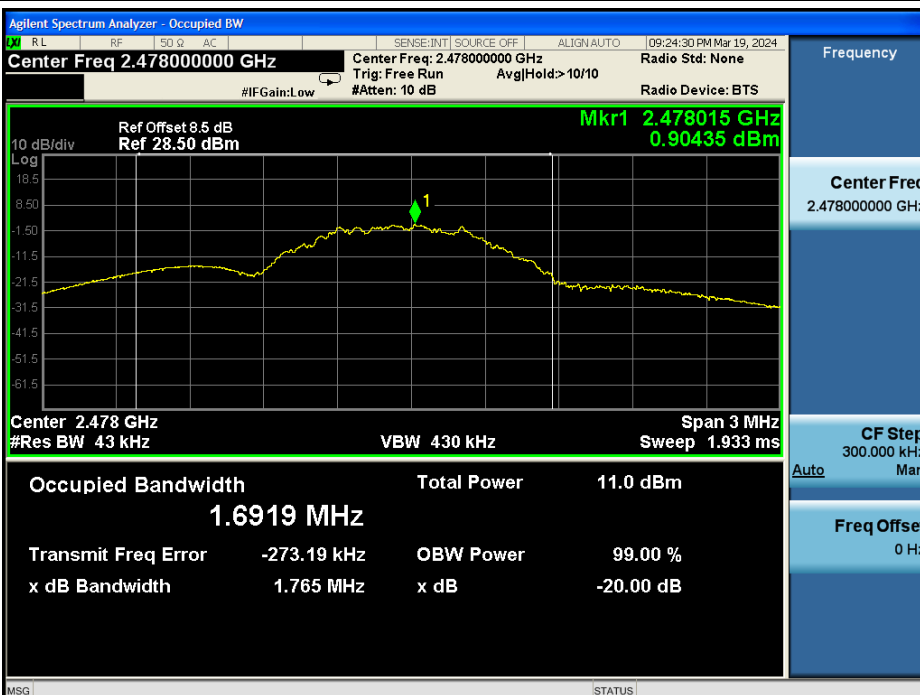
Test plots



2452MHz



2478MHz



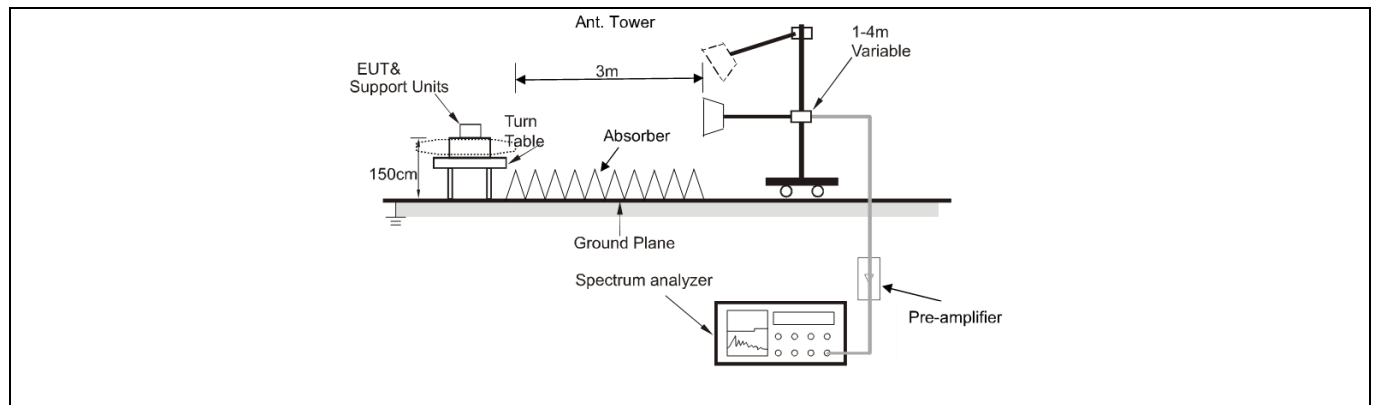
6.3 Field strength of fundamental

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 C63.10-2013 section 6.6		
Procedure:	ANSI C63.10-2013 section 6.6		

6.3.1 E.U.T. Operation:

Operating Environment:			
Temperature:	16.5 °C	Humidity:	40.5 %
Atmospheric Pressure:	99 kPa		
Pre test mode:	Mode1		
Final test mode:	Mode1		

6.3.2 Test Setup Diagram:



6.3.3 Test Data:
Field strength of fundamental

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dB μ V/m	dB μ V/m		
2404	H	77.66	114	PK	PASS
2404	H	76.91	94	AV	PASS
2404	V	77	114	PK	PASS
2404	V	76.42	94	AV	PASS

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dB μ V/m	dB μ V/m		
2452	H	72.65	114	PK	PASS
2452	H	71.24	94	AV	PASS
2452	V	73.21	114	PK	PASS
2452	V	71.65	94	AV	PASS

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dB μ V/m	dB μ V/m		
2478	H	73.91	114	PK	PASS
2478	H	73.38	94	AV	PASS
2478	V	73.67	114	PK	PASS
2478	V	73.14	94	AV	PASS

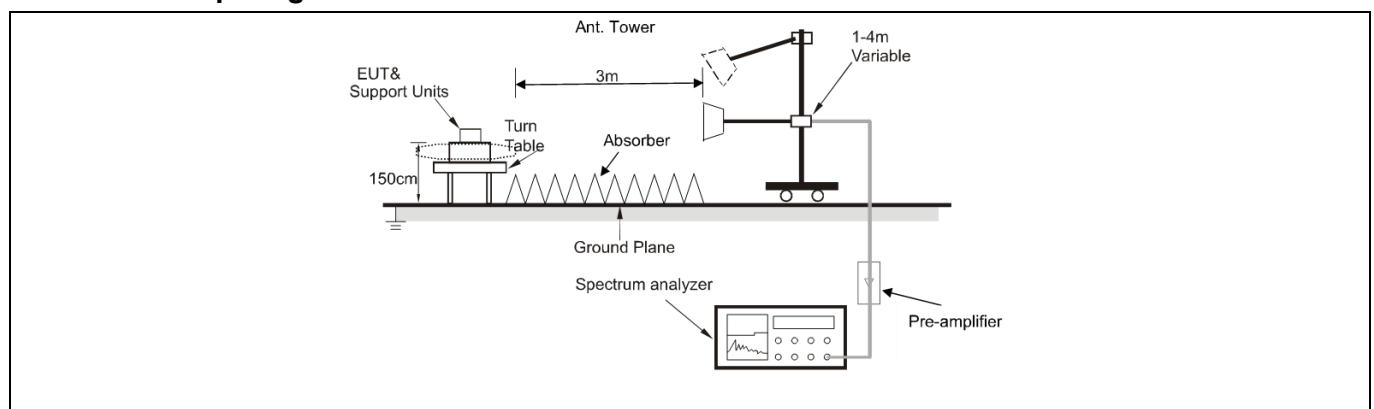
6.4 Band edge emissions (Radiated)

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:	<div>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.</div> <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> <div>** 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. 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.</div>			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
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 C63.10-2013 section 6.6.4																										
Procedure:	ANSI C63.10-2013 section 6.6.4																										

6.4.1 E.U.T. Operation:

Operating Environment:					
Temperature:	34.2 °C	Humidity:	67.3 %	Atmospheric Pressure:	99 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	Measure- ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2310.000	52.44	-12.83	39.61	74.00	-34.39	peak
2	*	2310.000	42.61	-12.83	29.78	54.00	-24.22	AVG
3		2390.000	56.89	-12.42	44.47	74.00	-29.53	peak
4		2390.000	41.73	-12.42	29.31	54.00	-24.69	AVG
5		2400.000	60.68	-12.37	48.31	74.00	-25.69	peak
6		2400.000	41.79	-12.37	29.42	54.00	-24.58	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		2310.000	52.05	-12.83	39.22	74.00	-34.78	peak
2	*	2310.000	42.44	-12.83	29.61	54.00	-24.39	AVG
3		2390.000	56.17	-12.42	43.75	74.00	-30.25	peak
4		2390.000	41.58	-12.42	29.16	54.00	-24.84	AVG
5		2400.000	58.33	-12.37	45.96	74.00	-28.04	peak
6		2400.000	41.28	-12.37	28.91	54.00	-25.09	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		2310.000	52.44	-12.83	39.61	74.00	-34.39	peak
2	*	2310.000	42.61	-12.83	29.78	54.00	-24.22	AVG
3		2390.000	56.89	-12.42	44.47	74.00	-29.53	peak
4		2390.000	41.73	-12.42	29.31	54.00	-24.69	AVG
5		2400.000	60.68	-12.37	48.31	74.00	-25.69	peak
6		2400.000	41.79	-12.37	29.42	54.00	-24.58	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	86.13	-12.46	73.67	114.00	-40.33	peak
2	*	2478.000	85.60	-12.46	73.14	94.00	-20.86	AVG
3		2483.500	57.06	-12.44	44.62	74.00	-29.38	peak
4		2483.500	41.60	-12.44	29.16	54.00	-24.84	AVG
5		2500.000	51.95	-12.35	39.60	74.00	-34.40	peak
6		2500.000	42.07	-12.35	29.72	54.00	-24.28	AVG

6.5 Emissions in frequency bands (below 1GHz)

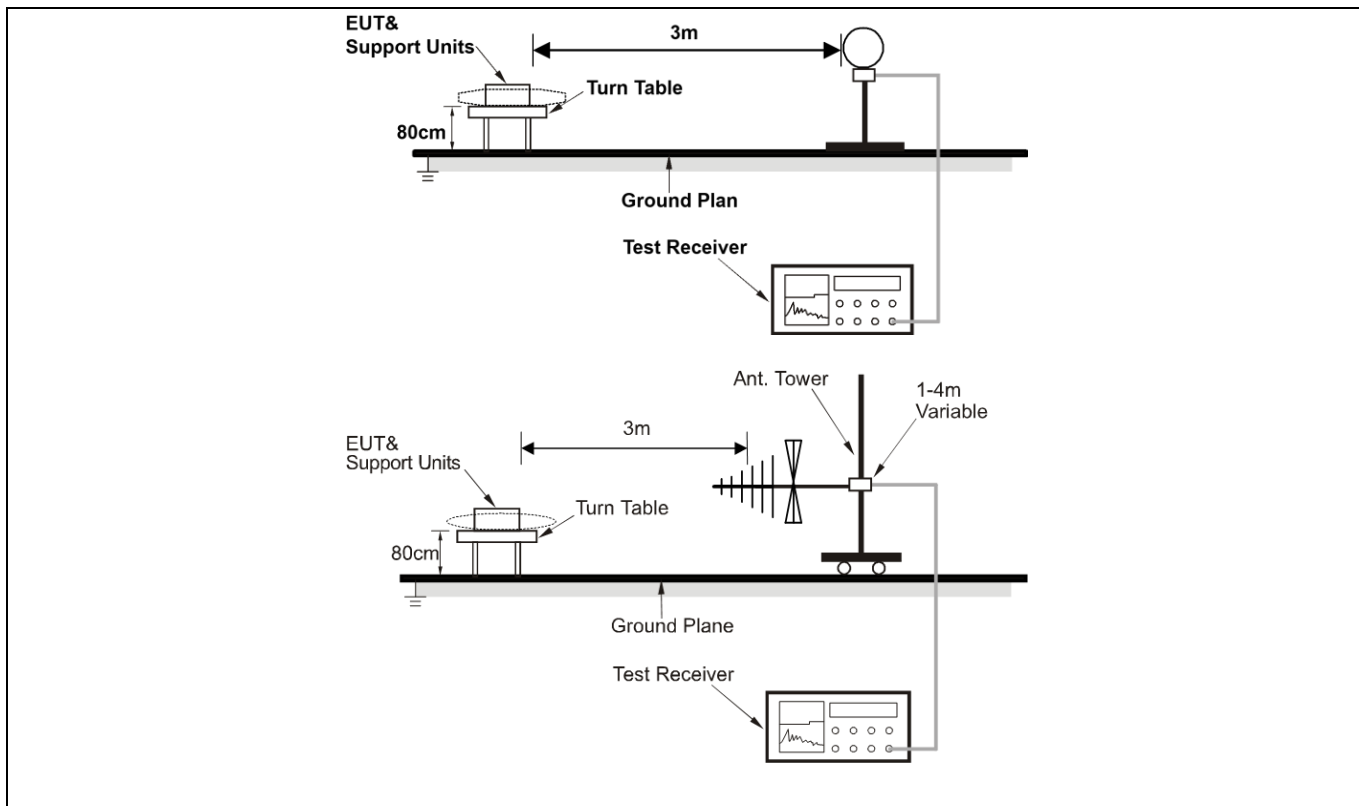
Test Requirement:	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)																																								
Test Limit:	<p>Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:</p> <table border="1"> <thead> <tr> <th>Fundamental frequency</th><th>Field strength of fundamental (millivolts/meter)</th><th>Field strength of harmonics (microvolts/meter)</th></tr> </thead> <tbody> <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> </tbody> </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 border="1"> <thead> <tr> <th>Frequency (MHz)</th><th>Field strength (microvolts/meter)</th><th>Measurement distance (meters)</th></tr> </thead> <tbody> <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> </tbody> </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																																							
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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 C63.10-2013 section 6.5																																								
Procedure:	ANSI C63.10-2013 section 6.5																																								

6.5.1 E.U.T. Operation:

Operating Environment:					
Temperature:	34.2 °C	Humidity:	67.3 %	Atmospheric Pressure:	99 kPa

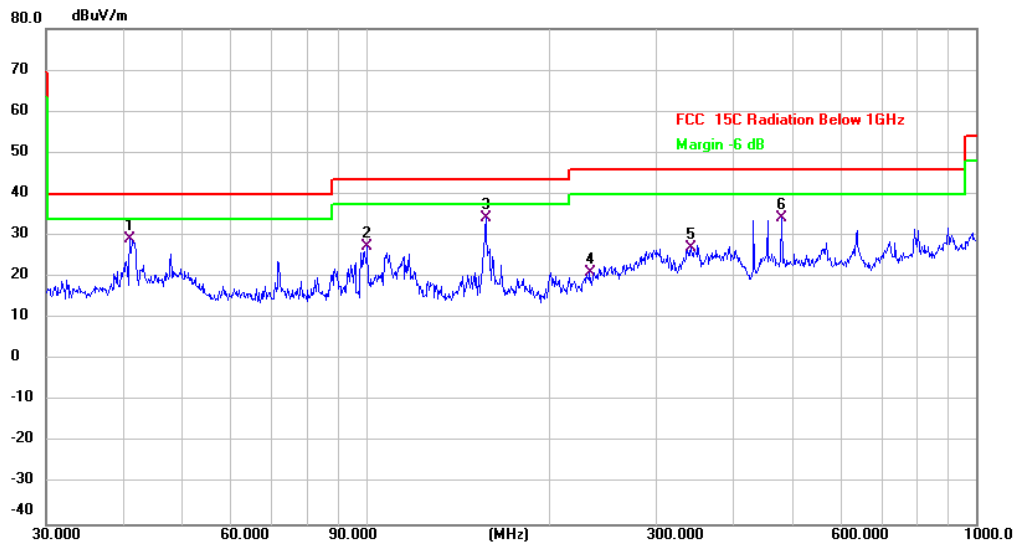
Pre test mode:	Mode1
Final test mode:	Mode1

6.5.2 Test Setup Diagram:



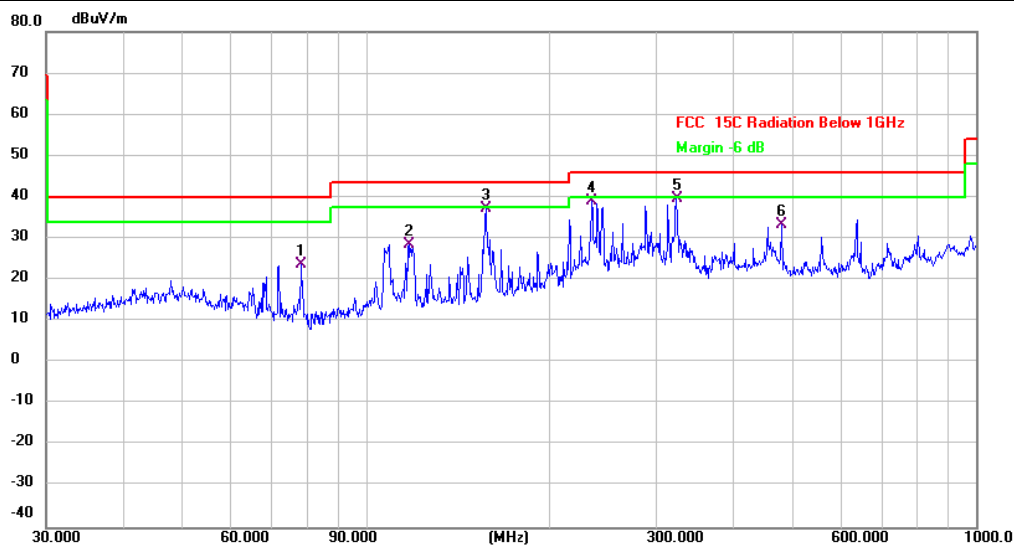
6.5.3 Test Data:

Mode1 / Polarization: Horizontal / CH: M



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		41.1320	37.41	-8.20	29.21	40.00	-10.79	QP	
2		100.5806	35.82	-8.53	27.29	43.50	-16.21	QP	
3	*	157.0074	44.69	-10.36	34.33	43.50	-9.17	QP	
4		233.3487	28.16	-7.18	20.98	46.00	-25.02	QP	
5		341.9786	30.75	-3.79	26.96	46.00	-19.04	QP	
6		480.5276	37.93	-3.71	34.22	46.00	-11.78	QP	

Mode1 / Polarization: Vertical / CH: M



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		78.4133	36.65	-12.98	23.67	40.00	-16.33	QP	
2		117.7725	37.04	-8.40	28.64	43.50	-14.86	QP	
3		157.0074	47.49	-10.36	37.13	43.50	-6.37	QP	
4		234.9909	46.22	-7.11	39.11	46.00	-6.89	QP	
5	*	323.3204	46.07	-6.36	39.71	46.00	-6.29	QP	
6		480.5276	37.01	-3.71	33.30	46.00	-12.70	QP	

6.6 Emissions in frequency bands (above 1GHz)

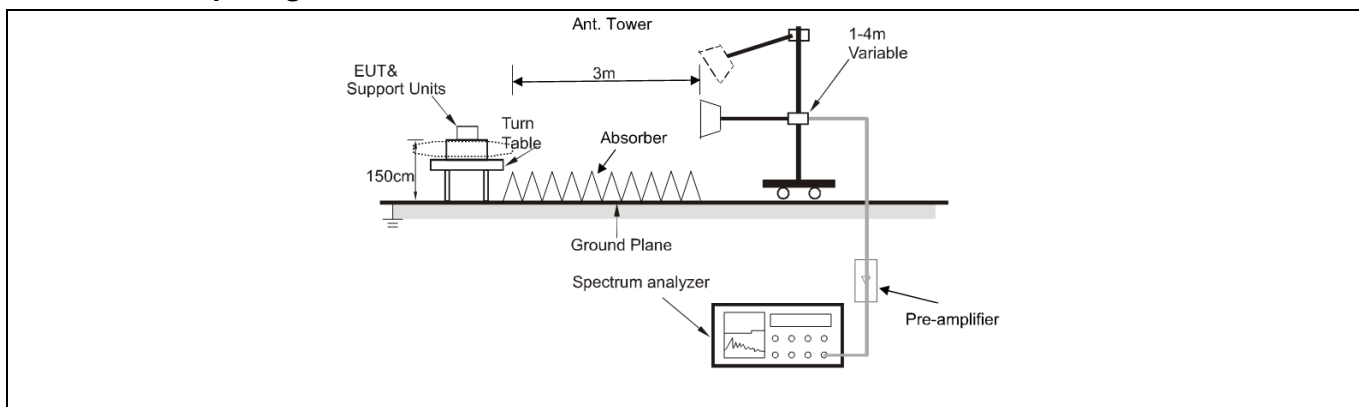
Test Requirement:	47 CFR 15.249(a) 47 CFR 15.249(d) 47 CFR 15.249(e)																																									
Test Limit:	<p>Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:</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)																																								
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216-960	200 **	3																																								
Above 960	500	3																																								
Test Method:	ANSI C63.10-2013 section 6.6																																									
Procedure:	ANSI C63.10-2013 section 6.6																																									

6.6.1 E.U.T. Operation:

Operating Environment:					
Temperature:	16.5 °C	Humidity:	40.5 %	Atmospheric Pressure:	99 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. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		4808.000	52.86	-7.41	45.45	74.00	-28.55	peak
2		4808.000	46.76	-7.41	39.35	54.00	-14.65	AVG
3		7212.000	49.77	0.92	50.69	74.00	-23.31	peak
4		7212.000	43.62	0.92	44.54	54.00	-9.46	AVG
5		9616.000	48.89	2.19	51.08	74.00	-22.92	peak
6	*	9616.000	42.93	2.19	45.12	54.00	-8.88	AVG

Mode1 / Polarization: Vertical / CH: L

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		4808.000	53.05	-7.41	45.64	74.00	-28.36	peak
2		4808.000	46.95	-7.41	39.54	54.00	-14.46	AVG
3		7212.000	53.93	0.92	54.85	74.00	-19.15	peak
4	*	7212.000	47.28	0.92	48.20	54.00	-5.80	AVG
5		9616.000	49.79	2.19	51.98	74.00	-22.02	peak
6		9616.000	43.48	2.19	45.67	54.00	-8.33	AVG

Mode1 / Polarization: Horizontal /CH: M

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		4904.000	50.63	-7.43	43.20	74.00	-30.80	peak
2		4904.000	44.55	-7.43	37.12	54.00	-16.88	AVG
3		7356.000	48.70	1.02	49.72	74.00	-24.28	peak
4		7356.000	42.34	1.02	43.36	54.00	-10.64	AVG
5		9808.000	47.68	3.25	50.93	74.00	-23.07	peak
6	*	9808.000	41.44	3.25	44.69	54.00	-9.31	AVG

Mode1 / Polarization: Vertical / CH: M

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		4904.000	51.37	-7.43	43.94	74.00	-30.06	peak
2		4904.000	45.11	-7.43	37.68	54.00	-16.32	AVG
3		7356.000	50.76	1.02	51.78	74.00	-22.22	peak
4	*	7356.000	44.63	1.02	45.65	54.00	-8.35	AVG
5		9808.000	47.11	3.25	50.36	74.00	-23.64	peak
6		9808.000	41.07	3.25	44.32	54.00	-9.68	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		4956.000	50.79	-7.24	43.55	74.00	-30.45	peak
2		4956.000	44.78	-7.24	37.54	54.00	-16.46	AVG
3		7434.000	48.32	0.99	49.31	74.00	-24.69	peak
4		7434.000	42.27	0.99	43.26	54.00	-10.74	AVG
5		9912.000	47.56	3.05	50.61	74.00	-23.39	peak
6	*	9912.000	41.49	3.05	44.54	54.00	-9.46	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		4956.000	50.47	-7.24	43.23	74.00	-30.77	peak
2		4956.000	44.50	-7.24	37.26	54.00	-16.74	AVG
3		7434.000	50.26	0.99	51.25	74.00	-22.75	peak
4	*	7434.000	44.25	0.99	45.24	54.00	-8.76	AVG
5		9912.000	47.31	3.05	50.36	74.00	-23.64	peak
6		9912.000	41.18	3.05	44.23	54.00	-9.77	AVG

Photographs of the test setup

Refer to Appendix - Test Setup Photos

Photographs of the EUT

Refer to Appendix - EUT Photos

----End of Report----