

TEST REPORT

Applicant: SHENZHEN QIAOHUA INDUSTRIES LIMITED

Address of Applicant: Room 301, No.1 building, Qiaohua Industrial Park, Luotian forestry center, Yanchuan, Yanluo, town, Bao An, Shenzhen 518127, China

Manufacturer/Factory: SHENZHEN QIAOHUA INDUSTRIES LIMITED

Address of Manufacturer/Factory: Room 301, No.1 building, Qiaohua Industrial Park, Luotian forestry center, Yanchuan, Yanluo, town, Bao An, Shenzhen 518127, China

Equipment Under Test (EUT)

Product Name: Laser Projector

Model No.: SR-2

FCC ID: 2AAV8SR-2

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.231

Date of sample receipt: July 18, 2024

Date of Test: July 19-31, 2024

Date of report issued: July 31, 2024

Test Result : PASS *

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

Authorized Signature:



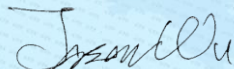
Robinson Luo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
01	July 31, 2024	Original

Prepared By:

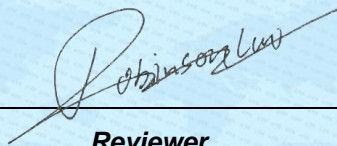


Date:

July 31, 2024

Project Engineer

Check By:



Reviewer

Date:

July 31, 2024

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203	Pass
Conduction Emission	15.207	N/A
Field strength of the Fundamental Signal	15.231 (b)	Pass
Spurious Emissions	15.231 (b)/15.209	Pass
20dB Bandwidth	15.231 (c)	Pass
Deactivation Testing	15.231 (a)(2)	Pass

Pass: The EUT complies with the essential requirements in the standard.

N/A: Not applicable.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

Product Name:	Laser Projector
Model No.:	SR-2
S/N:	N/A
Test sample(s) ID:	GTS2024070271-1
Sample(s) Status:	Engineer sample
Operation Frequency:	433.92MHz
Modulation technology:	ASK
Antenna Type:	PCB Antenna
Antenna gain:	-9.88dBi(declare by applicant)
Power supply:	DC 3V(1*3V Size"CR2032" Lithium Battery)

Remark:

1. Antenna gain information provided by the customer
2. The relevant information of the sample is provided by the entrusting company, and the laboratory is not responsible for its authenticity.

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode. The new battery used
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Per-test mode.

We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which only the worst case was shown in this test report and defined as follows:

433.92MHz	Axis	X	Y	Z
	Field Strength(dBuV/m)	84.97	85.34	83.46

5.3 Description of Support Units

None.

5.4 Test Facility

<p>The test facility is recognized, certified, or accredited by the following organizations:</p> <ul style="list-style-type: none"> ● FCC —Registration No.: 381383 Designation Number: CN5029 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. ● ISED—Registration No.: 9079A CAB identifier: CN0091 The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of ISED for radio equipment testing. ● NVLAP (LAB CODE:600179-0) Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
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5.5 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. No.123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China Tel: 0755-27798480 Fax: 0755-27798960

5.6 Other Information Requested by the Customer

None.

5.7 Additional Instructions

EUT Software Settings:

Mode	Continuously transmitter by manufacturer, power set default
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6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	June 22, 2024	June 21, 2027
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	April 11, 2024	April 10, 2025
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9168	GTS640	March 19, 2023	March 18, 2025
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	April 17, 2023	April 16, 2025
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	April 11, 2024	April 10, 2025
8	Loop Antenna	ZHINAN	ZN30900A	GTS534	Nov. 13, 2023	Nov.12, 2024
9	Broadband Preampfier	SCHWARZBECK	BBV9718	GTS535	April 11, 2024	April 10, 2025
10	Amplifier(1GHz-26.5GHz)	HP	8449B	GTS601	April 11, 2024	April 10, 2025
11	Horn Antenna (18-26.5GHz)	/	UG-598A/U	GTS664	Oct. 29, 2023	Oct. 28, 2024
12	Horn Antenna (26.5-40GHz)	A.H Systems	SAS-573	GTS665	Oct. 29, 2023	Oct. 28, 2024
13	FSV·Signal Analyzer (10Hz-40GHz)	Keysight	FSV-40-N	GTS666	March 12, 2024	March 11, 2025
14	Amplifier	/	LNA-1000-30S	GTS650	April 11, 2024	April 10, 2025
15	CDNE M2+M3-16A	HCT	30MHz-300MHz	GTS692	Nov. 08, 2023	Nov.07, 2024
16	Wideband Amplifier	/	WDA-01004000-15P35	GTS602	April 11, 2024	April 10, 2025
17	Thermo meter	JINCHUANG	GSP-8A	GTS643	April 18, 2024	April 17, 2025
18	RE cable 1	GTS	N/A	GTS675	July 02. 2024	July 01. 2025
19	RE cable 2	GTS	N/A	GTS676	July 02. 2024	July 01. 2025
20	RE cable 3	GTS	N/A	GTS677	July 02. 2024	July 01. 2025
21	RE cable 4	GTS	N/A	GTS678	July 02. 2024	July 01. 2025
22	RE cable 5	GTS	N/A	GTS679	July 02. 2024	July 01. 2025
23	RE cable 6	GTS	N/A	GTS680	July 02. 2024	July 01. 2025
24	RE cable 7	GTS	N/A	GTS681	July 05. 2024	July 04. 2025
25	RE cable 8	GTS	N/A	GTS682	July 05. 2024	July 04. 2025

RF Conducted Test:						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	April 11, 2024	April 10, 2025
2	EMI Test Receiver	R&S	ESCI 7	GTS552	April 11, 2024	April 10, 2025
3	PSA Series Spectrum Analyzer	Agilent	E4440A	GTS536	April 11, 2024	April 10, 2025
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	April 11, 2024	April 10, 2025
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	April 11, 2024	April 10, 2025
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	April 11, 2024	April 10, 2025
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	April 11, 2024	April 10, 2025
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	April 11, 2024	April 10, 2025
9	Thermo meter	JINCHUANG	GSP-8A	GTS641	April 18, 2024	April 17, 2025

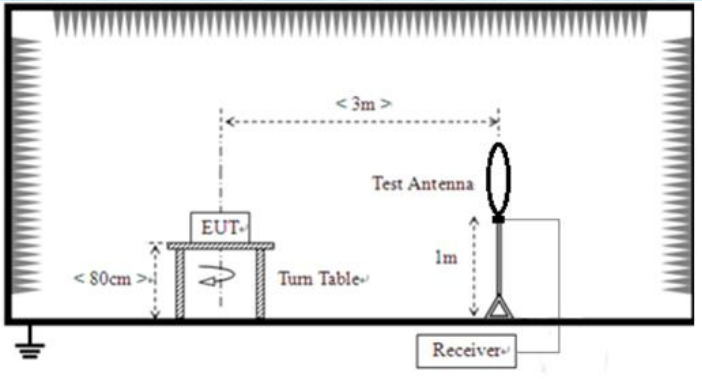
General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Barometer	KUMAO	SF132	GTS647	April 18, 2024	April 17, 2025

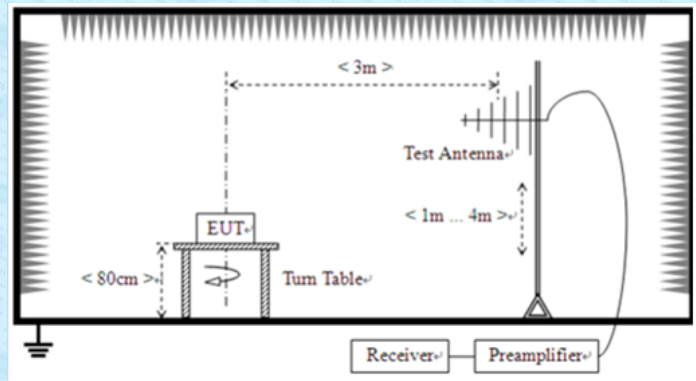
7 Test results and Measurement Data

7.1 Antenna requirement

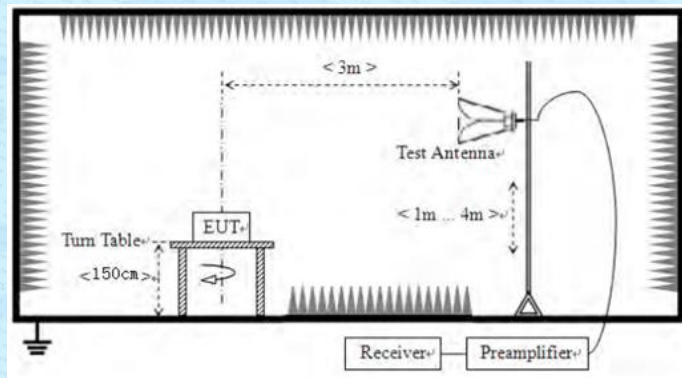
Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement:	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
EUT Antenna:	
	The antenna is PCB antenna, reference to the appendix II for details.

7.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.231 (b)& Section 15.209					
Test Method:	ANSI C63.10:2013					
Test Frequency Range:	9kHz to 6000MHz					
Test site:	Measurement Distance: 3m					
Receiver setup:	Frequency	Detector	RBW	VBW	Value	
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak	
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak	
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak	
	Above 1GHz	Peak	1MHz	3MHz	Peak	
Peak		1MHz	10Hz	Average		
Limit: (Field strength of the fundamental signal)	Frequency	Limit (dBuV/m @3m)		Remark		
	433.92MHz	100.83		Peak Value		
		80.83		Average Value		
Limit: (Spurious Emissions)	Fundamental Frequency (MHz)	Field Strength of fundamental (microvolts/meter)		Field Strength of Unwanted Emissions (microvolts/meter)		
	40.66-40.70	2250		225		
	70-130	1250		125		
	130-174	1250 to 3750**		125 to 735		
	174-260	3750		375		
	260-470	3750 to 12500		375 to 1250		
	Above 470	12500		1250		
	Frequency (MHz)	Class B(dBuV/m @3m)				
		Above 1000	Peak		Average	
			74		54	
	Or The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level whichever limit permits higher field strength.					
	Test setup:	Below 30MHz				
						
	Below 1GHz					



Above 1GHz



Test Instruments:	Refer to section 6.0 for details				
Test mode:	Refer to section 5.2 for details				
Test environment:	Temp.:	25 °C	Humid.:	50%	Press.: 1 010mbar
Test results:	Pass				

Measurement data:

7.2.1 Field Strength of The Fundamental Signal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
433.92	85.55	15.58	3.99	32.23	72.89	100.83	-27.94	Vertical
433.92	98.00	15.58	3.99	32.23	85.34	100.83	-15.49	Horizontal

Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
433.92	72.89	-8.10	64.79	80.83	-16.04	Horizontal
433.92	85.34	-8.10	77.24	80.83	-3.59	Vertical

Remarks:

Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

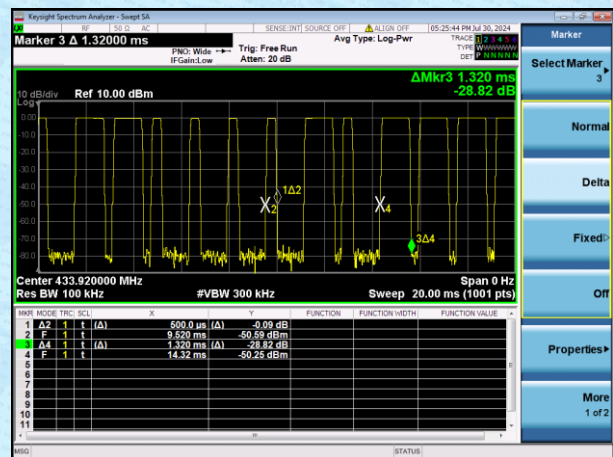
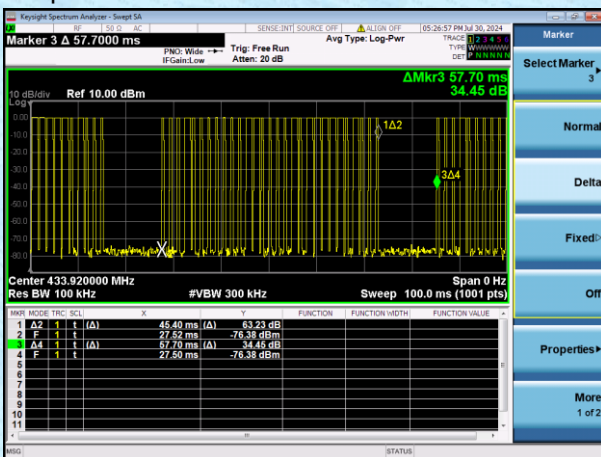
Average value:	
Calculate Formula:	Average value=Peak value + Duty Cycle Factor
	Duty cycle factor=20 log(Duty cycle)
	Duty cycle=on time/100 milliseconds or period, whichever is less
Test data:	T on time =22.7(ms)
	T period =57.7(ms)
	Duty cycle=0.393
	duty cycle factor=-8.10

The formula as below:

T on time= (1.32*10) + (0.5*19) =13.2+9.5=22.7

Duty cycle= T on time/ T period=22.7/57.7=0.393

Test plot as follows:



7.2.2 Spurious Emissions

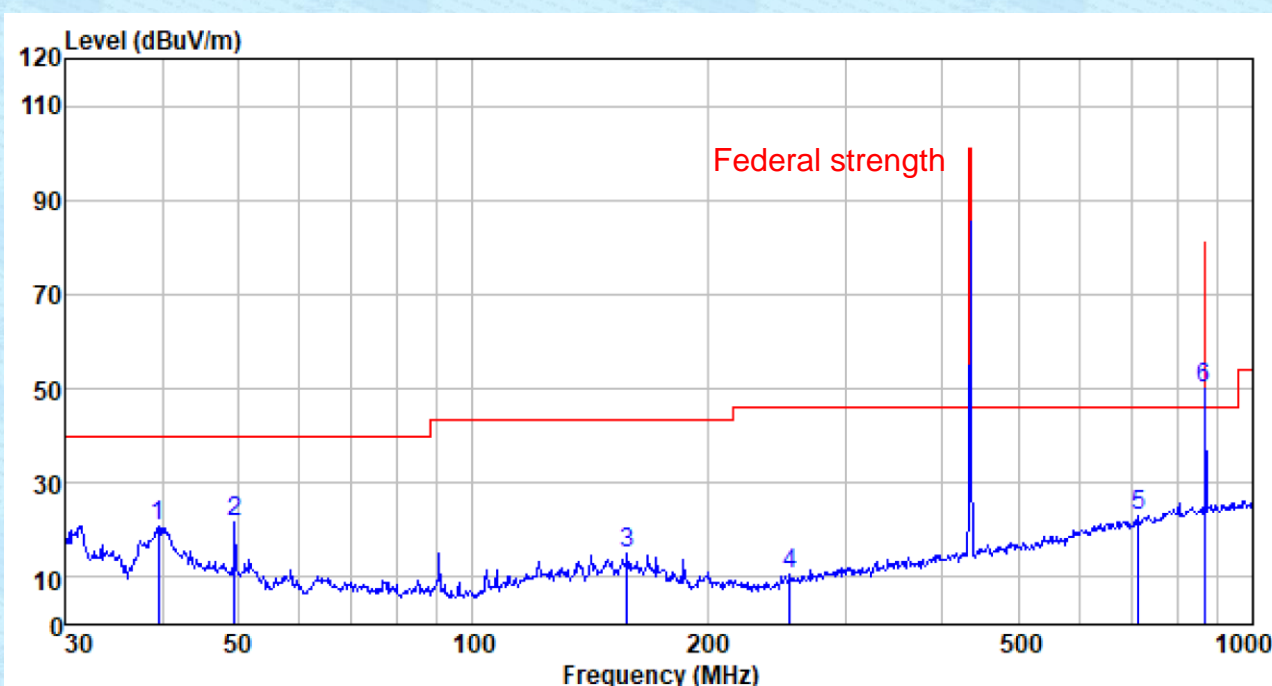
Measurement data:

9 kHz ~ 30 MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

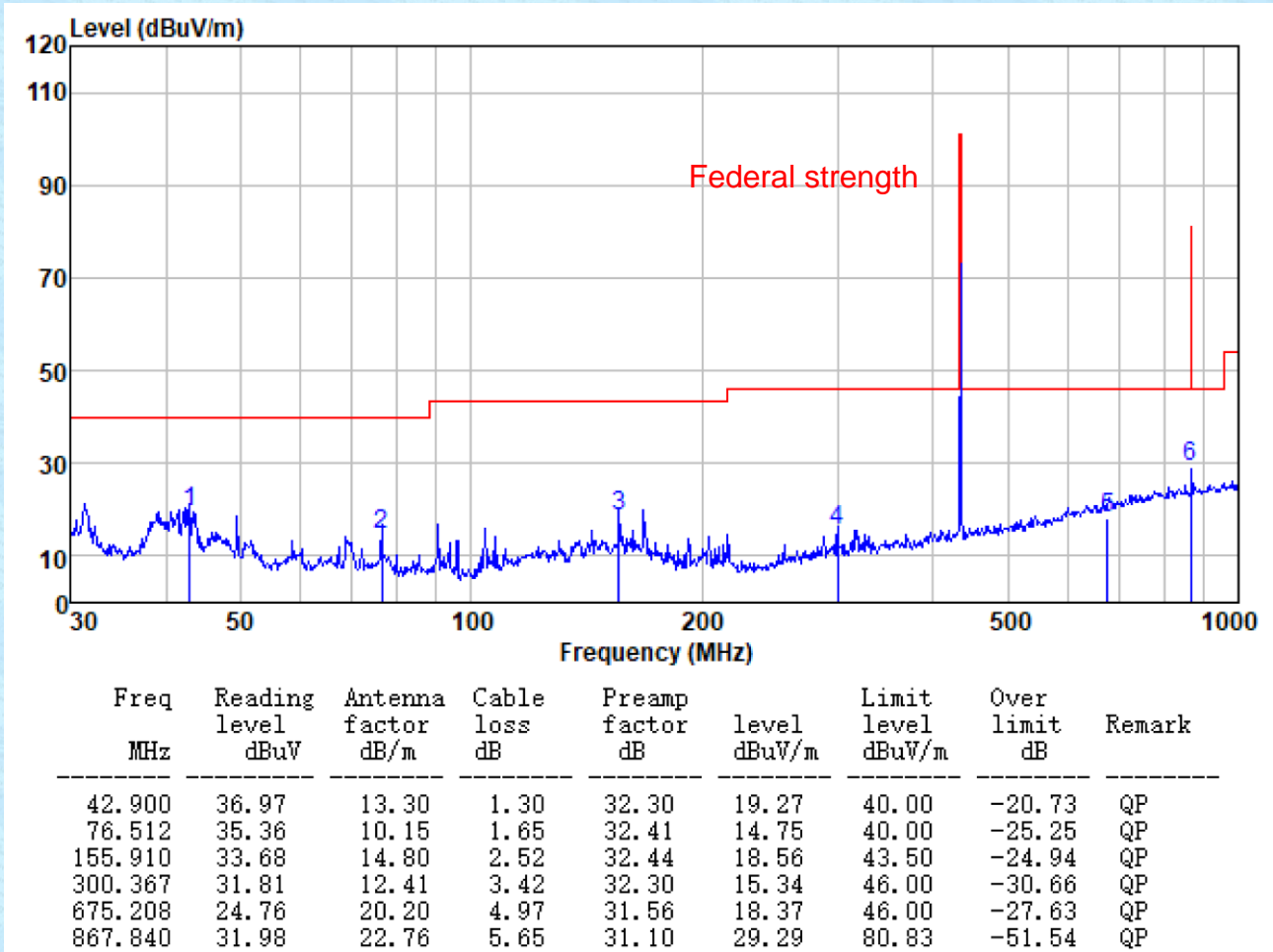
Below 1GHz:

Mode:	Transmitting mode	Polarization:	Horizontal
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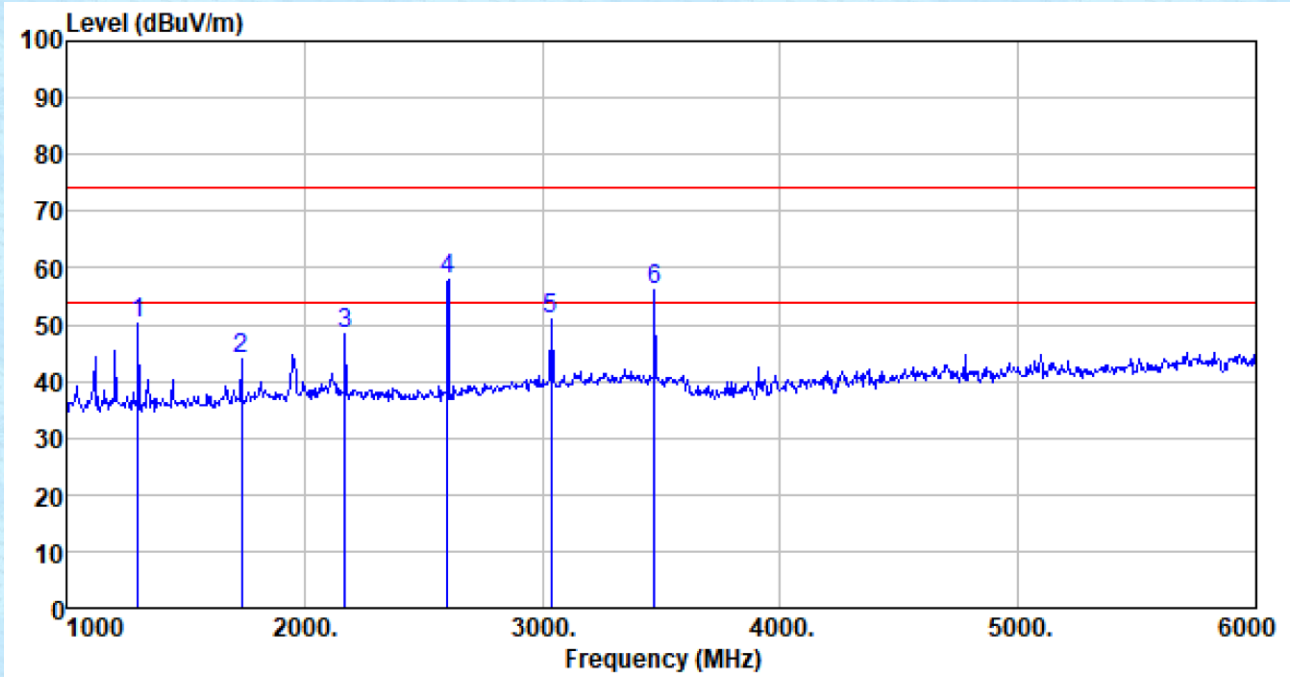
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
39.576	37.69	14.32	1.25	32.30	20.96	40.00	-19.04	QP
49.533	39.87	12.69	1.38	32.30	21.64	40.00	-18.36	QP
157.559	30.11	14.74	2.53	32.44	14.94	43.50	-28.56	QP
254.728	29.11	10.69	3.19	32.35	10.64	46.00	-35.36	QP
714.173	28.62	20.70	5.14	31.41	23.05	46.00	-22.95	QP
867.840	52.53	22.76	5.65	31.10	49.84	80.83	-30.99	QP

Mode: Transmitting mode **Polarization:** Vertical



Above 1G:

Mode:	Transmitting mode	Polarization:	Horizontal
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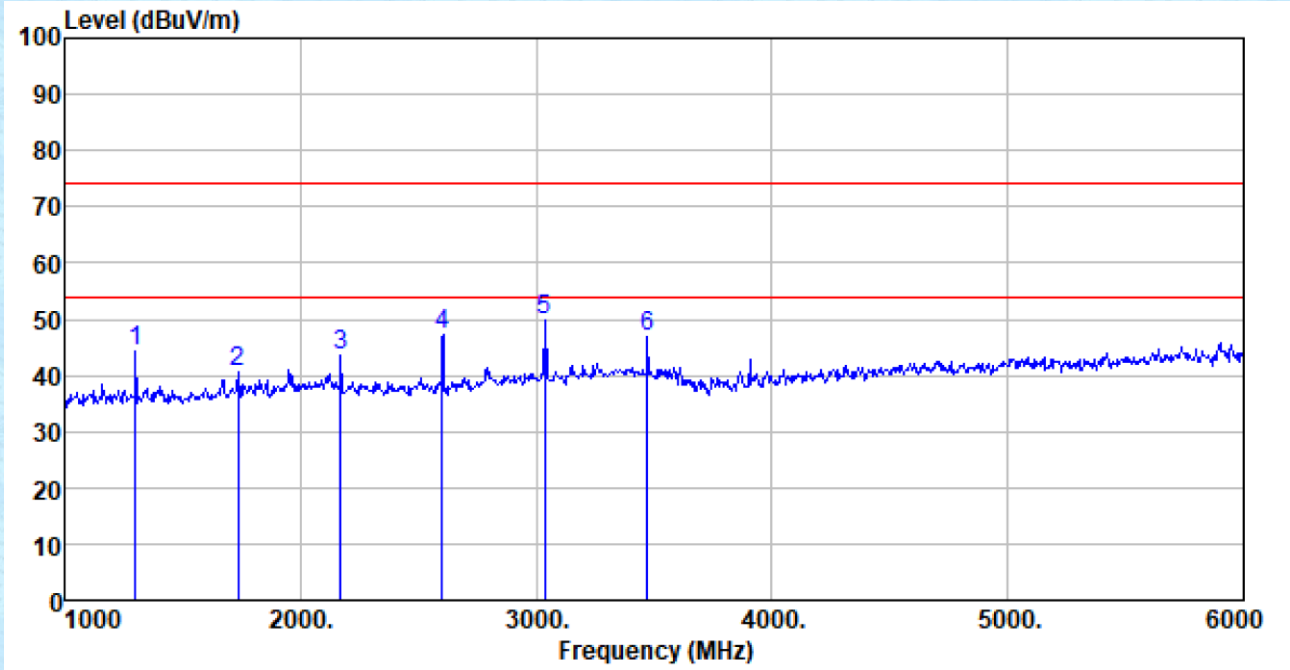
Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1301.76	61.56	25.10	3.54	40.08	50.12	74.00	-23.88	Horizontal
1735.68	53.44	24.90	4.43	39.03	43.74	74.00	-30.26	Horizontal
2169.60	56.23	26.74	4.11	38.81	48.27	74.00	-25.73	Horizontal
2603.52	65.75	27.61	3.95	39.48	57.83	74.00	-16.17	Horizontal
3037.44	56.43	28.80	4.65	38.98	50.90	74.00	-23.10	Horizontal
3471.36	60.45	29.34	5.01	38.72	56.08	74.00	-17.92	Horizontal

Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average Value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1301.76	50.12	-8.10	42.02	54.00	-11.98	Horizontal
1735.68	43.74	-8.10	35.64	54.00	-18.36	Horizontal
2169.60	48.27	-8.10	40.17	54.00	-13.83	Horizontal
2603.52	57.83	-8.10	49.73	54.00	-4.27	Horizontal
3037.44	50.90	-8.10	42.80	54.00	-11.20	Horizontal
3471.36	56.08	-8.10	47.98	54.00	-6.02	Horizontal

Mode:	Transmitting mode	Polarization:	Vertical
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1301.76	55.60	25.10	3.54	40.08	44.16	74.00	-29.84	V
1735.68	50.12	24.90	4.43	39.03	40.42	74.00	-33.58	V
2169.60	51.61	26.74	4.11	38.81	43.65	74.00	-30.35	V
2603.52	55.32	27.61	3.95	39.48	47.40	74.00	-26.60	V
3037.44	55.43	28.80	4.65	38.98	49.90	74.00	-24.10	V
3471.36	51.36	29.34	5.01	38.72	46.99	74.00	-27.01	V

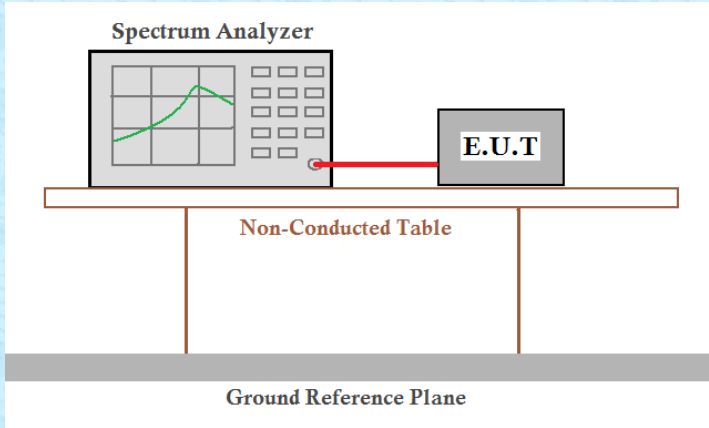
Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average Value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1301.76	44.16	-8.10	36.06	54.00	-17.94	V
1735.68	40.42	-8.10	32.32	54.00	-21.68	V
2169.60	43.65	-8.10	35.55	54.00	-18.45	V
2603.52	47.40	-8.10	39.30	54.00	-14.70	V
3037.44	49.90	-8.10	41.80	54.00	-12.20	V
3471.36	46.99	-8.10	38.89	54.00	-15.11	V

Remarks:

Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

7.3 20dB Occupy Bandwidth

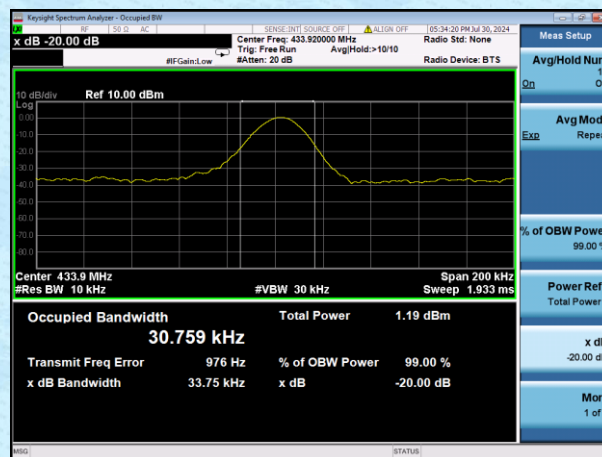
Test Requirement:	FCC Part15 C Section 15.231 (c)
Test Method:	ANSI C63.10:2013
Limit:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

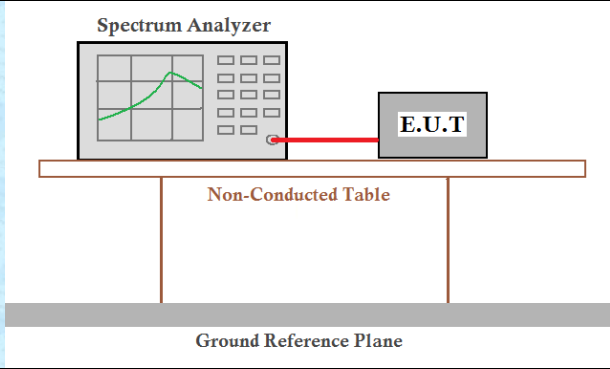
Test Frequency (MHz)	20dB bandwidth (kHz)	Limit (MHz)	Result
433.92	33.75	1.0848	Pass

Note: Limit= Fundamental frequency×0.25%
 $433.92 \times 0.25\% = 1.0848\text{MHz}$

Test plot as follows:



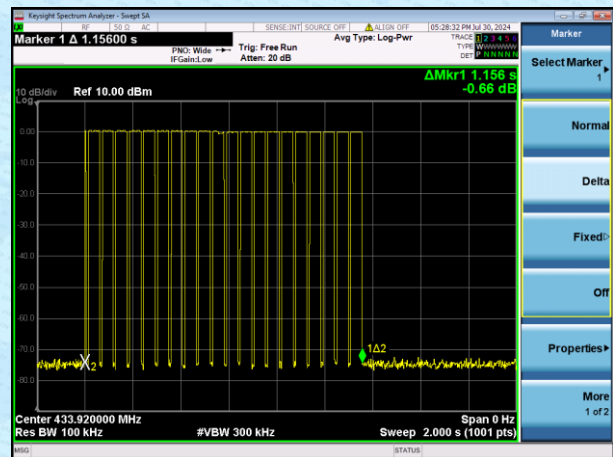
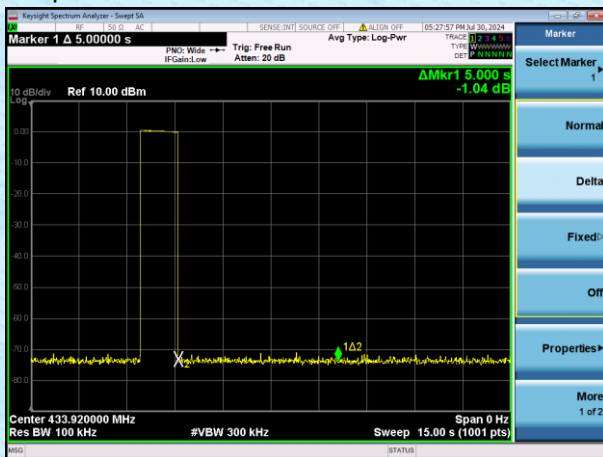
7.4 Deactivation Testing

Test Requirement:	FCC Part15 C Section 15.231 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=1MHz, VBW=1MHz, span=0Hz, detector: Peak
Limit:	Not more than 5 seconds
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Frequency (MHz)	Duration of each TX (s)	Limit (second)	Result
433.92	1.156	<5.0	Pass

Test plot as follows:



8 Test Setup Photo

Reference to the **Appendix I** for details.

9 EUT Constructional Details

Reference to the **Appendix II** for details.

----- End -----