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Test Report

Report No.: CQASZ20220200182E
Applicant: Shenzhen Rongyuan Technology Co., Ltd.
Address of Applicant: Tian 'an Yungu Industrial Park, Gangtou Community, Bantian Street, Shenzhen, China

Equipment Under Test (EUT):

EUT Name: 2.4G Receiver
Model No.: RX2451, RX2451U, RX2451UA, RX2451UP, RX2451UPA
Test Model No.: RX2451
Brand Name: N/A
FCC ID: 2A4MR-2451
Standards: 47 CFR Part 15, Subpart C
Date of Receipt: 2022-02-14
Date of Test: 2022-02-14 to 2022-02-28
Date of Issue: 2022-03-03
Test Result: PASS*

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

Tested By: Lewis Zhou

(Lewis Zhou)

Reviewed By: Rock Huang

(Rock Huang)

Approved By: Jack Ai

(Jack Ai)



1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20220200182E	Rev.01	Initial report	2022-03-03

2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203	ANSI C63.10 (2013)	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 (2013)	PASS
Field Strength of the Fundamental Signal	47 CFR Part 15, Subpart C Section 15.249 (a)	ANSI C63.10 (2013)	PASS
Spurious Emissions	47 CFR Part 15, Subpart C Section 15.249 (a)/15.209	ANSI C63.10 (2013)	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.249(a)/15.205	ANSI C63.10 (2013)	PASS
20dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.215 (c)	ANSI C63.10 (2013)	PASS

3 Contents

	Page
1 VERSION	2
2 TEST SUMMARY	3
3 CONTENTS	4
4 GENERAL INFORMATION	5
4.1 CLIENT INFORMATION	5
4.2 GENERAL DESCRIPTION OF EUT	5
4.3 TEST ENVIRONMENT AND MODE	7
4.4 DESCRIPTION OF SUPPORT UNITS	7
4.5 STATEMENT OF THE MEASUREMENT UNCERTAINTY	8
4.6 TEST LOCATION	9
4.7 TEST FACILITY	9
4.8 DEVIATION FROM STANDARDS	9
4.9 ABNORMALITIES FROM STANDARD CONDITIONS	9
4.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER	9
4.11 EQUIPMENT LIST	10
5 TEST RESULTS AND MEASUREMENT DATA	11
5.1 ANTENNA REQUIREMENT	11
5.2 CONDUCTED EMISSIONS	12
5.3 RADIATED EMISSION	15
5.4 20dB BANDWIDTH	23
6 PHOTOGRAPHS	26
6.1 RADIATED EMISSION TEST SETUP	26
6.2 CONDUCTED EMISSION TEST SETUP	27
6.3 EUT CONSTRUCTIONAL DETAILS	28

4 General Information

4.1 Client Information

Applicant:	Shenzhen Rongyuan Technology Co. , Ltd.
Address of Applicant:	Tian 'an Yungu Industrial Park, Gangtou Community, Bantian Street, Shenzhen, Chnia
Manufacturer:	Shenzhen Rongyuan Technology Co. , Ltd.
Address of Manufacturer:	Tian 'an Yungu Industrial Park, Gangtou Community, Bantian Street, Shenzhen, Chnia

4.2 General Description of EUT

EUT Name:	2.4G Receiver
Test Model No.:	RX2451, RX2451U, RX2451UA, RX2451UP, RX2451UPA
Model No.:	RX2451
Trade Mark:	N/A
Software Version:	V0.1.1
Hardware Version:	V0.1
Frequency Range:	2402MHz~2479MHz
Modulation Type:	GFSK
Number of Channels:	3
Sample Type:	☐ Mobile ☒ Portable ☐ Fix Location
Test Software of EUT:	RF Test
Antenna Type:	PCB antenna
Antenna Gain:	-21.51 dBi
Power Supply:	Power by Computer

Note:

Model No.: RX2451, RX2451U, RX2451UA, RX2451UP, RX2451UPA.

Only the model RX2451P was tested, their electrical circuit design, layout, components used and internal wiring are identical, only the model is different.

Operation Frequency each of channel					
Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	2	2446MHz	3	2479MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel(CH1)	2402MHz
The Middle channel(CH2)	2446MHz
The Highest channel(CH3)	2479MHz

4.3 Test Environment and Mode

Operating Environment:	
Radiated Emissions:	
Temperature:	27 °C
Humidity:	59 % RH
Atmospheric Pressure:	1009mbar
Temperature:	26 °C
Humidity:	59 % RH
Atmospheric Pressure:	1009mbar
Radio conducted item test (RF Conducted test room):	
Temperature:	25.3 °C
Humidity:	55 % RH
Atmospheric Pressure:	1009mbar
Test mode:	
Transmitting mode:	Use test software (RF test) to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT.

4.4 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Manufacturer	Model No.	Certification	Supplied by
Computer	apple	macbookpro	DOC	CQA

2) Cable

Cable No.	Description	Manufacturer	Cable Type/Length	Supplied by
/	/	/	/	/

4.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** quality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for **CQA** laboratory is reported:

Test	Range	Uncertainty	Notes
Radiated Emission	Below 1GHz	5.12dB	(1)
Radiated Emission	Above 1GHz	4.60dB	(1)
Conducted Disturbance	0.15~30MHz	3.34dB	(1)

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

4.6 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

4.7 Test Facility

- **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

- **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology 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 our files. Registration No.:522263

4.8 Deviation from Standards

None.

4.9 Abnormalities from Standard Conditions

None.

4.10 Other Information Requested by the Customer

None.

4.11 Equipment List

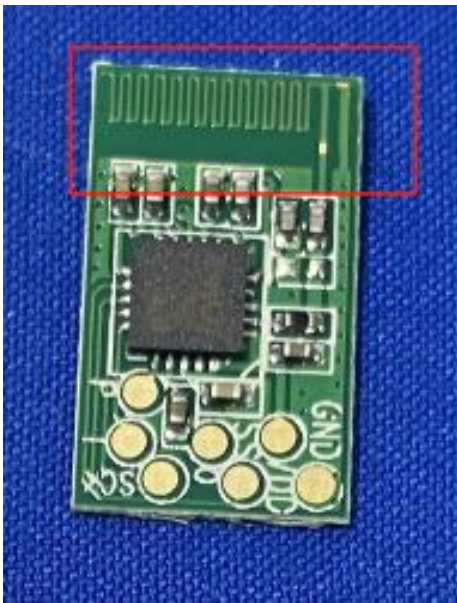
Test Equipment	Manufacturer	Model No.	Instrument No.	Calibration Date	Calibration Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2021/9/10	2022/9/9
Spectrum analyzer	R&S	FSU26	CQA-038	2021/9/10	2022/9/9
Preamplifier	MITEQ	AMF-6D-02001800-29-20P	CQA-036	2021/9/10	2022/9/9
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2021/9/16	2024/9/15
Bilog Antenna	R&S	HL562	CQA-011	2021/9/16	2024/9/15
Horn Antenna	R&S	HF906	CQA-012	2021/9/16	2024/9/15
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2021/9/16	2024/9/15
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2021/9/10	2022/9/9
Coaxial Cable (Below 1GHz)	CQA	N/A	C013	2021/9/10	2022/9/9
Antenna Connector	CQA	RFC-01	CQA-080	2021/9/10	2022/9/9
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2021/9/10	2022/9/9
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2021/9/10	2022/9/9

Note:

The temporary antenna connector is soldered on the pcb board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

5 Test results and Measurement Data

5.1 Antenna Requirement

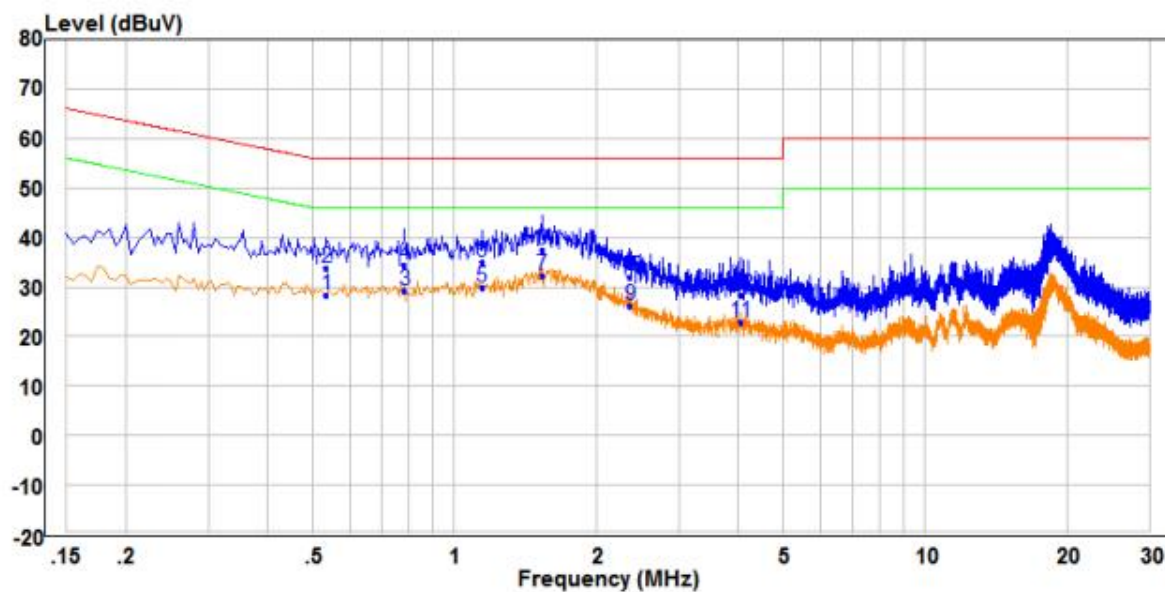
Standard requirement:	47 CFR Part 15C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique 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. The best case gain of the antenna is -21.51dBi.	

Page:12 of 29

Test Mode:	Transmitting mode.
Final Test Mode:	Transmitting mode
Test Results:	Pass

Measurement Data:

Live line:

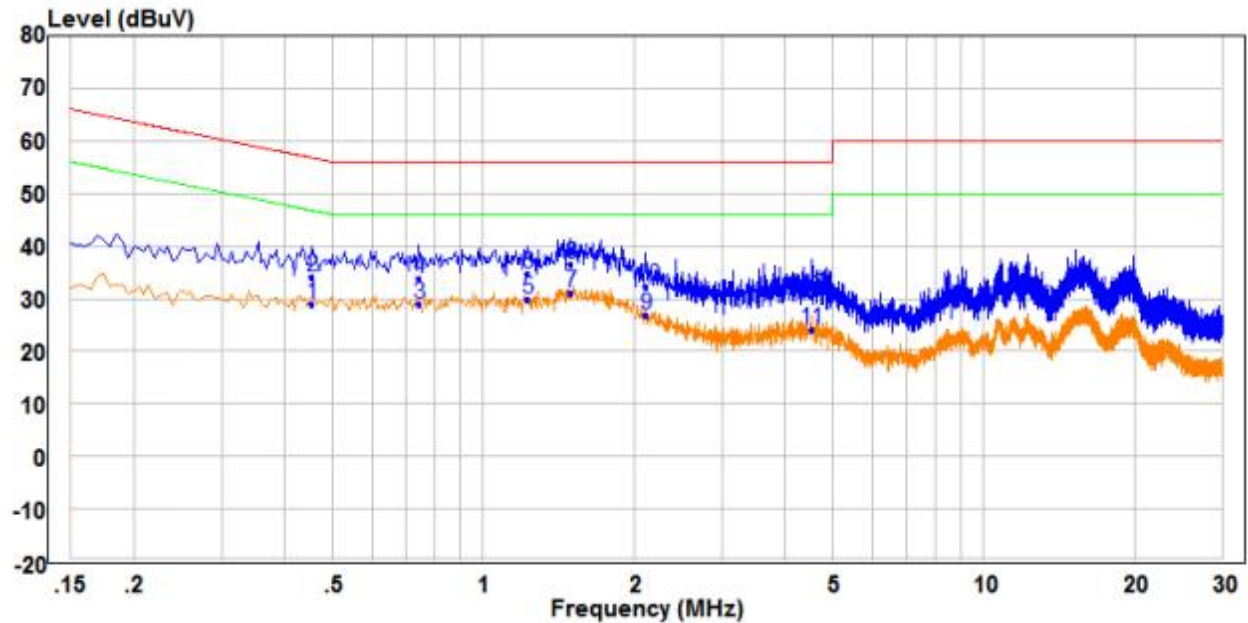


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.535	18.74	9.74	28.48	46.00	-17.52	Average	Line
2	0.535	24.16	9.74	33.90	56.00	-22.10	QP	Line
3	0.785	19.42	9.84	29.26	46.00	-16.74	Average	Line
4	0.785	24.61	9.84	34.45	56.00	-21.55	QP	Line
5	1.145	19.92	10.08	30.00	46.00	-16.00	Average	Line
6	1.145	25.04	10.08	35.12	56.00	-20.88	QP	Line
7 PP	1.535	21.48	10.90	32.38	46.00	-13.62	Average	Line
8 QP	1.535	26.47	10.90	37.37	56.00	-18.63	QP	Line
9	2.365	15.00	11.29	26.29	46.00	-19.71	Average	Line
10	2.365	20.79	11.29	32.08	56.00	-23.92	QP	Line
11	4.065	12.60	10.16	22.76	46.00	-23.24	Average	Line
12	4.065	18.16	10.16	28.32	56.00	-27.68	QP	Line

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.455	19.34	9.66	29.00	46.78	-17.78	Average	Neutral
2	0.455	24.37	9.66	34.03	56.78	-22.75	QP	Neutral
3	0.745	19.04	9.87	28.91	46.00	-17.09	Average	Neutral
4	0.745	24.01	9.87	33.88	56.00	-22.12	QP	Neutral
5	1.230	20.22	9.71	29.93	46.00	-16.07	Average	Neutral
6	1.230	25.05	9.71	34.76	56.00	-21.24	QP	Neutral
7 PP	1.500	21.44	9.72	31.16	46.00	-14.84	Average	Neutral
8 QP	1.500	26.74	9.72	36.46	56.00	-19.54	QP	Neutral
9	2.120	17.01	9.75	26.76	46.00	-19.24	Average	Neutral
10	2.120	22.49	9.75	32.24	56.00	-23.76	QP	Neutral
11	4.535	14.13	9.81	23.94	46.00	-22.06	Average	Neutral
12	4.535	20.53	9.81	30.34	56.00	-25.66	QP	Neutral

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

5.3 Radiated Emission

Test Requirement:	47 CFR Part 15C Section 15.249 and 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30KHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100 kHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Note: For fundamental frequency, RBW=5MHz, VBW=5MHz, Peak detector is for PK value, RMS detector is for Average value.					
Limit: (Spurious Emissions and band edge)	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
	Note: 1) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device. 2) 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 Section 15.209, whichever is the lesser attenuation.				
Limit: (Field strength of the fundamental signal)	Frequency	Limit (dBuV/m @3m)		Remark	
	2400MHz-2483.5MHz	94.0		Average Value	
		114.0		Peak Value	

Test Setup:

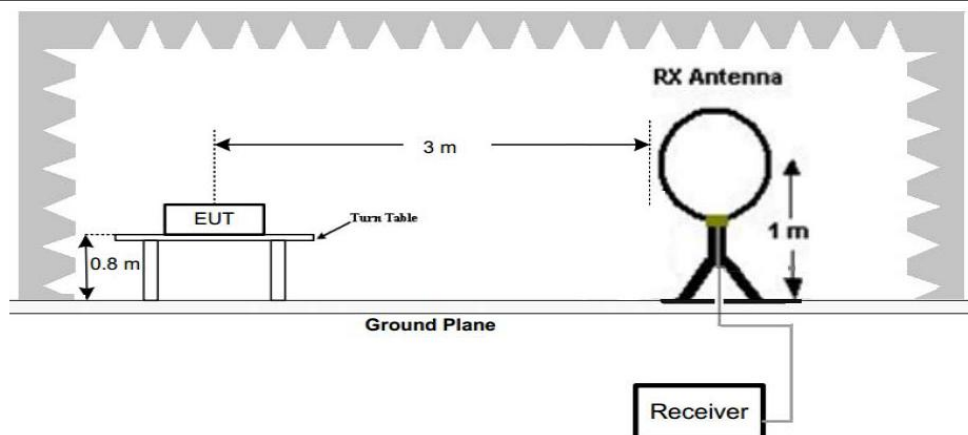


Figure 1. Below 30MHz

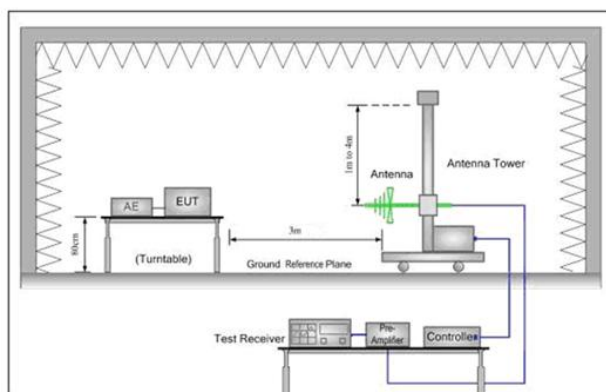


Figure 2. 30MHz to 1GHz

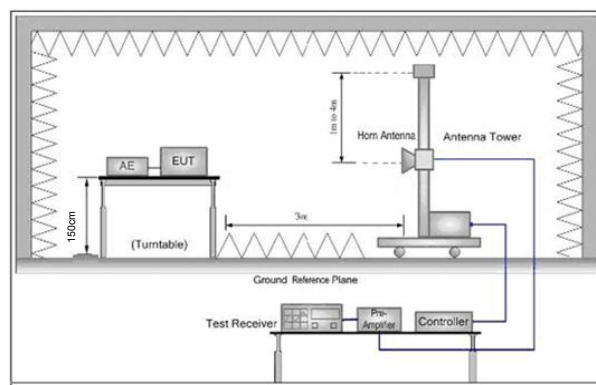


Figure 3. Above 1 GHz

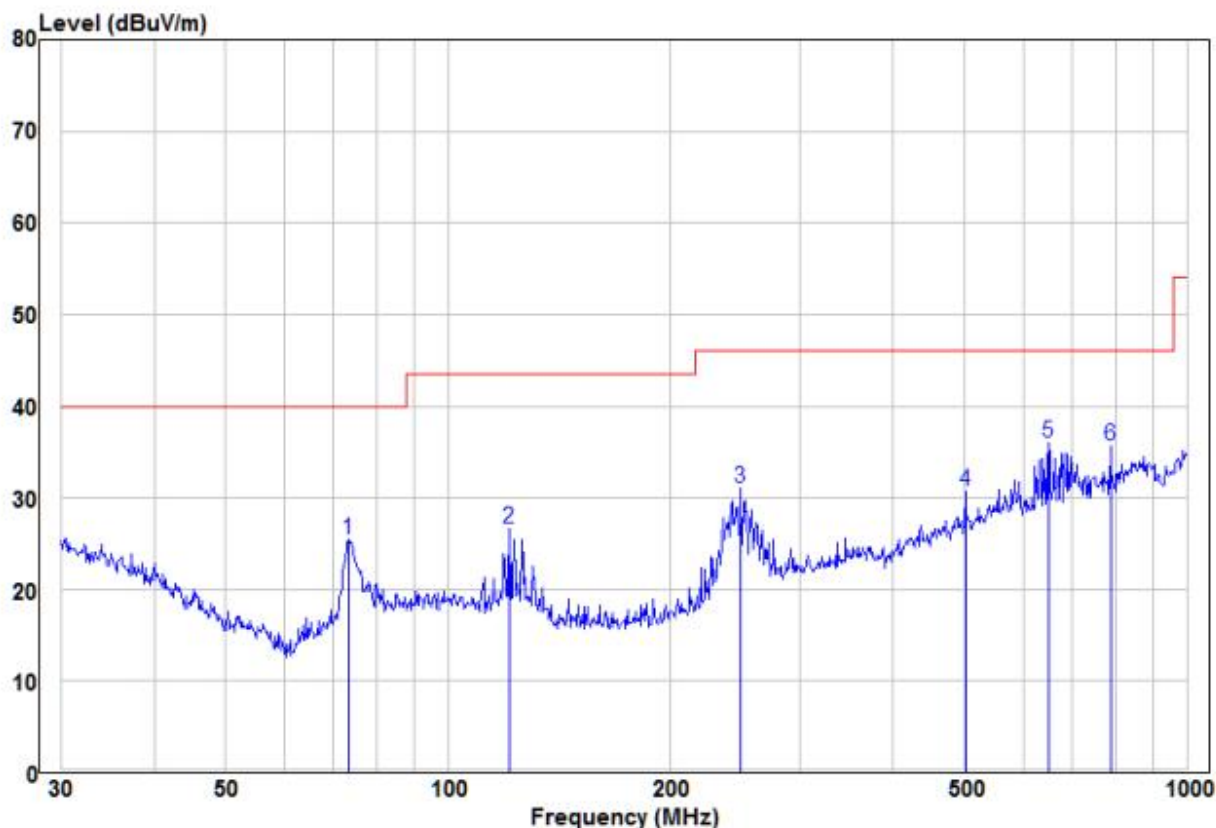
Test Procedure:

- a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
 - 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- Note: For the radiated emission test above 1GHz:
- Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
 - c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
 - d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table

	was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel,the middle channel,the Highest channel h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse case. i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Test Results:	Pass

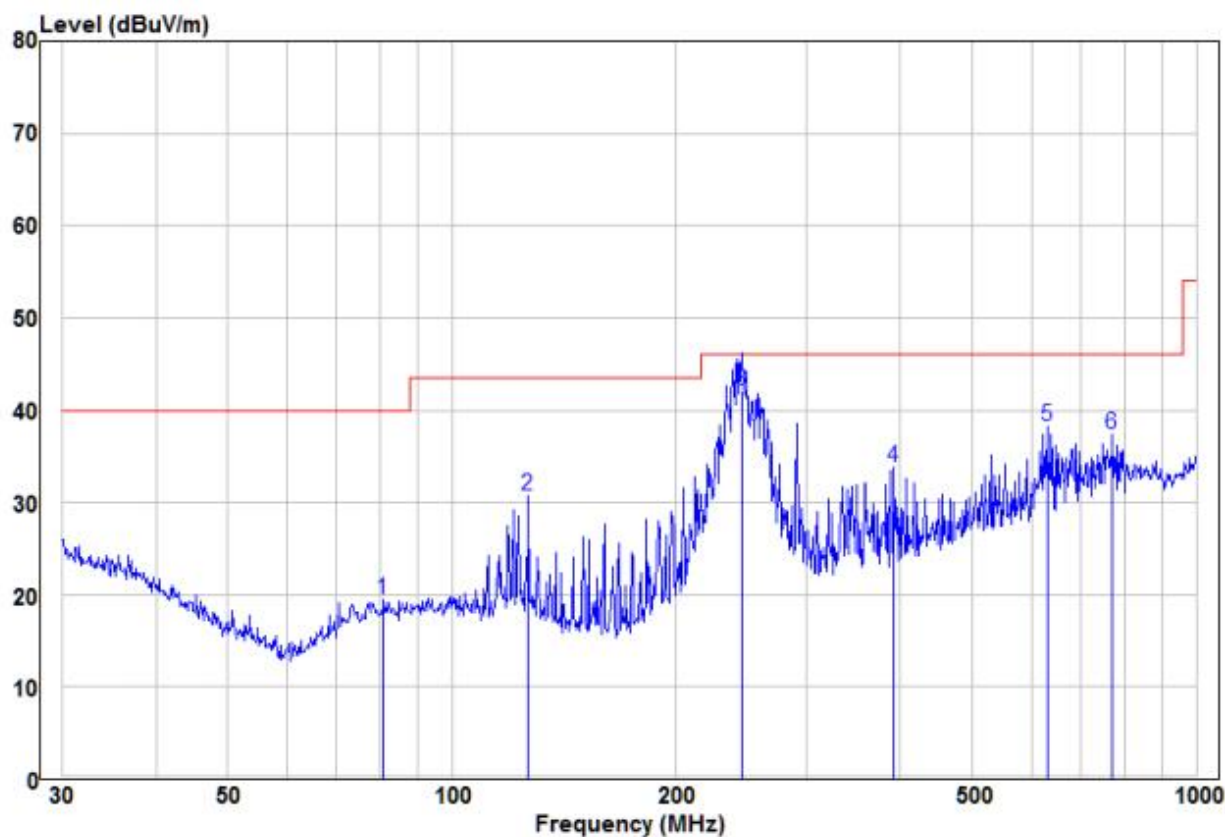
Measurement Data

30MHz~1GHz		
Test mode:	Transmitting	Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	73.36	16.74	8.70	25.44	40.00	-14.56	Peak	VERTICAL
2	121.12	15.91	10.66	26.57	43.50	-16.93	Peak	VERTICAL
3	249.43	18.92	12.06	30.98	46.00	-15.02	Peak	VERTICAL
4	501.18	12.40	18.29	30.69	46.00	-15.31	Peak	VERTICAL
5 pp	649.66	16.25	19.67	35.92	46.00	-10.08	Peak	VERTICAL
6	787.85	13.48	22.23	35.71	46.00	-10.29	Peak	VERTICAL

Test mode:	Transmitting	Horizontal
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	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	80.93	9.59	9.81	19.40	40.00	-20.60	Peak	HORIZONTAL
2	126.77	20.33	10.44	30.77	43.50	-12.73	Peak	HORIZONTAL
3 pp	245.09	30.19	11.93	42.12	46.00	-3.88	QP	HORIZONTAL
4	392.10	18.76	14.96	33.72	46.00	-12.28	Peak	HORIZONTAL
5 pk	629.48	18.97	19.32	38.29	46.00	-7.71	Peak	HORIZONTAL
6	771.45	15.36	22.09	37.45	46.00	-8.55	Peak	HORIZONTAL

Above 1GHz							
Test mode:		Transmitting		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2390	61.52	-9.2	52.32	74	-21.68	Peak	H
2390	45.50	-9.2	36.30	54	-17.70	AVG	H
2400	44.14	-9.39	34.75	74	-39.25	Peak	H
2400	46.62	-9.39	37.23	54	-16.77	AVG	H
2402	100.36	-9.33	91.03	114	-22.97	peak	H
2402	96.06	-9.33	86.73	94	-7.27	AVG	H
4804	54.99	-4.28	50.71	74	-23.29	peak	H
4804	42.79	-4.28	38.51	54	-15.49	AVG	H
7206	53.45	1.13	54.58	74	-19.42	peak	H
7206	36.46	1.13	37.59	54	-16.41	AVG	H
2390	62.44	-9.2	53.24	74	-20.76	peak	V
2390	45.90	-9.2	36.70	54	-17.30	AVG	V
2400	59.76	-9.39	50.37	74	-23.63	peak	V
2400	45.05	-9.39	35.66	54	-18.34	AVG	V
2402	97.07	-9.33	87.74	114	-26.26	peak	V
2402	93.23	-9.33	83.90	94	-10.10	AVG	V
4804	56.27	-4.28	51.99	74	-22.01	peak	V
4804	42.13	-4.28	37.85	54	-16.15	AVG	V
7206	51.12	1.13	52.25	74	-21.75	peak	V
7206	37.56	1.13	38.69	54	-15.31	AVG	V

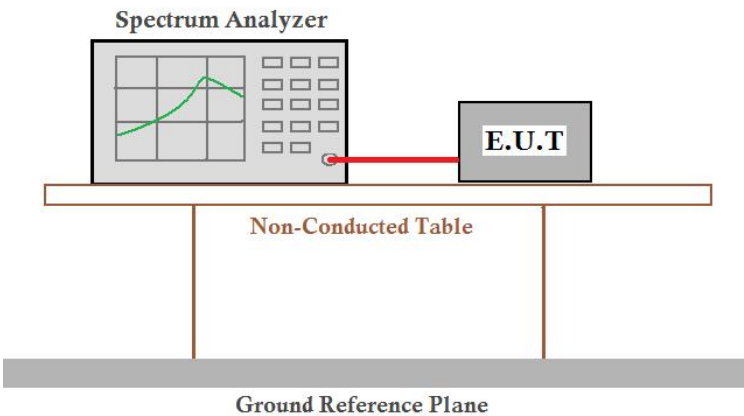
Test mode:		Transmitting		Test channel:		Middle	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2446	99.95	-9.37	90.58	114	-23.42	peak	H
2446	96.36	-9.37	86.99	94	-7.01	AVG	H
4892	57.13	-4.14	52.99	74	-21.01	peak	H
4892	40.77	-4.14	36.63	54	-17.37	AVG	H
7338	52.69	0.56	53.25	74	-20.75	peak	H
7338	35.78	0.56	36.34	54	-17.66	AVG	H
2446	94.73	-9.36	85.37	114	-28.63	peak	V
2446	94.16	-9.36	84.80	94	-9.20	AVG	V
4892	55.77	-4.14	51.63	74	-22.37	peak	V
4892	41.24	-4.14	37.10	54	-16.90	AVG	V
7338	52.22	0.56	52.78	74	-21.22	peak	V
7338	36.50	0.56	37.06	54	-16.94	AVG	V

Test mode:		Transmitting		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2479	100.00	-9.23	90.77	114	-23.23	peak	H
2479	95.73	-9.23	86.50	94	-7.50	AVG	H
2483.5	61.50	-9.29	52.21	74	-21.79	Peak	H
2483.5	43.99	-9.29	34.70	54	-19.30	AVG	H
4958	56.36	-4.03	52.33	74	-21.67	peak	H
4958	42.97	-4.03	38.94	54	-15.06	AVG	H
7437	51.70	1.68	53.38	74	-20.62	peak	H
7437	36.82	1.68	38.50	54	-15.50	AVG	H
2479	96.91	-9.23	87.68	114	-26.32	peak	V
2479	93.51	-9.23	84.28	94	-9.72	AVG	V
2483.5	61.21	-9.29	51.92	74	-22.08	peak	V
2483.5	44.61	-9.29	35.32	54	-18.68	AVG	V
4958	57.06	-4.03	53.03	74	-20.97	peak	V
4958	40.70	-4.03	36.67	54	-17.33	AVG	V
7437	51.01	1.68	52.69	74	-21.31	peak	V
7437	35.74	1.68	37.42	54	-16.58	AVG	V

Remark:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 2) Scan from 9kHz to 25GHz, The disturbance above 10GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported .

5.4 20dB Bandwidth

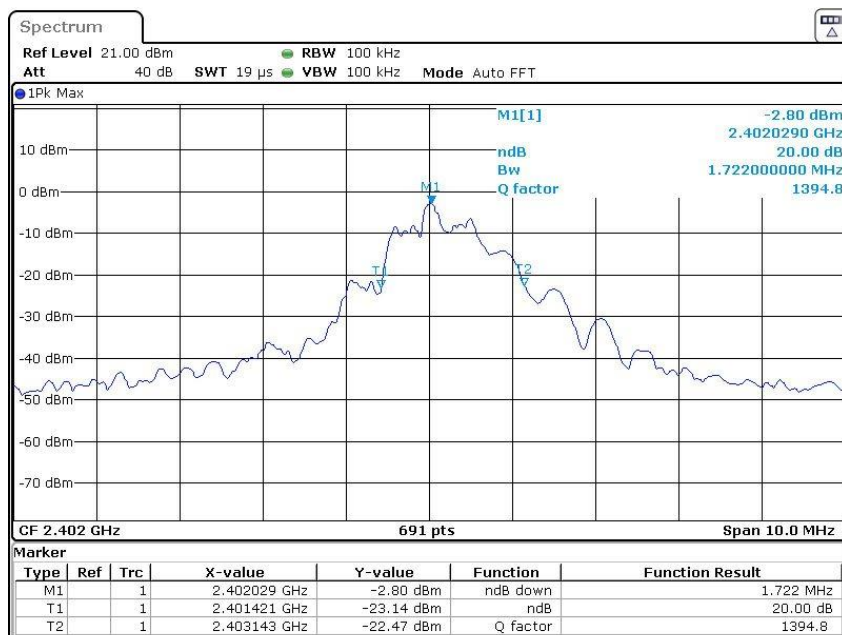
Test Requirement:	47 CFR Part 15C Section 15.215
Test Method:	ANSI C63.10:2013
Test Setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T are placed on a Non-Conducted Table. The table is supported by two vertical legs and sits on a Ground Reference Plane.
Test Mode:	Transmitting with GFSK modulation.
Limit:	N/A
Test Results:	Pass

Measurement Data

Test channel	20dB bandwidth (MHz)	Results
Lowest	1.722	Pass
Middle	1.274	Pass
Highest	1.881	Pass

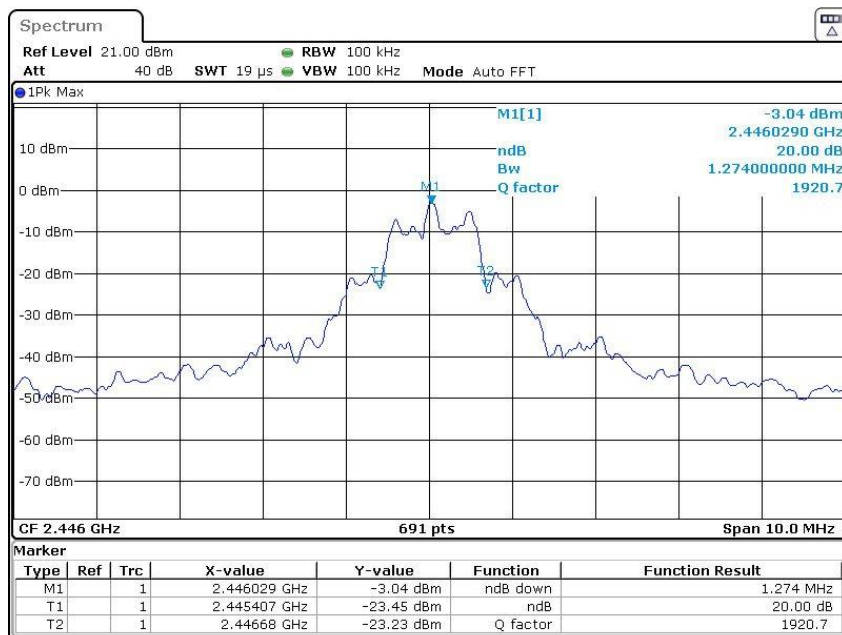
Test plot as follows:

Test channel: Lowest



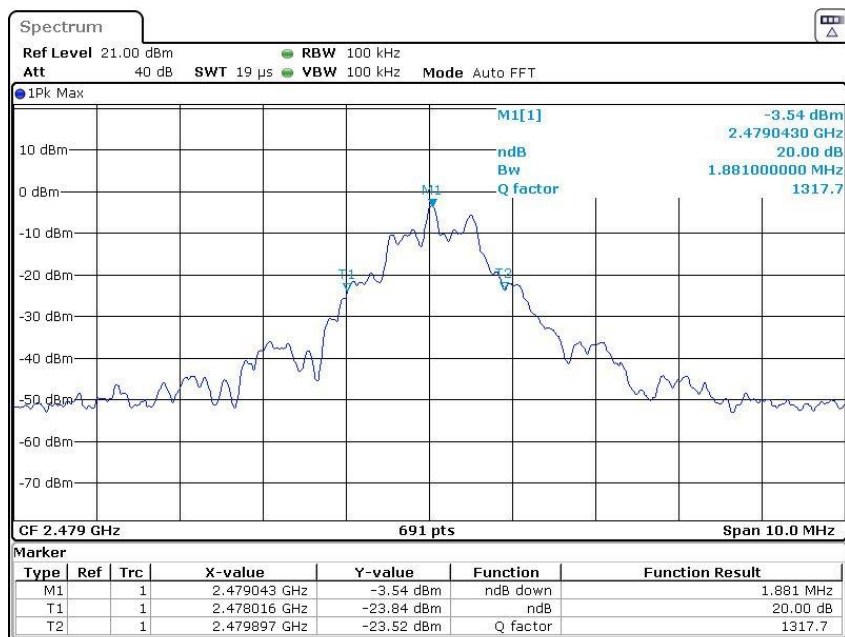
Date: 25.FEB.2022 06:01:20

Test channel: Middle



Date: 25.FEB.2022 06:02:05

Test channel: Highest



Date: 25.FEB.2022 06:02:41

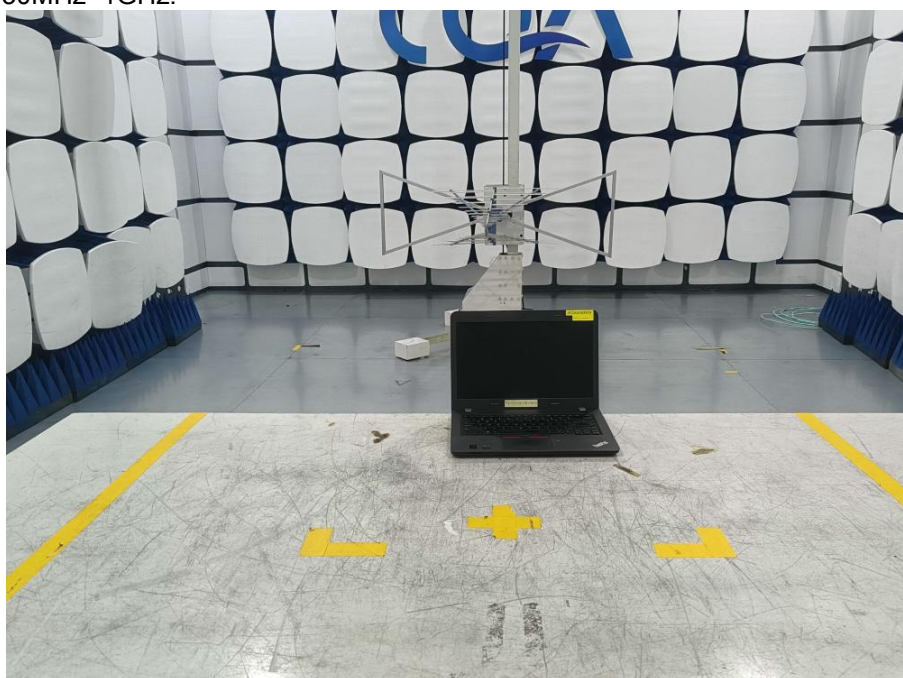
6 Photographs

6.1 Radiated Emission Test Setup

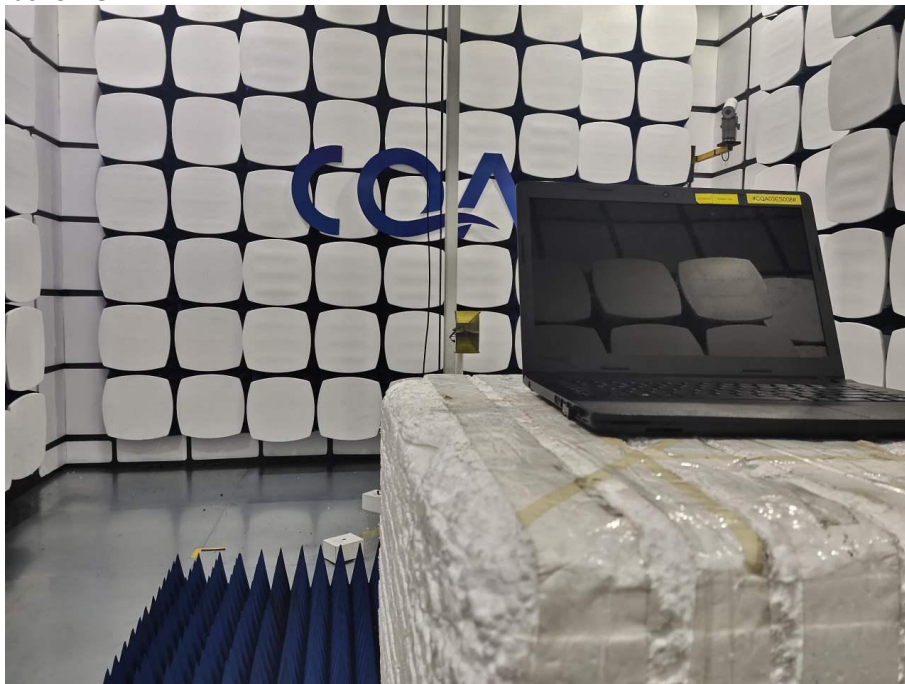
9kHz~30MHz



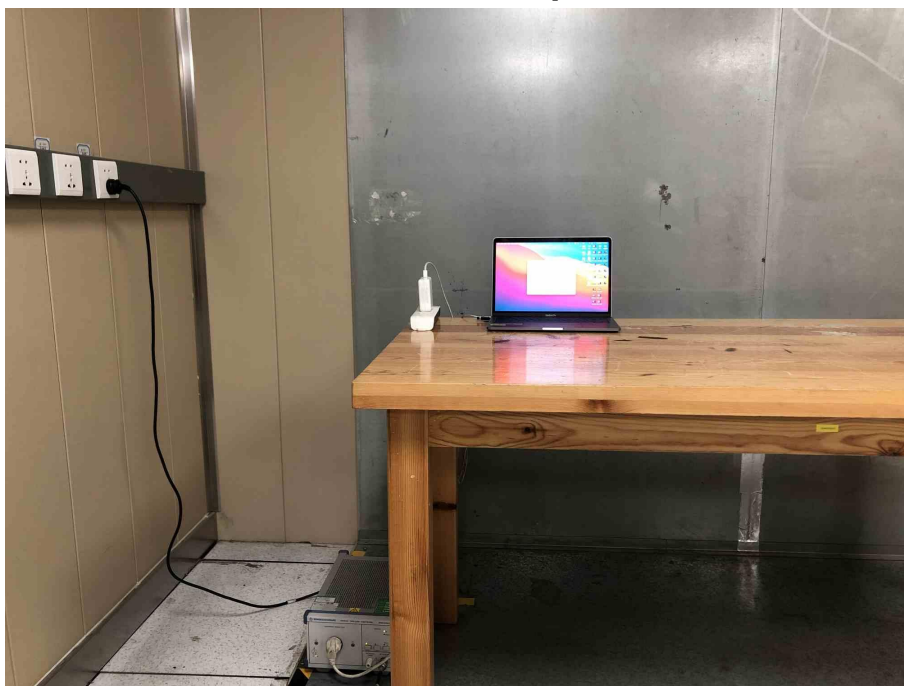
30MHz~1GHz:



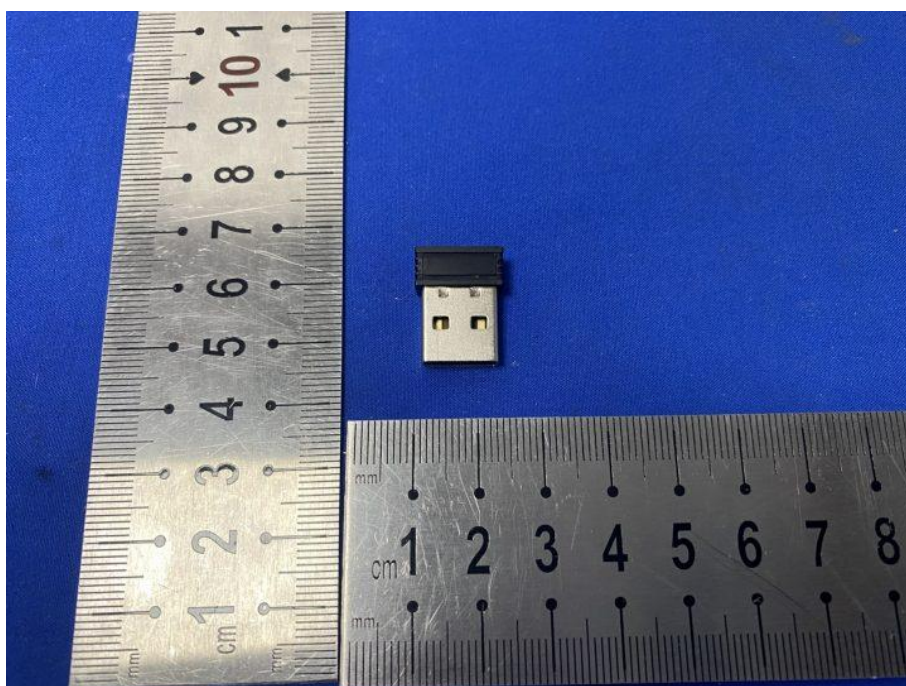
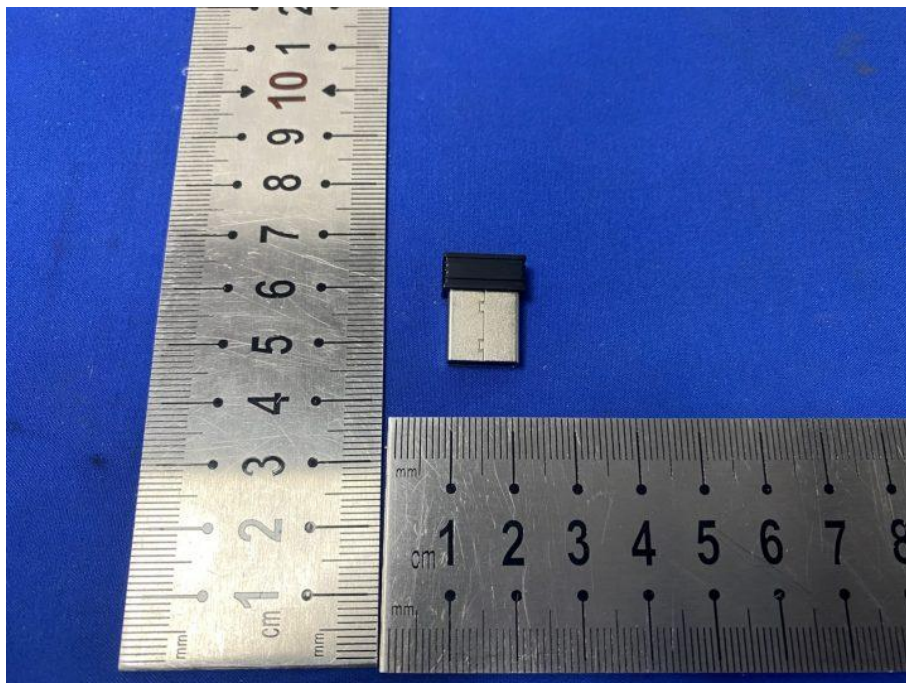
Above 1GHz:

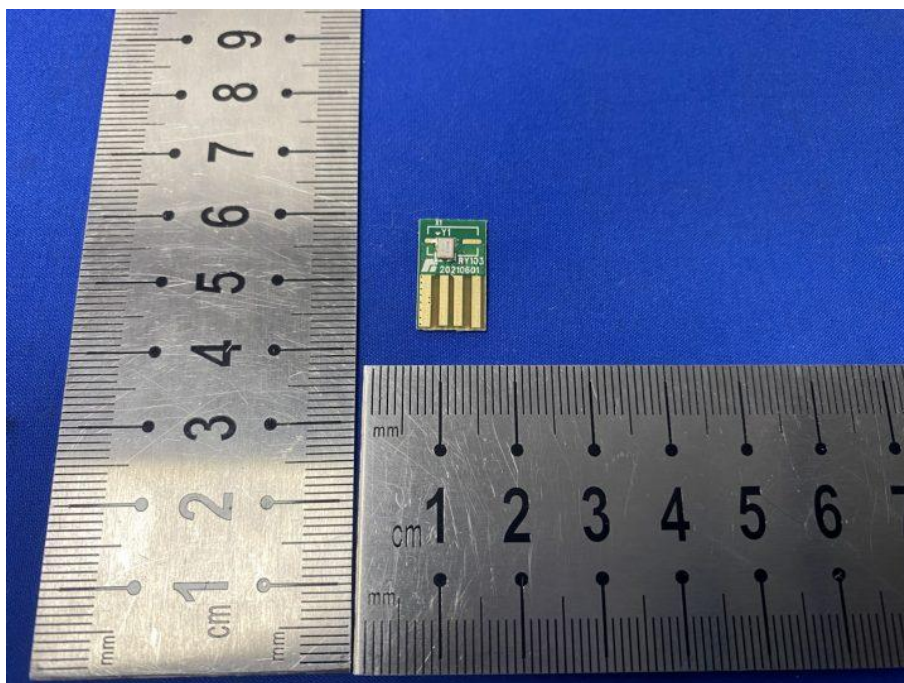
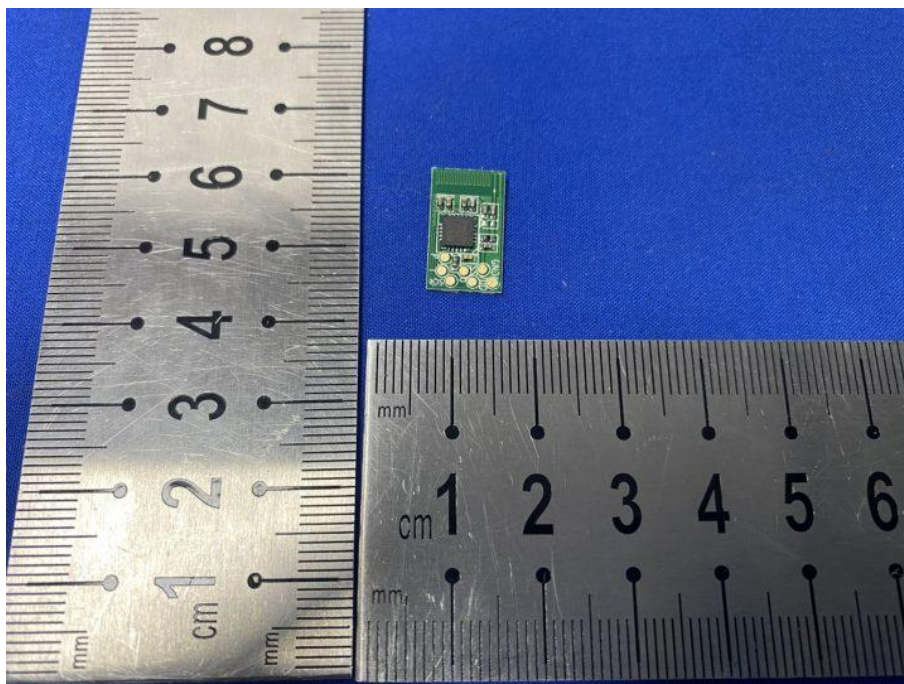


6.2 Conducted Emission Test Setup



6.3 EUT Constructional Details





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