FCC TEST REPORT

FCC ID: 2BHA7-MQ-QS2T-001

Product	:	Johnson Generation 2
Model Name	:	MQ-QS2T-001
Brand	:	N/A
Report No.	:	PTC24050812004E-FC01

Prepared for

Dongguan MoQu Technology Co., Ltd.

Room 402, Building 3, No.13, Qiaozi Road, Changping Town, Dongguan City, Guangdong Province, China

Prepared by

Precise Testing & Certification Co., Ltd

Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

1.TEST RESULT CERTIFICATION

Applicant's name	:	Dongguan MoQu Technology Co., Ltd.
Address	:	Room 402, Building 3, No.13, Qiaozi Road, Changping Town, Dongguan City, Guangdong Province, China
Manufacture's name	:	Dongguan MoQu Technology Co., Ltd.
Address	:	Room 402, Building 3, No.13, Qiaozi Road, Changping Town, Dongguan City, Guangdong Province, China
Product	:	Johnson Generation 2
Model	:	MQ-QS2T-001
Standards	:	FCC CFR47 Part 15 Section 15.231
Test procedure	:	ANSI C63.10:2013
Test Date	:	May. 20, 2024 to Jun. 28, 2024
Date of Issue	:	Jul. 01, 2024
Test Result	:	Pass

This device described above has been tested by PTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

Jack zhou / Engineer

Technical Manager:

Simon Pu / Manager

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2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	N/A
Transmission Cease Time	15.231(a)	PASS
Radiated Emission	15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside of Band Emission	15.231(b) 15.205 15.209	PASS
20dB Bandwidth	15:215(c)	PASS
Antenna Requirement	15.203	PASS
Remark: N/A: Not Applicable		

3 General Information

3.1 General Description of E.U.T.

Product Name : Johnson Generation 2

Model Name : MQ-QS2T-001

Operation Frequency: : 433.92MHz

Antenna installation: : PCB Antenna

Antenna Gain: : 0dBi

Type of Modulation : ASK

Power supply : Lithium Cell : DC 3V

3.2 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Modulation	Test mode	Low channel	Middle channel	High channel
ASK	continuously Transmitting	433.92MHz	\	\

3.3 Test Site

Precise Testing & Certification Co., Ltd

Address: Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A

FCC Designation Number: CN1219

4 Equipment During Test

4.1 Equipments List

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibration Interval
1	EMI Test Receiver	Rohde & Schwarz	ESCI7	101671	Aug. 17,2023	1 Year
2	EMC Analyzer (9k~26.5GHz)	Agilent	E4407B	MY45109572	Aug.22, 2023	1 Year
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3355	Aug. 17,2023	1 Year
4	Amplifier	SCHWARZBECK	BBV 9475	9745-0013	Aug. 17,2023	1 Year
5	Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1246	Aug. 17,2023	1 Year
6	Coaxial Cable(below 1GHz)	LARGE	CALB1	-	Aug. 17,2023	1 Year
7	Coaxial Cable(above 1GHz)	LARGE	CALB2	-	Aug. 17,2023	1 Year
8	Loop Antenna	Schwarzbeck	FMZB 1519	012	Aug. 17,2023	1 Year

4.2 Measurement Uncertainty

Parameter	**Uncertainty**
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10^{-6}
Bandwidth	± 1.5 x 10^{-6}
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(9kHz~30MHz)	±3.15dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

5 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method	:	ANSI C63.10: 2013
Test Result	:	PASS
Frequency Range	:	150kHz to 30MHz
Class/Severity	:	Class B

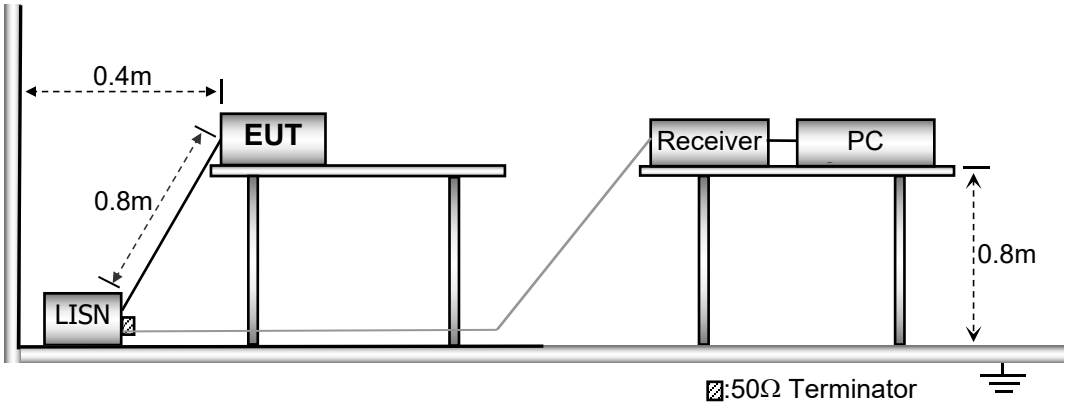
5.1 E.U.T. Operation

Operating Environment :

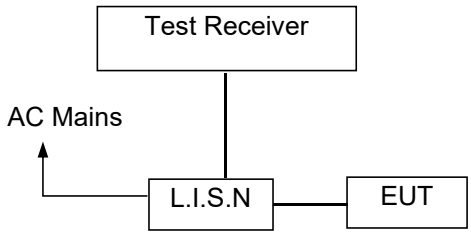
Temperature	:	23.9 °C
Humidity	:	51.4 % RH
Atmospheric Pressure	:	101.21kPa

5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



5.3 Test SET-UP (Block Diagram of Configuration)



5.4 Measurement Procedure

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

5.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:
1. The lower limit shall apply at the transition frequencies
2.The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

5.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

5.7 Conducted Emission Test Result

N/A

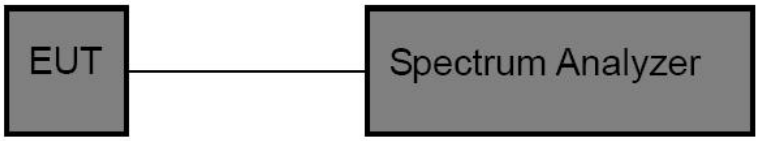
Note: Powered by non-rechargeable lithium cell.

6 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

6.1 Test Setup



Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

Duty Cycle Correction Factor (dB)=20 * Log_{10}(Duty Cycle(%))

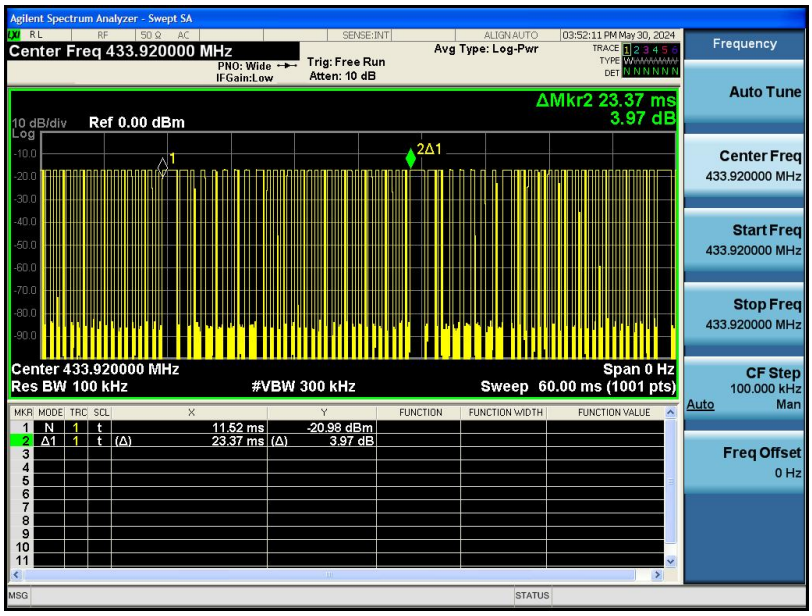
Total transmission time(ms)	1.36*1+0.69*2+0.32*27=11.38
Length of a complete transmission period(ms)	23.37
Duty Cycle(%)	48.90
Duty Cycle Correction Factor(dB)	-6.21

Refer to the duty cycle plot (as below), This device meets the FCC requirement.

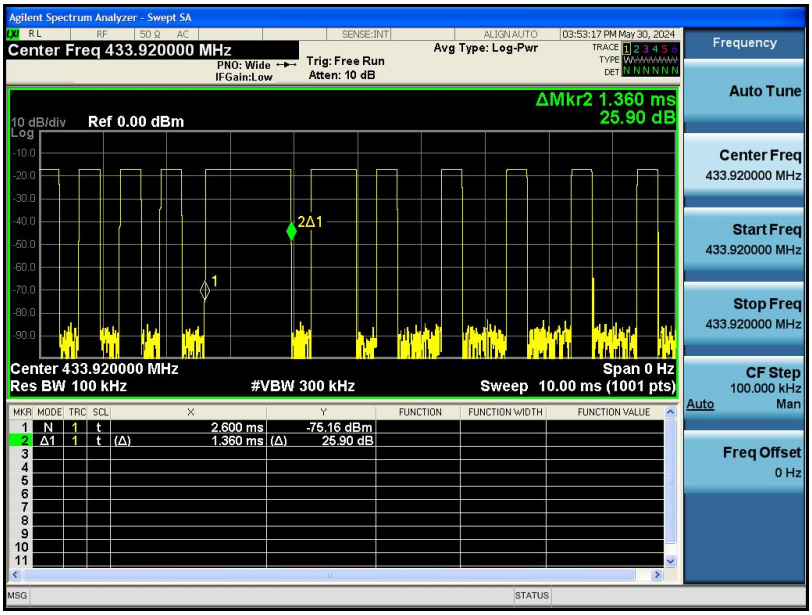
Length of a complete pulse train:

Remark: FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

Tp


Agilent Spectrum Analyzer - Swept SA
Center Freq 433.920000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
03:52:11 PM May 30, 2024
ΔMkr2 23.37 ms
3.97 dB
10 dB/div
Ref 0.00 dBm
Log
Center 433.920000 MHz
Span 0 Hz
Res BW 100 kHz
#VBW 300 kHz
Sweep 60.00 ms (1001 pts)
1 N 1 t 11.52 ms -20.98 dBm
2 Δ1 1 t (Δ) 23.37 ms (Δ) 3.97 dB
Frequency
Auto Tune
Center Freq
433.920000 MHz
Start Freq
433.920000 MHz
Stop Freq
433.920000 MHz
CF Step
100.000 kHz
Auto
Man
Freq Offset
0 Hz

Pulse 1


Agilent Spectrum Analyzer - Swept SA
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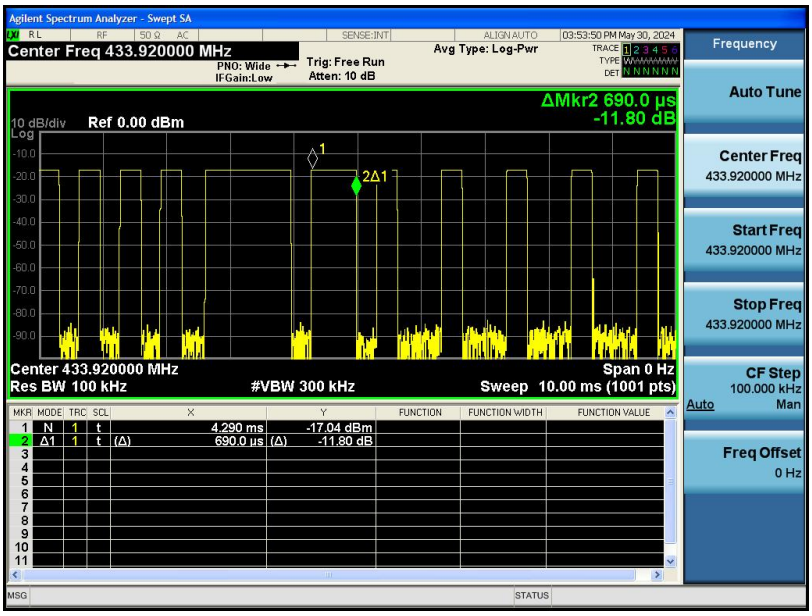
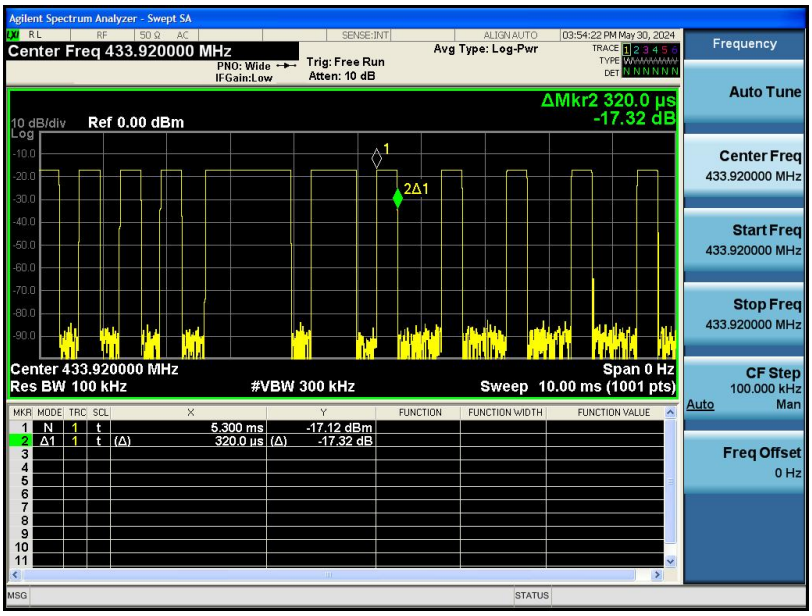
03:53:17 PM May 30, 2024
ΔMkr2 1.360 ms
25.90 dB
10 dB/div
Ref 0.00 dBm
Log
Center 433.920000 MHz
Span 0 Hz
Res BW 100 kHz
#VBW 300 kHz
Sweep 10.00 ms (1001 pts)
1 N 1 t 2.600 ms -75.16 dBm
2 Δ1 1 t (Δ) 1.360 ms (Δ) 25.90 dB
Frequency
Auto Tune
Center Freq
433.920000 MHz
Start Freq
433.920000 MHz
Stop Freq
433.920000 MHz
CF Step
100.000 kHz
Auto
Man
Freq Offset
0 Hz

Pulse 2

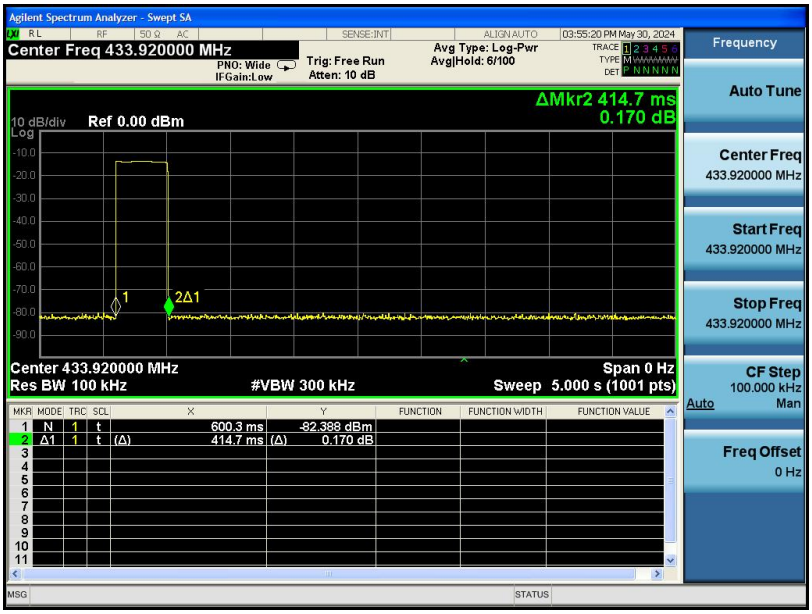


Pulse 3



FCC Part15.231 (a) (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.



7 Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.231 & 15.207 &15.205

Test Method: : ANSI C63.10:2013

Test Result: : PASS

Measurement Distance: : 3m

Limit: : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750	125 to 375
174-260	3,750	375
260-470	3,750 to 12,500	375 to 1250
Above 470	12,500	1,250

Note: Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, μV/m at 3 meters = 56.81818(F) - 6136.3636; for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

7.1 EUT Operation

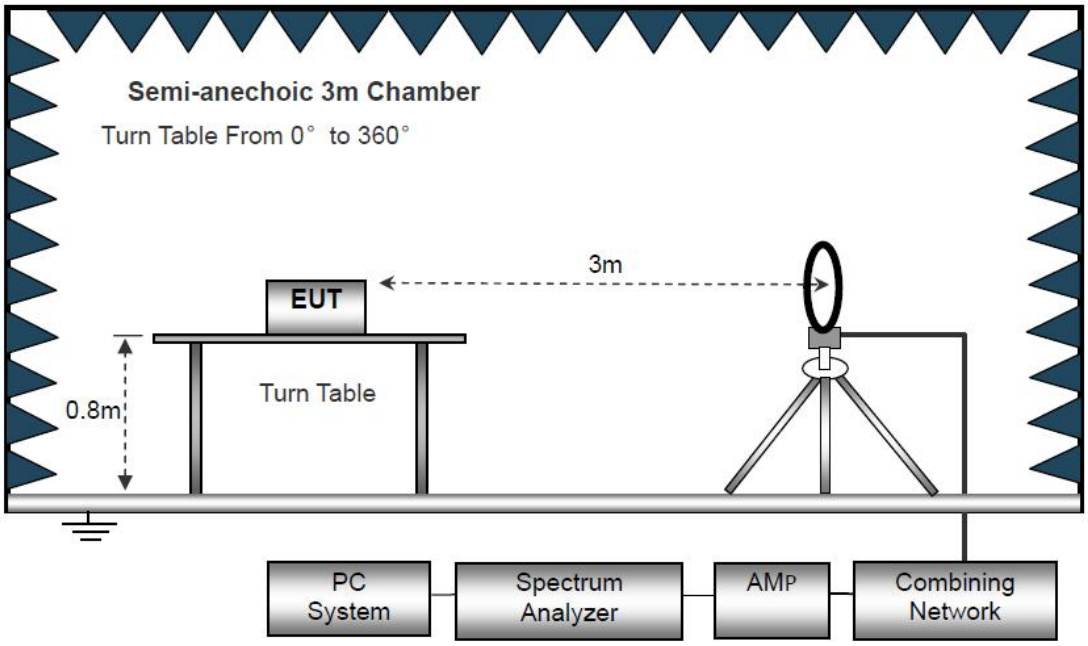
Operating Environment :

Temperature:	:	23.5 °C
Humidity:	:	51.1 % RH
Atmospheric Pressure:	:	101.2kPa
EUT Operation :	:	Refer to section 3.3

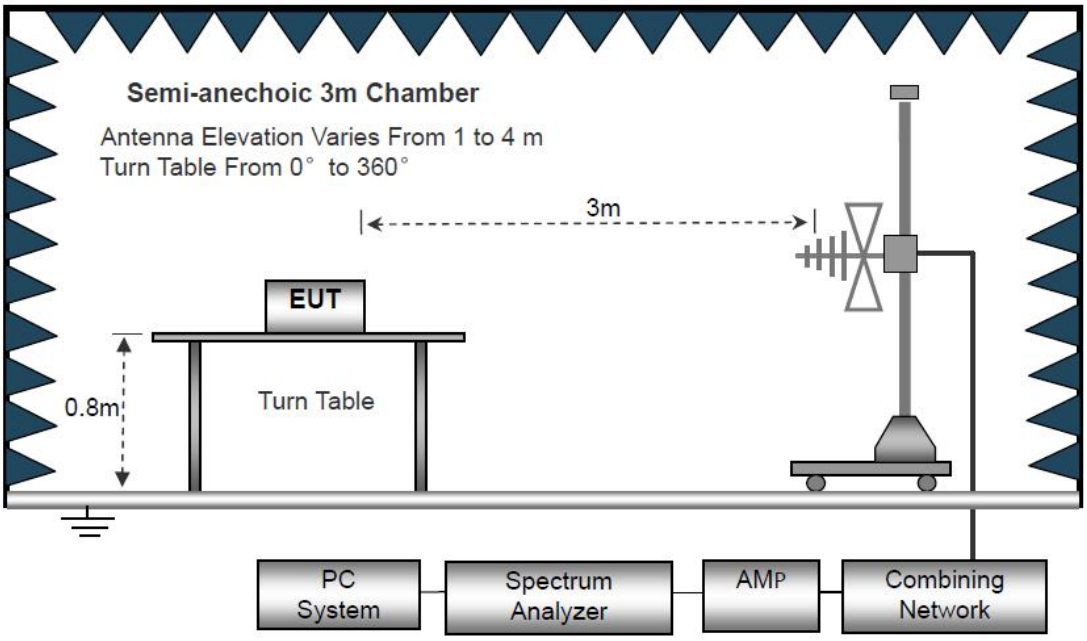
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

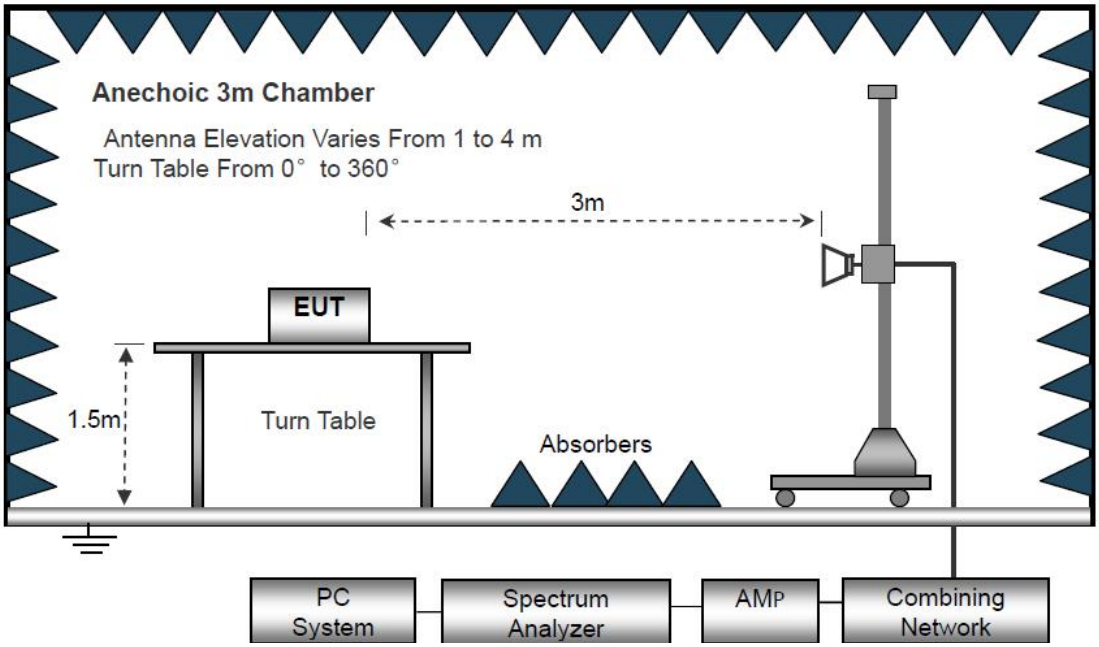
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



7.3 Spectrum Analyzer Setup

Below 30MHz

IF Bandwidth		10kHz
Resolution Bandwidth		10kHz
Video Bandwidth		10kHz

30MHz ~ 1GHz

Detector	:	PK
Resolution Bandwidth	:	100kHz
Video Bandwidth	:	300kHz
Detector	:	QP
Resolution Bandwidth	:	120kHz
Video Bandwidth	:	300kHz

Above 1GHz

Detector	:	PK
Resolution Bandwidth	:	1MHz
Video Bandwidth	:	3MHz
Detector	:	AV
Resolution Bandwidth	:	1MHz
Video Bandwidth	:	10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m or 1.5m above ground plane.

2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.

5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

6. Repeat above procedures until the measurements for all frequencies are complete.

7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

8. The test above 1GHz must be use the fully anechoic room, and the test below 1GHz use the half anechoic room

7.5 Summary of Test Results

Test Frequency: Below 30MHz

The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

Test Frequency: 30MHz ~ 5GHz

All applicable test modes have been tested with TX mode(433.86MHz)

Test Result of Fundamental Emission:

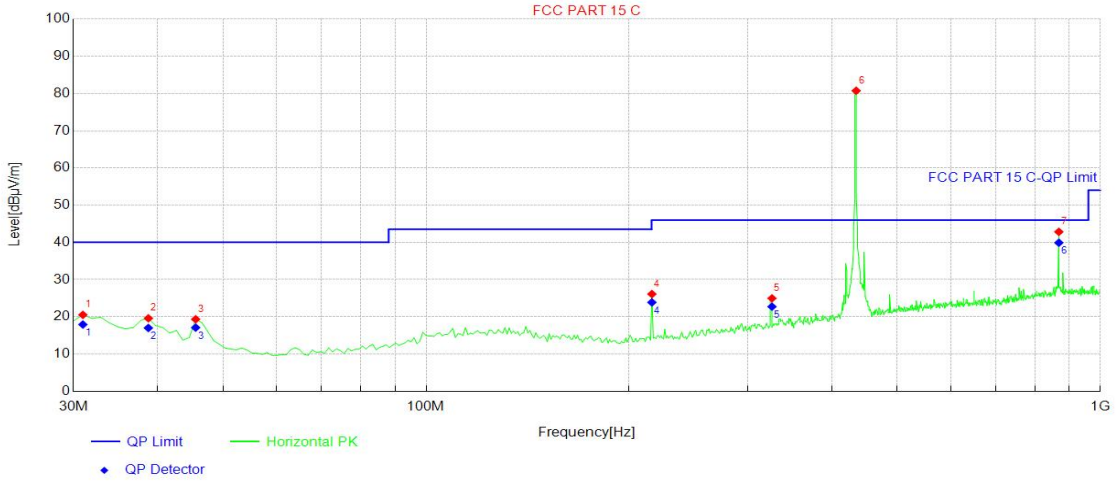
Frequency (MHz)	Reading (dBuV)	Factor (dB)	Peak Value (dBμV/m)	PDCF	Average value (dBuV/m)	Average Limit (dBμV/m)	Margin Limit (dB)	Polarization
433.92	91.68	12.32	79.36	-6.21	73.15	80.8	7.65	H
433.92	87.64	12.32	75.32	-6.21	69.11	80.8	11.69	V

Note: PDCF is the abbreviation of duty cycle factor, DCF= 20 log(Duty cycle).

Test Result of Spurious Emissions:

Blow 1GHz:

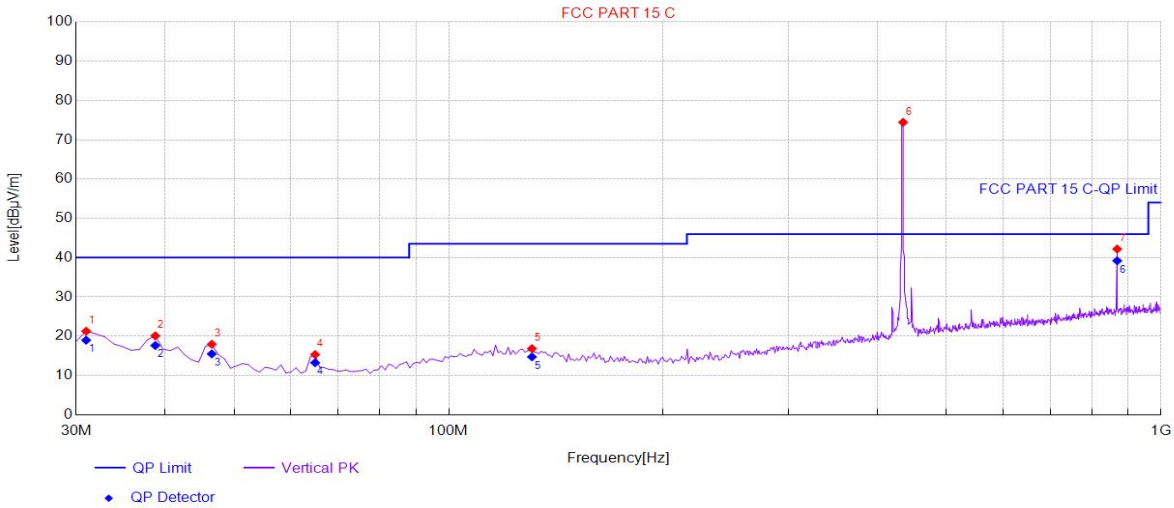
Antenna Polarization: Horizontal



Final Data List[QP]								
NO.	Freq. [MHz]	QP Reading [dBµV]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity	Verdict
1	30.97	31.85	-13.94	17.91	40.00	22.09	Horizontal	PASS
2	38.73	34.17	-17.18	16.99	40.00	23.01	Horizontal	PASS
3	45.52	36.89	-19.80	17.09	40.00	22.91	Horizontal	PASS
4	216.24	43.23	-19.36	23.87	46.00	22.13	Horizontal	PASS
5	325.85	38.41	-15.69	22.72	46.00	23.28	Horizontal	PASS
6	868.08	47.11	-7.21	39.90	46.00	6.10	Horizontal	PASS

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Antenna Polarization: Vertical



Final Data List[QP]								
NO.	Freq. [MHz]	QP Reading [dBµV]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity	Verdict
1	30.97	32.91	-13.94	18.97	40.00	21.03	Vertical	PASS
2	38.73	34.80	-17.18	17.62	40.00	22.38	Vertical	PASS
3	46.49	35.65	-20.17	15.48	40.00	24.52	Vertical	PASS
4	64.92	36.62	-23.39	13.23	40.00	26.77	Vertical	PASS
5	130.88	32.03	-17.31	14.72	43.50	28.78	Vertical	PASS
6	868.08	46.41	-7.21	39.20	46.00	6.80	Vertical	PASS

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Above 1GHz:

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB]	PDCF	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Detector
1	1301.76	52.01	-11.6	/	40.41	74	33.59	PASS	H	PK
2	1735.68	55.30	-7.98	/	47.32	74	26.68	PASS	H	PK
3	2169.6	52.22	-6.99	/	45.23	74	28.77	PASS	H	PK
4	2603.52	55.04	-4.31	/	50.73	74	23.27	PASS	H	PK
5	3037.44	50.73	-3.5	/	47.23	74	26.77	PASS	H	PK
6	3471.36	51.61	-0.38	/	51.23	74	22.77	PASS	H	PK
7	1301.76	57.23	-11.6	/	45.63	74	28.37	PASS	V	PK
8	1735.68	54.37	-7.98	/	46.39	74	27.61	PASS	V	PK
9	2169.6	55.24	-6.99	/	48.25	74	25.75	PASS	V	PK
10	2603.52	51.95	-4.07	/	47.88	74	26.12	PASS	V	PK
11	3037.44	49.07	-1.91	/	47.16	74	26.84	PASS	V	PK
12	3471.36	48.98	1.25	/	50.23	74	23.77	PASS	V	PK

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB]	PDCF	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Detector
1	1301.76	52.09	-11.6	-6.21	34.28	54	19.72	PASS	H	AV
2	1735.68	55.25	-7.98	-6.21	41.06	54	12.94	PASS	H	AV
3	2169.6	52.87	-6.99	-6.21	39.67	54	14.33	PASS	H	AV
4	2603.52	55.65	-4.31	-6.21	45.13	54	8.87	PASS	H	AV
5	3037.44	51.3	-3.5	-6.21	41.59	54	12.41	PASS	H	AV
6	3471.36	51.36	-0.38	-6.21	44.77	54	9.23	PASS	H	AV
7	1301.76	57.94	-11.6	-6.21	40.13	54	13.87	PASS	V	AV
8	1735.68	55.29	-7.98	-6.21	41.10	54	12.9	PASS	V	AV
9	2169.6	54.86	-6.99	-6.21	41.66	54	12.34	PASS	V	AV
10	2603.52	51.51	-4.07	-6.21	41.23	54	12.77	PASS	V	AV
11	3037.44	49.84	-1.91	-6.21	41.72	54	12.28	PASS	V	AV
12	3471.36	49.84	1.25	-6.21	44.88	54	9.12	PASS	V	AV

Remark:

1.The field strength is calculated by adding the Antenna Factor, Cable Factor and Preamplifier.

The formula is as follows is as follows:

Final Test Level =Receiver Reading +Correct Factor

8 20dB Bandwidth Measurement

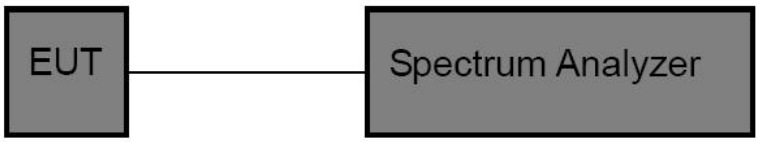
Test Requirement	:	FCC Part15.231(c)
Test Method	:	FCC Part15.231(c)
Test Mode	:	Refer to section 3.3
Limit	:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 1% to 5% of the OBW, VBW = three times the RBW,

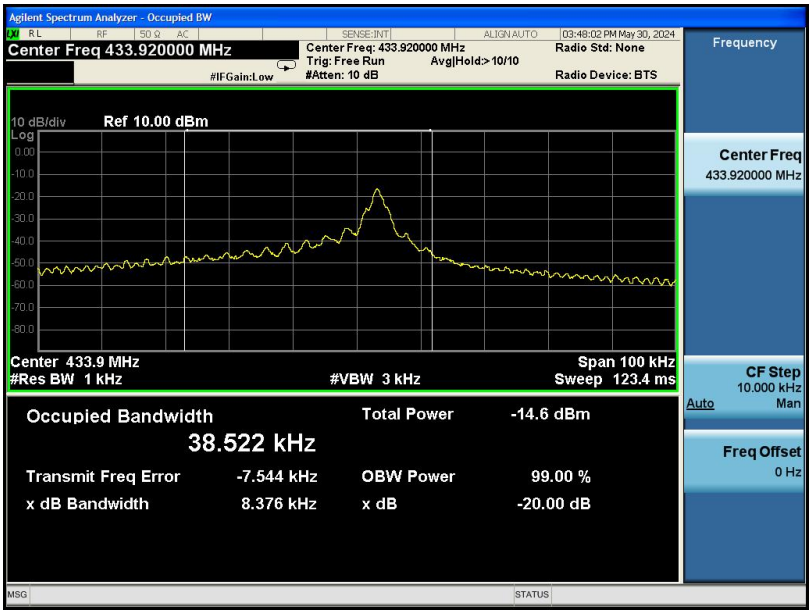
8.2 Test Setup



8.3 Test Result

Test Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
433.86	8.376	1084.80	pass

Test plots

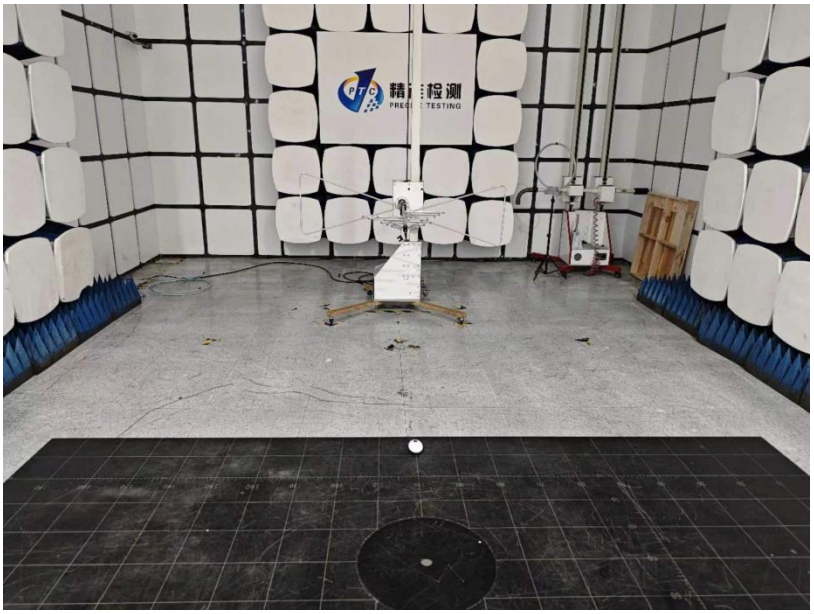


9 Antenna Requirement

According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has an PCB Antenna which meet the requirement of this section.

10 Test Setup

Radiated Spurious Emissions
From 30MHz-1000MHz



Above 1GHz

11 EUT Photos

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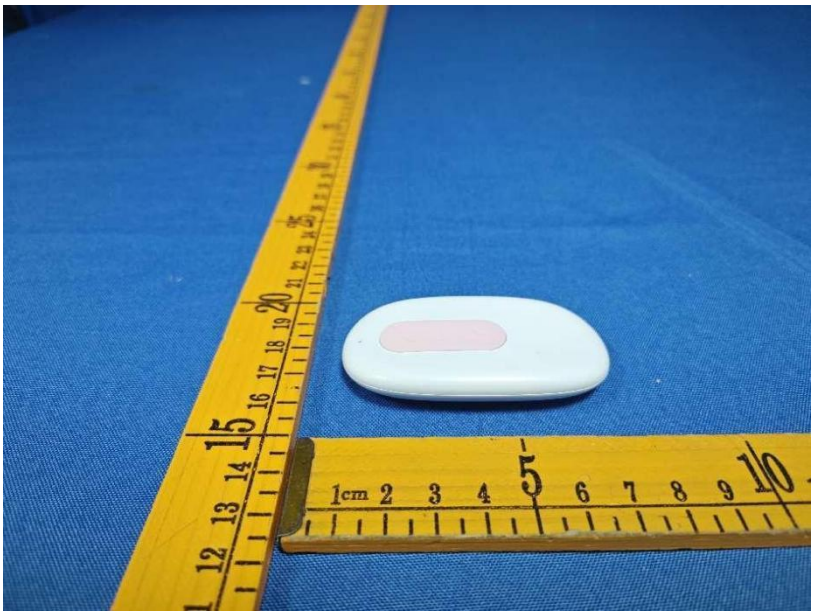
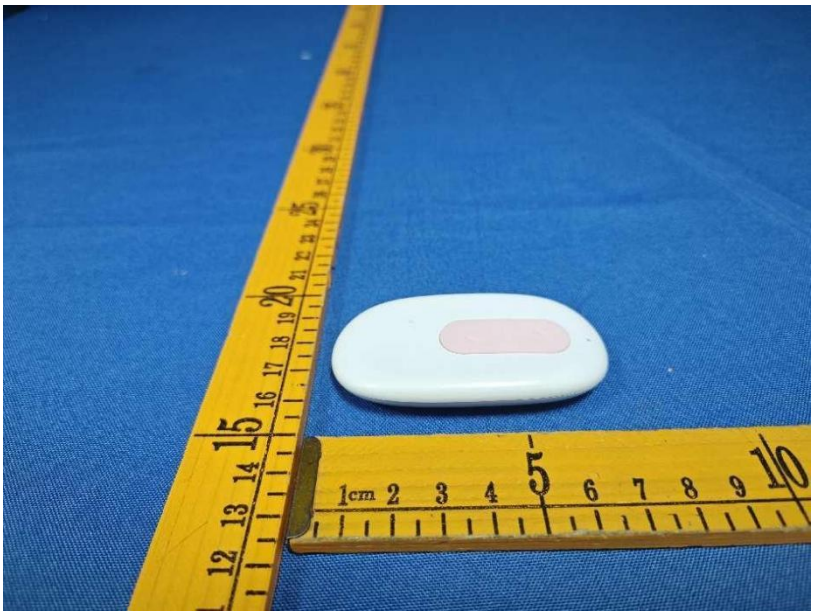
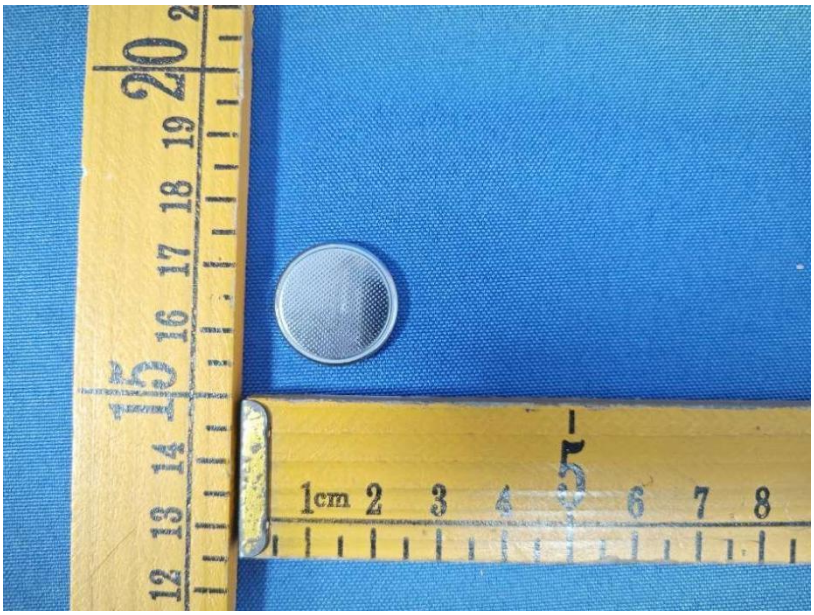

1cm 2 3 4 5 6 7 8 9 10
12 13 14 15 16 17 18 19 20

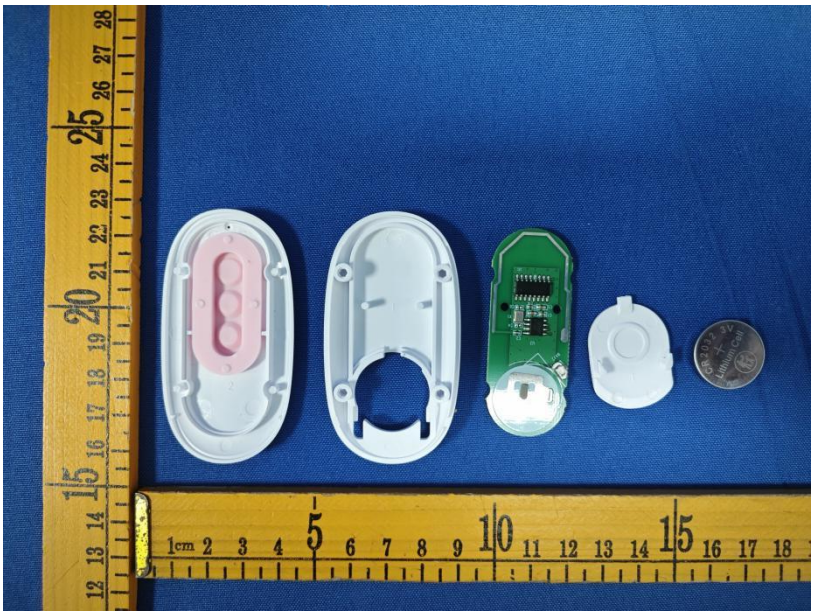
1cm 2 3 4 5 6 7 8
12 13 14 15 16 17 18 19 20

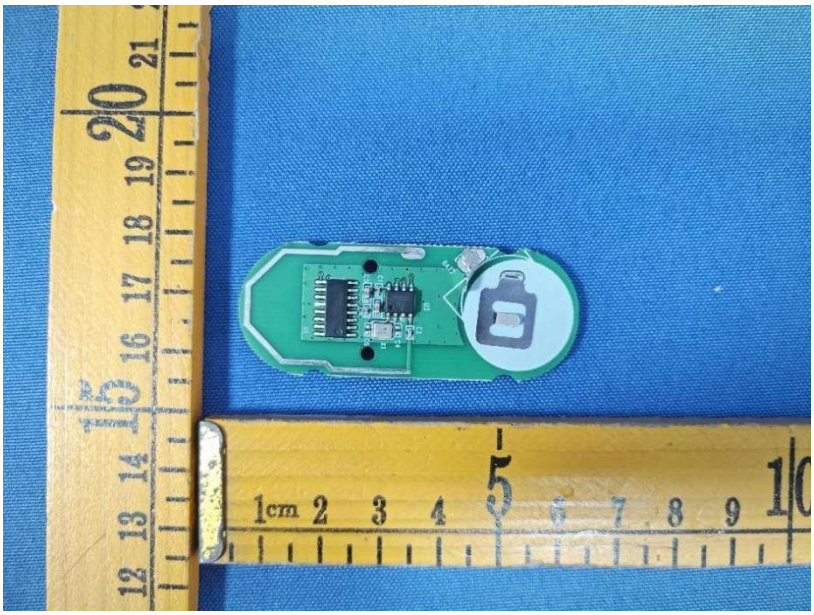

1cm 2 3 4 5 6 7 8 9 10
12 13 14 15 16 17 18 19 20

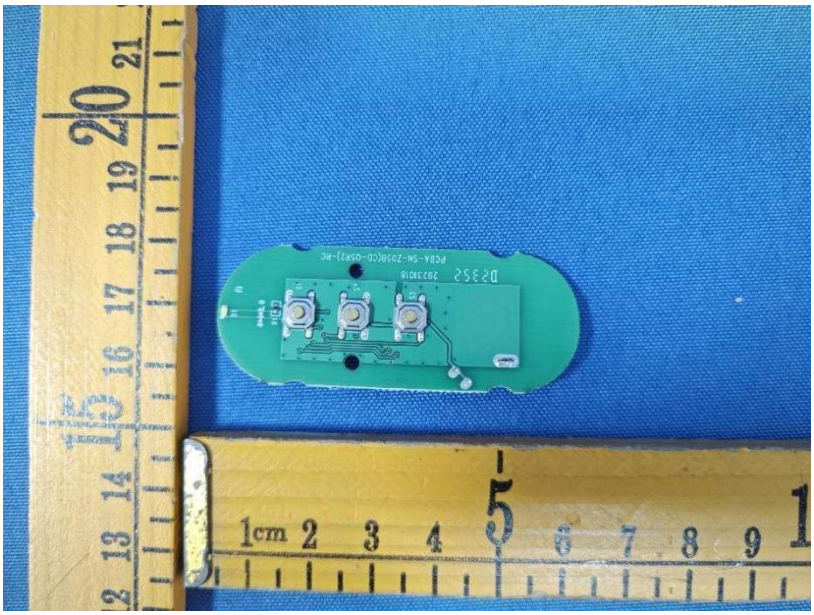
1cm 2 3 4 5 6 7 8
12 13 14 15 16 17 18 19 20



Lithium Cell







********THE END REPORT********