Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.231(e)

Report Reference No.....:	**GTS20230331013-1-6**
FCC ID..... :	**2BAU6M3-2**
Compiled by (position+printed name+signature) .:	File administrators Peter Xiao
Supervised by (position+printed name+signature) .:	Test Engineer Jenny Zeng
Approved by (position+printed name+signature) .:	Manager Jason Hu
Date of issue .....:	Apr.23, 2023
Representative Laboratory Name.:	**Shenzhen Global Test Service Co.,Ltd.**
Address .....:	No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong,China
Applicant's name.....:	**Dongguan FutureX Limited**
Address .....:	Room 202, Building 6, No. 24, Gongye East Road, Songshanhu Park, Dongguan, Guangdong, China
Test specification.....**:**	
Standard.....:	**FCC Part 15.231(e)**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF .....:	Dated 2014-12

Test item description .....:	**intelligent robot vacuum cleaner**
Trade Mark .....:	N/A
Manufacturer .....:	Dongguan FutureX Limited
Model/Type reference .....:	M3-2
Listed Models .....:	N/A
Modulation Type.....:	GFSK
Operation Frequency.....:	From 433.0-445.0MHz
Hardware Version .....:	N/A
Software Version .....:	N/A
Rating .....:	DC 14.6V by battery Recharged by DC 24.0V
Result .....:	**PASS**

TEST REPORT

Test Report No. :	**GTS20230331013-1-6**	Apr.23, 2023 Date of issue

Equipment under Test	:	intelligent robot vacuum cleaner
Model /Type	:	M3-2
Listed model	:	N/A
Applicant	:	**Dongguan FutureX Limited**
Address	:	Room 202, Building 6, No. 24, Gongye East Road, Songshanhu Park, Dongguan, Guangdong, China
Manufacturer	:	**Dongguan FutureX Limited**
Address	:	Room 202, Building 6, No. 24, Gongye East Road, Songshanhu Park, Dongguan, Guangdong, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.231: Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	Apr. 06, 2023
Testing commenced on	:	Apr. 06, 2023
Testing concluded on	:	Apr. 23, 2023

2.2. Product Description

Product Name	intelligent robot vacuum cleaner
Trade Mark	N/A
Model/Type reference	M3-2
List Models	N/A
Model Declaration	N/A
Power supply:	DC 14.6V by battery Recharged by DC 24.0V
Sample ID	GTS20230331013-1-S0001-1#&GTS20230331013-1-S0001-2#
WIFI(2.4G Band)	
Frequency Range	2412MHz ~ 2462MHz
Channel Spacing	5MHz
Channel Number	11 Channel for 20MHz bandwidth(2412~2462MHz) 7 Channel for 40MHz bandwidth(2422~2452MHz)
Modulation Type	802.11b: DSSS; 802.11g/n: OFDM
Antenna Description	Internal Antenna, 0.79dBi(Max.)
SRD	
Frequency Range	433.0-445.0MHz
Channel Number	16 Channels
Modulation Type	GFSK
Antenna Description	Internal Antenna, 0dBi(Max.)

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 14.6V

2.4. Short description of the Equipment under Test (EUT)

This is a intelligent robot vacuum cleaner .
For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

Mode of Operations	Frequency Range (MHz)	Data Rate (Mbps)
SRD	433.0	1
	439.4	1
	445.0	1
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

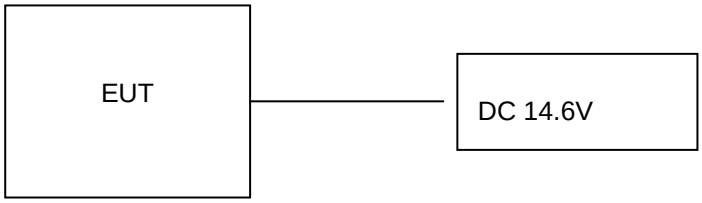
Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	**433.0**	**9**	**439.4**
2	433.8	10	440.2
3	434.6	11	441.0
4	435.4	12	441.8
5	436.2	13	442.6
6	437.0	14	443.4
7	437.8	15	444.2
8	438.6	**16**	**445.0**

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be SRD mode.

2.6. Block Diagram of Test Setup



2.7. EUT Exercise Software

After the product is powered on, the signal is transmitted through the operation button.

2.8. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
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2.9. External I/O Cable

I/O Port Description	Quantity	Cable
DC Interface	1	N/A

2.10. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2BAU6M3-2** filing to comply with Section 15.231 of the FCC Part 15, Subpart C Rules.

2.11. Modifications

No modifications were implemented to meet testing criteria.

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong,China.

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS (No. CNAS L8169)
Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.
A2LA (Certificate No. 4758.01)
Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.
Industry Canada Registration Number. is 24189.
FCC Designation Number is CN1234.
FCC Registered Test Site Number is165725.

3.3. Environmental conditions

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

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. 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 Global Test Service 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 Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

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

3.5. Test Description

Applied Standard: FCC Part 15 Subpart C				
ISED Rules	Description of Test	Test Sample	Result	Remark
§15.203	Antenna Requirement	GTS20230331013-1-S0001-1#	/	/
§15.205	Restricted Bands Of Operation	GTS20230331013-1-S0001-1#	Compliant	Note 1
§15.209	Radiated Emission Limits, General Requirements.	GTS20230331013-1-S0001-1# GTS20230331013-1-S0001-2#	Compliant	Note 1
§15.231 (e)	Field Strength Of Fundamental and Harmonics	GTS20230331013-1-S0001-1# GTS20230331013-1-S0001-2#	Compliant	Note 1
§15.231 (c)	20dB Bandwidth	GTS20230331013-1-S0001-1#	Compliant	Note 1
§15.231 (e)	Duration of each Transmission and the silent period	GTS20230331013-1-S0001-1#	Compliant	Note 1
§15.231	Duty cycle Factor	GTS20230331013-1-S0001-1#	Compliant	Note 1
§15.207	AC Conducted Emissions	GTS20230331013-1-S0001-2#	Compliant	Note 1

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. Note 1 – Test results inside test report;
4. Note 2 – Test results in other test report (MPE Report).
5. We tested all test mode and recorded worst case in report

3.6. Equipments Used during the Test

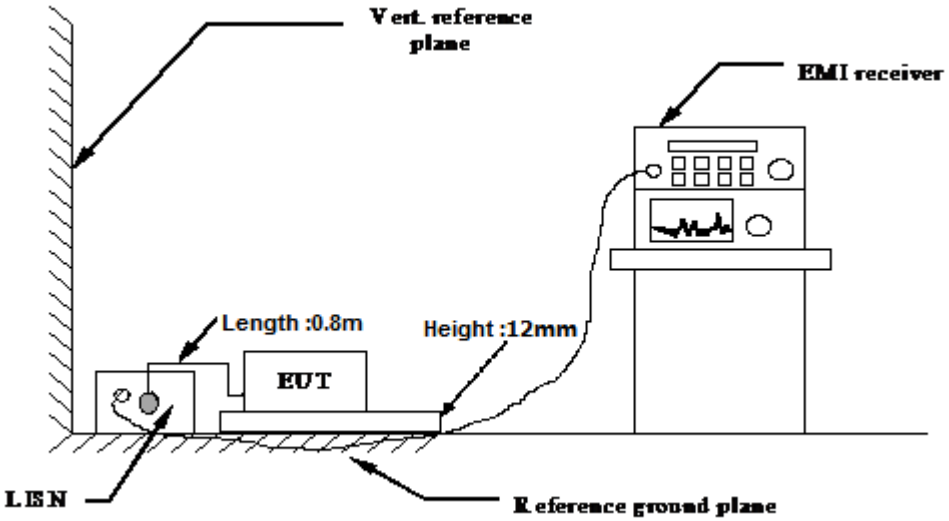
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	CYBERTEK	EM5040A	E1850400105	2022/07/13	2023/07/12
LISN	R&S	ESH2-Z5	893606/008	2022/07/13	2023/07/12
EMI Test Receiver	R&S	ESPI3	101841-cd	2022/07/13	2023/07/12
EMI Test Receiver	R&S	ESCI7	101102	2021/09/19	2022/09/18
Spectrum Analyzer	Agilent	N9020A	MY48010425	2021/09/19	2022/09/18
Spectrum Analyzer	R&S	FSV40	100019	2022/07/13	2023/07/12
Vector Signal generator	Agilent	N5181A	MY49060502	2022/07/13	2023/07/12
Signal generator	Agilent	N5182A	3610AO1069	2021/09/19	2022/09/18
Climate Chamber	ESPEC	EL-10KA	A20120523	2021/09/19	2022/09/18
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2021/09/19	2022/09/18
Active Loop Antenna	Beijing Da Ze Technology Co.,Ltd.	ZN30900C	15006	2021/09/19	2022/09/18
Bilog Antenna	Schwarzbeck	VULB9163	000976	2021/08/08	2022/08/07
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2021/09/19	2022/09/18
Amplifier	Schwarzbeck	BBV 9743	#202	2022/07/13	2023/07/12
Amplifier	Schwarzbeck	BBV9179	9719-025	2022/07/13	2023/07/12
Amplifier	EMCI	EMC051845B	980355	2022/07/13	2023/07/12
Temperature/Humidity Meter	Gangxing	CTH-608	02	2022/07/13	2023/07/12
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2022/07/13	2023/07/12
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2022/07/13	2023/07/12
RF Cable(below 1GHz)	HUBER+SUHNER	RG214	RE01	2022/07/13	2023/07/12
RF Cable(above 1GHz)	HUBER+SUHNER	RG214	RE02	2022/07/13	2023/07/12
Data acquisition card	Agilent	U2531A	TW53323507	2022/07/13	2023/07/12
Power Sensor	Agilent	U2021XA	MY5365004	2022/07/13	2023/07/12
Test Control Unit	Tonscend	JS0806-1	178060067	2022/07/13	2023/07/12
Automated filter bank	Tonscend	JS0806-F	19F8060177	2022/07/13	2023/07/12
EMI Test Software	Tonscend	JS1120-1	Ver 2.6.8.0518	/	/
EMI Test Software	Tonscend	JS1120-3	Ver 2.5.77.0418	/	/
EMI Test Software	Tonscend	JS32-CE	Ver 2.5	/	/
EMI Test Software	Tonscend	JS32-RE	Ver 2.5.1.8	/	/

Note: 1. The Cal.Interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a Floor-standing equipment, a wooden table with a height of 12mm is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4 The EUT received DC 24V power, the adapter received AC120V/60Hz or AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
6 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
7 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

Frequency range (MHz)	Limit (dBuV)	
	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.		

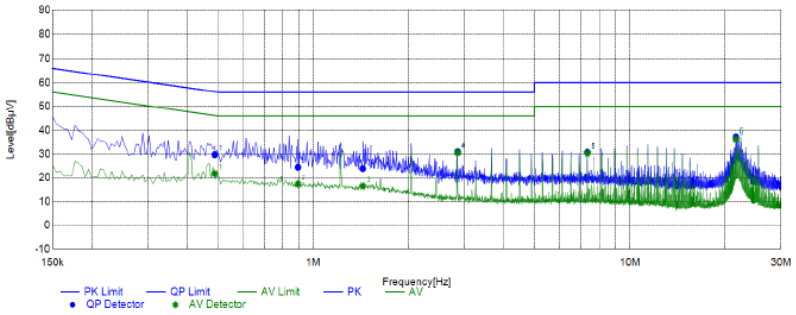
TEST RESULTS

Remark: We measured Conducted Emission at GFSK mode from 150 KHz to 30MHz in AC120V and the worst case was recorded.

Temperature	24.2℃	Humidity	54.2%
Test Engineer	Jenny Zeng	Configurations	SRD

Power supply:	AC 120V/60Hz	Polarization	L

Test Graph



Final Data List

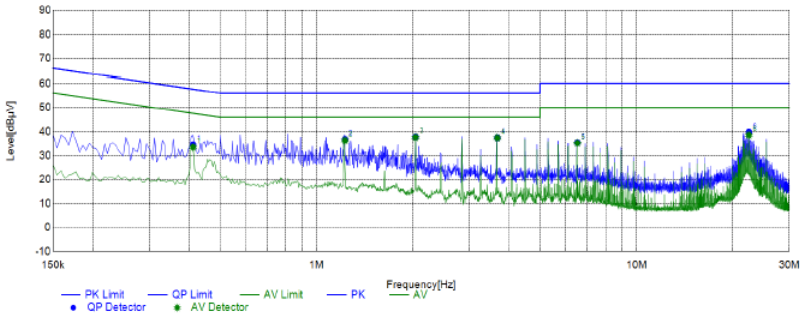
NO.	Frequency	QP Reading	AVG. Reading	Factor	QP Result	AVG. Result	QP Limit	AVG. Limit	QP Margin	AVG. Margin	Line	Remark
1	0.4883	20.38	12.33	9.40	29.78	21.73	56.20	46.20	26.42	24.47	L1	PASS
2	0.8947	15.06	8.06	9.37	24.43	17.43	56.00	46.00	31.57	28.57	L1	PASS
3	1.4346	14.49	7.20	9.38	23.87	16.58	56.00	46.00	32.13	29.42	L1	PASS
4	2.8585	21.64	21.31	9.35	30.99	30.66	56.00	46.00	25.01	15.34	L1	PASS
5	7.3470	21.46	21.15	9.28	30.74	30.43	60.00	50.00	29.26	19.57	L1	PASS
6	21.6320	27.95	26.97	9.23	37.18	36.20	60.00	50.00	22.82	13.80	L1	PASS

Note: 1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

Power supply:	AC 120V/60Hz	Polarization	N

Test Graph



Final Data List

NO.	Frequency	QP Reading	AVG. Reading	Factor	QP Result	AVG. Result	QP Limit	AVG. Limit	QP Margin	AVG. Margin	Line	Remark
1	0.4110	25.08	24.03	9.47	34.55	33.50	57.63	47.63	23.08	14.13	N	PASS
2	1.2262	27.37	26.96	9.38	36.75	36.34	56.00	46.00	19.25	9.66	N	PASS
3	2.0394	28.44	28.28	9.35	37.79	37.63	56.00	46.00	18.21	8.37	N	PASS
4	3.6720	28.06	28.00	9.37	37.43	37.37	56.00	46.00	18.57	8.63	N	PASS
5	6.5281	26.08	25.86	9.32	35.40	35.18	60.00	50.00	24.60	14.82	N	PASS
6	22.4412	30.48	29.31	9.24	39.72	38.55	60.00	50.00	20.28	11.45	N	PASS

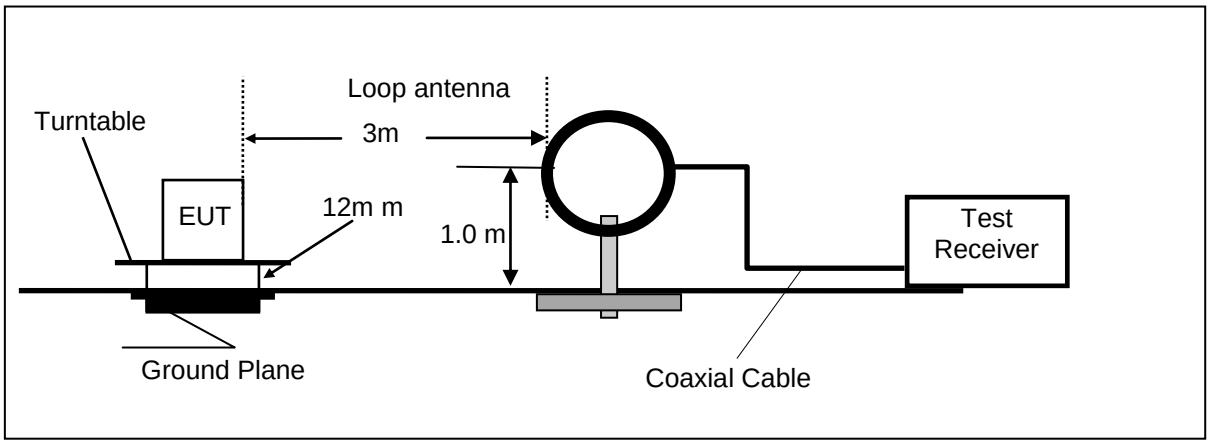
Note: 1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

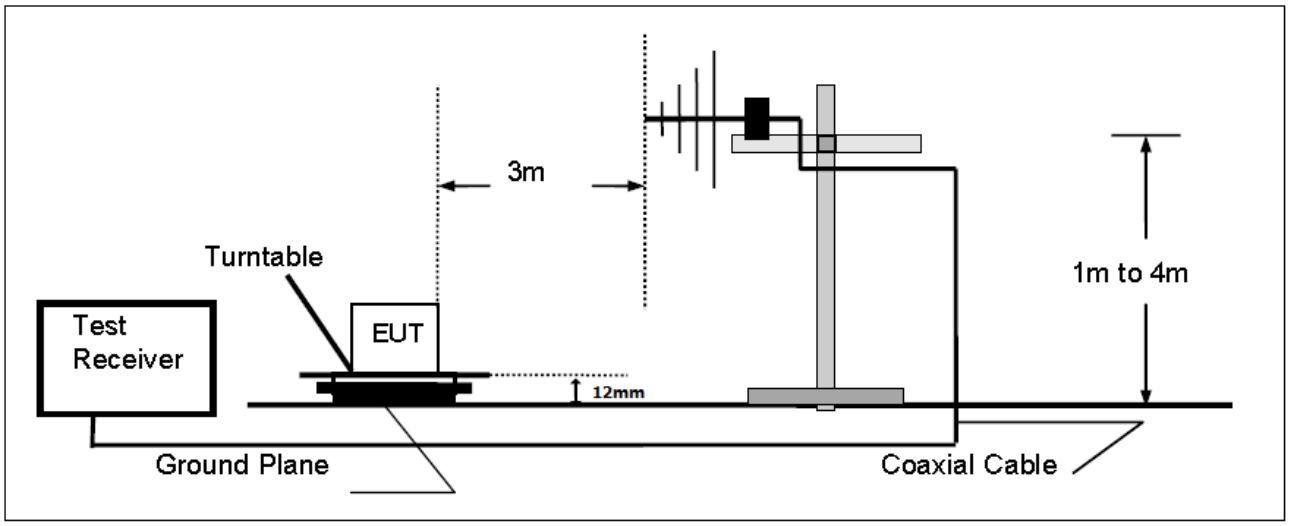
4.2. Transmitter Field Strength of Emissions

TEST CONFIGURATION

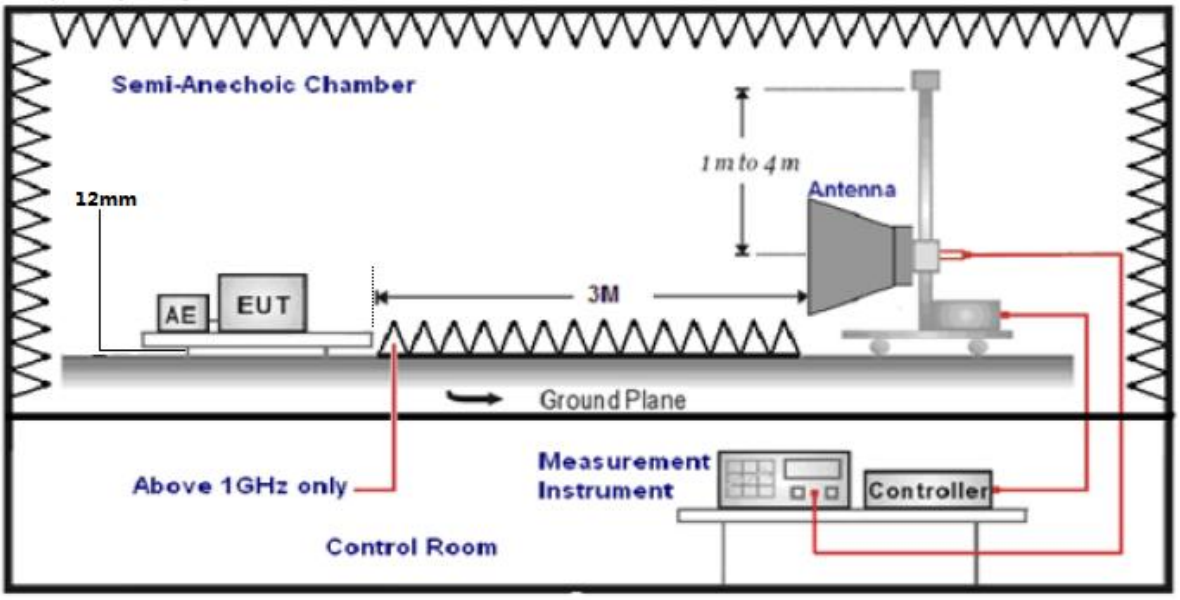
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 12mm above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 12mm above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 30MHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

According to §15.231 (e): 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:

Frequencies(MHz)	Field Strength (microvolts/meter)	Field Strength of spurious emissions(microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500	50 to 150
174-260	1,500	150
260-470	1,500 to 5,000	150 to 500
Above 470	5,000	500

[1]Linear interpolations.
[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 260-470 MHz, μV/m at 3 meters = 16.66667(F) - 2833.333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293.	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

** 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., Sections 15.231 and 15.241.
§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

TEST RESULTS

Remark: We measured Radiated Emission at OOK mode from 30 MHz to 25GHz in AC120V and the worst case was recorded.

Temperature	25℃	Humidity	60%
Test Engineer	Jenny Zeng	Configurations	SRD

For 9 KHz~30MHz

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:
The low frequency, which started from 9 KHz to 30 MHz, was pre-scan and the result was 20dB lower than the limit line per 15.31(o) was not reported.
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

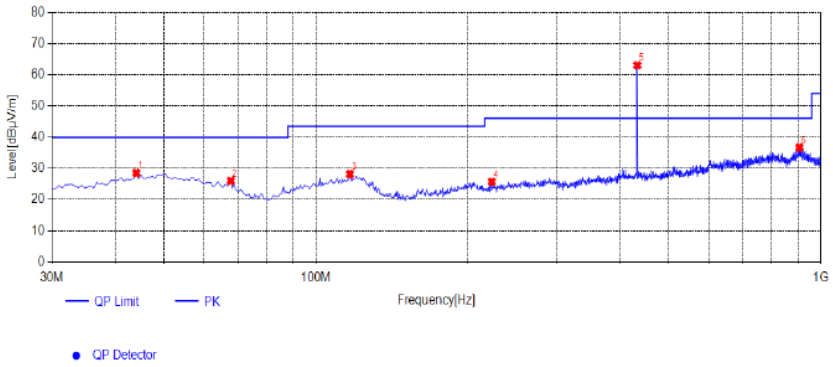
For 30MHz to 1000MHz

Fundamental and Harmonics Average Result						
Frequency (MHz)	Peak Level (dBμV/m)	AV Factor(dBμV/m) (see Section 4.5)	Average Level (dBμV/m)	Limit(dBμV/m) (average)	Margin(dB)	Conclusion
433.04	63.03	-11.40	51.63	72.84	21.21	PASS
439.86	62.76	-11.47	51.29	73.04	21.75	PASS
445.16	61.29	-11.21	50.08	73.22	23.14	PASS

Frequency (MHz)	Pol.	Measure Result(AV, dBuV/m)	ERP(dBm)	Limit (dBuV/m)	Result
433.04	H	51.63	-43.53	72.84	PASS
439.86	H	51.29	-43.87	73.04	PASS
445.16	H	50.08	-45.08	73.22	PASS

Horizontal(433.0MHz)

Test Graph



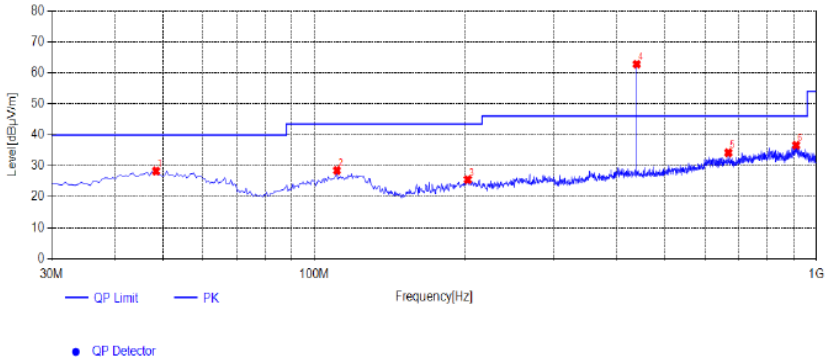
Suspected List											
NO.	Frequency [MHz]	Reading [dBμV/m]	Factor [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	44.065	44.42	-15.86	28.56	40.00	11.44	100	72	PK	Horizonta	PASS
2	67.83	44.60	-18.61	25.99	40.00	14.01	100	216	PK	Horizonta	PASS
3	116.815	46.91	-18.72	28.19	43.50	15.31	100	197	PK	Horizonta	PASS
4	223.03	44.56	-18.88	25.68	46.00	20.32	100	29	PK	Horizonta	PASS
5	433.035	77.39	-14.36	63.03	72.84	9.81	100	323	PK	Horizonta	PASS
6	907.85	44.27	-7.63	36.64	46.00	9.36	100	62	PK	Horizonta	PASS

Note: 1. Result (dBμV/m) = Reading(dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Horizontal(439.4MHz)

Test Graph



Suspected List

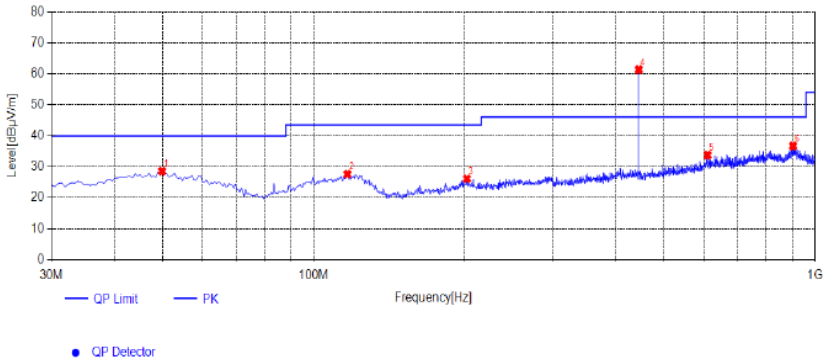
NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	48.43	44.12	-15.77	28.35	40.00	11.65	100	282	PK	Horizonta	PASS
2	110.995	46.51	-17.97	28.54	43.50	14.96	100	243	PK	Horizonta	PASS
3	202.175	43.76	-18.25	25.51	43.50	17.99	100	263	PK	Horizonta	PASS
4	439.855	76.72	-13.96	62.76	73.04	10.28	100	39	PK	Horizonta	PASS
5	667.775	45.18	-10.99	34.19	46.00	11.81	100	26	PK	Horizonta	PASS
6	911.73	44.04	-7.46	36.58	46.00	9.42	100	351	PK	Horizonta	PASS

Note: 1. Result (dBµV/m) = Reading(dBµV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Horizontal(445.0MHz)

Test Graph



Suspected List

NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	49.885	44.12	-15.51	28.61	40.00	11.39	100	12	PK	Horizonta	PASS
2	116.815	46.34	-18.72	27.62	43.50	15.88	100	29	PK	Horizonta	PASS
3	202.175	44.37	-18.25	26.12	43.50	17.38	100	68	PK	Horizonta	PASS
4	445.16	75.51	-14.22	61.29	73.22	11.93	100	32	PK	Horizonta	PASS
5	610.545	45.10	-11.38	33.72	46.00	12.28	100	52	PK	Horizonta	PASS
6	903.97	44.61	-7.94	36.67	46.00	9.33	100	265	PK	Horizonta	PASS

Note: 1. Result (dBµV/m) = Reading(dBµV/m) + Factor (dB) .

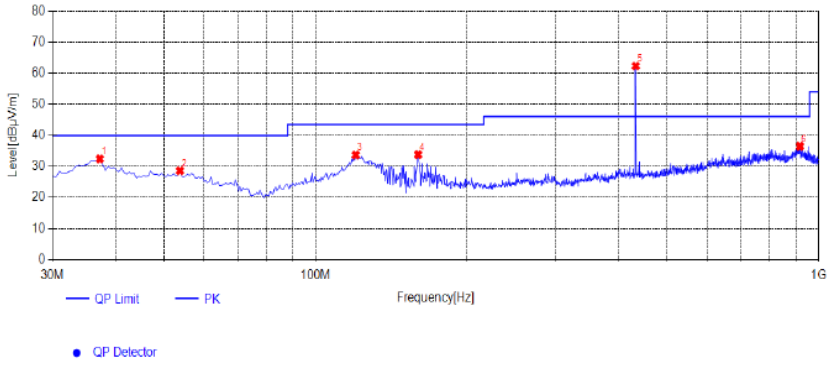
2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Fundamental and Harmonics Average Result						
Frequency (MHz)	Peak Level (dBμV/m)	AV Factor(dBμV/m) (see Section 4.5)	Average Level (dBμV/m)	Limit(dBμV/m) (average)	Margin(dB)	Conclusion
433.04	62.29	-11.40	50.89	72.84	21.95	PASS
439.86	61.85	-11.47	50.38	73.04	22.66	PASS
445.16	62.07	-11.21	50.86	73.22	22.36	PASS

Frequency (MHz)	Pol.	Measure Result(AV, dBuV/m)	ERP(dBm)	Limit (dBuV/m)	Result
433.04	V	50.89	-44.27	72.84	PASS
439.86	V	50.38	-44.78	73.04	PASS
445.16	V	50.86	-44.3	73.22	PASS

Vertical(433.0MHz)

Test Graph



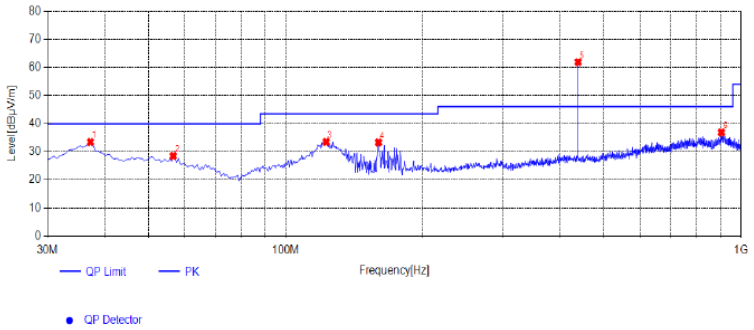
Suspected List											
NO.	Frequency [MHz]	Reading [dBμV/m]	Factor [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	37.275	50.61	-18.19	32.42	40.00	7.58	100	39	PK	Vertical	PASS
2	53.765	44.55	-15.90	28.65	40.00	11.35	100	36	PK	Vertical	PASS
3	120.21	53.11	-19.46	33.65	43.50	9.85	100	327	PK	Vertical	PASS
4	159.98	54.56	-20.78	33.78	43.50	9.72	100	274	PK	Vertical	PASS
5	433.035	76.65	-14.36	62.29	72.84	10.55	100	236	PK	Vertical	PASS
6	917.55	44.26	-7.82	36.44	46.00	9.56	100	357	PK	Vertical	PASS

Note: 1. Result (dBμV/m) = Reading(dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Vertical(439.4MHz)

Test Graph



Suspected List

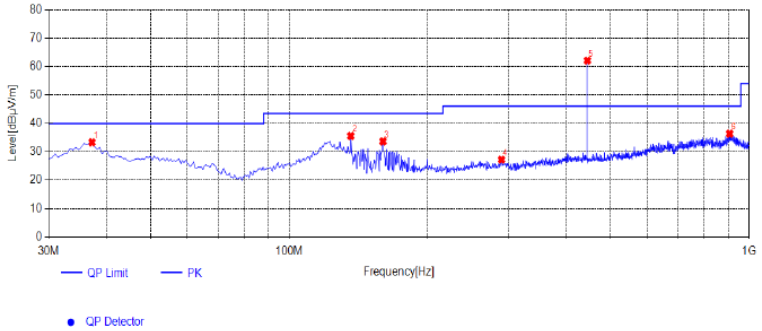
NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	37.275	51.64	-18.19	33.45	40.00	6.55	100	9	PK	Vertical	PASS
2	56.675	44.71	-16.15	28.56	40.00	11.44	100	250	PK	Vertical	PASS
3	122.635	53.48	-20.00	33.48	43.50	10.02	100	309	PK	Vertical	PASS
4	159.98	54.09	-20.78	33.31	43.50	10.19	100	240	PK	Vertical	PASS
5	439.855	75.81	-13.96	61.85	73.04	11.19	100	220	PK	Vertical	PASS
6	905.91	44.58	-7.76	36.82	46.00	9.18	100	269	PK	Vertical	PASS

Note: 1. Result (dBµV/m) = Reading(dBµV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Vertical(445.0MHz)

Test Graph



Suspected List

NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	37.275	51.51	-18.19	33.32	40.00	6.68	100	358	PK	Vertical	PASS
2	136.215	57.06	-21.52	35.54	43.50	7.96	100	358	PK	Vertical	PASS
3	159.98	54.40	-20.78	33.62	43.50	9.88	100	11	PK	Vertical	PASS
4	289.475	44.05	-16.82	27.23	46.00	18.77	100	212	PK	Vertical	PASS
5	445.16	76.29	-14.22	62.07	73.22	11.15	100	321	PK	Vertical	PASS
6	907.85	43.96	-7.63	36.33	46.00	9.67	100	57	PK	Vertical	PASS

Note: 1. Result (dBµV/m) = Reading(dBµV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Notes:

1). Measured= Reading- Pre. Fac.+ Ant. Fac.+ Cab. Loss

2). Margin = Measured- Limit

3). Average values = Peak values + DC factor = Peak values – 0

4).point 4 is the fundamental, Limit is 100.80 dBµV/m, 6 is the second harmonic, Limit is 80.80 dBµV/m

5).ERP = EMeas + 20log (dMeas) −104.7

ERP: is the equivalent isotropically radiated power, in dBm

EMeas: is the field strength of the emission at the measurement distance, in dBuV/m

dMeas: is the measurement distance, in m

For 1GHz to 5GHz

Channel 1 / 433.0 MHz

Peak Value				
Frequency (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1299.00	51.88	74.00	22.12	Horizontal
1732.00	51.32	74.00	22.68	Horizontal
1299.00	55.95	74.00	18.05	Vertical
1732.00	51.78	74.00	22.22	Vertical

Average Value:						
Frequency (MHz)	Level (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1299.00	51.88	-11.40	40.48	54.00	13.52	Horizontal
1732.00	51.32	-11.40	39.92	54.00	14.08	Horizontal
1299.00	55.95	-11.40	44.55	54.00	9.45	Vertical
1732.00	51.78	-11.40	40.38	54.00	13.62	Vertical

Channel 9 / 439.4 MHz

Peak Value				
Frequency (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1318.20	52.70	74.00	-21.30	Horizontal
1757.60	52.21	74.00	-21.79	Horizontal
1318.20	55.74	74.00	-18.26	Vertical
1757.60	52.44	74.00	-21.56	Vertical

Average Value:						
Frequency (MHz)	Level (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1318.20	52.70	-11.47	41.23	54.00	12.77	Horizontal
1757.60	52.21	-11.47	40.74	54.00	13.26	Horizontal
1318.20	55.74	-11.47	44.27	54.00	9.73	Vertical
1757.60	52.44	-11.47	40.97	54.00	13.03	Vertical

Channel 16 / 445.0 MHz

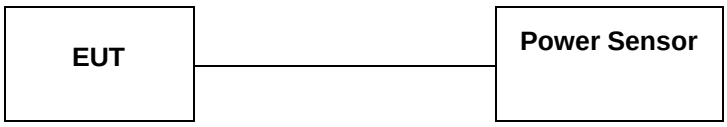
Peak Value				
Frequency (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1335.00	51.37	74.00	-22.63	Horizontal
1780.00	52.29	74.00	-21.71	Horizontal
1335.00	55.07	74.00	-18.93	Vertical
1780.00	52.16	74.00	-21.84	Vertical

Average Value:						
Frequency (MHz)	Level (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1335.00	51.37	-11.21	40.16	54.00	13.84	Horizontal
1780.00	52.29	-11.21	41.08	54.00	12.92	Horizontal
1335.00	55.07	-11.21	43.86	54.00	10.14	Vertical
1780.00	52.16	-11.21	40.95	54.00	13.05	Vertical

Notes:
1). Measuring frequencies from 9 KHz~10^{th} harmonic (ex. 5GHz), No emission found between lowest internal used/generated frequency to 30MHz.
2). Radiated emissions measured in frequency range from 9 KHz~10^{th} harmonic (ex. 5GHz) were made with an instrument using Peak detector mode.
3). Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

4.3. Duration of each Transmission and the silent period

TEST CONFIGURATION



TEST PROCEDURE

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations. The antenna was all opened.

LIMIT

According to §15.231 (e)

devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

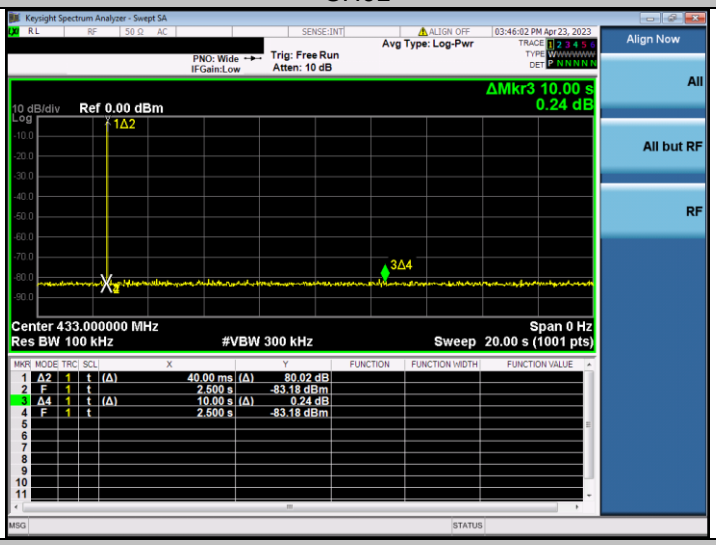
TEST RESULTS

Temperature	22.9℃	Humidity	53.2%
Test Engineer	Jenny Zeng	Configurations	SRD

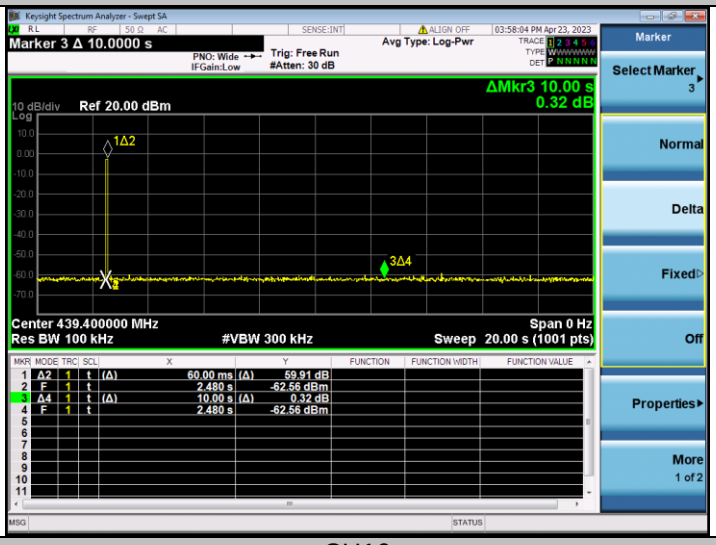
Frequency (MHz)	Duration of each Transmission Time (s)	Limit: not more than 1 seconds (s)	Conclusion
433.0	0.04	1	PASS
439.4	0.06	1	PASS
445.0	0.08	1	PASS

Frequency (MHz)	the silent period (s)	Limit: At least 30 times the duration of the transmission but in no case less than 10s	Conclusion
433.0	>10s	>10s	PASS
439.4	>10s	>10s	PASS
445.0	>10s	>10s	PASS

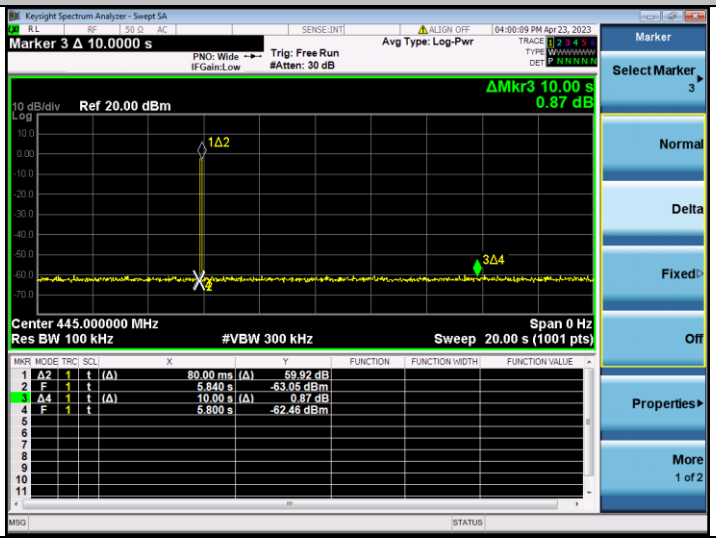
CH01



CH09

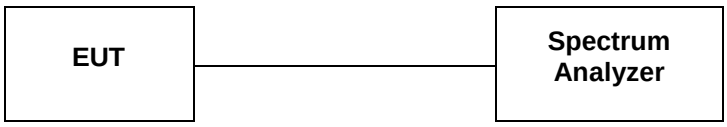


CH16



4.4. 20dB Bandwidth Emissions

TEST CONFIGURATION



TEST PROCEDURE

With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna which was connected to the spectrum analyzer with the START and STOP frequencies set to the EUT's operation band.

LIMIT

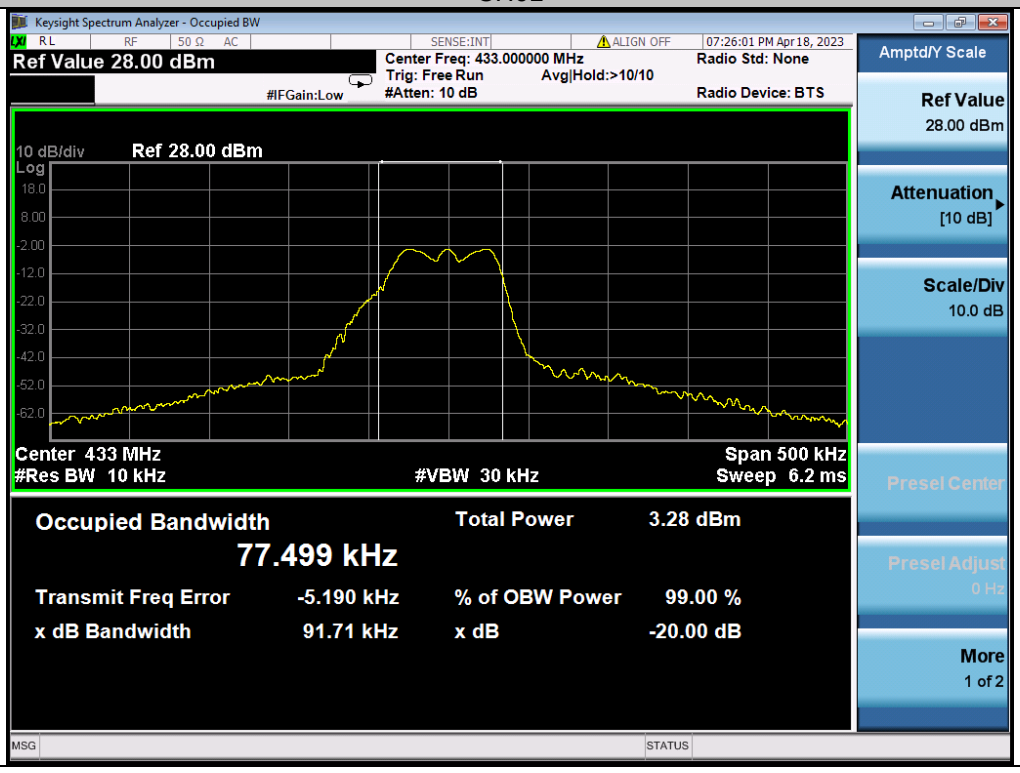
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

TEST RESULTS

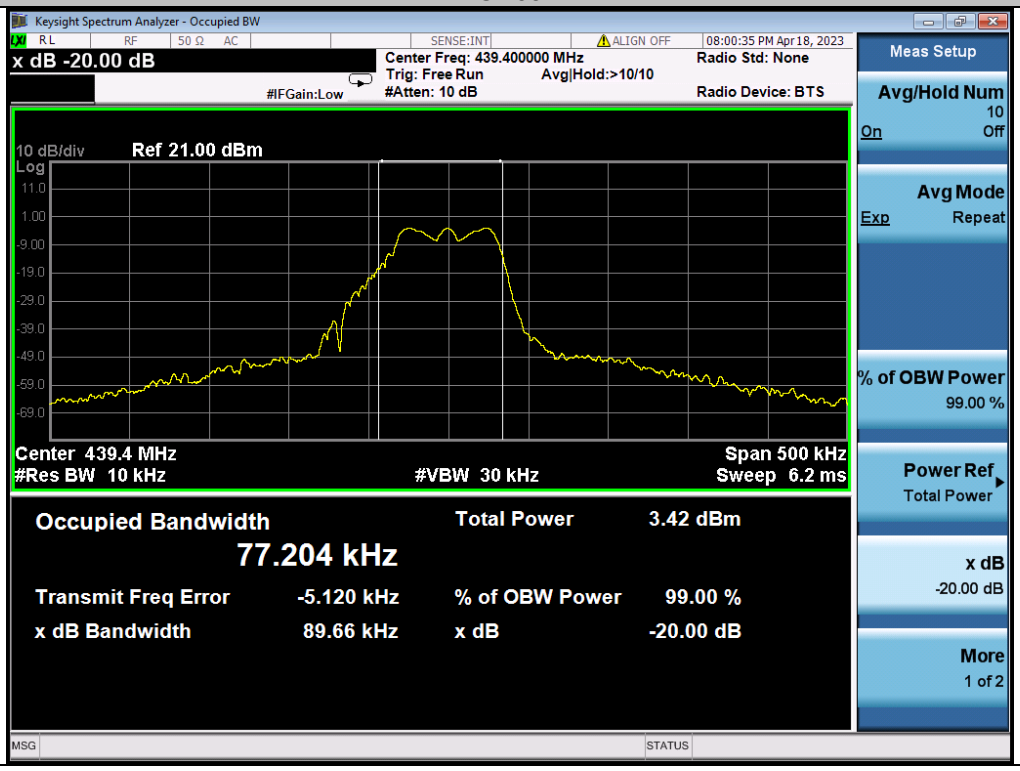
Temperature	22.9℃	Humidity	53.2%
Test Engineer	Jenny Zeng	Configurations	SRD

Transmit Frequency (MHz)	Limit (kHz)	20dB Bandwidth (kHz)	Result
433.0	1082.5	91.71	PASS
439.4	1098.5	89.66	PASS
445.0	1112.5	83.19	PASS
Maximum allowed bandwidth:	☒0.25% of the centre operating frequency ☐0.5% of the centre operating frequency		
RBW: VBW:	☒10kHz ☐100kHz ☐other 30kHz ☒30kHz ☐300kHz ☐other 100kHz		

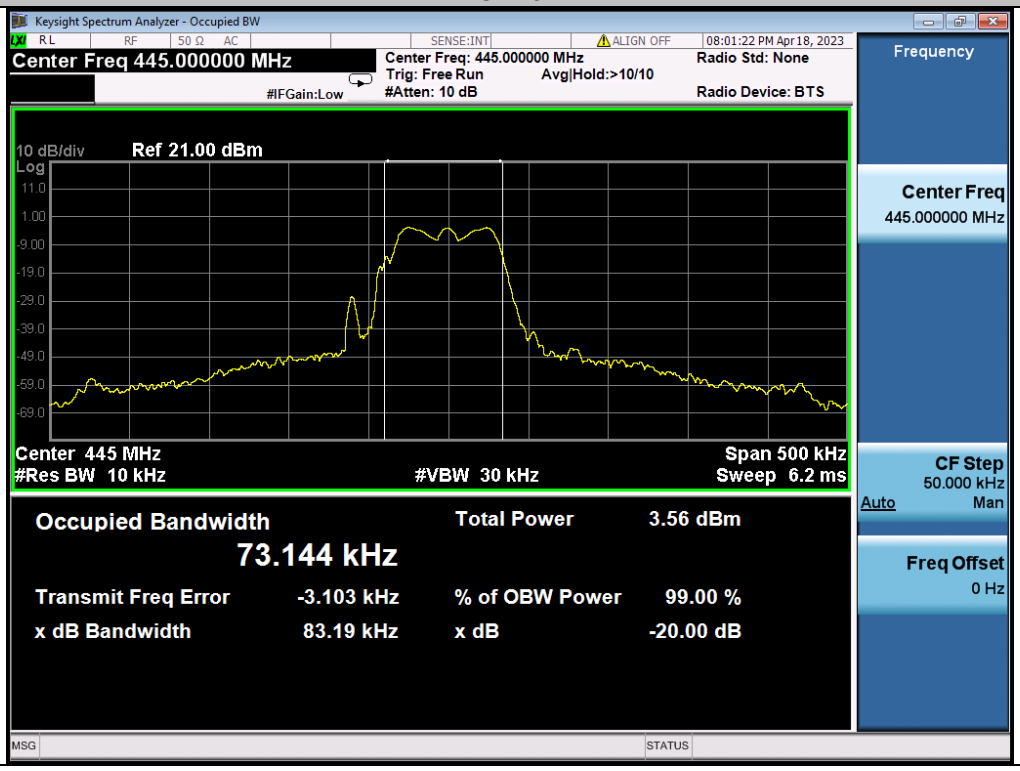
CH01



CH09


Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN OFF
08:00:35 PM Apr 18, 2023
x dB -20.00 dB
Center Freq: 439.400000 MHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 10 dB
Radio Std: None
Radio Device: BTS
Meas Setup
Avg/Hold Num
10
On
Off
Avg Mode
Exp
Repeat
10 dB/div
Log
Ref 21.00 dBm
11.0
1.00
-9.00
-19.0
-29.0
-39.0
-49.0
-59.0
-69.0
Center 439.4 MHz
#Res BW 10 kHz
#VBW 30 kHz
Span 500 kHz
Sweep 6.2 ms
% of OBW Power
99.00 %
Power Ref
Total Power
Occupied Bandwidth
77.204 kHz
Total Power 3.42 dBm
Transmit Freq Error -5.120 kHz
% of OBW Power 99.00 %
x dB Bandwidth 89.66 kHz
x dB -20.00 dB
x dB
-20.00 dB
More
1 of 2
MSG
STATUS

CH16

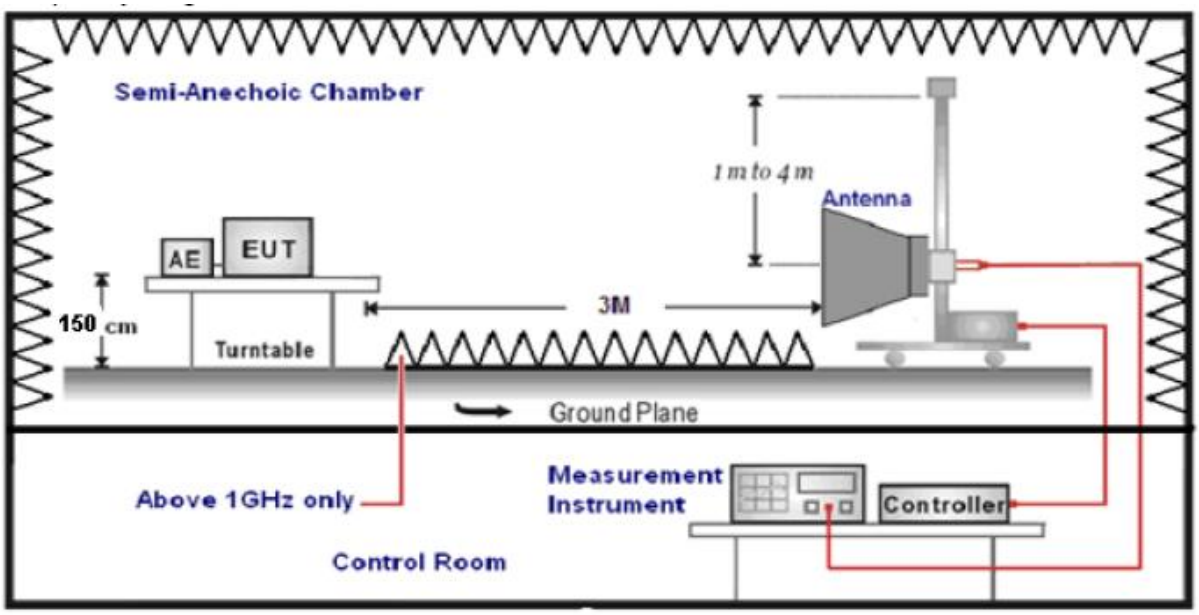

Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN OFF
08:01:22 PM Apr 18, 2023
Center Freq 445.000000 MHz
Center Freq: 445.000000 MHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 10 dB
Radio Std: None
Radio Device: BTS
Frequency
10 dB/div
Log
Ref 21.00 dBm
11.0
1.00
-9.00
-19.0
-29.0
-39.0
-49.0
-59.0
-69.0
Center 445 MHz
#Res BW 10 kHz
#VBW 30 kHz
Span 500 kHz
Sweep 6.2 ms
Center Freq
445.000000 MHz
CF Step
50.000 kHz
Auto
Man
Occupied Bandwidth
73.144 kHz
Total Power 3.56 dBm
Transmit Freq Error -3.103 kHz
% of OBW Power 99.00 %
x dB Bandwidth 83.19 kHz
x dB -20.00 dB
Freq Offset
0 Hz
MSG
STATUS

4.5. Duty cycle

TEST REQUIREMENT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyser.

3. Set centre frequency of spectrum analyser = operating frequency.

4. Set the spectrum analyser as RBW=1MHz, VBW=1MHz, Span=0Hz, Adjust Sweep=100ms to obtain the “worst-case” pulse on time

5. Repeat above procedures until all frequency measured was complete.

LIMIT

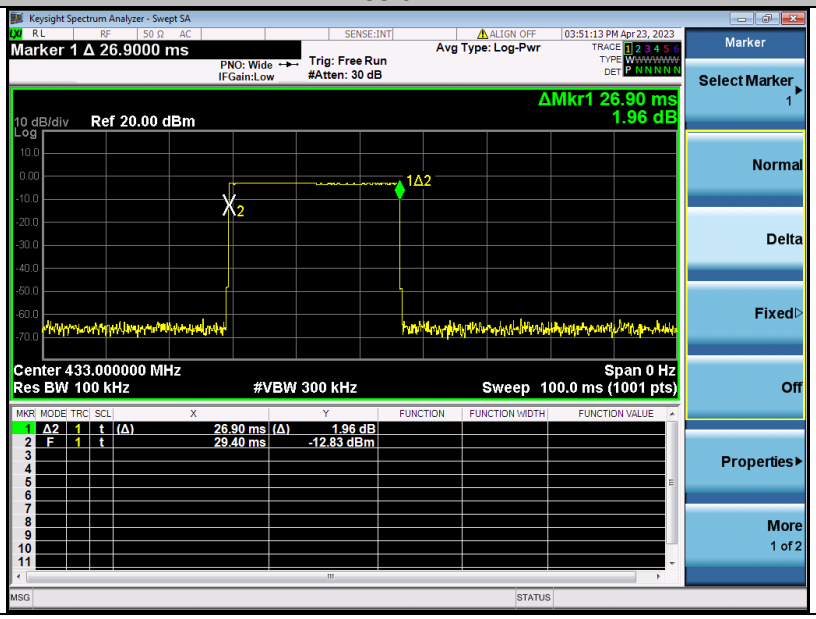
No dedicated limit specified in the Rules.

TEST RESULTS

Temperature	22.9℃	Humidity	53.2%
Test Engineer	Jenny Zeng	Configurations	SRD

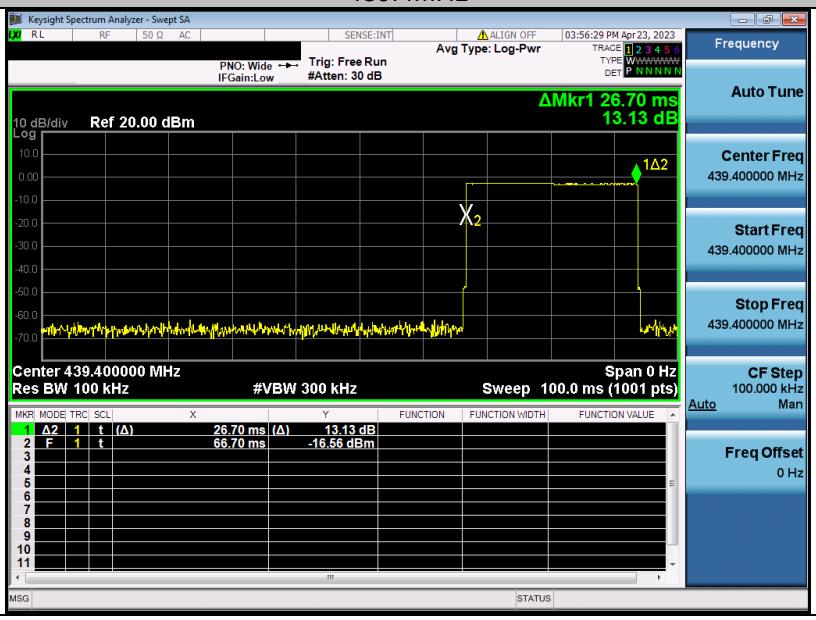
Ton = 26.90 (ms)
Tp = 100 (ms)
The duty cycle = 26.90/100=26.90%
Average Correction Factory = 20*log (Ton/Tp) =20*log (0.269) = -11.40dB

433.0MHz

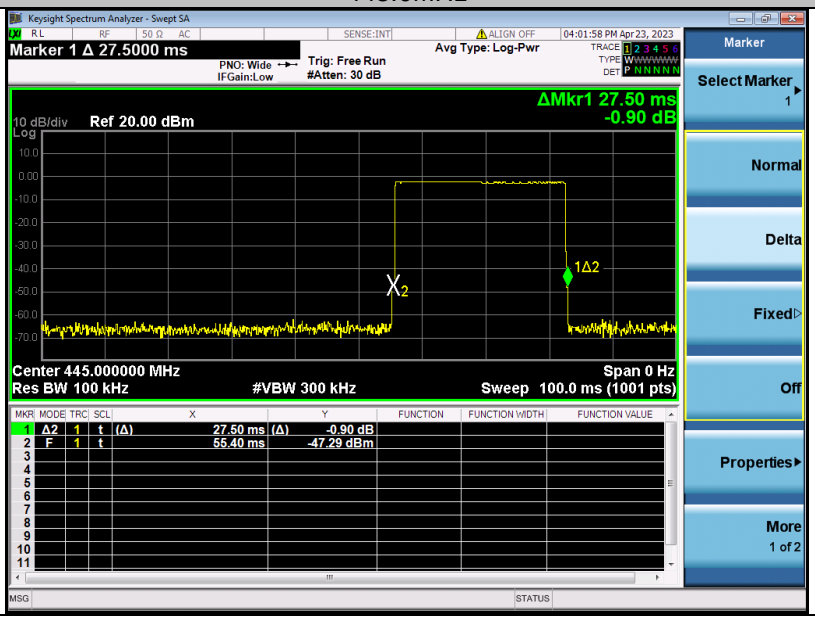


Ton = 26.70 (ms)
Tp = 100 (ms)
The duty cycle = 26.70/100=26.70%
Average Correction Factory = 20*log (Ton/Tp) =20*log (0.267) = -11.47dB

439.4MHz



Ton = 27.5 (ms)
Tp = 100 (ms)
The duty cycle = 27.50/100=27.50%
Average Correction Factory = 20*log (Ton/Tp) =20*log (0.275) = -11.21dB

445.0MHz


4.6. Antenna Requirement

Standard Applicable

According to § 15.203 & RSS-Gen, 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.

Test Result

The antenna used for this product is Internal Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0dBi.

Reference to the **Internal photos**.

5. TEST SETUP PHOTOS OF THE EUT

Photo of Radiated Emissions Measurement

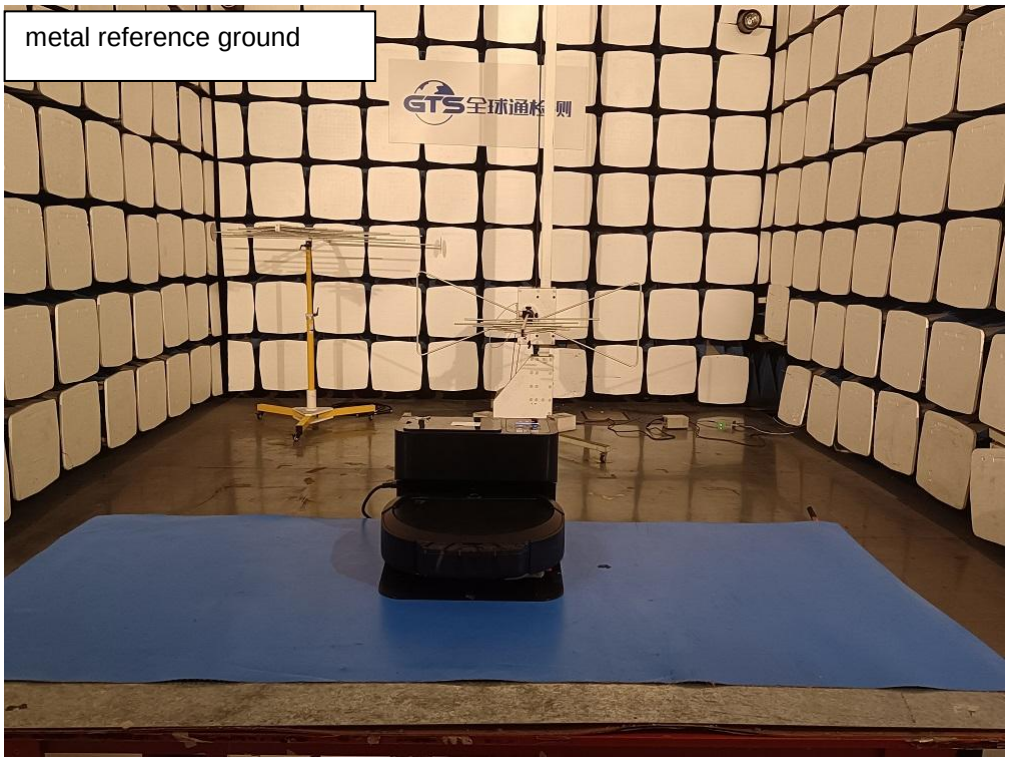


Fig. 1

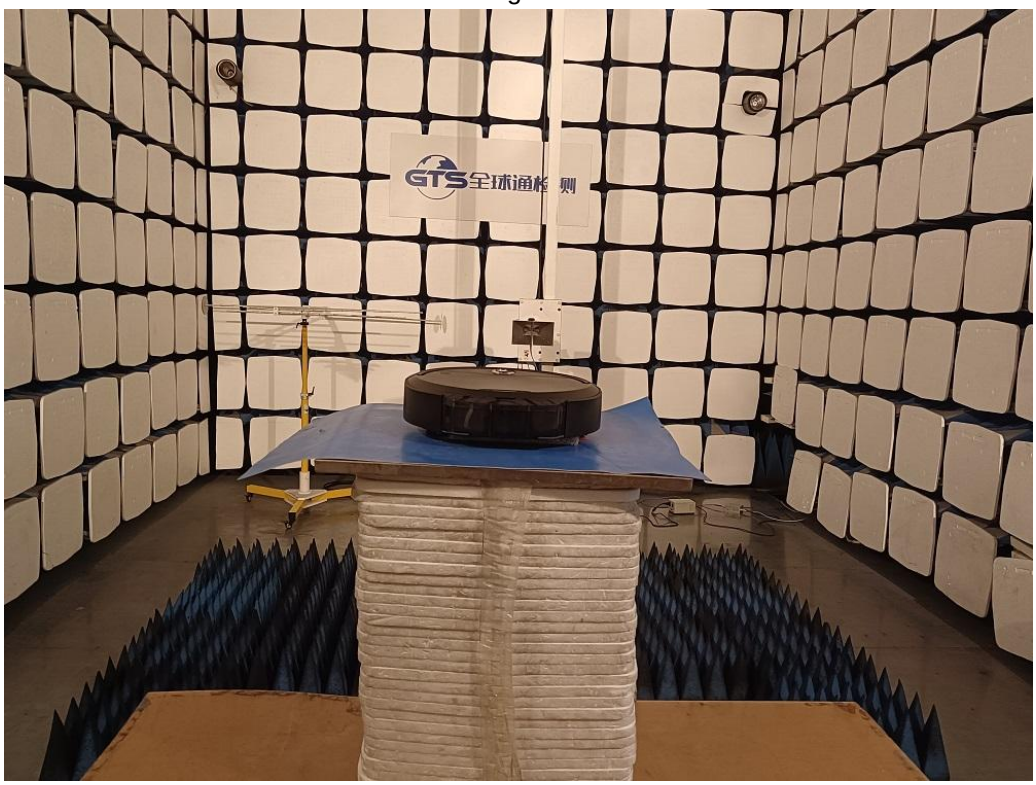


Fig. 2

Photo of Conducted Emission Measurement

Fig. 3

6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

Fig. 1

Fig. 2

Fig. 3

Fig. 4

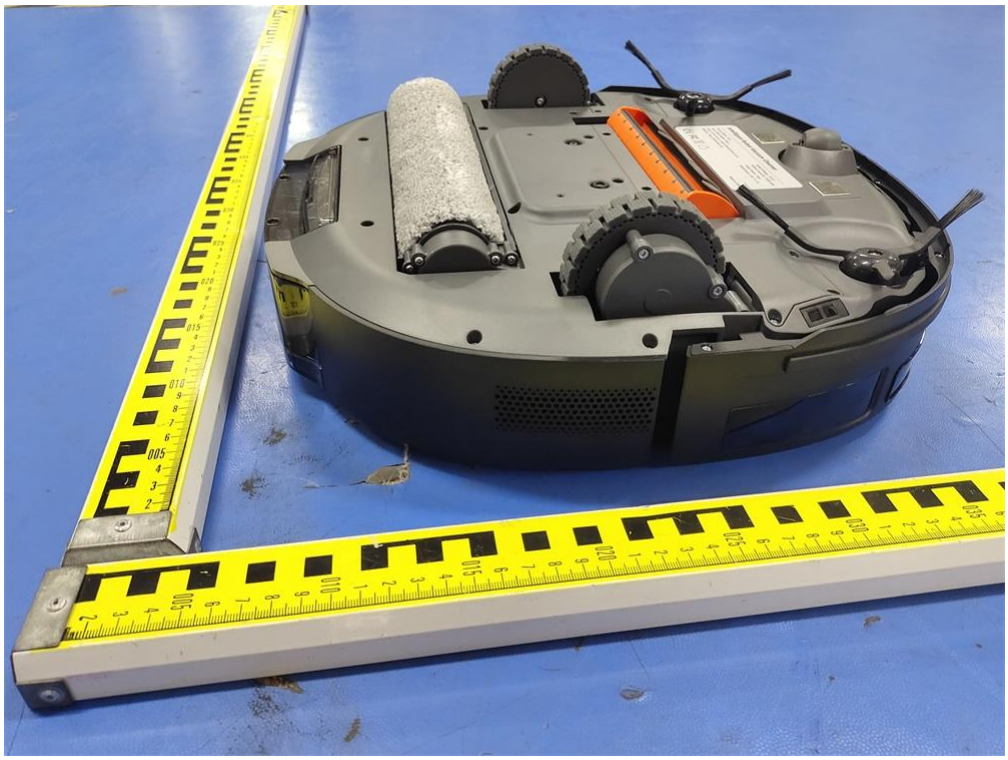


Fig. 5

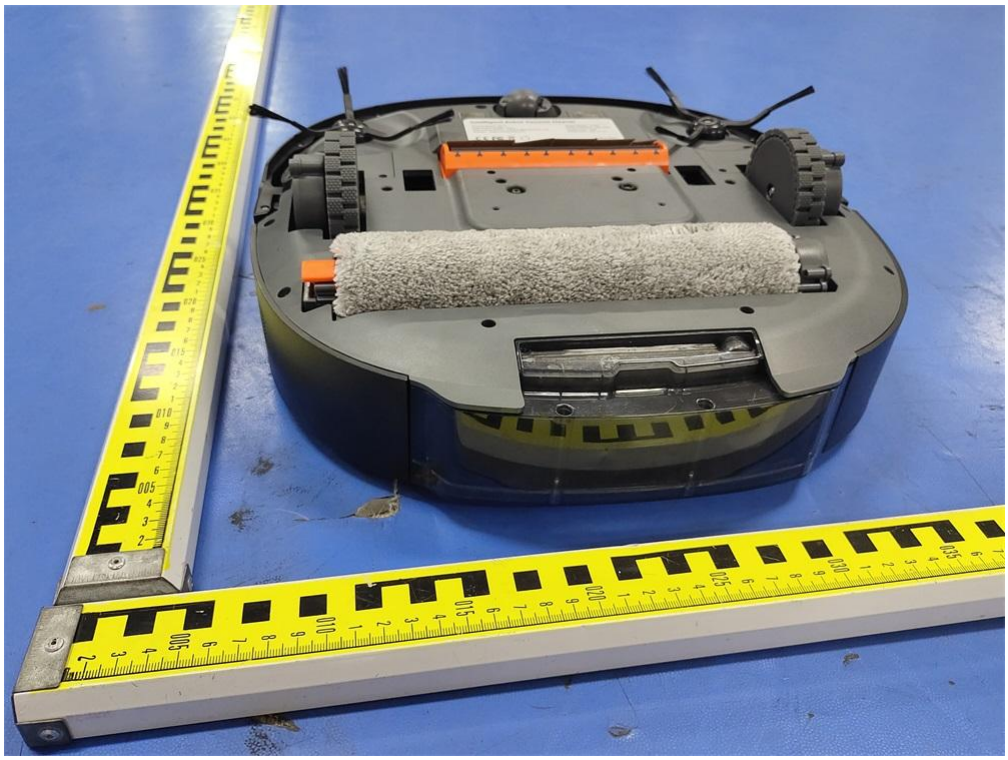


Fig. 6

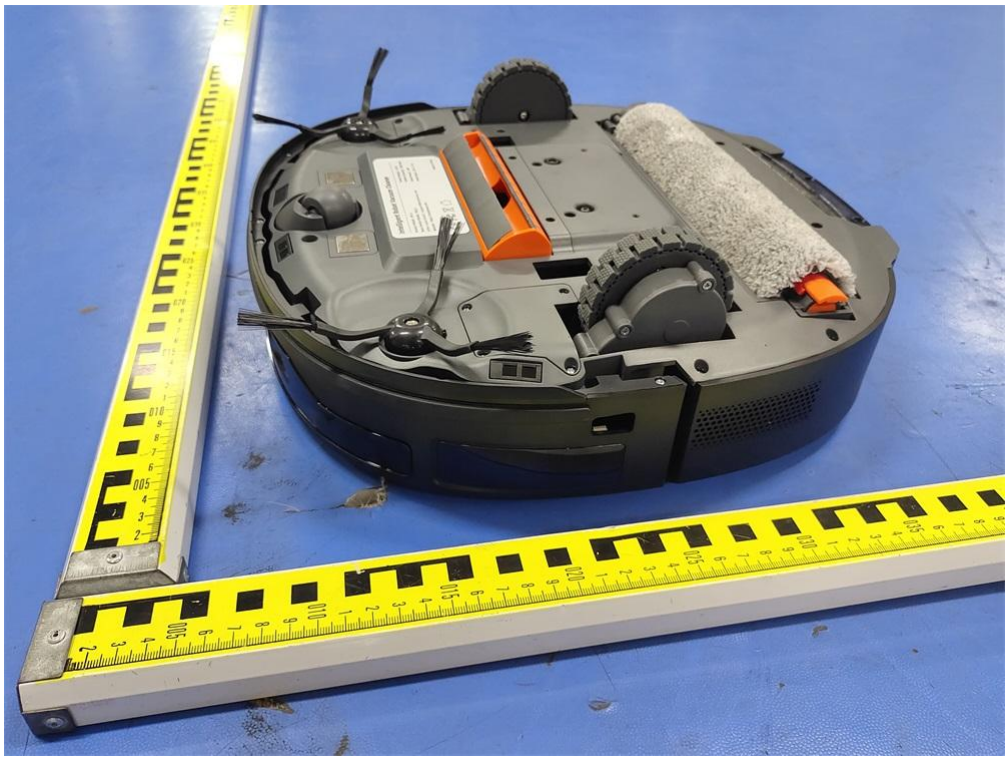


Fig. 7

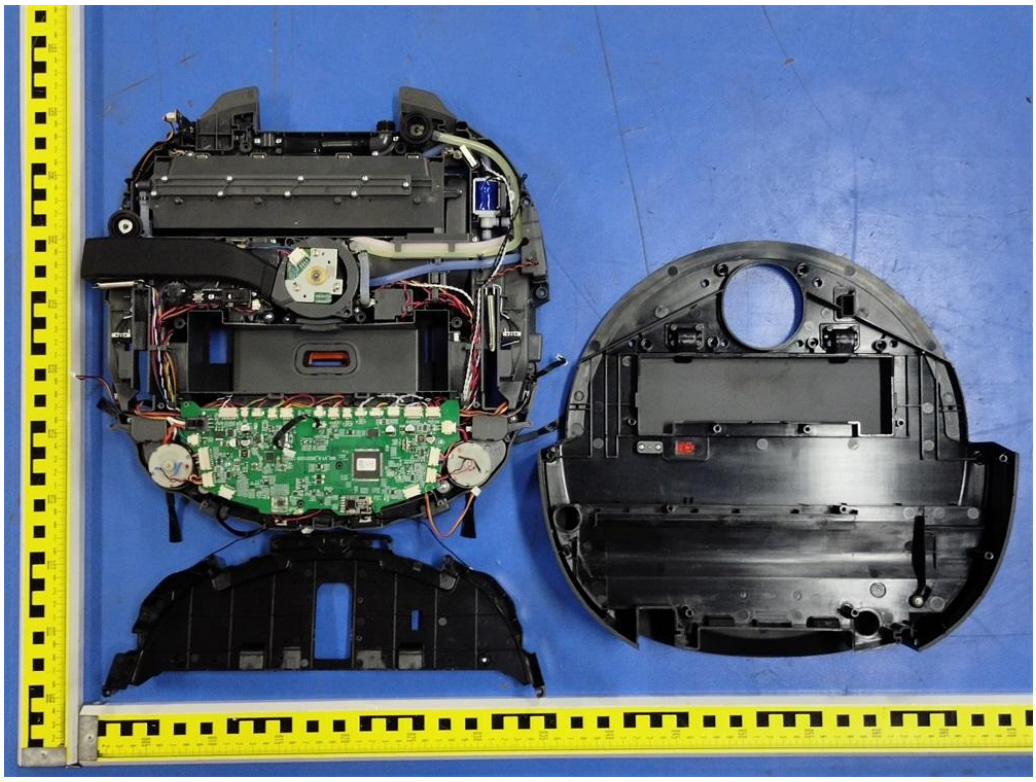


Fig. 8

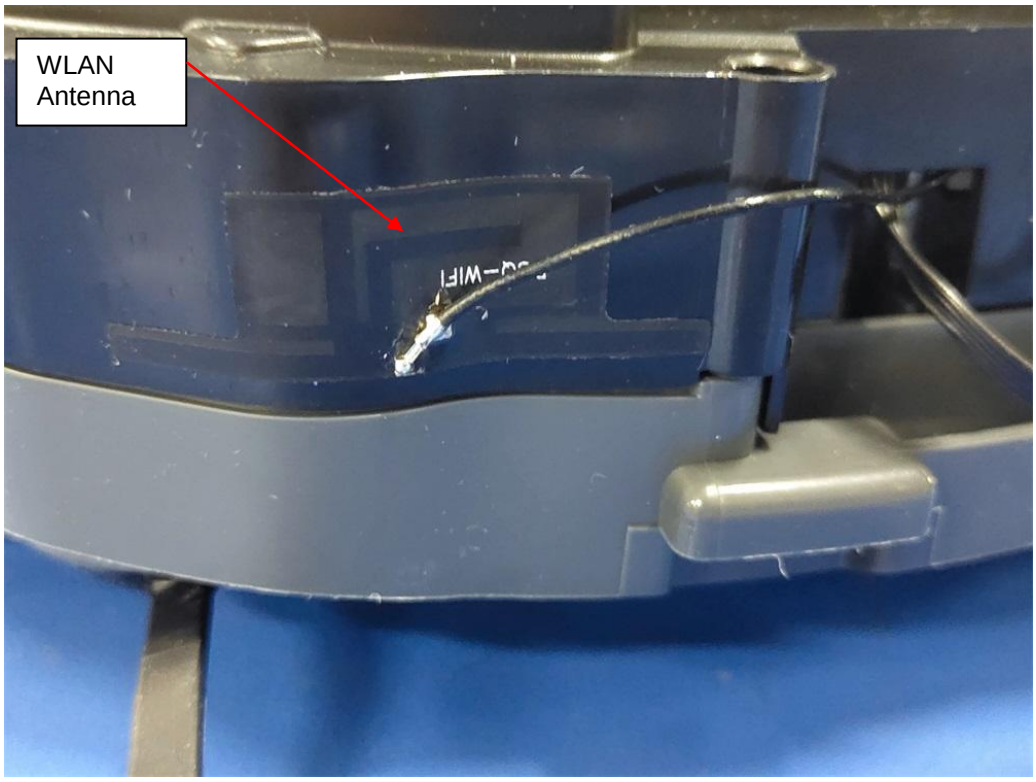


Fig. 9

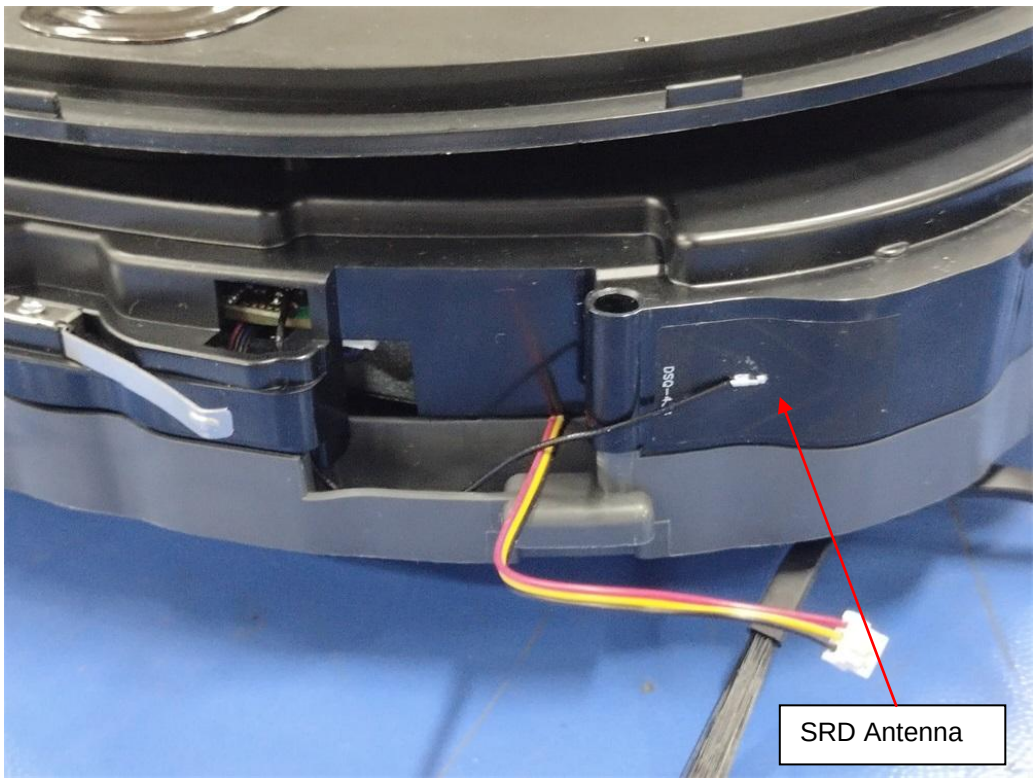


Fig. 10

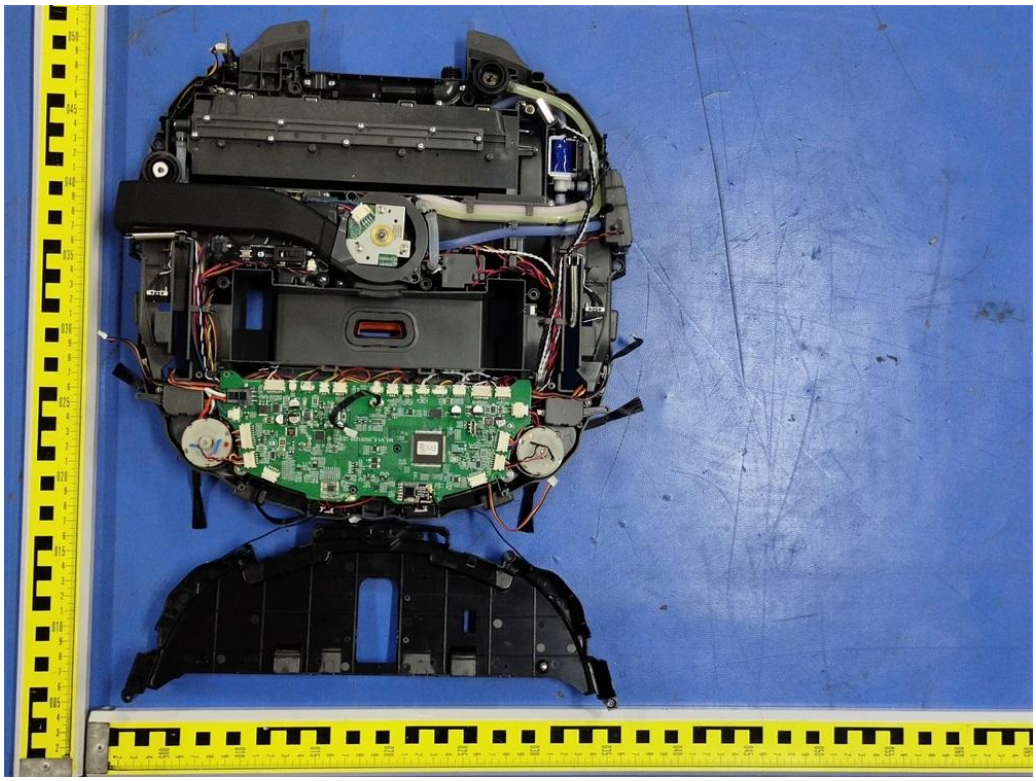


Fig. 11

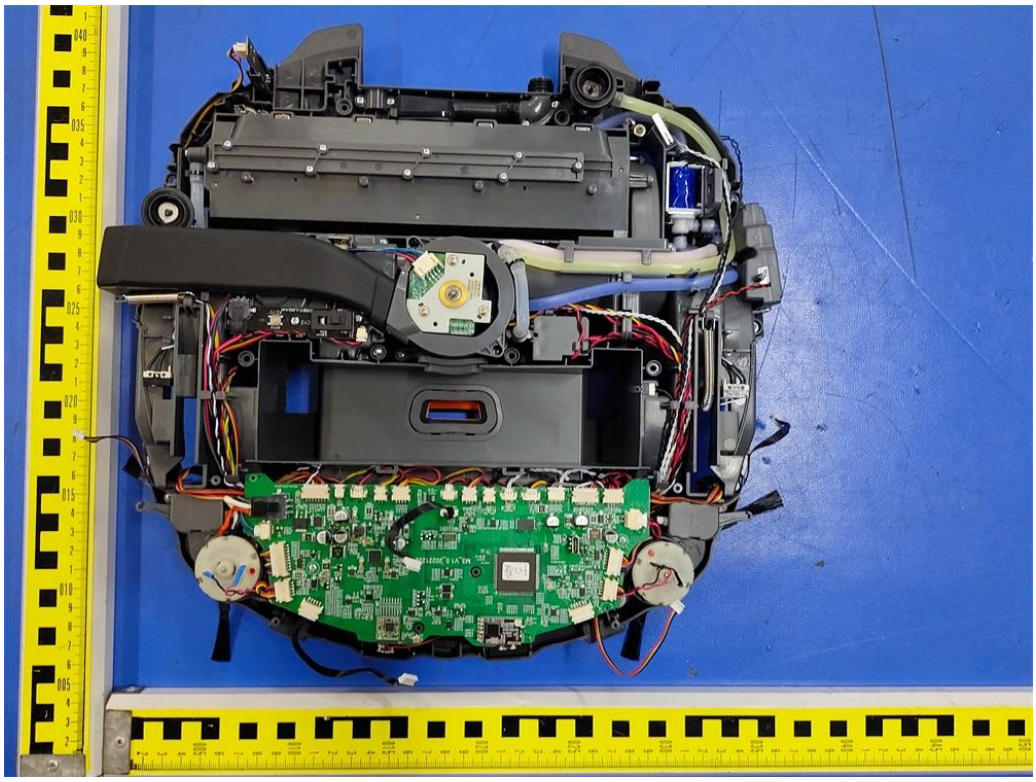


Fig. 12

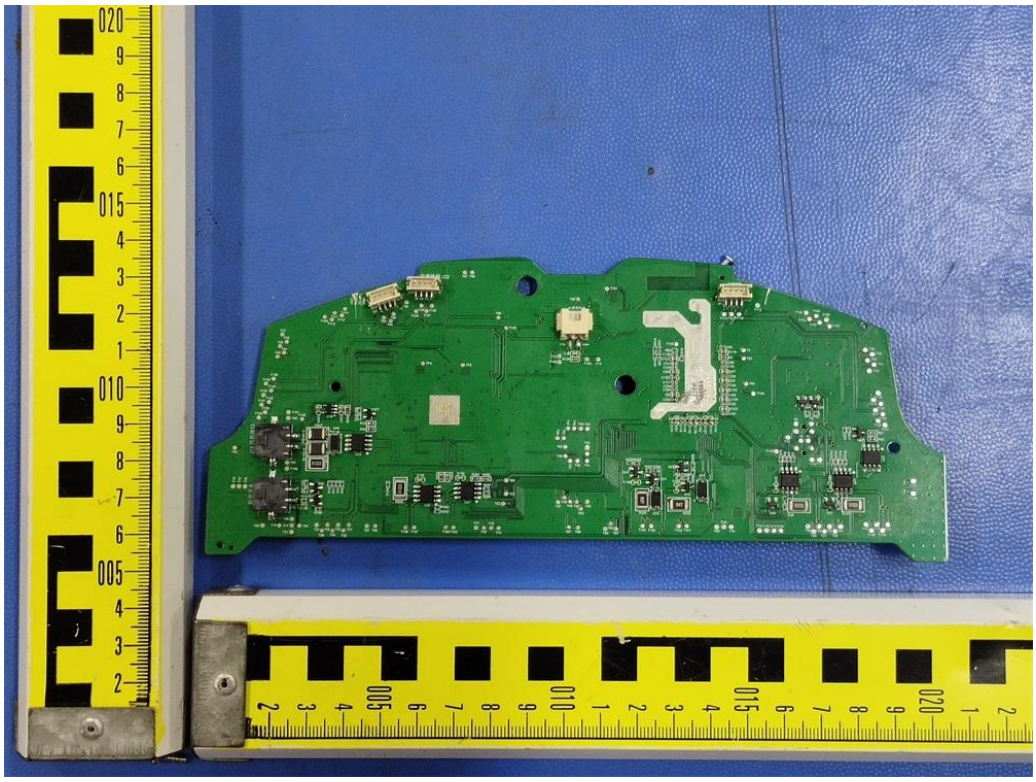


Fig. 13

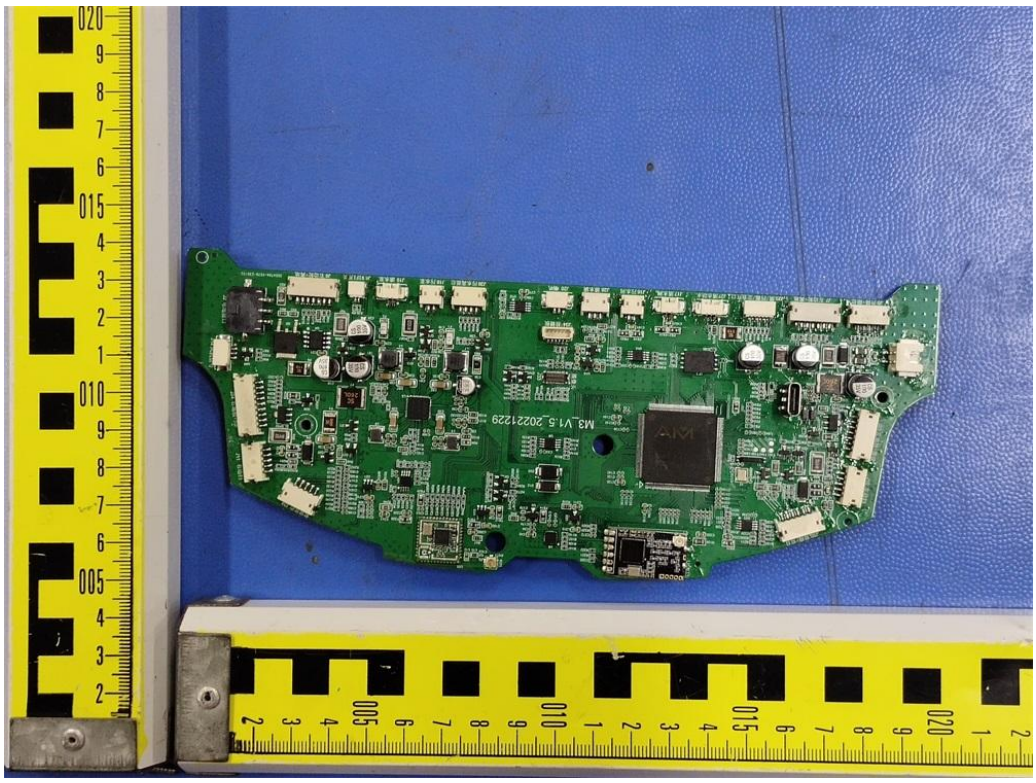


Fig. 14

Fig. 15

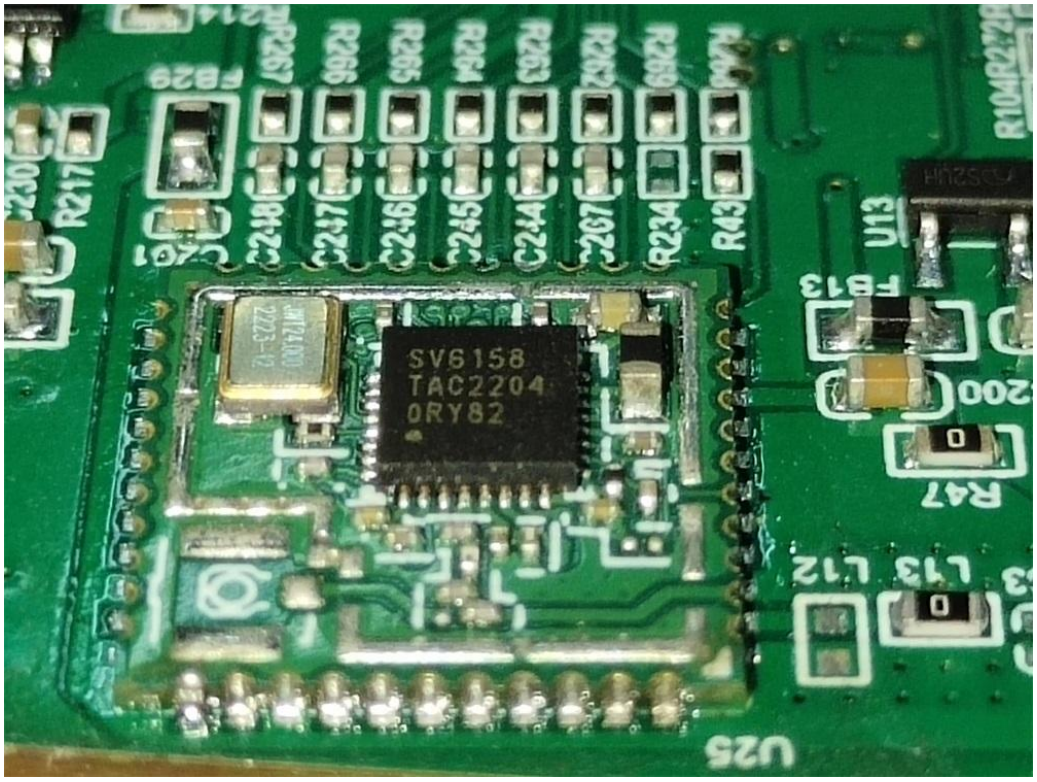


Fig. 16

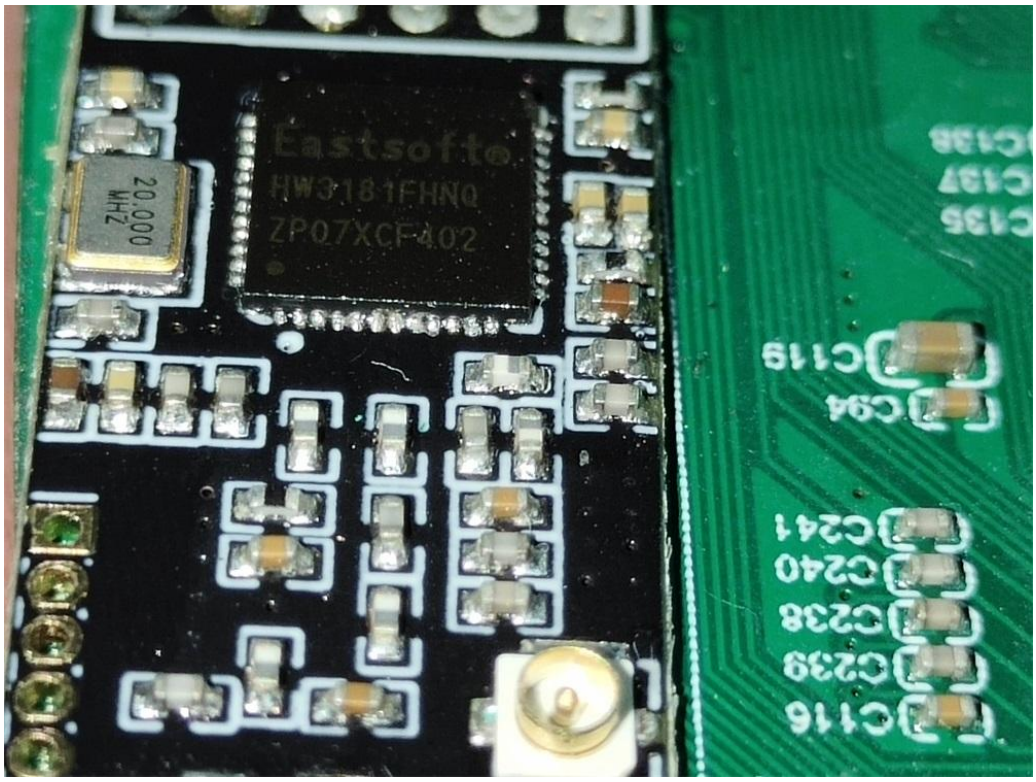

Eastsoft
HW3181FHNQ
ZP07XCF402
20.000
MHZ
C135
C137
C138
C119
C94
C241
C240
C238
C239
C116

Fig. 17

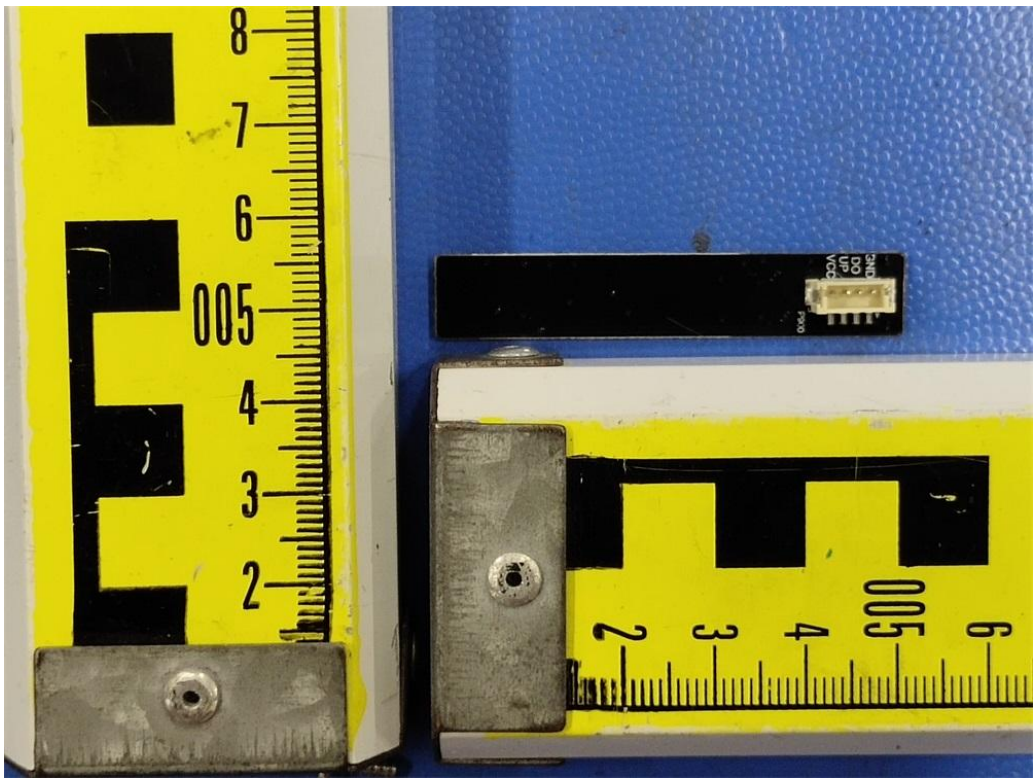

8
7
6
005
4
3
2
GND
VCC

Fig. 18

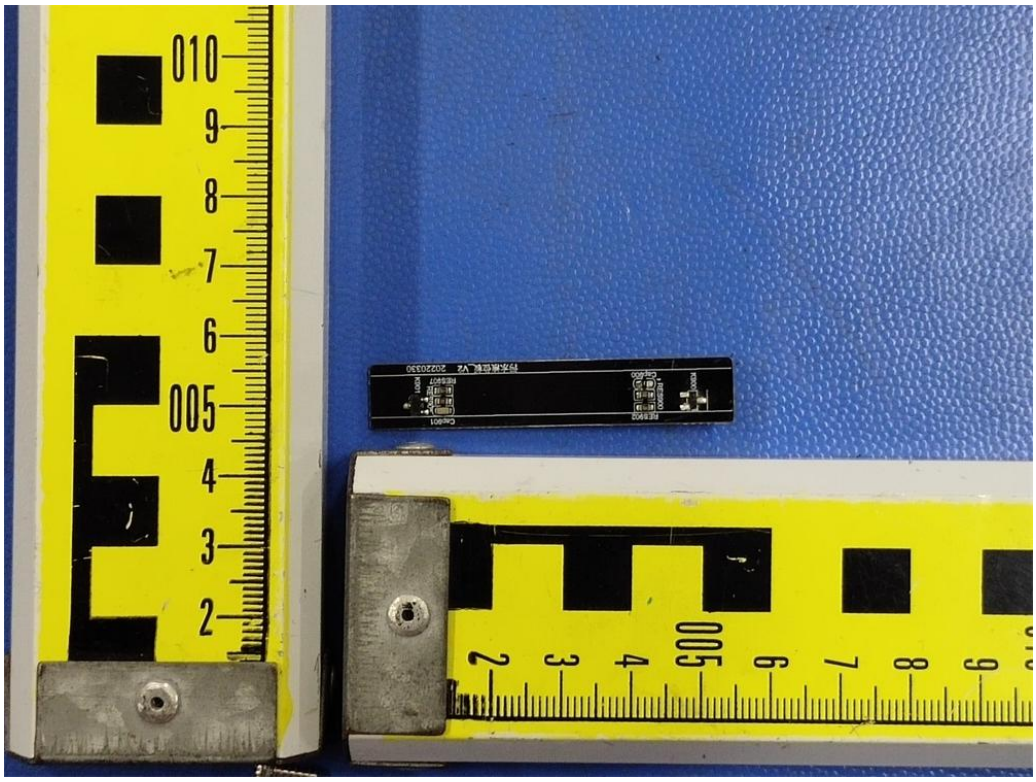


Fig. 19

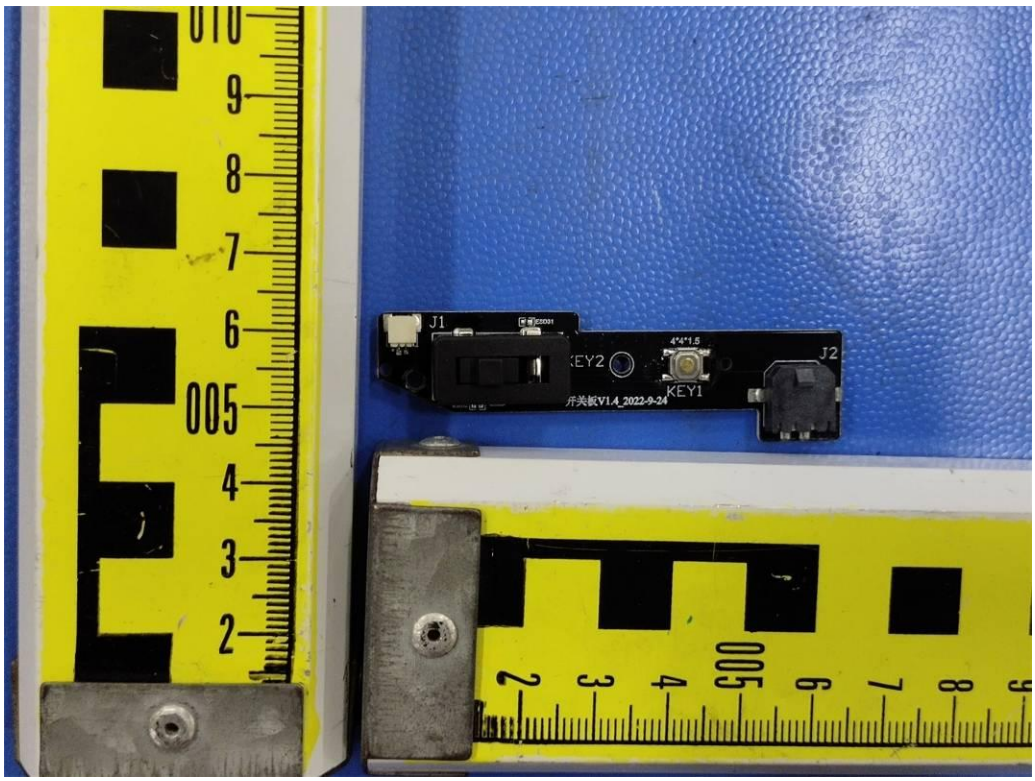


Fig. 20

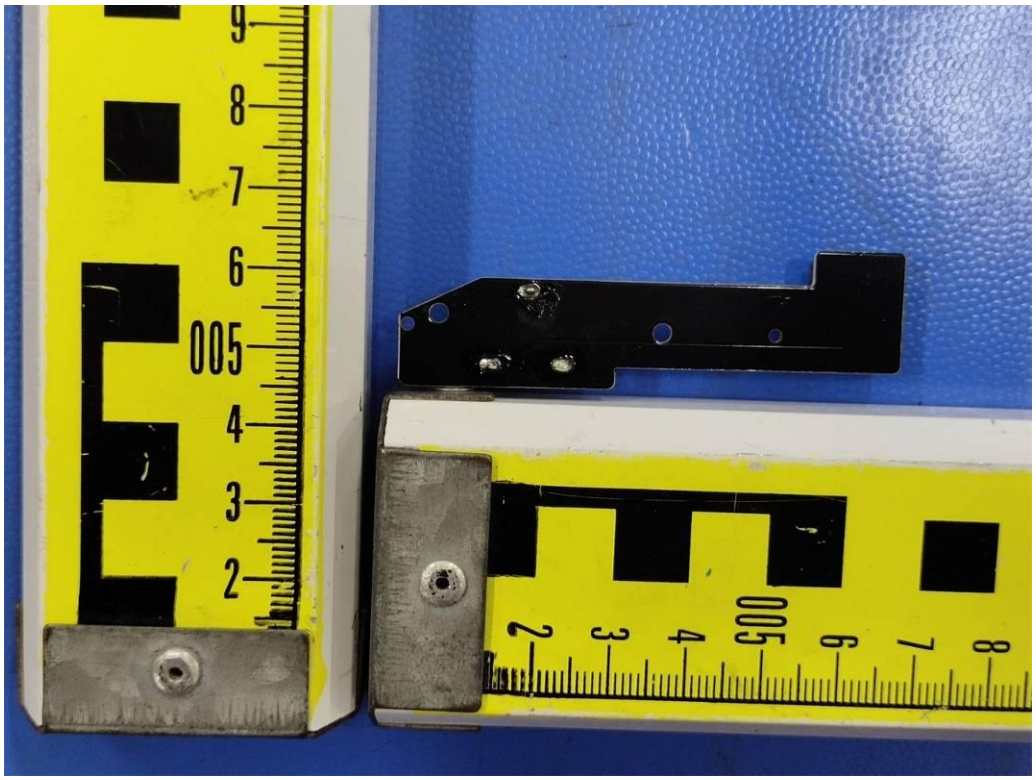


Fig. 21

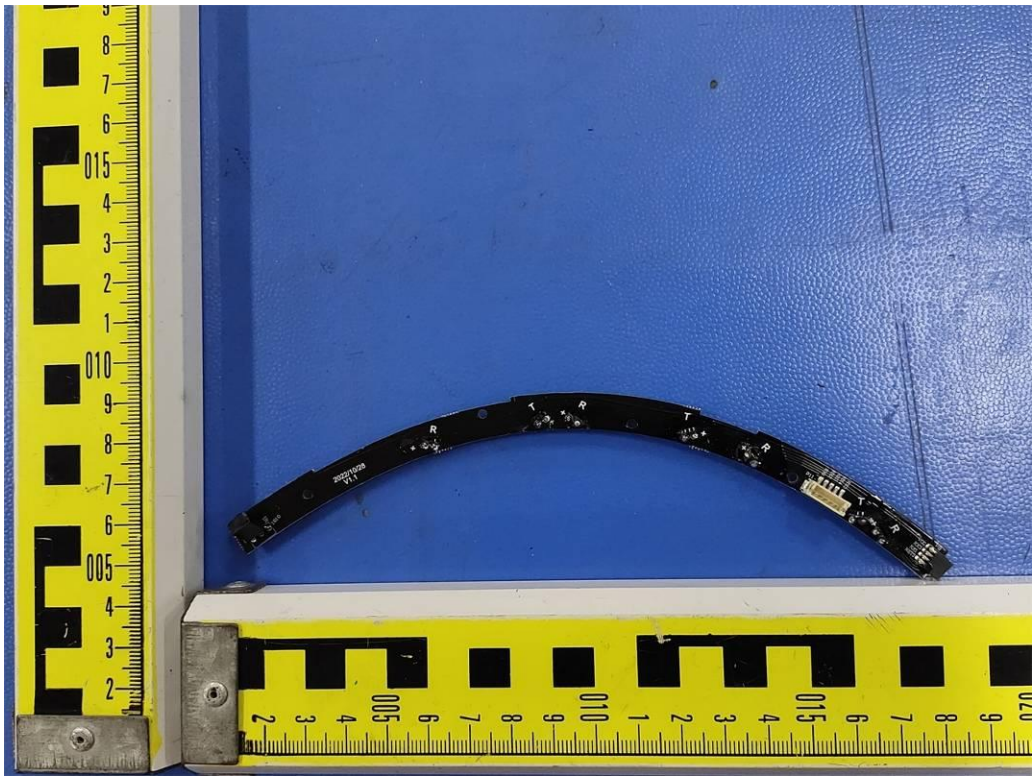


Fig. 22

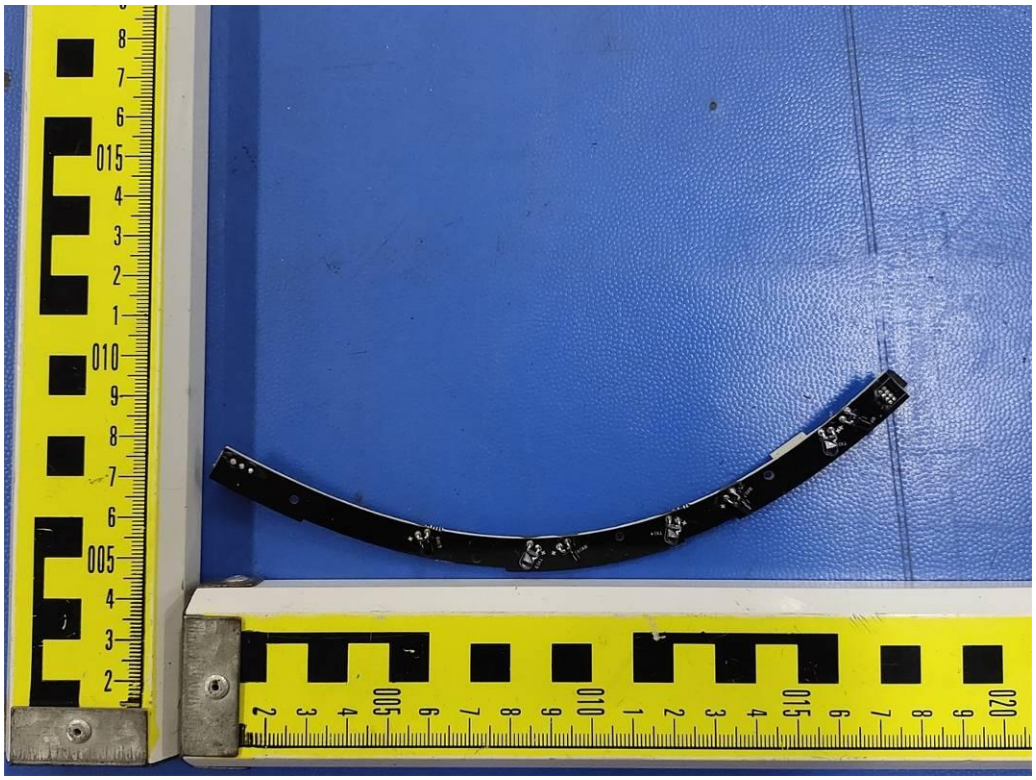


Fig. 23

Fig. 24

Fig. 25

Fig. 26

.....End of Report.....