Shenzhen CTA Testing Technology Co., Ltd.
Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

FCC PART 15 SUBPART C TEST REPORT
FCC PART 15.247

Report Reference No.....:	**CTA24071501901**
FCC ID..... :	**2BCRN-SHELLS1**
Compiled by (position+printed name+signature)..:	File administrators Jinghua Xiao
Supervised by (position+printed name+signature)..:	Test Engineer Lushan Kong
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Date of issue.....:	Aug. 13, 2024
Representative Laboratory Name.:	**Shenzhen CTA Testing Technology Co., Ltd.**
Address .....:	Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China
Applicant's name.....:	**Dongguan Aika Electronic Technology Co., Ltd.**
Address .....:	Room 201, Building 2, No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, China
Test specification .....**:**	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

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Test item description .....:	**Smart Karaoke Speaker**
Trade Mark .....:	Ikarao
Manufacturer .....:	Guangdong Taide Zhilian Technology Co., Ltd
Model/Type reference .....:	Shell S1
List Models .....:	Shell S2
Modulation Type.....:	GFSK, π/4-DQPSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Hardware Version .....:	V1.1
Software Version .....:	V2.1
Rating .....:	Input: DC 5.0 - 20.0V
Result .....:	**PASS**

TEST REPORT

Test Report No. : CTA24071501901	Aug. 13, 2024 Date of issue

Equipment under Test	:	Smart Karaoke Speaker
Model /Type	:	Shell S1
Listed model	:	Shell S2
Applicant	:	**Dongguan Aika Electronic Technology Co., Ltd.**
Address	:	Room 201, Building 2, No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, China
Manufacturer	:	**Guangdong Taide Zhilian Technology Co., Ltd**
Address	:	No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, 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 4

2. SUMMARY 5

2.1. General Remarks 5
2.2. Product Description 5
2.3. Equipment Under Test 7
2.4. Short description of the Equipment under Test (EUT) 7
2.5. EUT operation mode 7
2.6. Block Diagram of Test Setup 7
2.7. Related Submittal(s) / Grant (s) 8
2.8. EUT Exercise Software 8
2.9. Special Accessories 8
2.10. External I/O Cable 8
2.11. Modifications 8

3. TEST ENVIRONMENT 9

3.1. Address of the test laboratory 9
3.2. Test Facility 9
3.3. Environmental conditions 9
3.4. Statement of the measurement uncertainty 9
3.5. Summary of measurement results 10
3.6. Equipments Used during the Test 11

4. TEST CONDITIONS AND RESULTS 12

4.1. AC Power Conducted Emission 12
4.2. Radiated Emission 17
4.3. Maximum Peak Output Power 26
4.4. 99% and 20dB Bandwidth 27
4.5. Frequency Separation 28
4.6. Conducted Spurious Emissions and Band Edge Compliance of RF Emission 29
4.7. Number of hopping frequency 31
4.8. Time Of Occupancy(Dwell Time) 32
4.9. Pseudorandom Frequency Hopping Sequence 33
4.10. Antenna Requirement 34

5. TEST SETUP PHOTOS OF THE EUT 35

6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT 37

6.1. External photos of the EUT 37
6.2. Internal photos of the EUT 46

1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2020: American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance: Digital Transmission Systems (DTS) and Frequency Hopping measurement procedures

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	Jun. 20, 2024
Testing commenced on	:	Jun. 20, 2024
Testing concluded on	:	Aug. 12, 2024

2.2. Product Description

Product Name:	Smart Karaoke Speaker
Trade Mark:	Ikarao
Model/Type reference:	Shell S1
List Model:	Shell S2
Model Declaration	PCB board, structure and internal of these model(s) are the same, only the speaker, power amplifier chip, screen size, antenna and appearance are different.
Power supply:	Input: DC 5.0 - 20.0V
Hardware Version	V1.1
Software Version	V2.1
Sample ID	CTA240715019-S0001-1# CTA240715019-1-S0001-2#
Chip1: JL7034A6	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	79 channels for Bluetooth (BR/EDR)
Channel Spacing	1MHz for Bluetooth (BR/EDR)
Modulation Type	GFSK, π/4-DQPSK for Bluetooth (BR/EDR)
Antenna Description	Internal Antenna 1, 3.87dBi(Max.) for Shell S1 Internal Antenna 1, 7.87dBi(Max.) for Shell S2
Chip2: AC7066D4	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	40 channels for Bluetooth (BT LE) 40 channels for Bluetooth (BT 2LE)
Channel Spacing	2MHz for Bluetooth (BT LE) 2MHz for Bluetooth (BT 2LE)
Modulation Type	GFSK for Bluetooth (BT LE) GFSK for Bluetooth (BT 2LE)
Antenna Description	Internal Antenna 3, 3.96dBi(Max.) for Shell S1 Internal Antenna 3, 7.87dBi(Max.) for Shell S2
Chip3: AC7066D4	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	40 channels for Bluetooth (BT LE) 40 channels for Bluetooth (BT 2LE)
Channel Spacing	2MHz for Bluetooth (BT LE) 2MHz for Bluetooth (BT 2LE)
Modulation Type	GFSK for Bluetooth (BT LE) GFSK for Bluetooth (BT 2LE)
Antenna Description	Internal Antenna 4, 3.97dBi(Max.) for Shell S1

	Internal Antenna 4, 7.87dBi(Max.) for Shell S2
Module:RTL8821CS	
2.4GWLAN	
WLAN Operation frequency	IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz IEEE 802.11n HT40:2422-2452MHz
WLAN Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
Channel number:	11 Channel for IEEE 802.11b/g/n (HT20) 7 Channel for IEEE 802.11n (HT40)
Channel separation:	5MHz
WIFI (5.2G/5.3G/5.7G/5.8G Band)	
Frequency Range	5180-5240MHz/ 5260MHz to 5320MHz/ 5500MHz to 5700MHz/ 5745MHz to 5825MHz
Channel Number	4 Channels for 20MHz bandwidth(5180-5240MHz) 4 Channels for 20MHz bandwidth(5260-5320MHz) 11 Channels for 20MHz bandwidth(5500-5700MHz) 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 2 channels for 40MHz bandwidth(5270~5310MHz) 5 Channels for 40MHz bandwidth(5510-5670MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5210MHz) 1 channels for 80MHz bandwidth(5290MHz) 2 Channels for 80MHz bandwidth(5530-5610MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT20: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT40: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT80: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK)
Antenna Description	Shell S1: Internal Antenna 2, 4.72 dBi(Max.) for 2.4G Band and 5.26dBi(Max.) for 5G Band Shell S2: Internal Antenna 2, 5.26 dBi(Max.) for 2.4G Band and 5.33 dBi(Max.) for 5G Band
Note: Models Shell S1 and Shell S2 use different antennas of the same type and are tested using maximum antenna gain.	

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 20.0V

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

This is a Smart Karaoke Speaker.

For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT. Channel 00/39/78 was selected to test.

Mode of Operations	Frequency Range (MHz)	Data Rate (Mbps)
(BDR/EDR)	2402	1/2/3
	2441	1/2/3
	2480	1/2/3
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

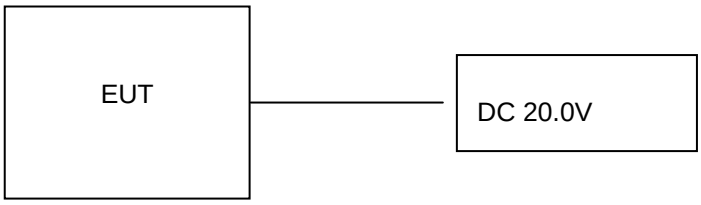
Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	**2402**	40	2442
01	2403	41	2443
02	2404	42	2444
--	--	--	--
--	--	--	--
38	2440	**78**	**2480**
39	2441		

AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case(AC 120V/60Hz).

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be TX (1Mbps).

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 TX(1Mbps-MCH).

2.6. Block Diagram of Test Setup



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

This submittal(s) (test report) is intended for **FCC ID: 2BCRN-SHELLS1** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. EUT Exercise Software

The system enters the engineering mode through the instructions provided by the application (MTK Mode), tests under continuous transmission conditions, and changes the test channel.

2.9. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
LANTO ELECTRONNIC LIMITED	Adapter	191106C	--	SDOC

Note: The Adapter only used for auxiliary testing.

2.10. External I/O Cable

I/O Port Description	Quantity	Cable
DC IN Port	1	1.0M, Unscreened Cable
AV Port	3	N/A
Type-c Port	1	N/A
USB Port	1	N/A
HDMI Port	1	N/A

2.11. Modifications

No modifications were implemented to meet testing criteria.

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Shenzhen CTA Testing Technology Co., Ltd.
Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:
FCC-Registration No.: 517856 Designation Number: CN1318
Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.
A2LA-Lab Cert. No.: 6534.01
Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.
The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

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 TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen CTA 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 Shenzhen CTA Testing Technology Co., Ltd. :

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.02 dB	(1)
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Output Peak power	30MHz~18GHz	0.55 dB	(1)
Power spectral density	/	0.57 dB	(1)
Spectrum bandwidth	/	1.1%	(1)
Radiated spurious emission (30MHz-1GHz)	30~1000MHz	4.10 dB	(1)
Radiated spurious emission (1GHz-18GHz)	1~18GHz	4.32 dB	(1)
Radiated spurious emission (18GHz-40GHz)	18-40GHz	5.54 dB	(1)

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

3.5. Summary of measurement results

Applied Standard: FCC Part 15 Subpart C				
FCC Rules	Description of Test	Test Sample	Result	Remark
§15.247(b)(1)	Maximum Conducted Output Power	CTA240715019-S0001-1#	Compliant	Appendix A
§15.247(a) (1) (i)	Frequency Separation	CTA240715019-S0001-1#	Compliant	Appendix A
§15.247(a) (1) (i)	99% and 20 dB Bandwidth	CTA240715019-S0001-1#	Compliant	Appendix A
§15.247(a)(1)(iii)	Number of Hopping Frequency	CTA240715019-S0001-1#	Compliant	Appendix A
§15.247(a)(1)(iii)	Time Of Occupancy (Dwell Time)	CTA240715019-S0001-1#	Compliant	Appendix A
§15.209, §15.205	Conducted Spurious Emissions and Band Edges Test	CTA240715019-S0001-1#	Compliant	Appendix A
§15.209, §15.247(d)	Radiated Spurious Emissions	CTA240715019-S0001-1# CTA240715019-S0001-2#	Compliant	Note 1
§15.205	Emissions at Restricted Band	CTA240715019-S0001-1#	Compliant	Appendix A
§15.207(a)	AC Conducted Emissions	CTA240715019-S0001-2#	Compliant	Note 1
§15.203 §15.247(c)	Antenna Requirements	CTA240715019-S0001-1#	Compliant	Note 1
§15.247(i)§2.1091	RF Exposure	/	Compliant	Note 2

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

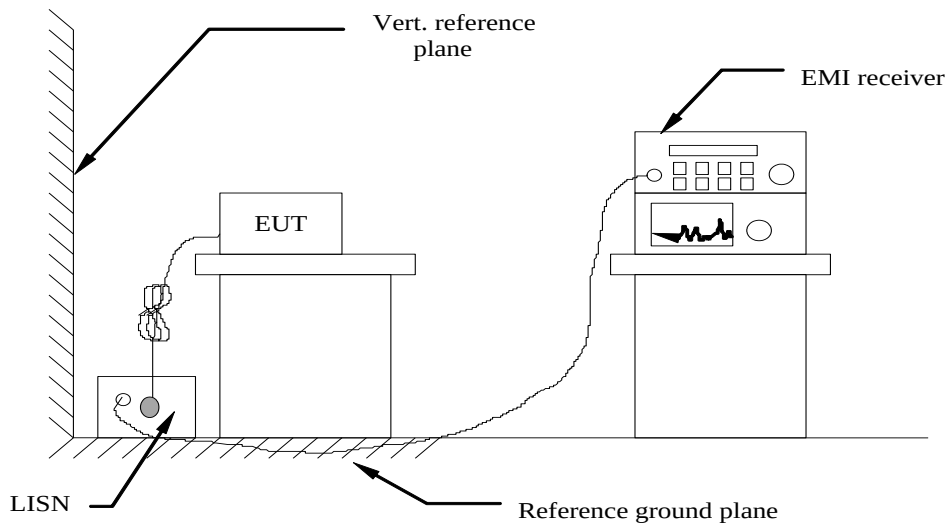
Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	CTA-308	2024/08/02	2025/08/01
LISN	R&S	ENV216	CTA-314	2024/08/02	2025/08/01
EMI Test Receiver	R&S	ESPI	CTA-307	2024/08/02	2025/08/01
EMI Test Receiver	R&S	ESCI	CTA-306	2024/08/02	2025/08/01
Spectrum Analyzer	Agilent	N9020A	CTA-301	2024/08/02	2025/08/01
Spectrum Analyzer	R&S	FSP	CTA-337	2024/08/02	2025/08/01
Vector Signal generator	Agilent	N5182A	CTA-305	2024/08/02	2025/08/01
Analog Signal Generator	R&S	SML03	CTA-304	2024/08/02	2025/08/01
Universal Radio Communication	CMW500	R&S	CTA-302	2024/08/02	2025/08/01
Temperature and humidity meter	Chigo	ZG-7020	CTA-326	2024/08/02	2025/08/01
Ultra-Broadband Antenna	Schwarzbeck	VULB9163	CTA-310	2023/10/17	2024/10/16
Horn Antenna	Schwarzbeck	BBHA 9120D	CTA-309	2023/10/13	2024/10/12
Loop Antenna	Zhinan	ZN30900C	CTA-311	2023/10/17	2024/10/16
Horn Antenna	Beijing Hangwei Dayang	OBH100400	CTA-336	2024/08/02	2025/08/01
Antenna Tower	Suzhou Keletuo electronic Technology Co., LTD	BK-*AT-BS	N/A	N/A	N/A
Amplifier	Schwarzbeck	BBV 9745	CTA-312	2024/08/02	2025/08/01
Amplifier	Taiwan chengyi	EMC051845B	CTA-313	2024/08/02	2025/08/01
Directional coupler	NARDA	4226-10	CTA-303	2024/08/02	2025/08/01
High-Pass Filter	XingBo	XBLBQ-GTA18	CTA-402	2024/08/02	2025/08/01
High-Pass Filter	XingBo	XBLBQ-GTA27	CTA-403	2024/08/02	2025/08/01
Automated filter bank	Tonscend	JS0806-F	CTA-404	2024/08/02	2025/08/01
Power Sensor	Agilent	U2021XA	CTA-405	2024/08/02	2025/08/01
Amplifier	Schwarzbeck	BBV9719	CTA-406	2024/08/02	2025/08/01

Note:
1. The Cal.Interval was one year.
2.All devices whose calibration expired on Aug.02, 2024 were calibrated from Aug.03, 2023 to Aug.02, 2024.

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 tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2020.
2 Support equipment, if needed, was placed as per ANSI C63.10-2020.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2020.
4 The EUT received DC 20V power, the received AC120V/60Hz or AC 240V/50Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
6 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.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.
9 The LISN is greater than 40 cm from the vertical reference plane.

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.		

DISTURBANCE Calculation

The AC mains conducted disturbance is calculated by adding the 10dB Pulse Limiter and Cable Factor and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

CD (dBuV) = RA (dBuV) + PL (dB) + CL (dB)

Where CD = Conducted Disturbance	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	PL = 10 dB Pulse Limiter Factor

TEST RESULTS

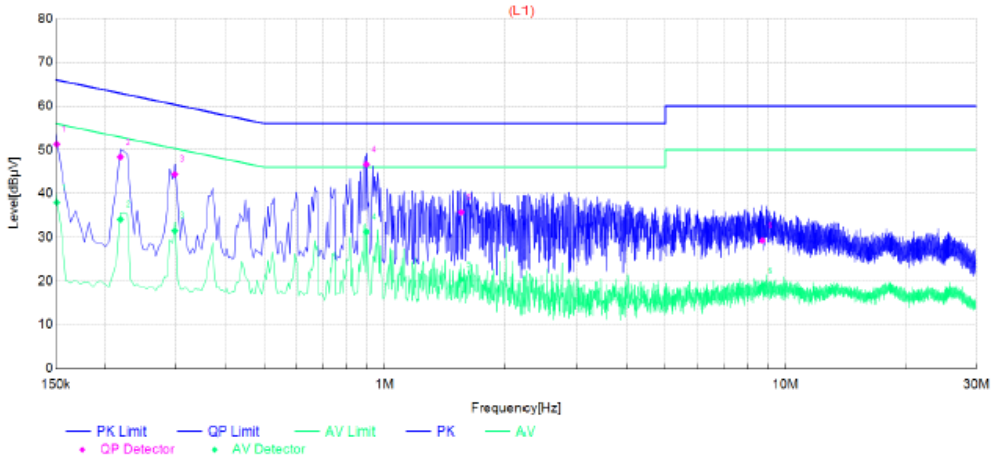
Remark: We measured Conducted Emission at GFSK, π/4-DQPSK and 8-DPSK mode in AC 120V/60Hz and AC 240V/50Hz, the worst case was recorded(GFSK 1Mbps-MCH) .

Temperature	25℃	Humidity	60%
Test Engineer	Lushan Kong	Configurations	BT

Model:Shell S1

Power supply:	AC 120V/60Hz	Polarization	L

Test Graph



Final Data List

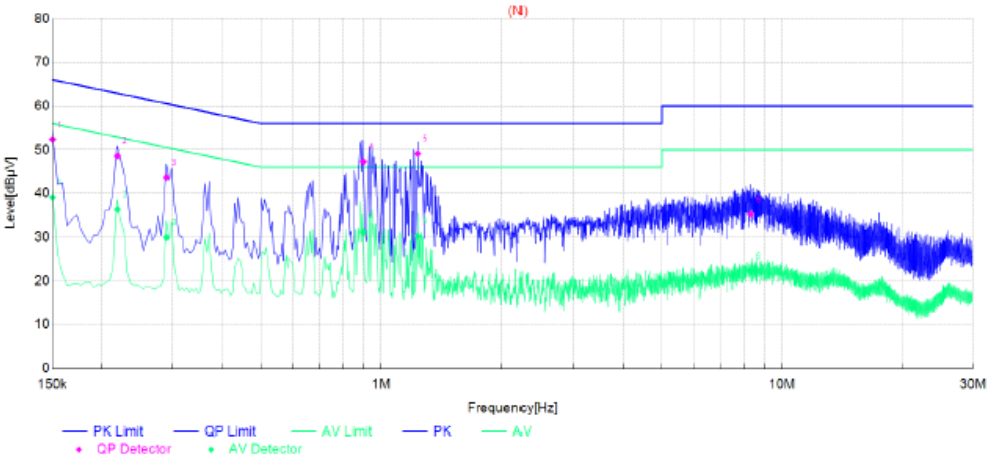
NO.	Frequency	QP Reading	AVG. Reading	Factor	QP Result	AVG. Result	QP Limit	AVG. Limit	QP Margin	AVG. Margin	Line	Remark
1	0.1508	40.93	27.58	10.35	51.28	37.93	65.96	55.96	14.68	18.03	L1	PASS
2	0.2178	38.21	23.91	10.15	48.36	34.06	62.90	52.90	14.54	18.84	L1	PASS
3	0.2978	34.30	21.36	10.10	44.40	31.46	60.30	50.30	15.90	18.84	L1	PASS
4	0.8989	36.41	20.98	10.23	46.64	31.21	56.00	46.00	9.36	14.79	L1	PASS
5	1.5548	25.47	10.06	10.24	35.71	20.30	56.00	46.00	20.29	25.70	L1	PASS
6	8.7403	18.70	8.41	10.56	29.26	18.97	60.00	50.00	30.74	31.03	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	0.1502	41.99	28.72	10.35	52.34	39.07	65.99	55.99	13.65	16.92	N	PASS
2	0.2184	38.43	26.20	10.14	48.57	36.34	62.88	52.88	14.31	16.54	N	PASS
3	0.2894	33.53	19.88	10.10	43.63	29.98	60.54	50.54	16.91	20.56	N	PASS
4	0.9014	37.03	20.92	10.23	47.26	31.15	56.00	46.00	8.74	14.85	N	PASS
5	1.2337	38.90	20.05	10.22	49.12	30.27	56.00	46.00	6.88	15.73	N	PASS
6	8.3537	24.68	11.72	10.57	35.25	22.29	60.00	50.00	24.75	27.71	N	PASS

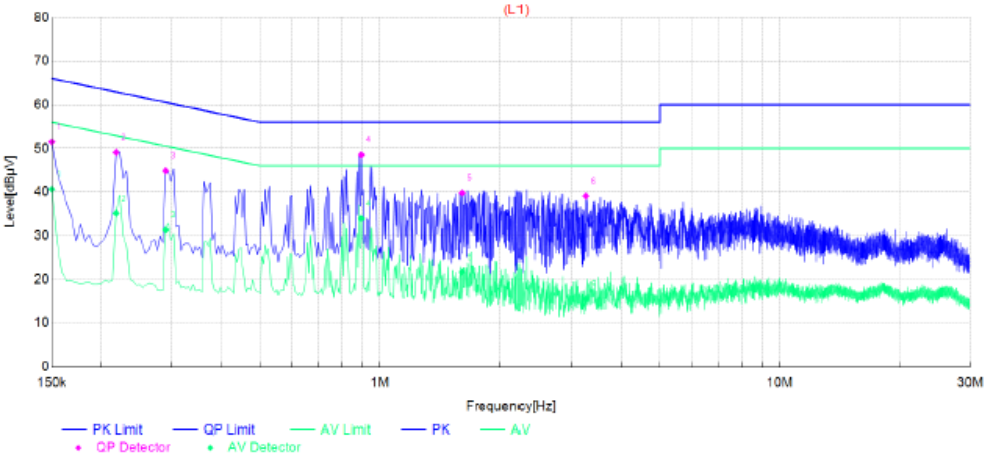
Note: 1. Result (dBµV) = Reading (dBµV) + Factor (dB).

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

Model:Shell S2

Power supply:	AC 120V/60Hz	Polarization	L

Test Graph



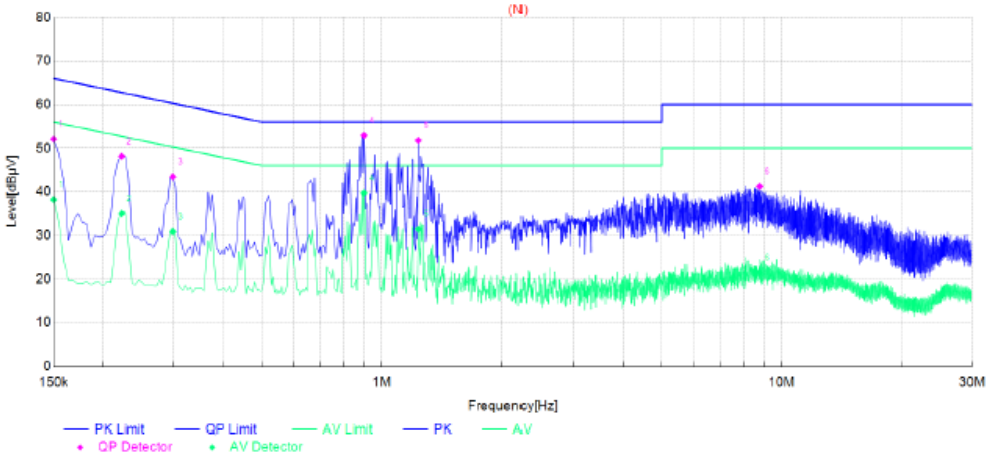
Final Data List												
NO.	Frequency	QP Reading	AVG. Reading	Factor	QP Result	AVG. Result	QP Limit	AVG. Limit	QP Margin	AVG. Margin	Line	Remark
1	0.15	41.16	30.28	10.35	51.51	40.63	66.00	56.00	14.49	15.37	L1	PASS
2	0.2175	38.96	24.98	10.14	49.10	35.12	62.91	52.91	13.81	17.79	L1	PASS
3	0.2895	34.76	21.25	10.10	44.86	31.35	60.54	50.54	15.68	19.19	L1	PASS
4	0.897	38.31	23.71	10.23	48.54	33.94	56.00	46.00	7.46	12.06	L1	PASS
5	1.608	29.55	11.47	10.24	39.79	21.71	56.00	46.00	16.21	24.29	L1	PASS
6	3.2595	28.74	5.22	10.35	39.09	15.57	56.00	46.00	16.91	30.43	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	0.15	41.77	27.84	10.35	52.12	38.19	66.00	56.00	13.88	17.81	N	PASS
2	0.222	38.00	24.86	10.14	48.14	35.00	62.74	52.74	14.60	17.74	N	PASS
3	0.2985	33.34	20.80	10.10	43.44	30.90	60.28	50.28	16.84	19.38	N	PASS
4	0.9015	42.72	29.50	10.23	52.95	39.73	56.00	46.00	3.05	6.27	N	PASS
5	1.2345	41.58	21.24	10.22	51.80	31.46	56.00	46.00	4.20	14.54	N	PASS
6	8.7945	30.71	11.01	10.55	41.26	21.56	60.00	50.00	18.74	28.44	N	PASS

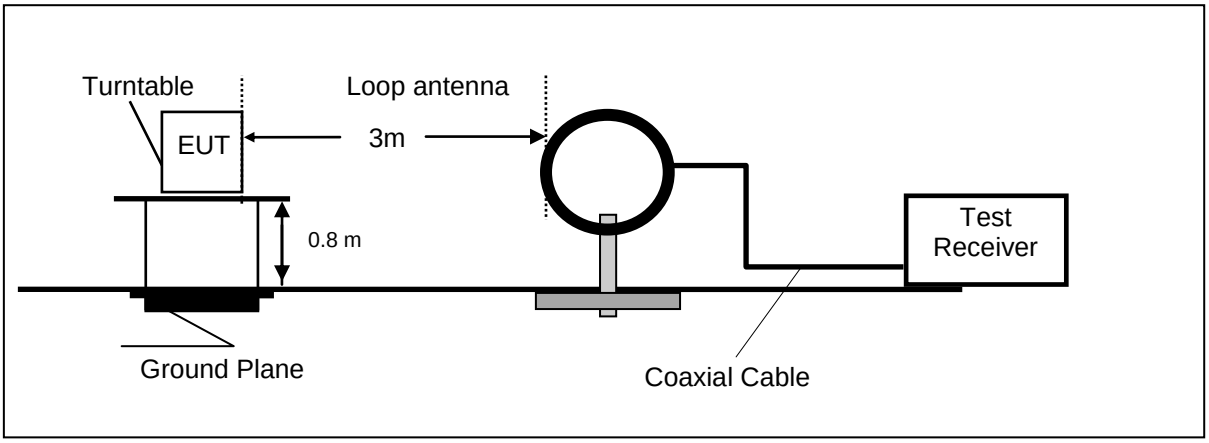
Note: 1. Result (dBµV) = Reading (dBµV) + Factor (dB).

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

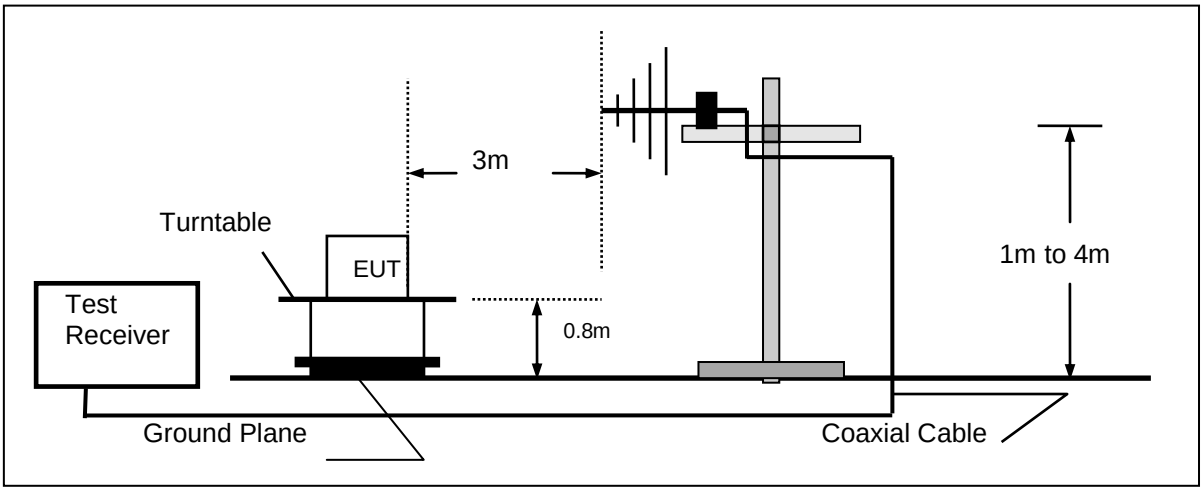
4.2. Radiated Emission

TEST CONFIGURATION

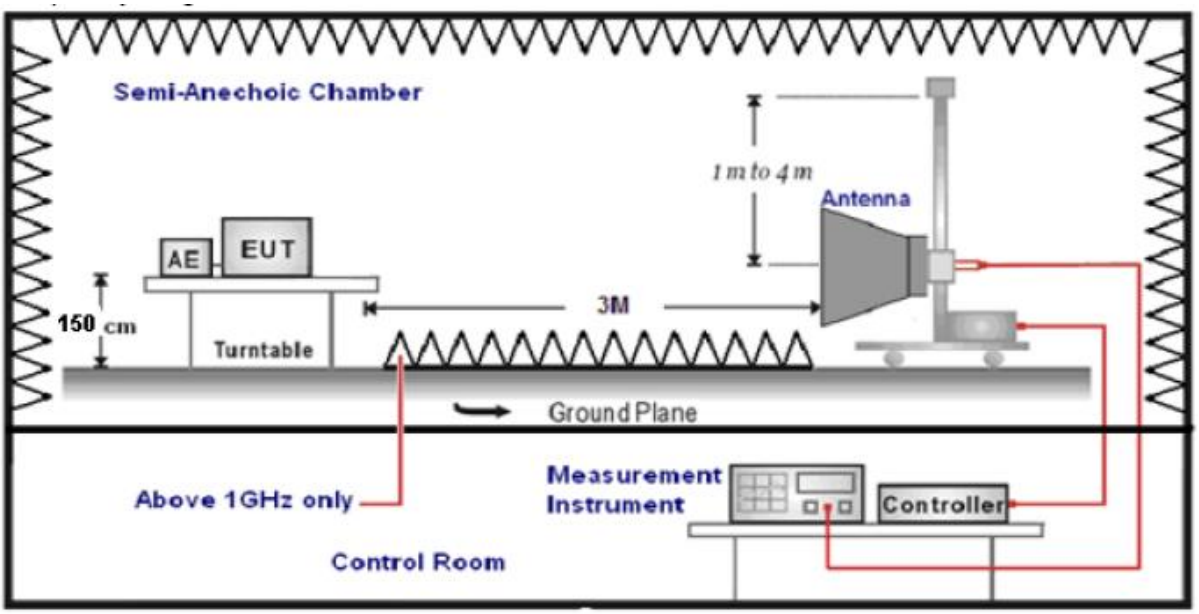
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m 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. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz 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

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.
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

TEST RESULTS

Remark: We measured Radiated Emission at GFSK, π/4-DQPSK and 8-DPSK mode from 9KHz to 25GHz and recorded worst case at GFSK(1Mbps-MCH) mode.

Temperature	25℃	Humidity	60%
Test Engineer	Lushan Kong	Configurations	BT

For 9 KHz~30MHz

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

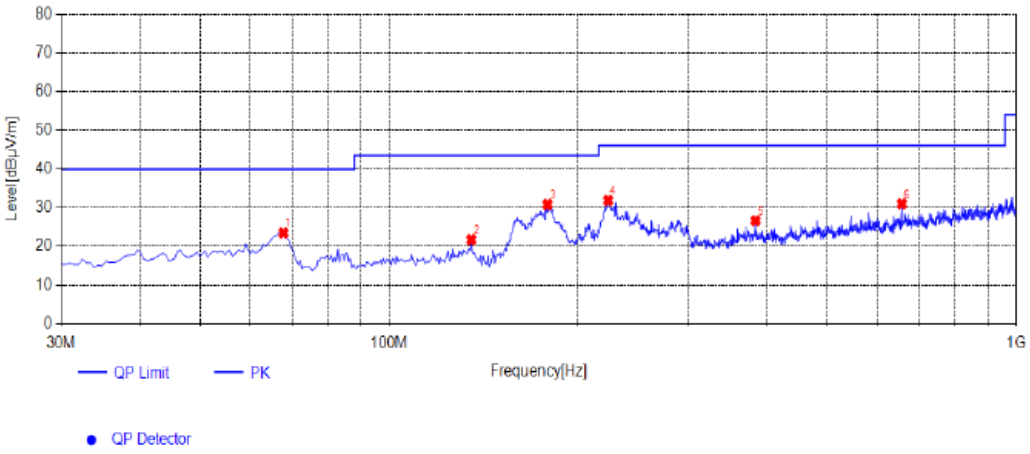
Note:
The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

Model:Shell S1

For 30MHz-1GHz

Horizontal

Test Graph



Suspected List

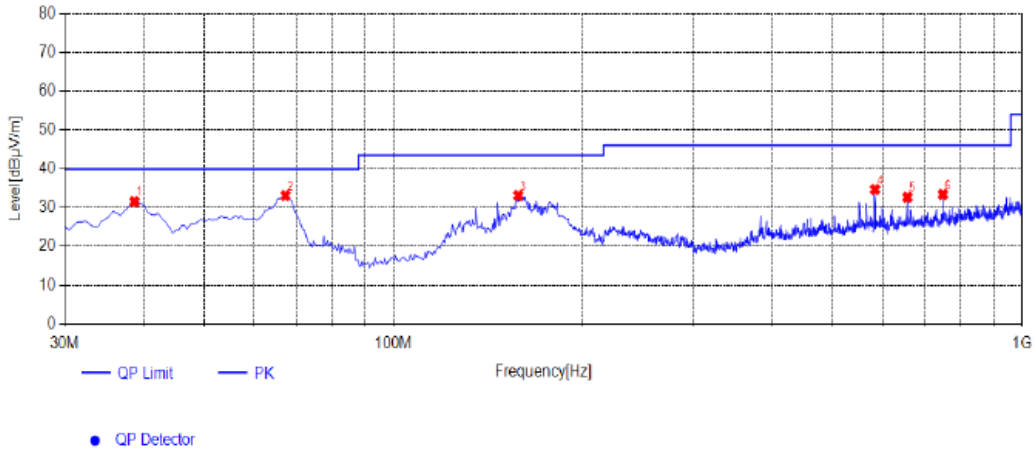
NO.	Frequency [MHz]	Reading [dBμV/m]	Factor [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remar
1	67.83	36.92	-13.48	23.44	40.00	16.56	100	249	PK	Horizonta	PASS
2	135.245	35.78	-14.07	21.71	43.50	21.79	100	68	PK	Horizonta	PASS
3	178.895	43.12	-12.28	30.84	43.50	12.66	100	82	PK	Horizonta	PASS
4	223.515	41.34	-9.45	31.89	46.00	14.11	100	39	PK	Horizonta	PASS
5	384.05	32.22	-5.58	26.64	46.00	19.36	100	118	PK	Horizonta	PASS
6	657.105	30.77	0.25	31.02	46.00	14.98	100	354	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).

Vertical

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	Rema
1	38.73	43.55	-11.99	31.56	40.00	8.44	100	21	PK	Vertical	PASS
2	67.345	46.44	-13.34	33.10	40.00	6.90	100	295	PK	Vertical	PASS
3	158.04	46.48	-13.36	33.12	43.50	10.38	100	8	PK	Vertical	PASS
4	583.87	35.39	-0.74	34.65	46.00	11.35	100	223	PK	Vertical	PASS
5	657.105	32.42	0.25	32.67	46.00	13.33	100	223	PK	Vertical	PASS
6	748.285	32.13	1.25	33.38	46.00	12.62	100	213	PK	Vertical	PASS

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

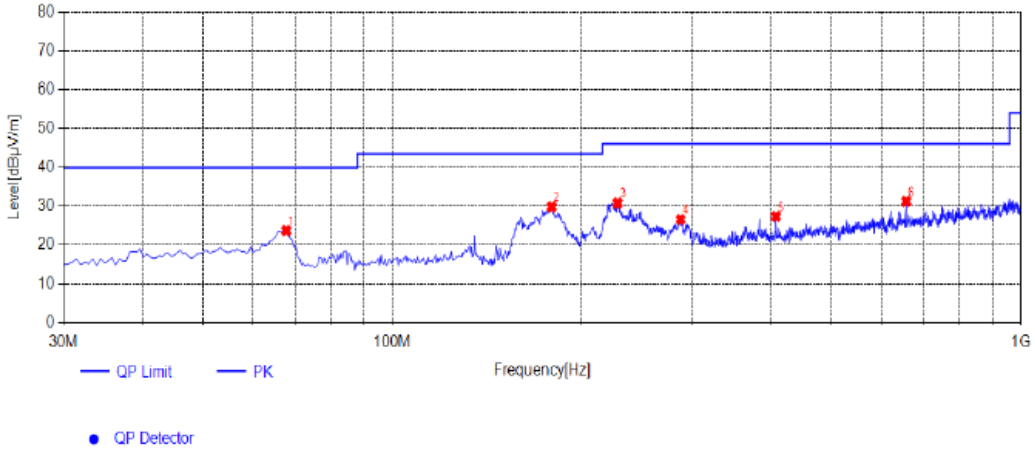
2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Model:Shell S2

For 30MHz-1GHz

Horizontal

Test Graph



Suspected List

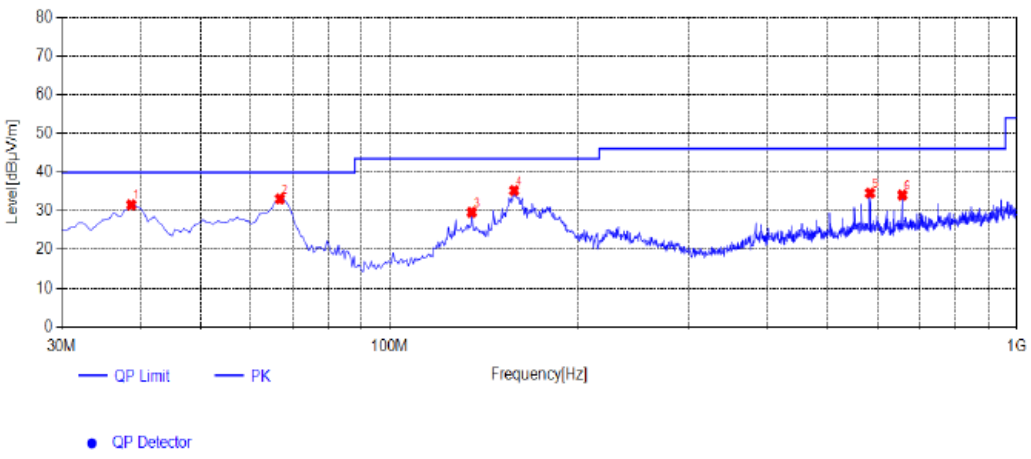
NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remar
1	67.83	37.15	-13.48	23.67	40.00	16.33	100	140	PK	Horizonta	PASS
2	179.38	42.11	-12.25	29.86	43.50	13.64	100	87	PK	Horizonta	PASS
3	228.365	40.16	-9.35	30.81	46.00	15.19	100	25	PK	Horizonta	PASS
4	287.535	34.28	-7.70	26.58	46.00	19.42	100	107	PK	Horizonta	PASS
5	407.815	32.41	-5.06	27.35	46.00	18.65	100	87	PK	Horizonta	PASS
6	657.105	31.00	0.25	31.25	46.00	14.75	100	341	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).

Vertical

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	38.73	43.57	-11.99	31.58	40.00	8.42	100	360	PK	Vertical	PASS
2	66.86	46.30	-13.20	33.10	40.00	6.90	100	263	PK	Vertical	PASS
3	135.245	43.73	-14.07	29.66	43.50	13.84	100	45	PK	Vertical	PASS
4	158.04	48.58	-13.36	35.22	43.50	8.28	100	36	PK	Vertical	PASS
5	583.87	35.31	-0.74	34.57	46.00	11.43	100	3	PK	Vertical	PASS
6	657.105	33.82	0.25	34.07	46.00	11.93	100	108	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).

For 1GHz to 25GHz

Model:Shell S1

GFSK /Channel 0 / 2402 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4804.00	50.88	32.44	30.25	7.95	61.02	74.00	-12.98	Peak	Horizontal
4804.00	36.32	32.44	30.25	7.95	46.46	54.00	-7.54	Average	Horizontal
4804.00	50.64	31.60	36.50	7.00	52.74	74.00	-21.26	Peak	Vertical
4804.00	36.18	31.60	36.50	7.00	38.28	54.00	-15.72	Average	Vertical

Channel 39 / 2441 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4882.00	49.91	32.52	30.31	8.12	60.24	74.00	-13.76	Peak	Horizontal
4882.00	36.56	32.52	30.31	8.12	46.89	54.00	-7.11	Average	Horizontal
4882.00	50.91	31.02	36.50	7.60	53.03	74.00	-20.97	Peak	Vertical
4882.00	35.76	31.02	36.50	7.60	37.88	54.00	-16.12	Average	Vertical

Channel 78 / 2480 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4960.00	51.53	32.68	30.27	7.88	61.82	74.00	-12.18	Peak	Horizontal
4960.00	36.68	32.68	30.27	7.88	46.97	54.00	-7.03	Average	Horizontal
4960.00	51.81	31.58	36.20	7.82	55.01	74.00	-18.99	Peak	Vertical
4960.00	37.33	31.58	36.20	7.82	40.53	54.00	-13.47	Average	Vertical

Model:Shell S2

GFSK /Channel 0 / 2402 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4804.00	49.84	32.44	30.25	7.95	59.98	74.00	-14.02	Peak	Horizontal
4804.00	36.67	32.44	30.25	7.95	46.81	54.00	-7.19	Average	Horizontal
4804.00	53.02	32.44	30.25	7.95	63.16	74.00	-10.84	Peak	Vertical
4804.00	36.14	32.44	30.25	7.95	46.28	54.00	-7.72	Average	Vertical

Channel 39 / 2441 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4882.00	49.95	32.52	30.31	8.12	60.28	74.00	-13.72	Peak	Horizontal
4882.00	36.92	32.52	30.31	8.12	47.25	54.00	-6.75	Average	Horizontal
4882.00	51.66	32.52	30.31	8.12	61.99	74.00	-12.01	Peak	Vertical
4882.00	36.30	32.52	30.31	8.12	46.63	54.00	-7.37	Average	Vertical

Channel 78 / 2480 MHz

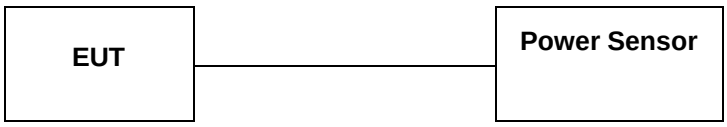
Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4960.00	50.18	32.68	30.27	7.88	60.47	74.00	-13.53	Peak	Horizontal
4960.00	35.37	32.68	30.27	7.88	45.66	54.00	-8.34	Average	Horizontal
4960.00	49.49	32.68	30.27	7.88	59.78	74.00	-14.22	Peak	Vertical
4960.00	31.36	32.68	30.27	7.88	41.65	54.00	-12.35	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz~10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic or 26.5GHz (which is less) 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). Measured= Reading- Pre. Fac.+ Ant. Fac.+ Cab. Loss
5). Margin = Measured- Limit
Note : All the modes have been tested and recorded worst mode in the report.

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2020 Maximum peak conducted output power for HFSS devices:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.
The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple derector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

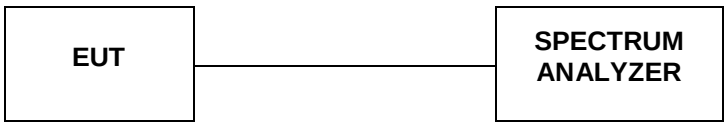
TEST RESULTS

For reporting purpose only.

Please refer to Appendix A.3.

4.4. 99% and 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30KHz and VBW=100KHz.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

TEST RESULTS

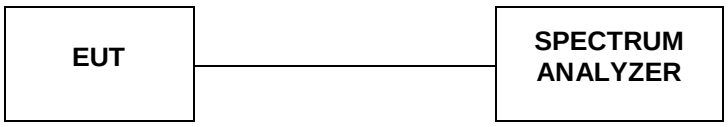
For reporting purpose only.

Please refer to Appendix A.1.

Please refer to Appendix A.2.

4.5. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100KHz and VBW=300KHz.

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST RESULTS

For reporting purpose only.

Please refer to Appendix A.4.

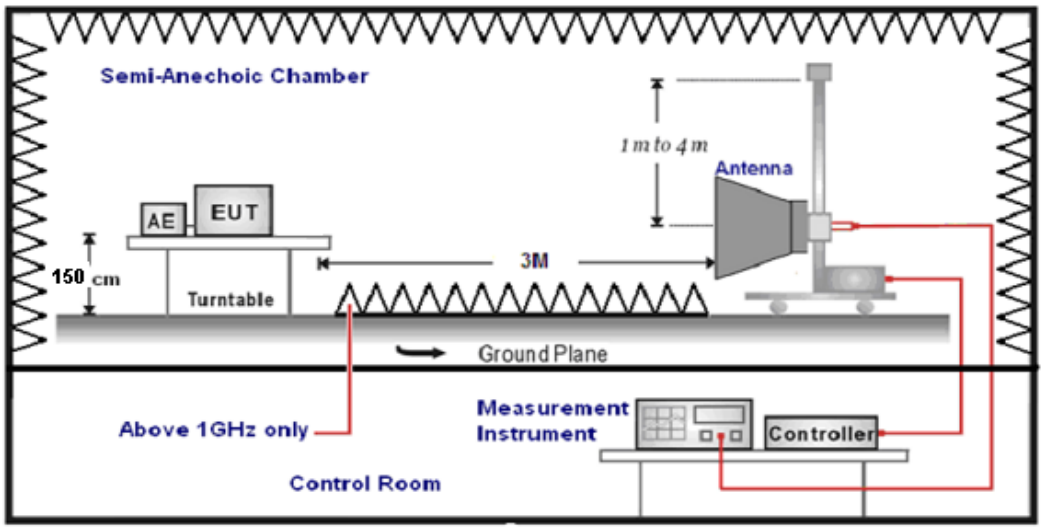
4.6. Conducted Spurious Emissions and Band Edge Compliance of RF Emission

TEST REQUIREMENT

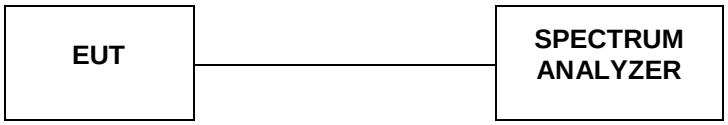
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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

For Radiated



For Conducted



TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
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. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=330Hz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.
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)

TEST RESULTS

4.6.1 For Conducted at Restricted Band Measurement

For reporting purpose only.

Please refer to Appendix A.9.

4.6.2 For Conducted Bandedge Measurement

For reporting purpose only.

Please refer to Appendix A.7.

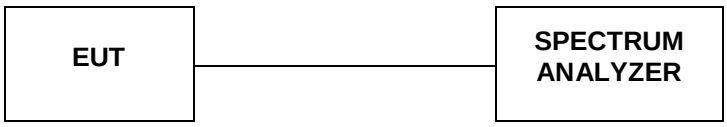
4.6.3 For Conducted Spurious Emissions Measurement

For reporting purpose only.

Please refer to Appendix A.8.

4.7. Number of hopping frequency

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=100KHz and VBW=300KHz.

LIMIT

Frequency hopping systems in the 2400–2483.5MHz band shall use at least 15 channels.

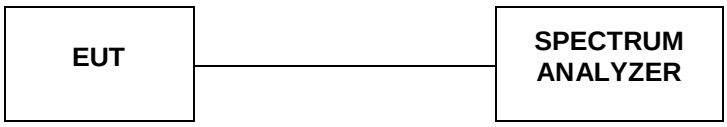
TEST RESULTS

For reporting purpose only.

Please refer to Appendix A.6.

4.8. Time Of Occupancy(Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

TEST RESULTS

For reporting purpose only.

Please refer to Appendix A.5.

4.9. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

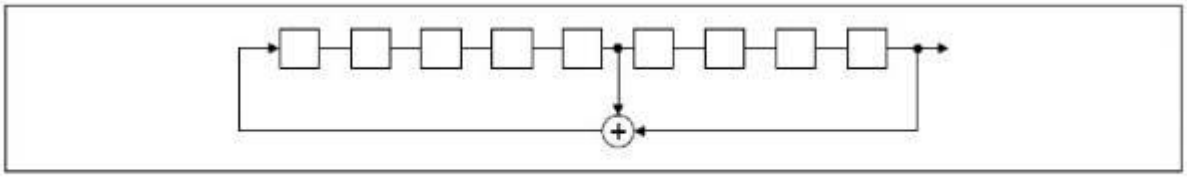
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

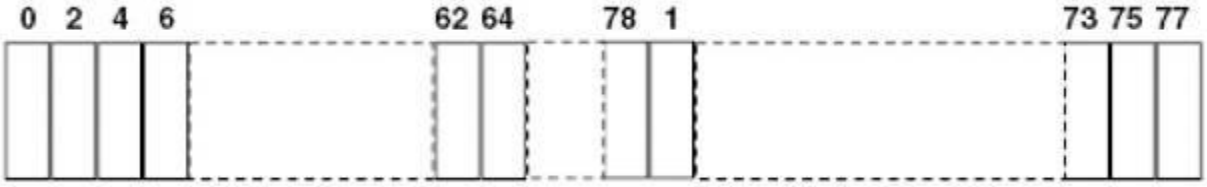
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the frist stage.The sequence begins with the frist one of 9 consecutive ones,for example:the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.10. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

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 7.87dBi.

Reference to the **Internal photos**.

5. TEST SETUP PHOTOS OF THE EUT

Photo of Radiated Emissions Measurement

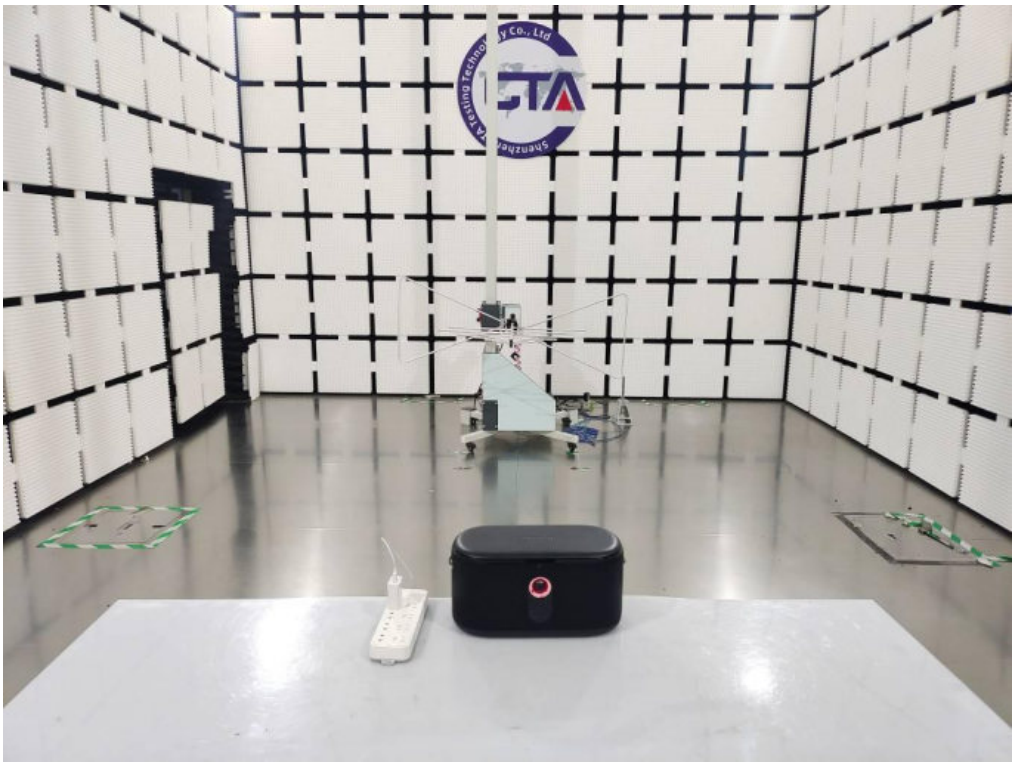


Fig. 1

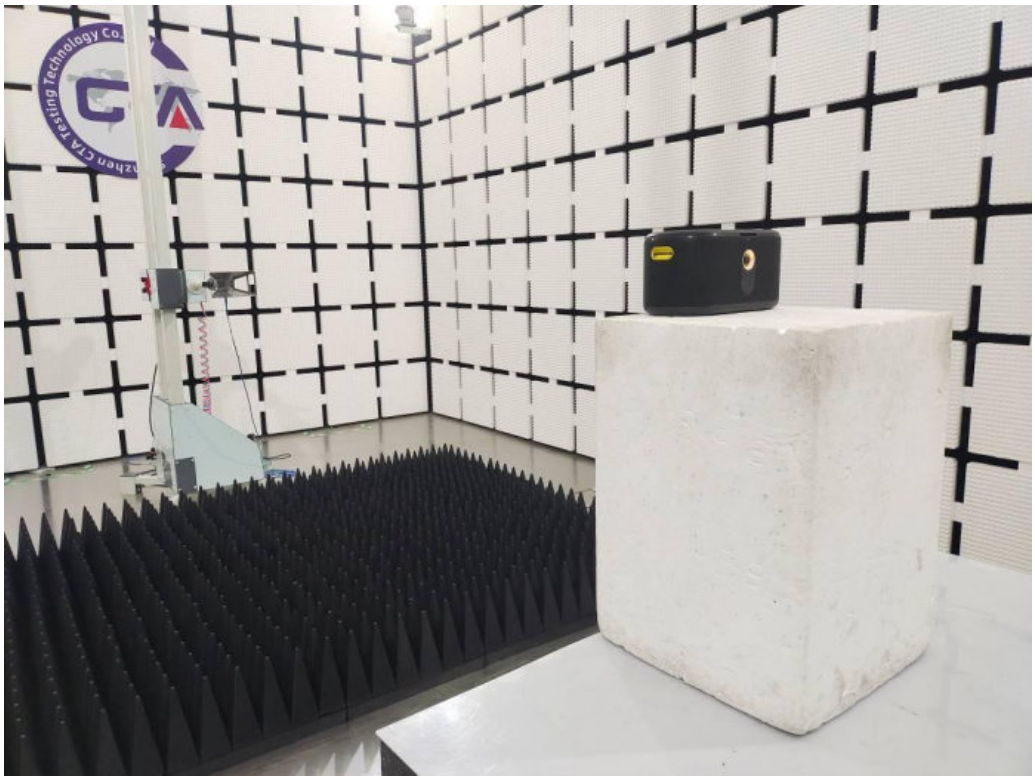


Fig. 2

Photo of Conducted Emission Measurement

Fig. 3

6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

6.1. External photos of the EUT

Fig. 1

Fig. 2

Fig. 3

Fig. 4

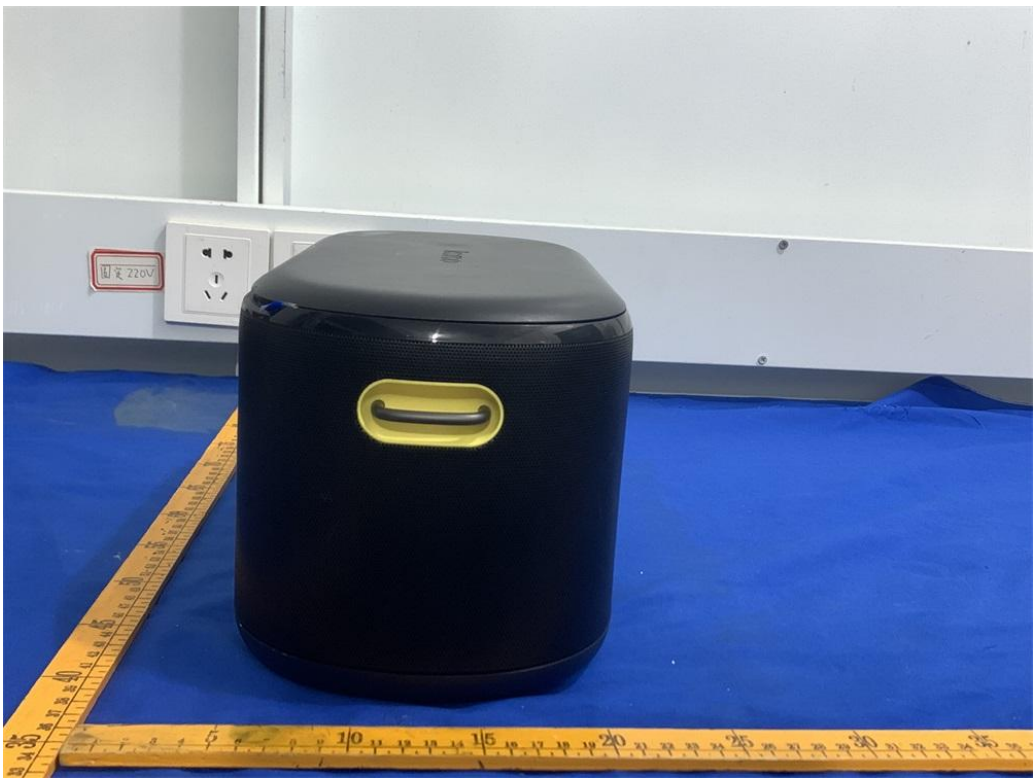


Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

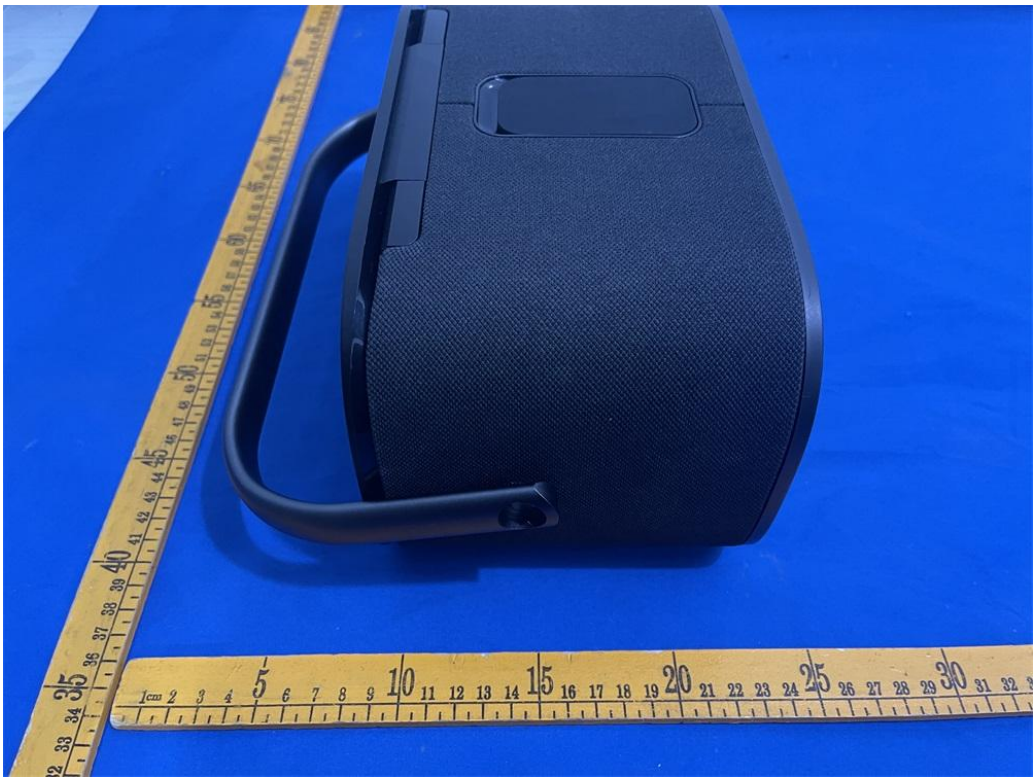


Fig. 14

Fig. 15

Fig. 16

Fig. 17

6.2. Internal photos of the EUT

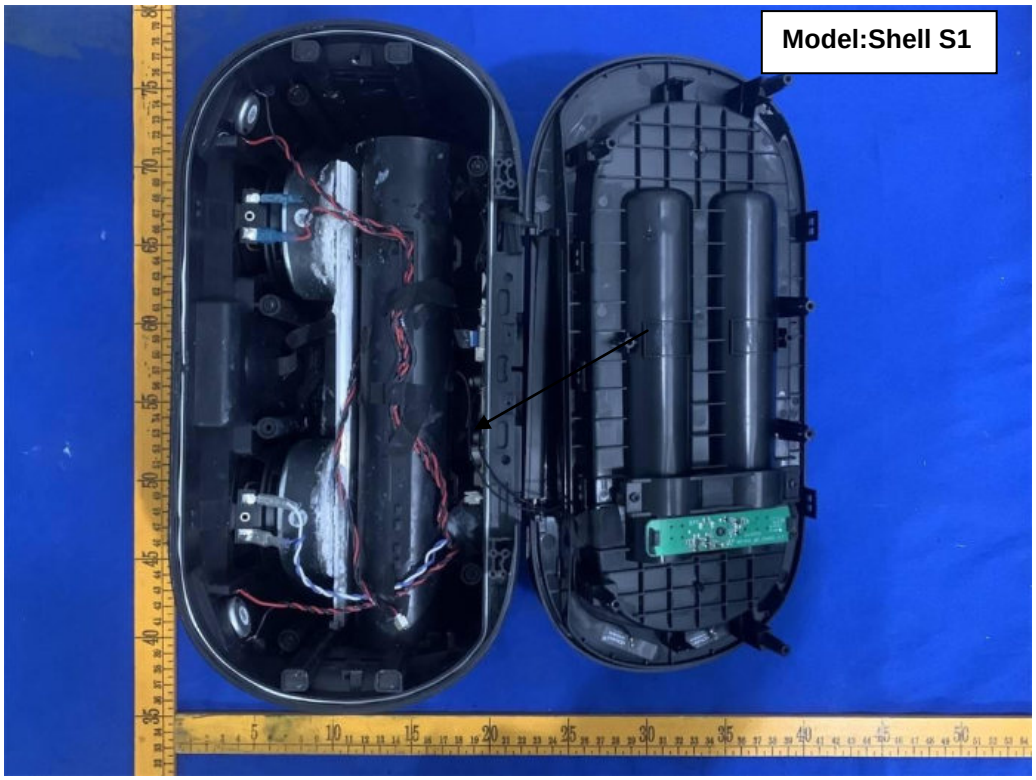


Fig. 18

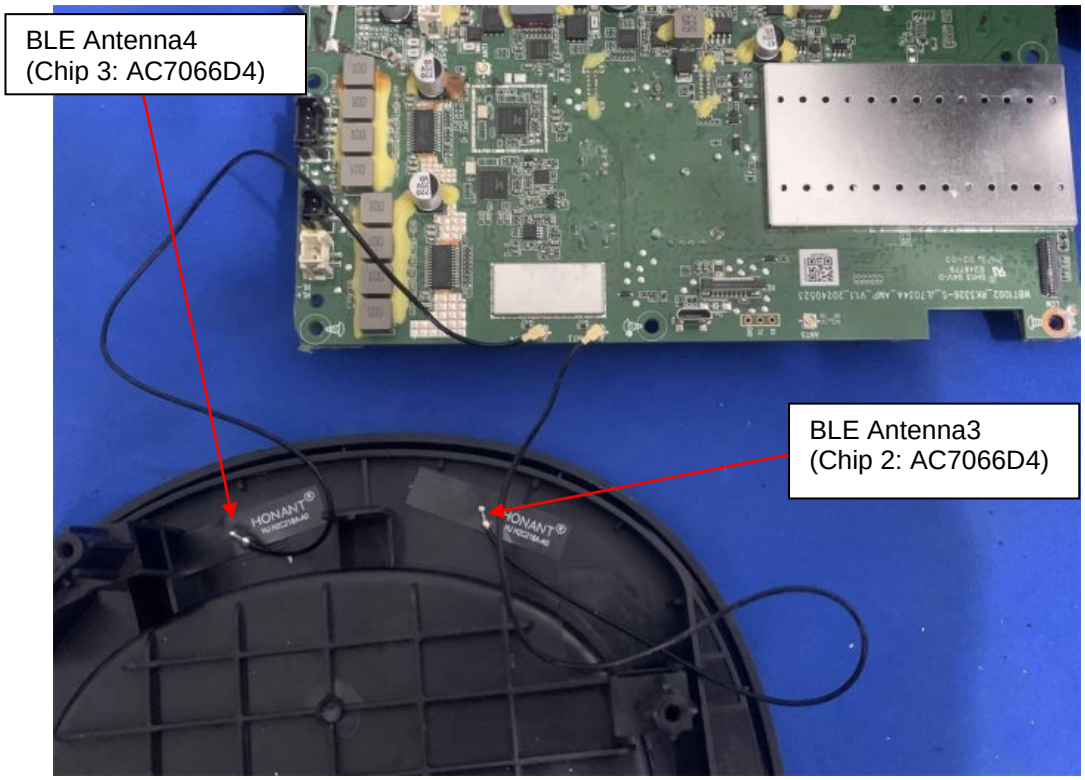


Fig. 19

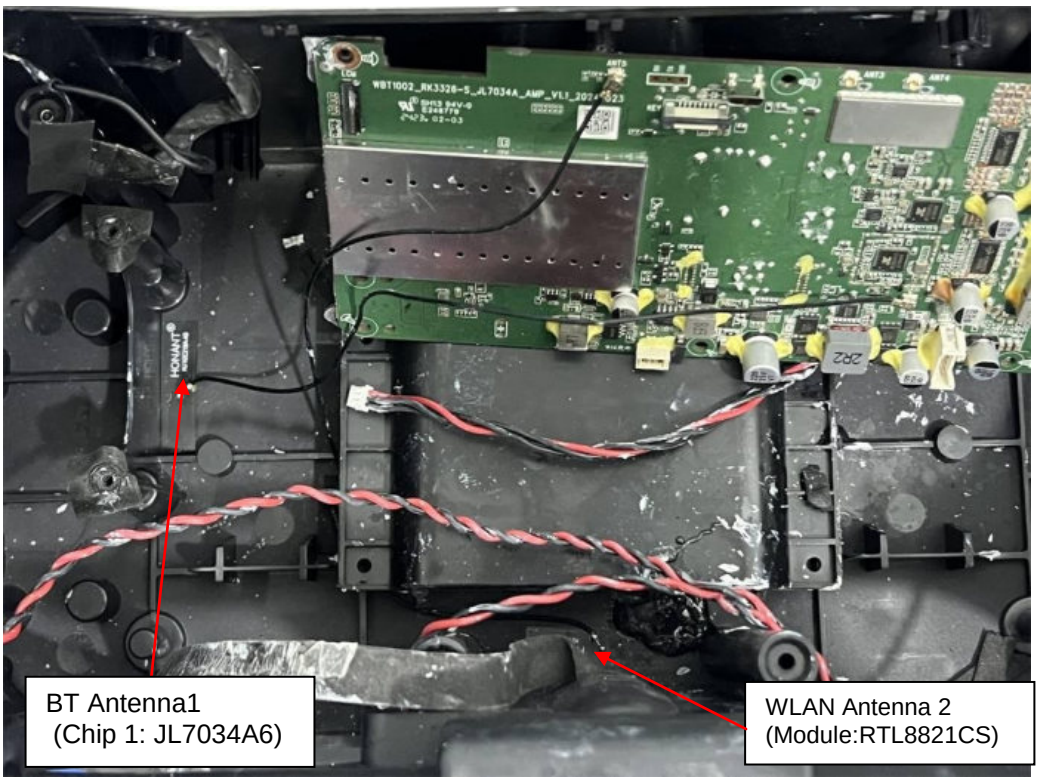

BT Antenna1
(Chip 1: JL7034A6)
WLAN Antenna 2
(Module:RTL8821CS)

Fig. 20

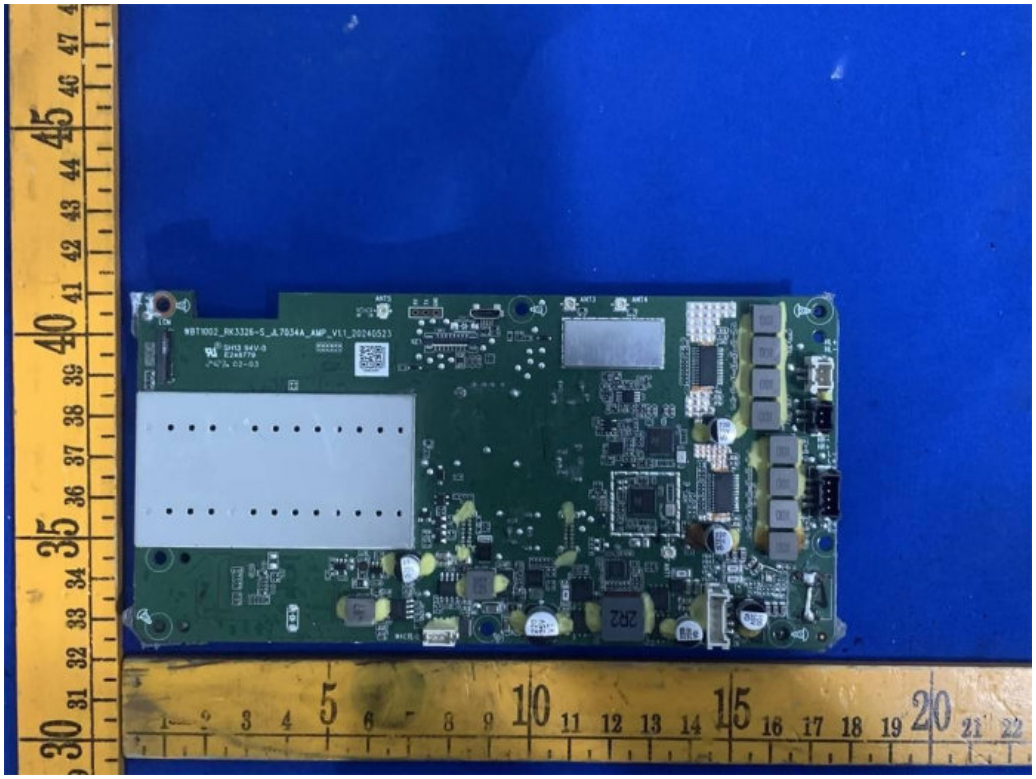


Fig. 21

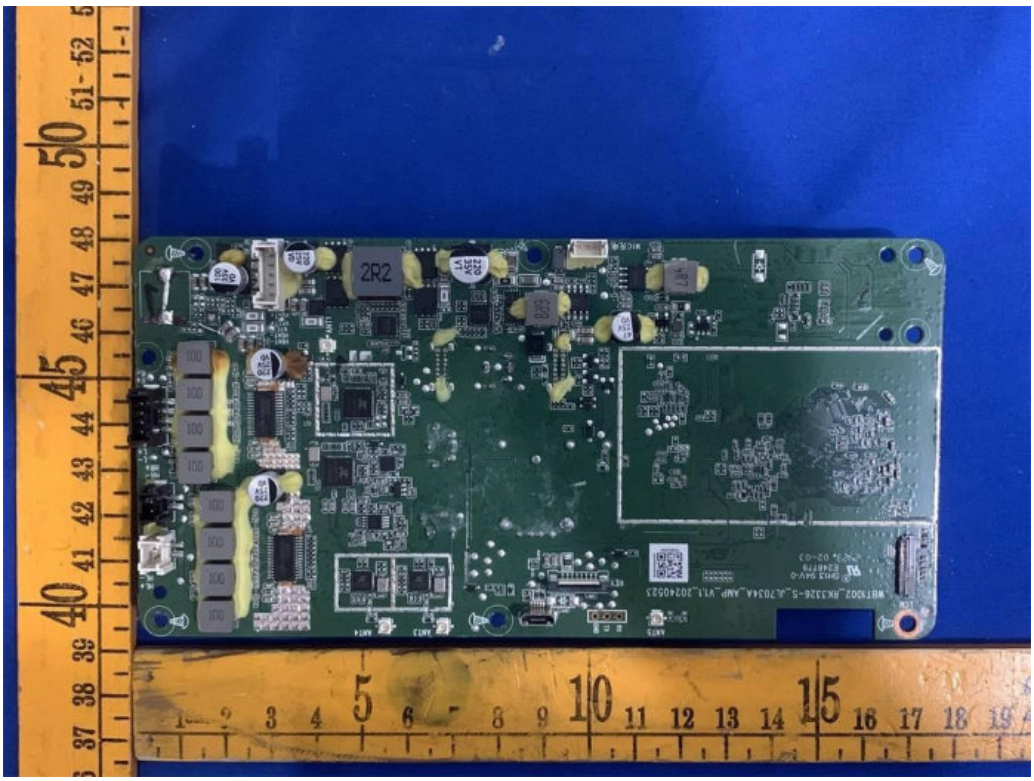


Fig. 22

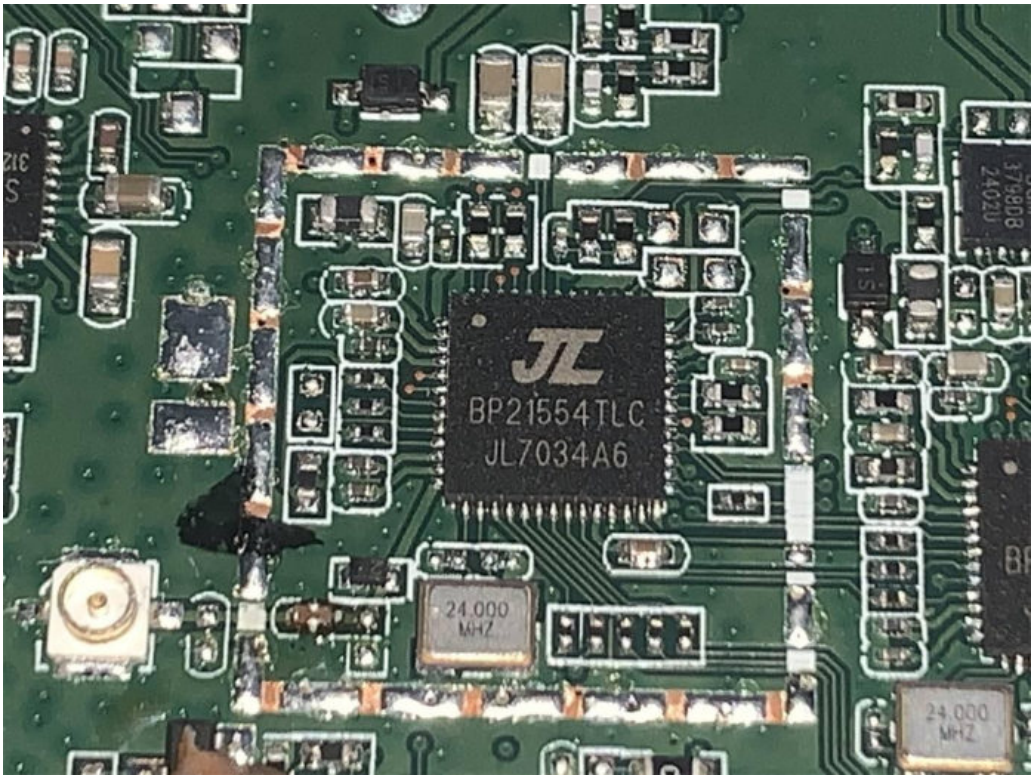


Fig. 23

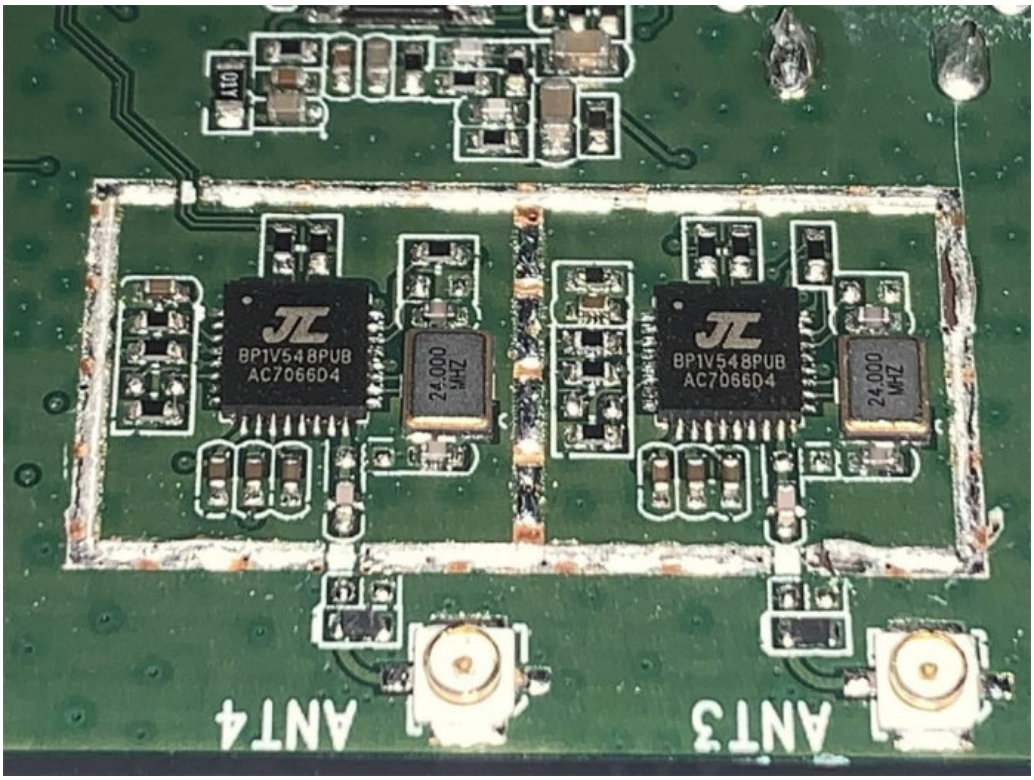

BP1V548PUB
AC7066D4
24.000
MHZ
BP1V548PUB
AC7066D4
24.000
MHZ
ANT4
ANT3

Fig. 24

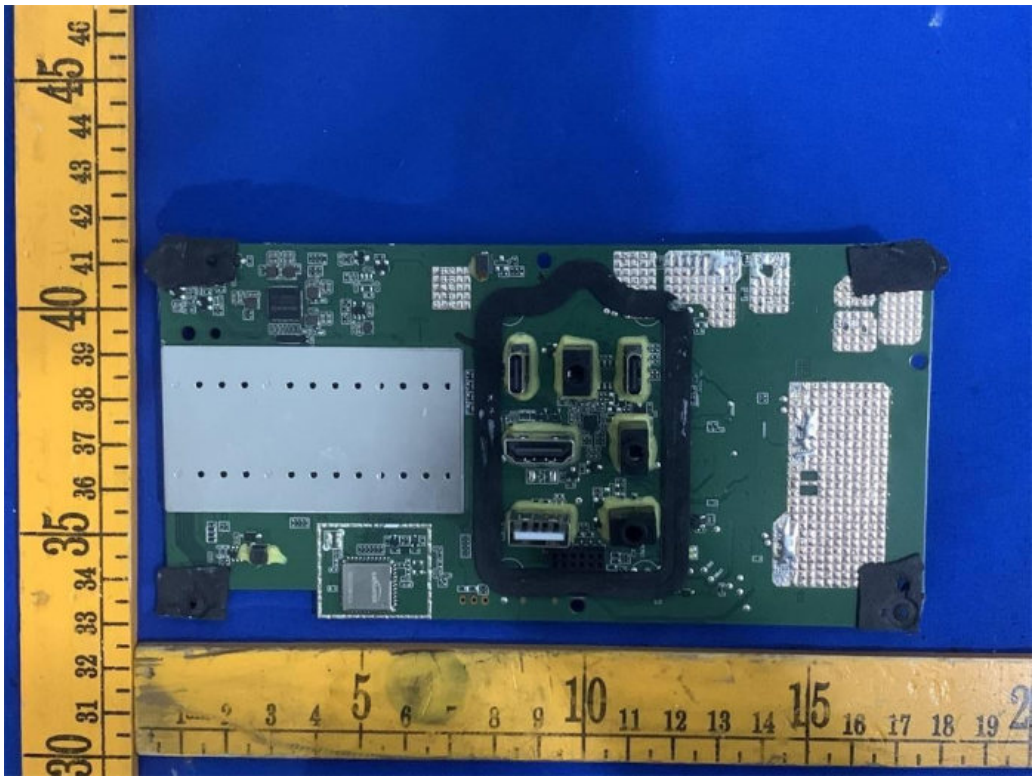


Fig. 25

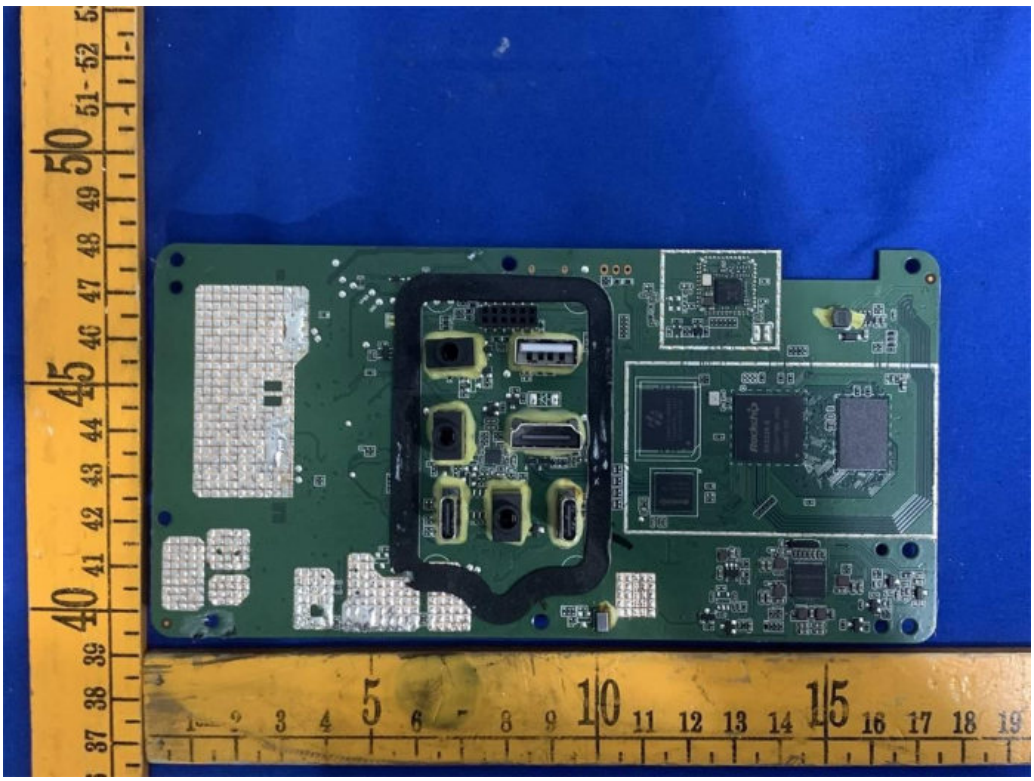


Fig. 26

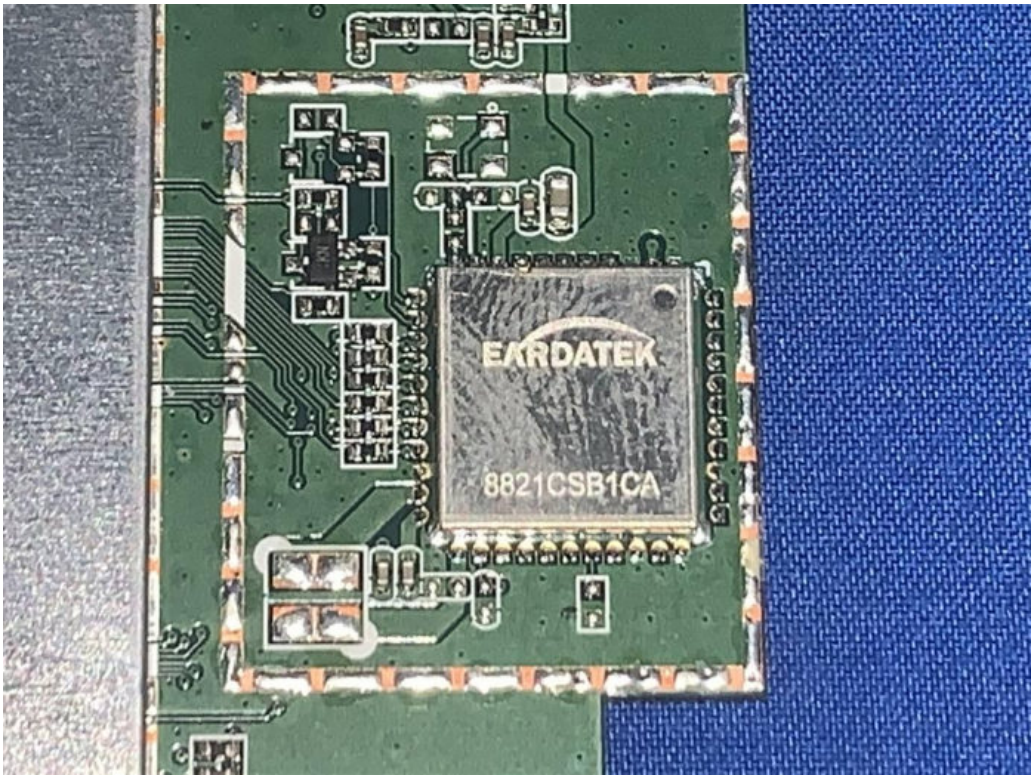


Fig. 27

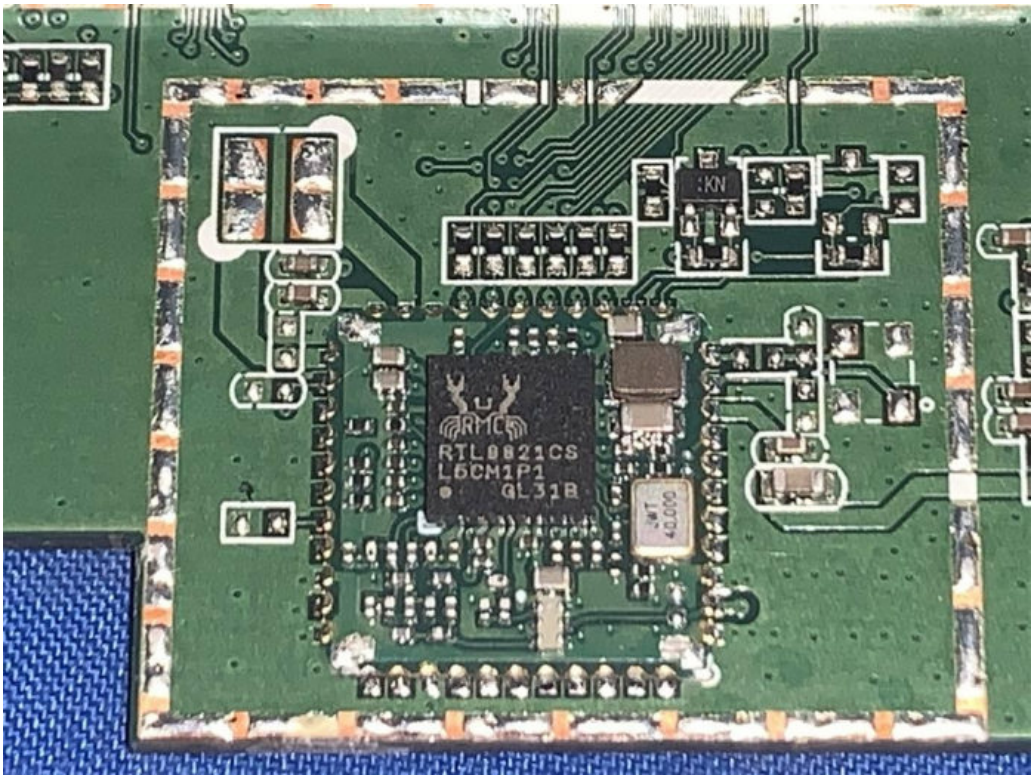

RTL8821CS
L6CM1P1
QL31B

Fig. 28

24.000
MHZ
Rockchip
RK3326-S
SCDUKF786S 2404
1189502 000

Fig. 29

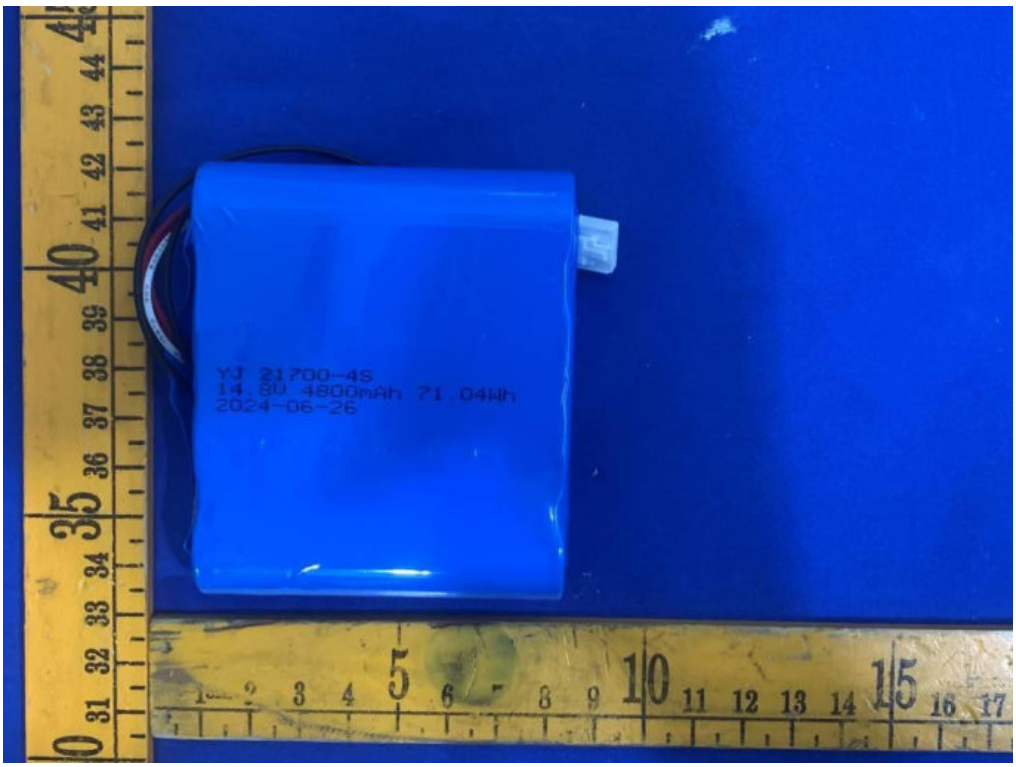


Fig. 30

Fig. 31

WLAN Antenna 2
(Module:RTL8821CS)

Fig. 32

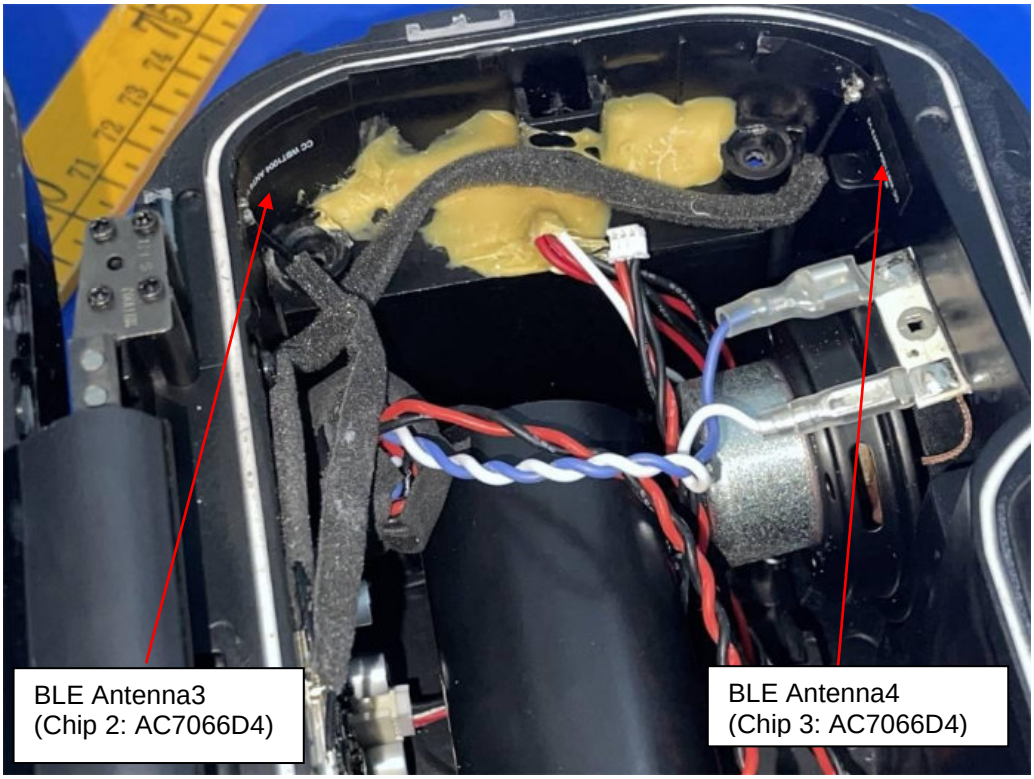

BLE Antenna3
(Chip 2: AC7066D4)
BLE Antenna4
(Chip 3: AC7066D4)

Fig. 33

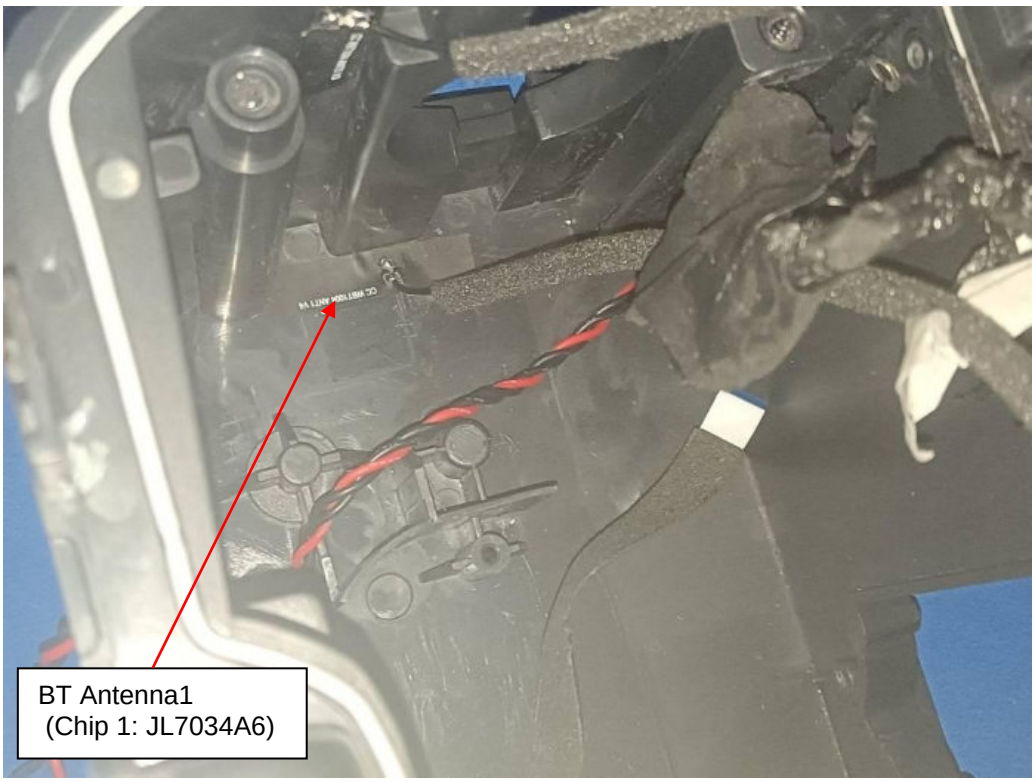
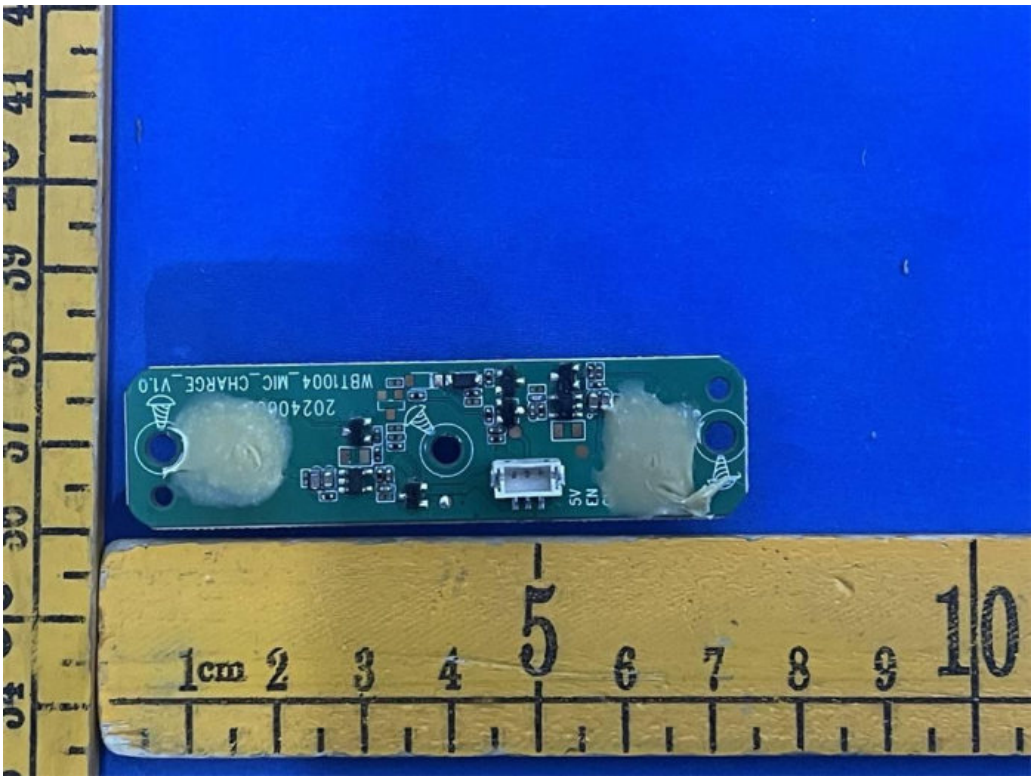

BT Antenna1
(Chip 1: JL7034A6)

Fig. 34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1cm 2 3 4 5 6 7 8 9 10

Fig. 35

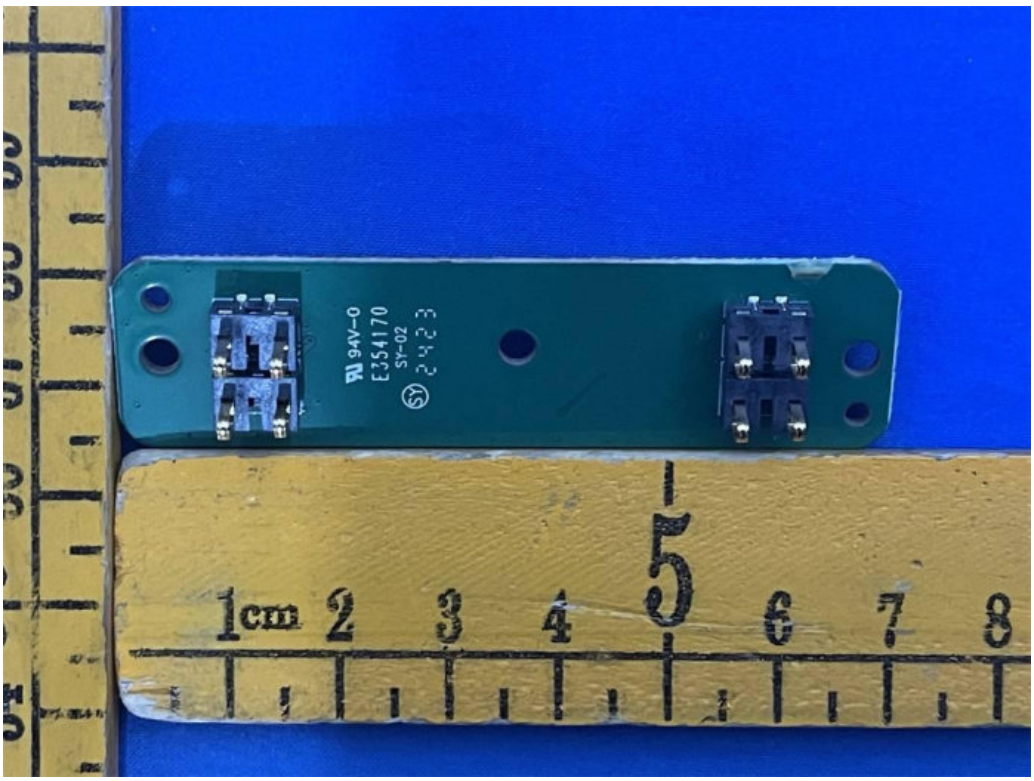
94V-0
E354170
SY-02
1cm 2 3 4 5 6 7 8

Fig. 36

1cm 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 37

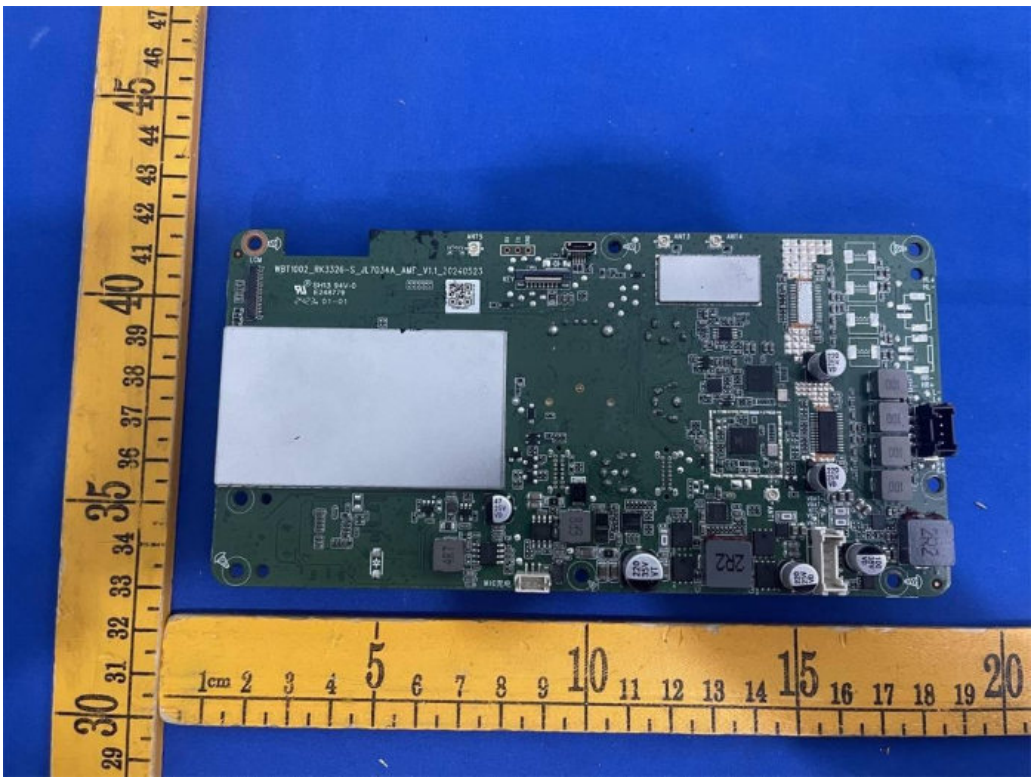

Fig. 38

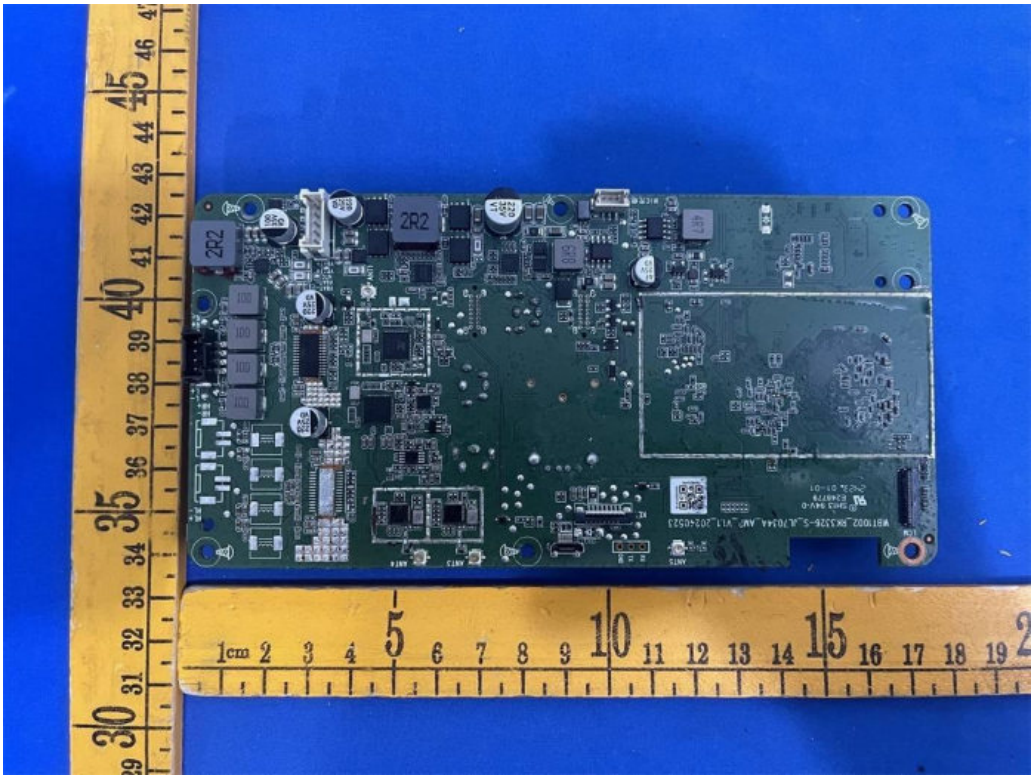

Fig. 39

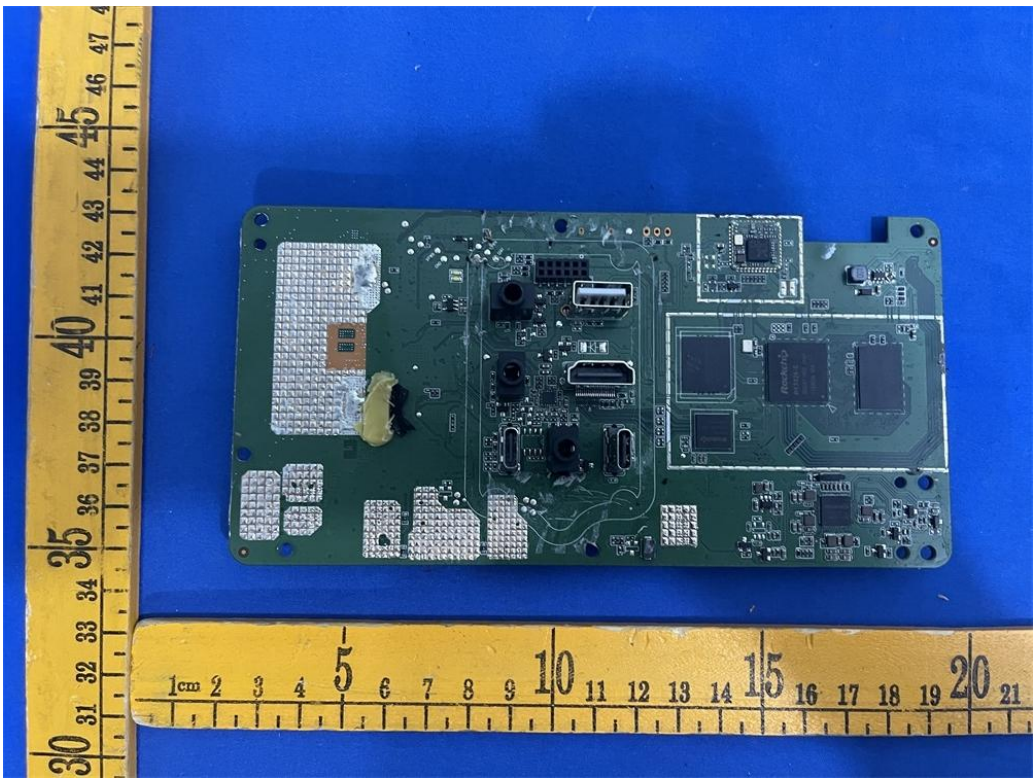

Fig. 40

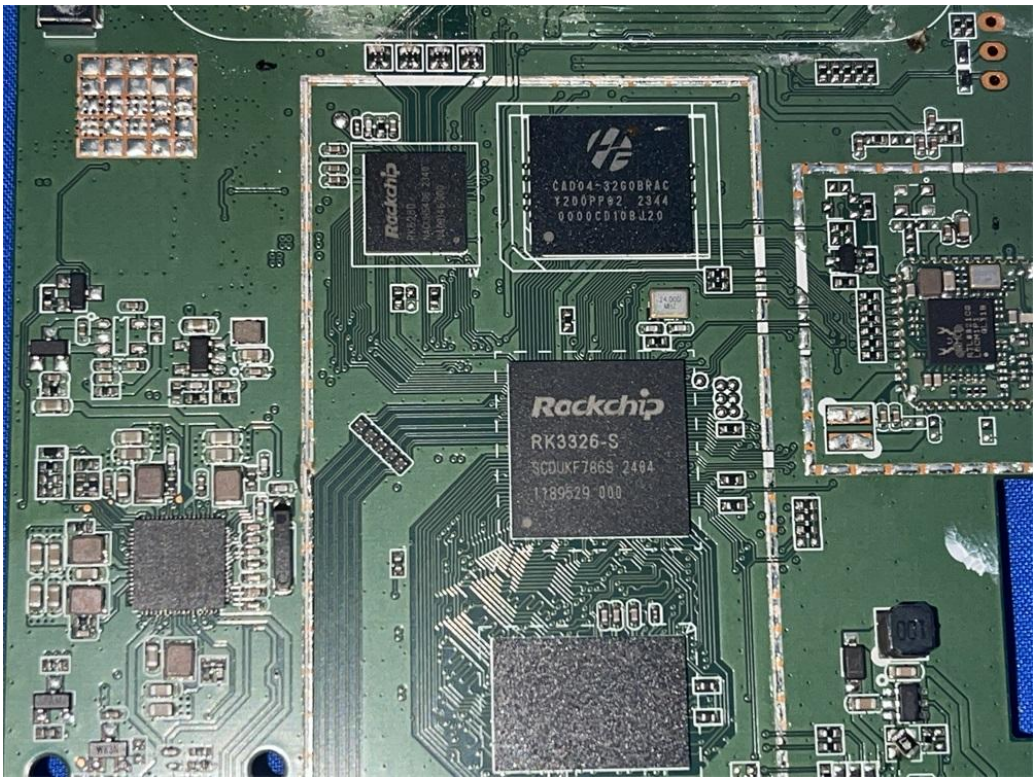

Fig. 41

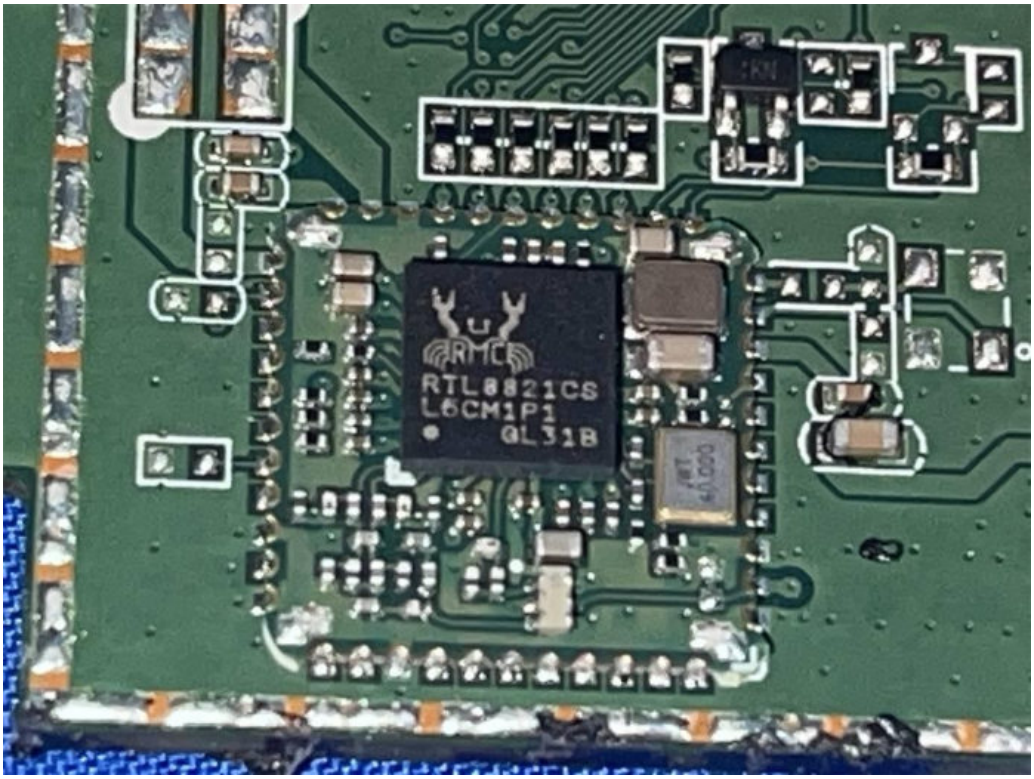

Fig. 42

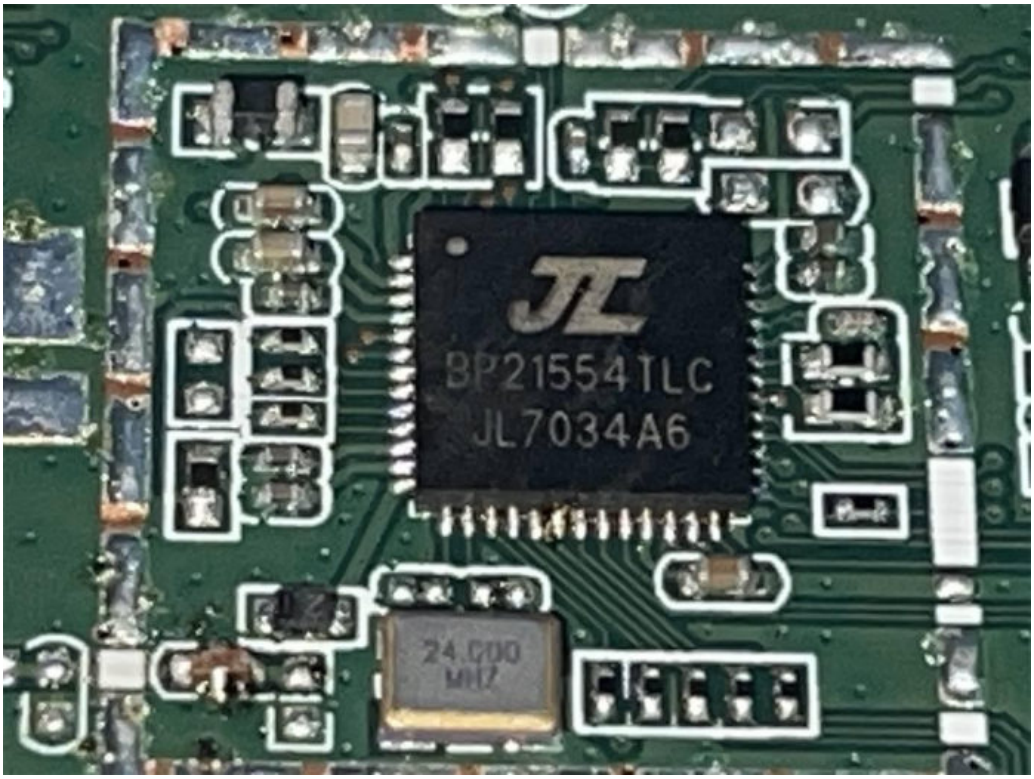

Fig. 43

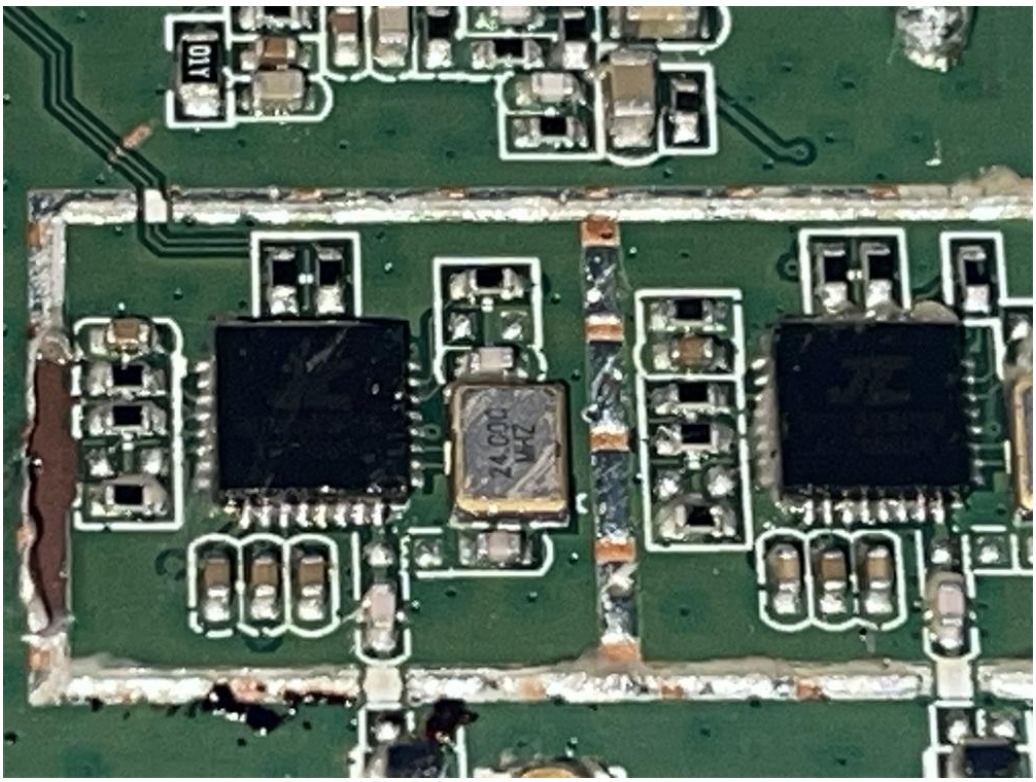

Fig. 44

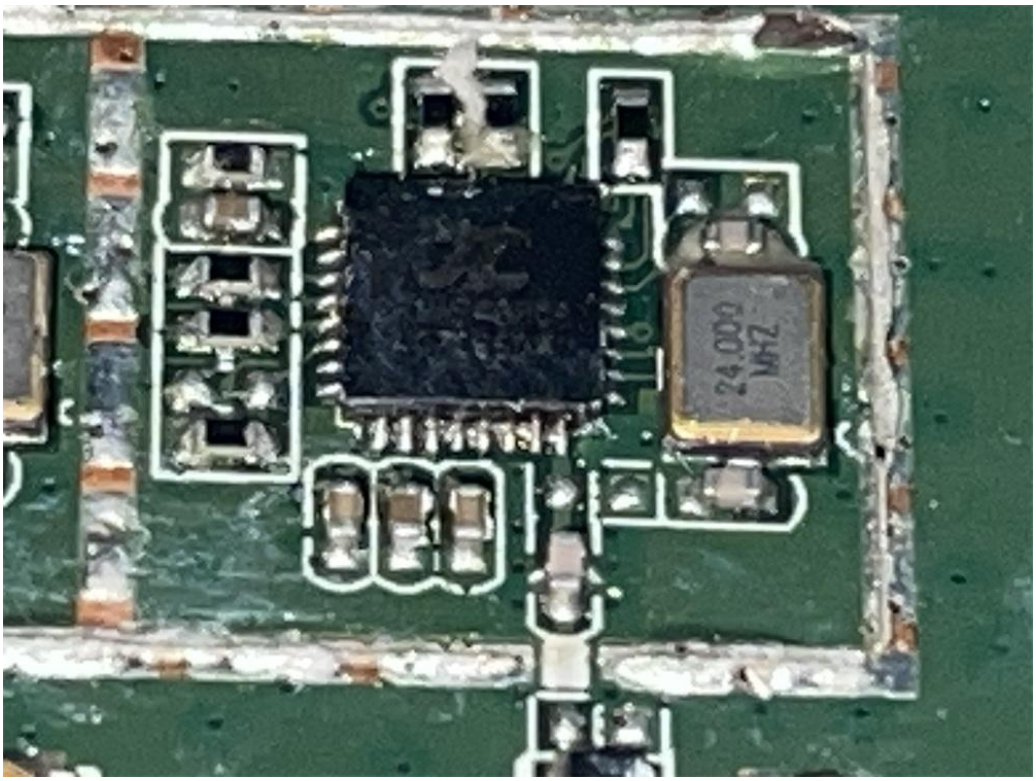

Fig. 45

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