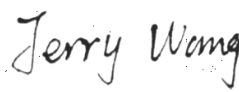


FCC EMC Test Report

For

Purism SPC

Test Standards:	<u>FCC 47 CFR Part 15 Subpart B</u>
Product Description:	<u>Librem Mini</u>
Tested Model:	<u>LMv1-01</u>
Classification	Supplier's Declaration of Conformity
Report No.:	<u>EC2005029RF05</u>
Tested Date:	<u>2020-05-29 to 2020-06-15</u>
Issued Date:	<u>2020-06-15</u>
Prepared By:	<u></u> Jerry Wang / Engineer
Approved By:	<u></u> Bacon Wu / RF Manager

Hunan Ecloud Testing Technology Co., Ltd.

Building A1, Changsha E Center, No. 18 Xiangtai Avenue, Liuyang Economic and
Technological Development Zone, Hunan, P.R.C

Tel.: +86-731-89634887 Fax.: +86-731-89634887

www.hn-ecloud.com

Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Hunan Ecloud Testing Technology Co., Ltd., the test report shall not be reproduced except in full.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2020.06.15	Valid	Original Report

TABLE OF CONTENTS

1	TEST LABORATORY	5
1.1	Test facility	5
2	GENERAL DESCRIPTION.....	6
2.1	Applicant	6
2.2	Manufacturer.....	6
2.3	General Description Of EUT	6
2.4	Support equipment List.....	7
2.5	Modification of EUT	7
2.6	Applicable Standards.....	7
3	TEST CONFIGURATION OF EQUIPMENT UNDER TEST.....	8
3.1	Descriptions of Test Mode	8
3.2	Connection of System Under Test.....	10
3.3	EUT Operation Test Setup	10
3.4	Test Setup	11
4	TEST RESULT	13
4.1	AC Conducted Emission Measurement.....	13
4.2	Radiated Emission Measurement.....	16
5	LIST OF MEASURING EQUIPMENT.....	21
6	UNCERTAINTY OF EVALUATION.....	22
	APPENDIX A. SETUP PHOTOGRAPHS	23
	APPENDIX B. PHOTOGRAPHS OF EUT.....	25

Summary of Test Result

FCC Rule	Description	Limit	Result	Remark
15.107	AC Conducted Emission	< 15.107	Pass	Under limit 8.24 dB at 7.566 MHz
15.109	Radiated Emission	< 15.109	Pass	Under limit 9.51 dB at 31.94 MHz

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012 , ISED#: 24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code : 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Purism SPC

1 Market Street, 36th Floor, San Francisco, CA94105, United States

2.2 Manufacturer

Purism, SPC

One Market Street, 36th Floor, San Francisco, CA 94105, USA

2.3 General Description Of EUT

Product	Librem Mini	
Model NO.	LMv1-01	
Additional NO.	N/A	
Difference Description	N/A	
Nominal Voltage	120Vac for adapter	
Modulation Type	WLAN	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM GFSK for BT LE
	RLAN	256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM
	Bluetooth	GFSK, $\pi/4$ -DQPSK, 8DPSK
Operating Frequency	WLAN	2412-2462MHz for 11b/g/n(HT20) 2422-2452MHz for 11n(HT40)
	RLAN	5150-5250MHz for 11a/n(HT20)/n(HT40)/ ac20(VHT20)/ ac40(VHT40) /ac80(VHT80)
	Bluetooth	2402MHz~2480MHz
HW Version	N/A	
SW Version	N/A	
I/O Ports	Refer to user's manual	
Accessory Devices	Refer to note as below	

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3. The EUT was powered by the following adapters:

MODEL:	ADS-40SI-19-3 19040E
INPUT:	100-240V~50/60Hz 1.0A MAX
OUTPUT:	19V DC 2.1A
DC LINE:	2.5 m

2.4 Support equipment List

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	NETGARE	R7800	PY315100319	N/A	unshielded AC I/P cable1.2 m
2.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m
3.	Flat Panel Monitor	Dell	P2317H	FCC DoC	N/A	Unshielded, 1.5 m
4.	Bluetooth Keyboard	Sariana LLC	ST-ACBKM	ZE9-ST-ACBKM	N/A	N/A

2.5 Modification of EUT

No modifications are made to the EUT during all test items.

2.6 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC 47 CFR Part 15 Subpart B
- ♦ ANSI C63.4-2014

3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2014 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz).

Radiated:

(a) For an intentional radiator:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(b) For unintentional radiators:

Including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705-108	1000.
108-500	2000.
500-1000	5000.
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b) of this section, whichever is the higher frequency range of investigation.

Details of Test line Items	
AC Conducted Emission	
Mode 1	: Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Mode 2	: Bluetooth Idle + WLAN(2.4G) Linking + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Mode 3	: Bluetooth Linking + WLAN(2.4G) Idle + RLAN(5G) Linking + Earphone + Burnin test + ping <Fig.1>
Mode 4	: Bluetooth Idle + WLAN(2.4G) Idle + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Radiated Emissions	
Mode 1	: Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Mode 2	: Bluetooth Idle + WLAN(2.4G) Linking + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Mode 3	: Bluetooth Linking + WLAN(2.4G) Idle + RLAN(5G) Linking + Earphone + Burnin test + ping <Fig.1>
Mode 4	: Bluetooth Idle + WLAN(2.4G) Idle + RLAN(5G) Idle + Earphone + Burnin test + ping <Fig.1>
Remark: Data Linking with Notebook means data application transferred mode between EUT and Notebook	

Worst mode of all test items listed in section 2.1

Test items	Worst mode
AC Conducted Emission	1
Radiated Emission	1

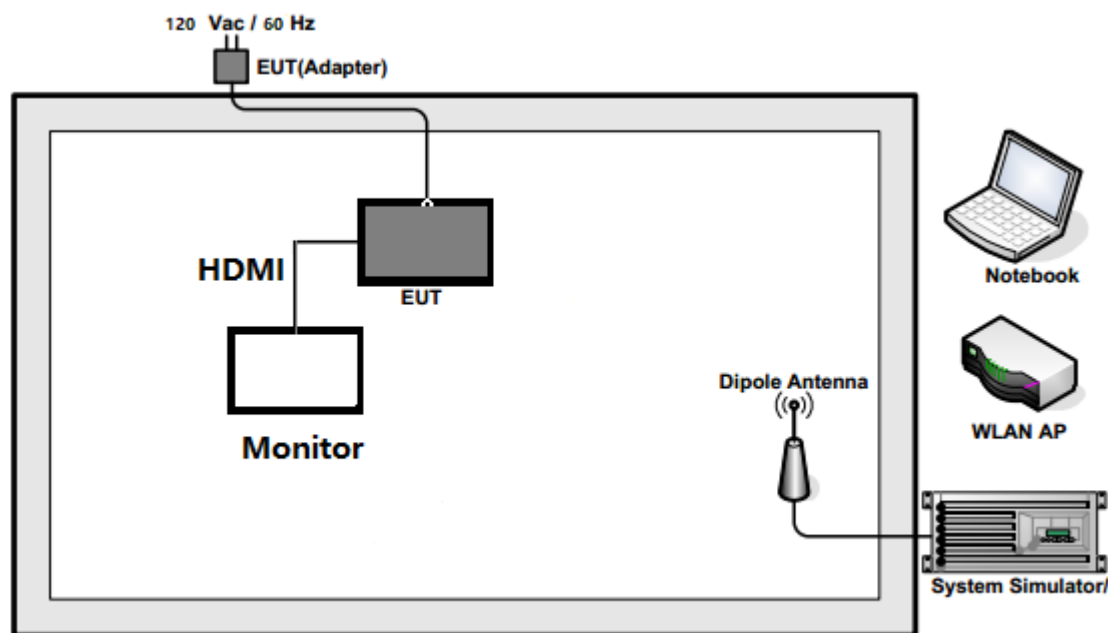
Remark:

- Only data of worst mode was reported in test result.
- The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was

determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

- c. For frequency above 18GHz, the measured value is much lower than the limit, therefore, it is not reflected in the report.

3.2 Connection of System Under Test



<Fig.1>

3.3 EUT Operation Test Setup

The EUT was set in below conditions during EMI testing

Read/Write and Storage of Data

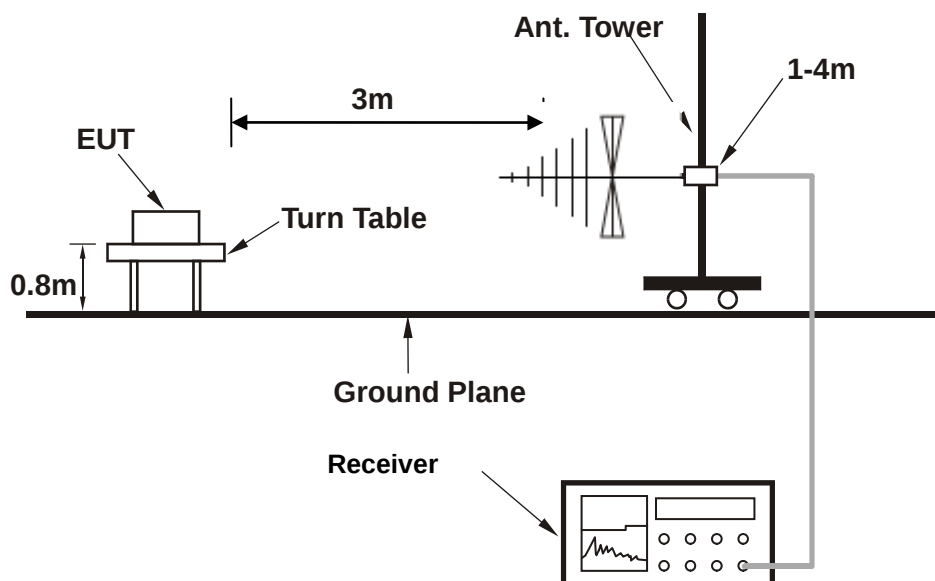
1. Let EUT be connected with notebook.
2. Execute the program for files transferring between EUT and storage device.
3. Monitor the data transmission by checking whether there some error or abnormal action occurred.

WLAN

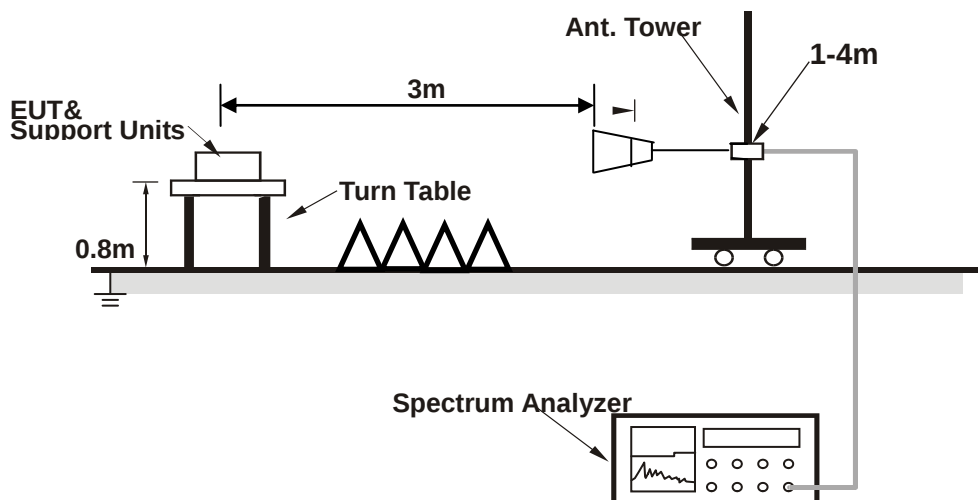
1. Enable WLAN function of the EUT.
2. The EUT links with supported units
3. Execute "PING IP" function under the "cmd" of Window system to transfer packet bi-directionally between the EUT and supported units.
4. Monitor the packet loss and WLAN radio performance.

Bluetooth (include Bluetooth Data Link and Bluetooth Headset)

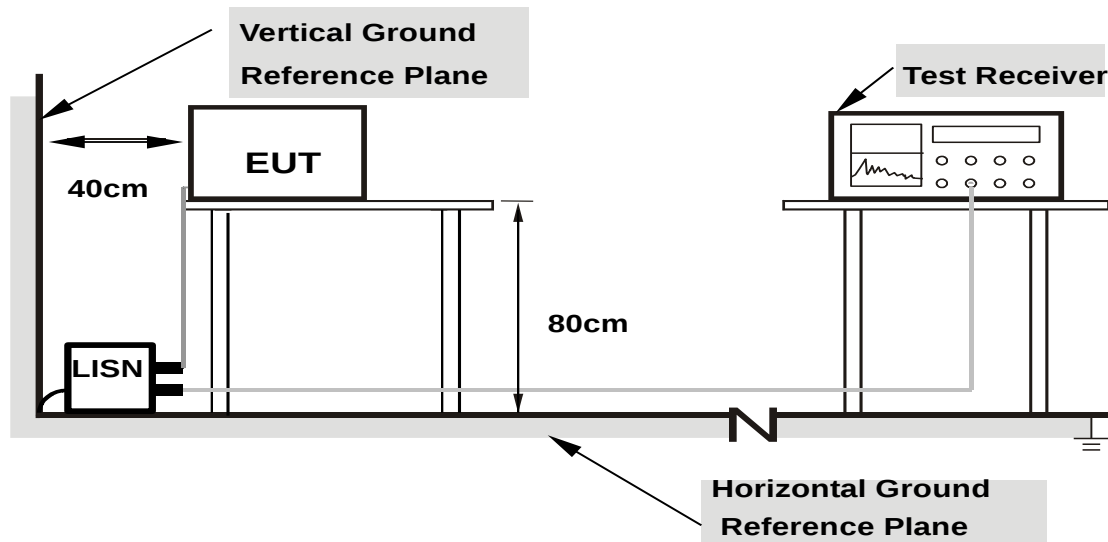
1. Link with supported unit via Bluetooth radio function.
2. Monitor the status of connection by checking the Bluetooth link performance without radio link drop.

3.4 Test Setup**Setup diagram for Raidation(Below 1G) Test**

Setup diagram for Raidation(Above 1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

4 Test Result

4.1 AC Conducted Emission Measurement

4.1.1 Limit of AC Conducted Emission

For Class B digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table:

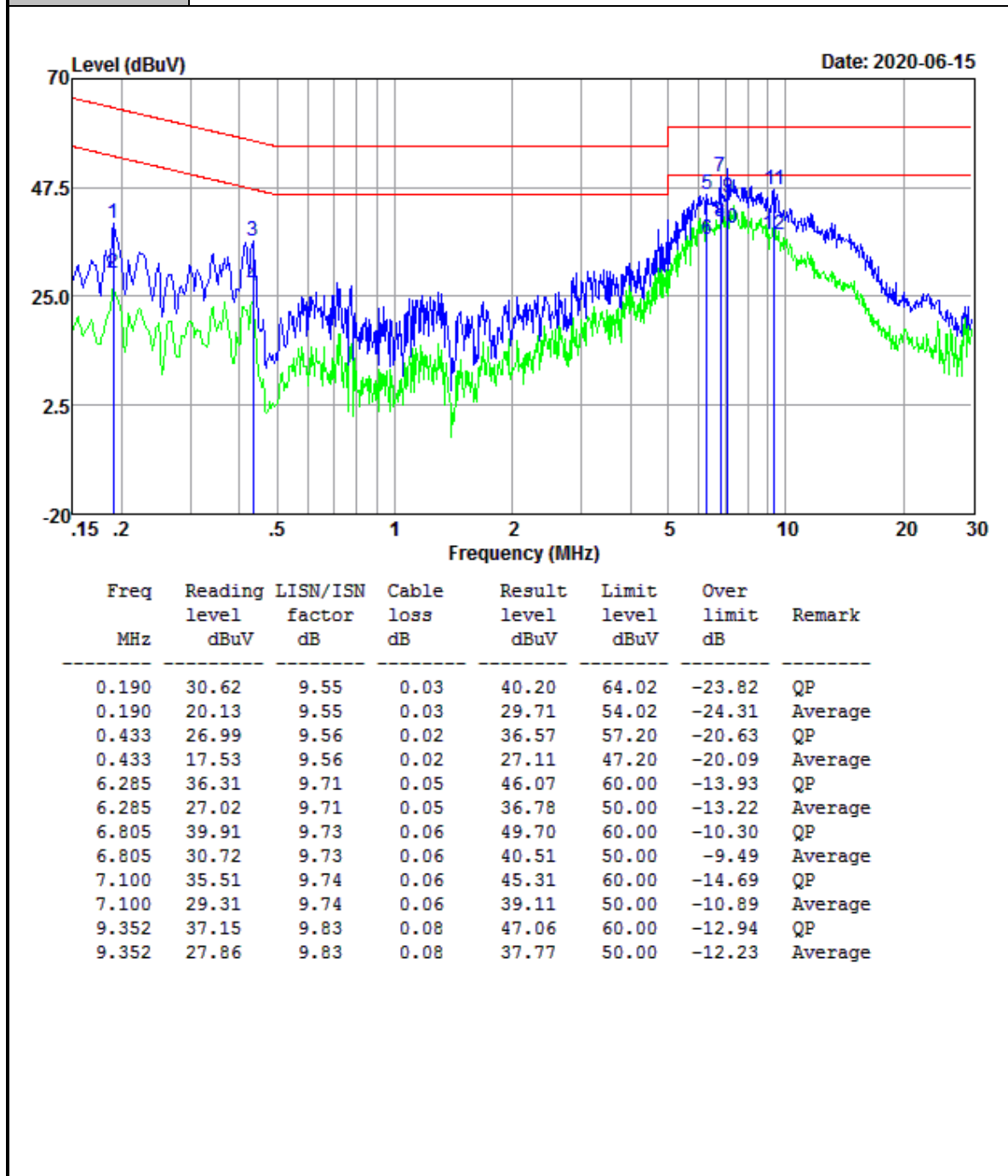
Frequency Range	Quasi Peak(dB μ V)	Average(dB μ V)
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50
*Decreases with the logarithm of the frequency.		

4.1.2 Test Procedures

1. During the conducted emissions test, the adapter was connected to the main outlet of the first LISN and the other support equipments were connected to the outlet of the second LISN.
2. Set the test-receiver system to Quasi-Peak and Average Detect Function and specified bandwidth (IF Bandwidth =9kHz) with Maximum Hold Mode. The frequency range from 150 kHz to 30 MHz was searched.

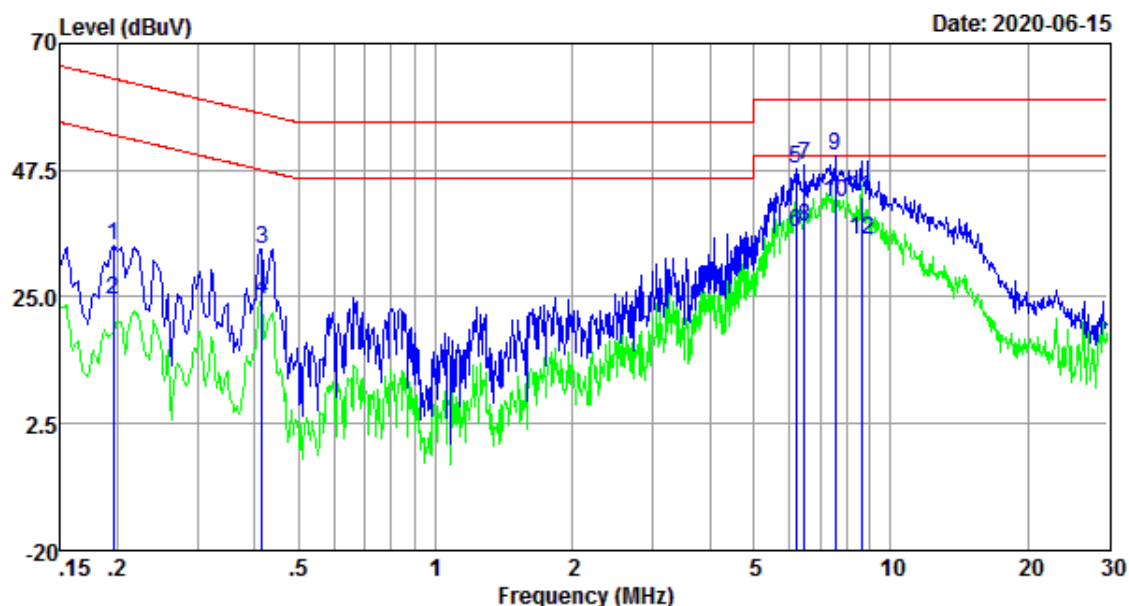
4.1.3 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		



Result Level= Reading Level + LISN Factor + Cable Loss

Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	Result level dBuV	Limit level dBuV	Over limit dB	Remark
0.195	24.66	9.56	0.03	34.25	63.80	-29.55	QP
0.195	14.77	9.56	0.03	24.36	53.80	-29.44	Average
0.415	23.87	9.58	0.02	33.47	57.55	-24.08	QP
0.415	14.92	9.58	0.02	24.52	47.55	-23.03	Average
6.186	37.92	9.78	0.05	47.75	60.00	-12.25	QP
6.186	26.55	9.78	0.05	36.38	50.00	-13.62	Average
6.454	38.59	9.79	0.06	48.44	60.00	-11.56	QP
6.454	27.62	9.79	0.06	37.47	50.00	-12.53	Average
7.566	40.17	9.84	0.07	50.08	60.00	-9.92	QP
7.566	31.85	9.84	0.07	41.76	50.00	-8.24	Average
8.637	32.90	9.88	0.08	42.86	60.00	-17.14	QP
8.637	25.30	9.88	0.08	35.26	50.00	-14.74	Average

Result Level= Reading Level + LISN Factor + Cable Loss

4.2 Radiated Emission Measurement

4.2.1 Limit of Radiated Emission

For Class B digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range (MHz)	Distance (Meters)	Field Strength (microvolts/meter)
30 ~ 88	3	100
88~216	3	150
216-960	3	200
Above 960	3	500

Note: (1) The smaller limit shall apply at the combination point between two frequency bands.

(2) Distance refers to the distance in meters between the measuring instrument antenna and periphery of the EUT.

(3) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function, unless otherwise specified.

(4) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

4.2.2 Test Procedures

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual.
2. Support equipment, if needed, was placed as per FCC 15B. All I/O cables were positioned to simulate typical actual usage as per FCC 15B.
3. The EUT was placed on a turntable with 0.8 meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For each suspected emission, the EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120kHz/VBW=300kHz for frequency below 1GHz; RBW=1MHz VBW=3MHz (Peak), RBW=1MHz/VBW=10Hz (Average) for frequency above 1GHz).
7. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.

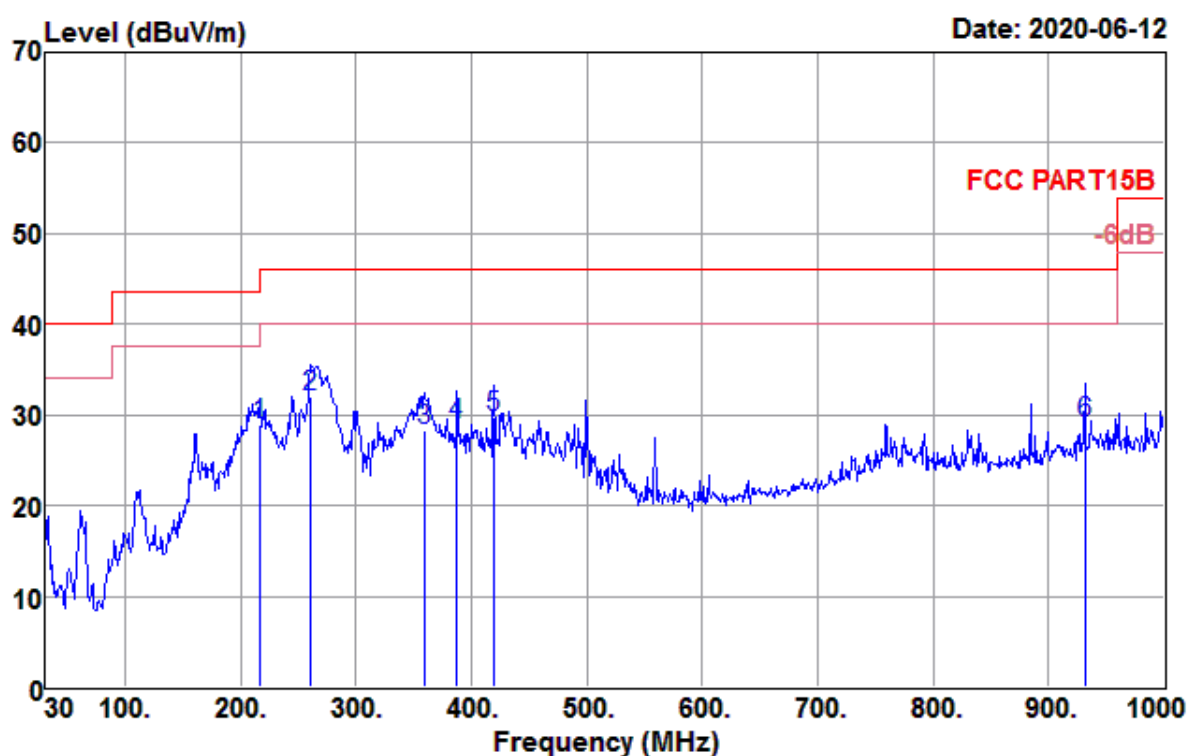
4.2.3 Test Result of Radiated Emission

Test Mode :	Mode1	Temperature :	22°C
Test Engineer :	Jack Liu	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Horizontal
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		

■ Emission level (dBμV/m) = 20 log Emission level (μV/m)

■ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Data: 10



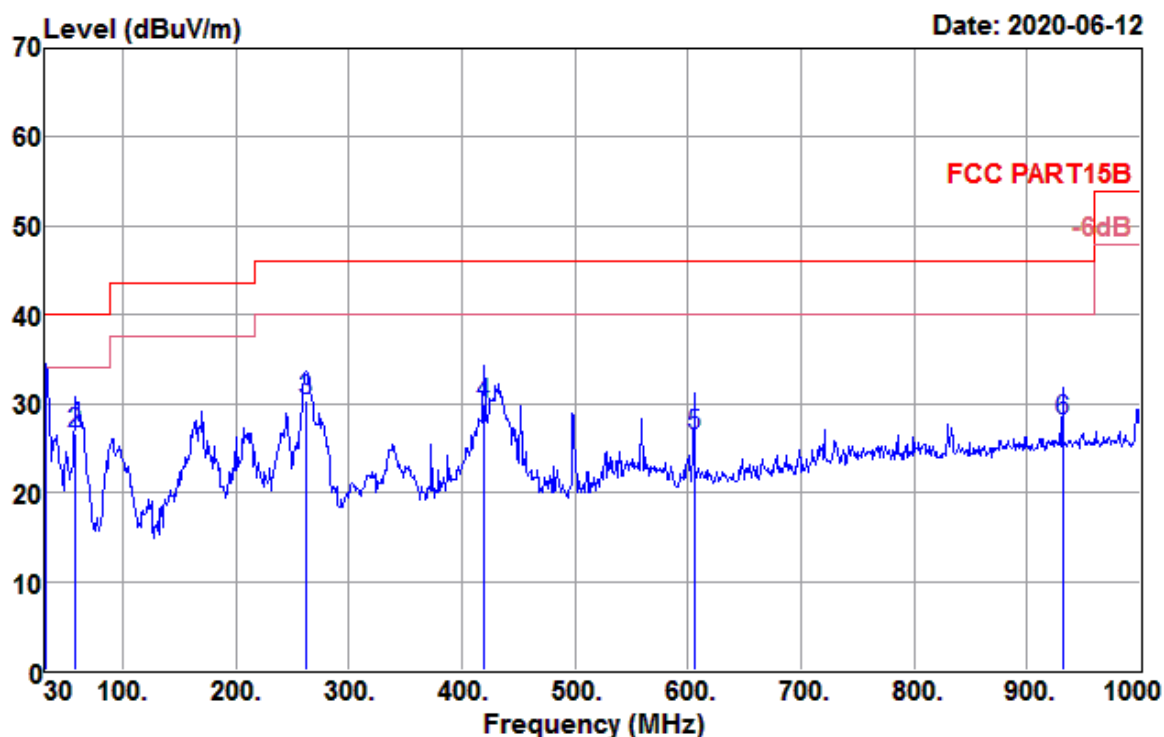
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
216.240	47.12	11.41	2.86	32.47	28.92	46.00	-17.08	QP
260.860	47.95	13.34	3.16	32.48	31.97	46.00	-14.03	QP
358.830	42.08	14.98	3.74	32.53	28.27	46.00	-17.73	QP
386.960	41.92	15.54	3.90	32.54	28.82	46.00	-17.18	QP
418.970	41.86	16.37	4.05	32.57	29.71	46.00	-16.29	QP
931.130	31.07	24.06	6.13	32.16	29.10	46.00	-16.90	QP

Test Mode :	Mode1	Temperature :	22°C
Test Engineer :	Jack Liu	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Vertical
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		

■ Emission level (dBμV/m) = 20 log Emission level (μV/m)

■ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Data: 9



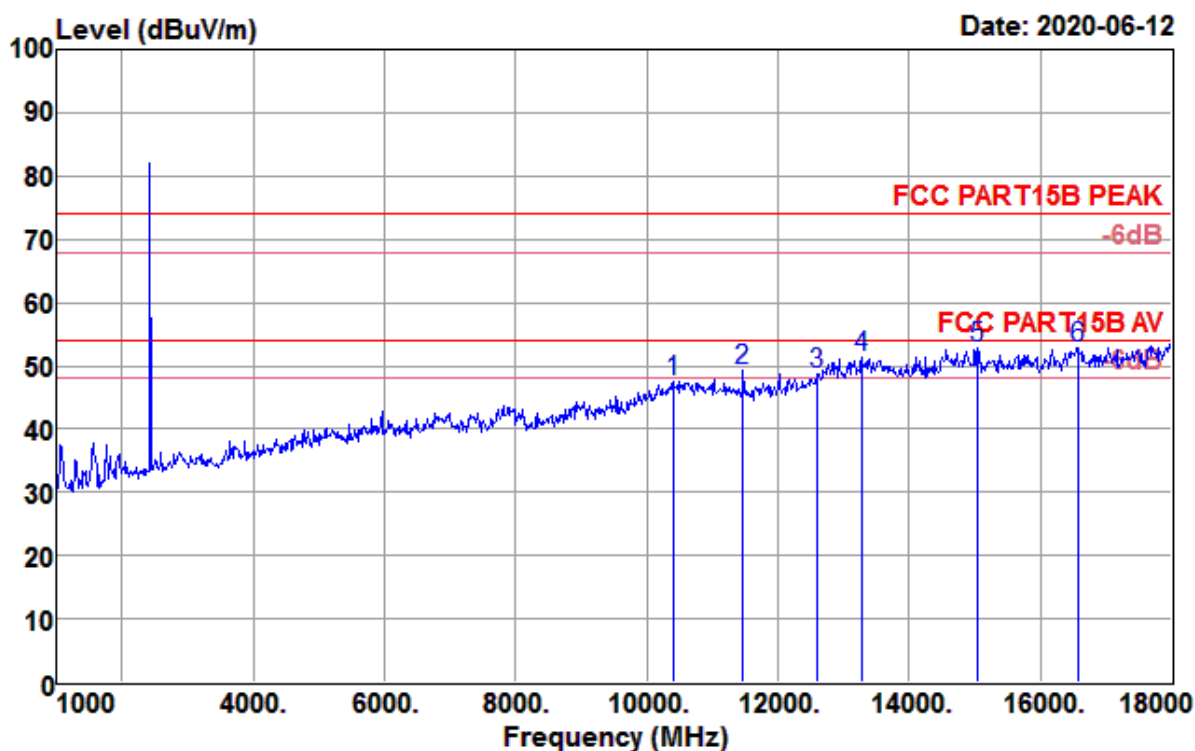
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
31.940	50.19	11.65	1.09	32.44	30.49	40.00	-9.51	QP
58.130	46.22	11.64	1.38	32.51	26.73	40.00	-13.27	QP
261.830	46.35	13.36	3.17	32.48	30.40	46.00	-15.60	QP
418.970	42.17	16.37	4.05	32.57	30.02	46.00	-15.98	QP
605.210	34.13	20.07	4.89	32.69	26.40	46.00	-19.60	QP
931.130	30.10	24.06	6.13	32.16	28.13	46.00	-17.87	QP

Test Mode :	Mode 1	Temperature :	22°C
Test Engineer :	Jack Liu	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Horizontal
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		
Remark :	The highest signal is is Fundamental Signal which can be ignored.		

■ Emission level (dBμV/m) = 20 log Emission level (μV/m)

■ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Data: 7



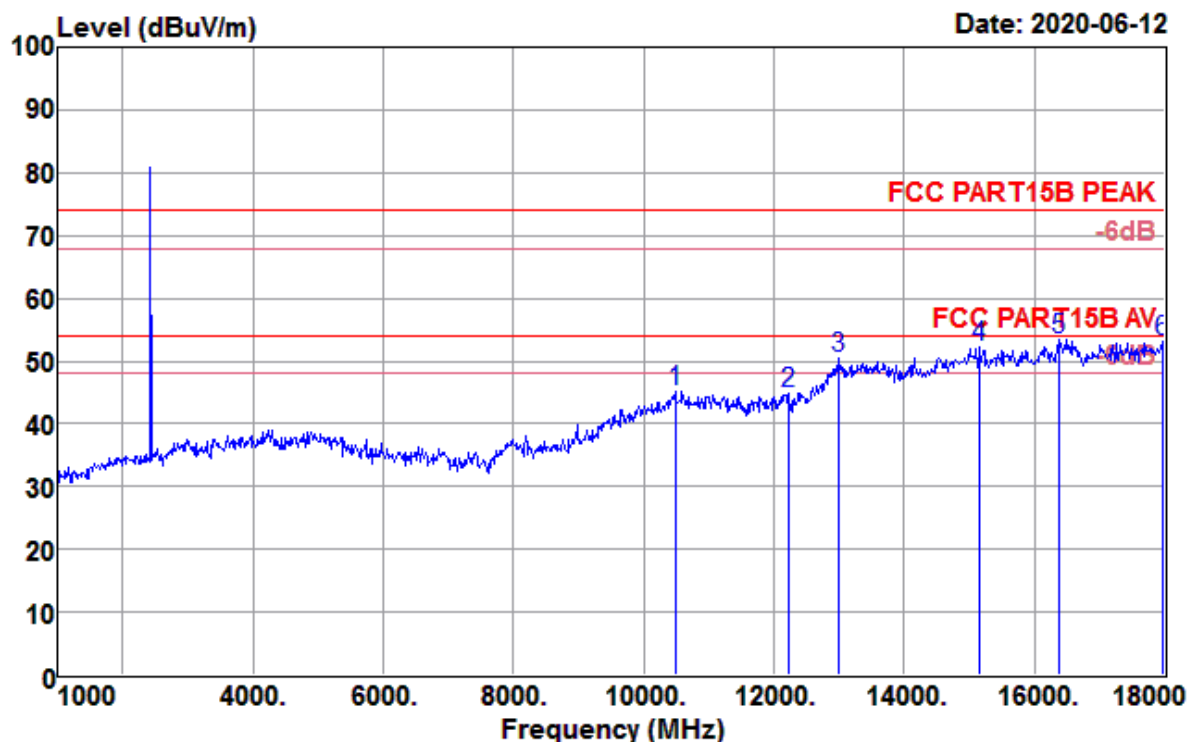
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
10401.000	26.09	39.26	14.21	32.09	47.47	74.00	-26.53	Peak
11472.000	27.70	39.71	14.70	32.90	49.21	74.00	-24.79	Peak
12611.000	25.00	38.23	18.32	32.79	48.76	74.00	-25.24	Peak
13274.000	24.05	39.14	21.13	33.09	51.23	74.00	-22.77	Peak
15042.000	24.36	39.97	20.54	32.12	52.75	74.00	-21.25	Peak
16572.000	24.45	38.82	20.09	30.47	52.89	74.00	-21.11	Peak

Test Mode :	Mode 1	Temperature :	22°C
Test Engineer :	Jack Liu	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Vertical
Function Type :	Bluetooth Linking + WLAN(2.4G) Linking + RLAN(5G) Idle + HDMI + TF Card Upload + USB playing		
Remark :	The highest signal is is Fundamental Signal which can be ignored.		

■ Emission level (dBμV/m) = 20 log Emission level (μV/m)

■ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Data: 8



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
10486.000	23.64	39.38	14.31	32.16	45.17	74.00	-28.83	Peak
12220.000	22.46	38.44	16.97	33.12	44.75	74.00	-29.25	Peak
12985.000	23.08	38.68	21.07	32.48	50.35	74.00	-23.65	Peak
15144.000	24.15	39.64	20.49	32.00	52.28	74.00	-21.72	Peak
16385.000	25.29	38.37	20.24	30.63	53.27	74.00	-20.73	Peak
17966.000	19.56	46.74	16.88	30.08	53.10	74.00	-20.90	Peak

5 List of Measuring Equipment

Test Equipment for Conducted Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
LISN	R&S	ENV216	102125	2020-01-08	2021-01-07
LISN	R&S	ENV432	101327	2020-01-08	2021-01-07
EMI Test Receiver	R&S	ESR3	102143	2020-01-16	2021-01-15
EMI Test Software	Audix	E3	N/A	N/A	N/A
Test Equipment for Radiated Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
EMI Test Receiver	R&S	ESR-3	102144	2020-01-16	2021-01-15
Spectrum Analyzer	R&S	FSV 40	101433	2020-01-16	2021-01-15
Amplifier	Sonoma	310	363917	2020-01-15	2021-01-14
Amplifier	Schwarzbeck	BBV 9718	327	2020-01-15	2021-01-14
Amplifier	Narda	TTA1840-35-HG	2034380	2020-05-14	2021-05-15
Broadband Antenna	Schwarzbeck	VULB9168	9168-757	2018-08-31	2021-08-30
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2020-02-14	2023-02-13
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19
EMI Test Software	Audix	E3	N/A	N/A	N/A

N/A: No Calibration Required

6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.42dB
Radiated emission	30MHz ~ 1GMHz	2.50dB
	1GHz ~ 18GHz	3.51dB
	18GHz ~ 40GHz	3.96dB

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

Appendix A. Setup Photographs



Fig. 1 Radiated emission setup photo(30MHz-1GHz)



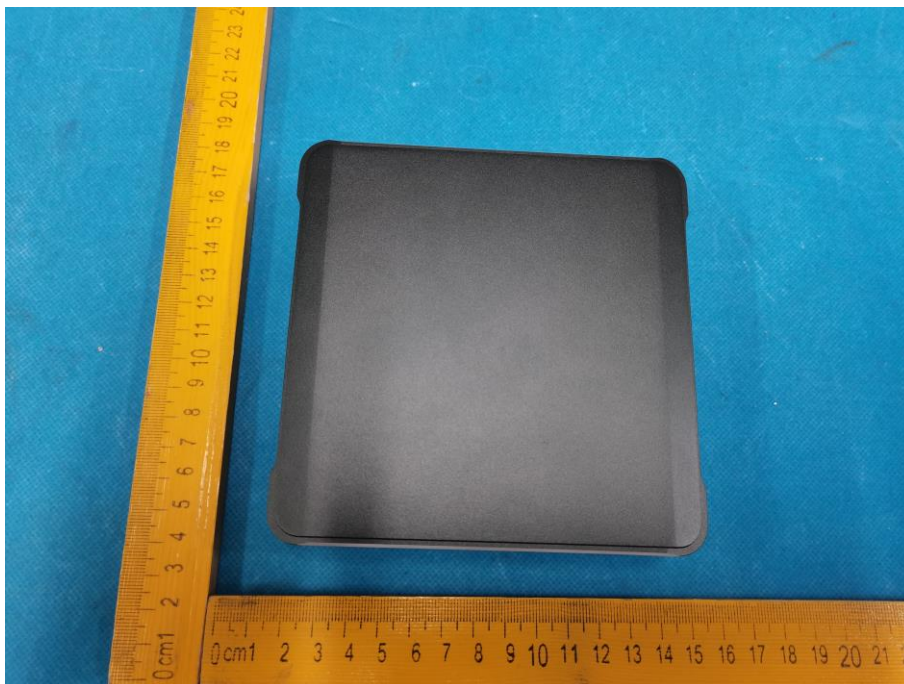
Fig. 2 Radiated emission setup photo(Above 1GHz)

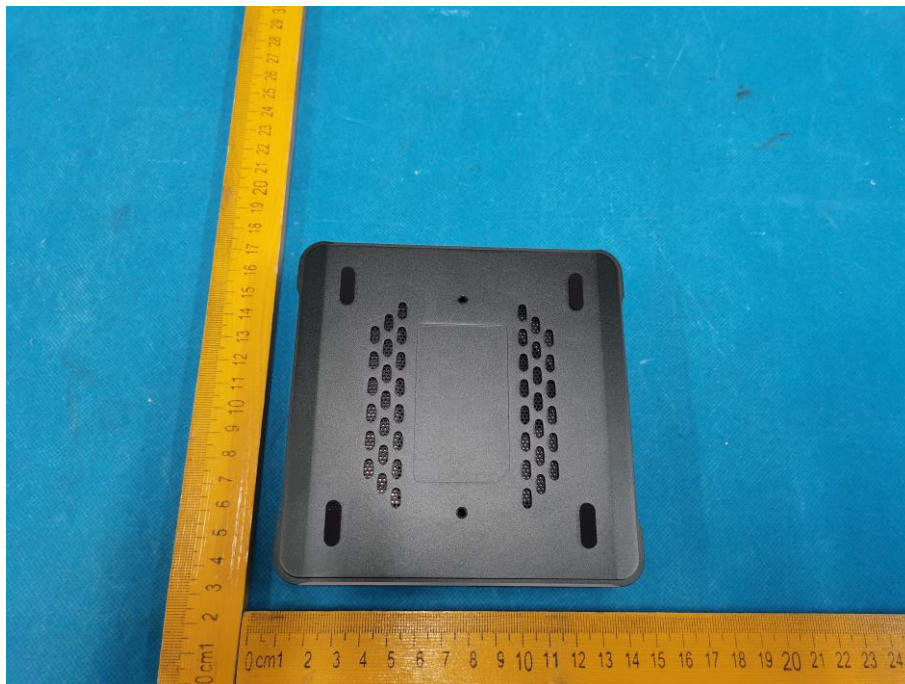


Fig. 3 Power line conducted emission setup photo

Appendix B. Photographs of EUT

External Photos

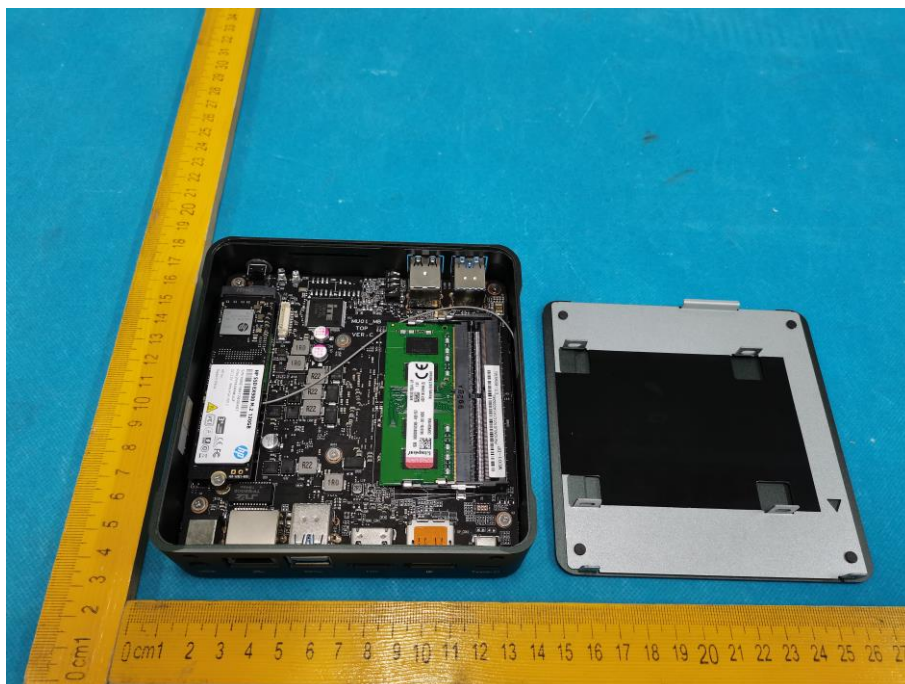


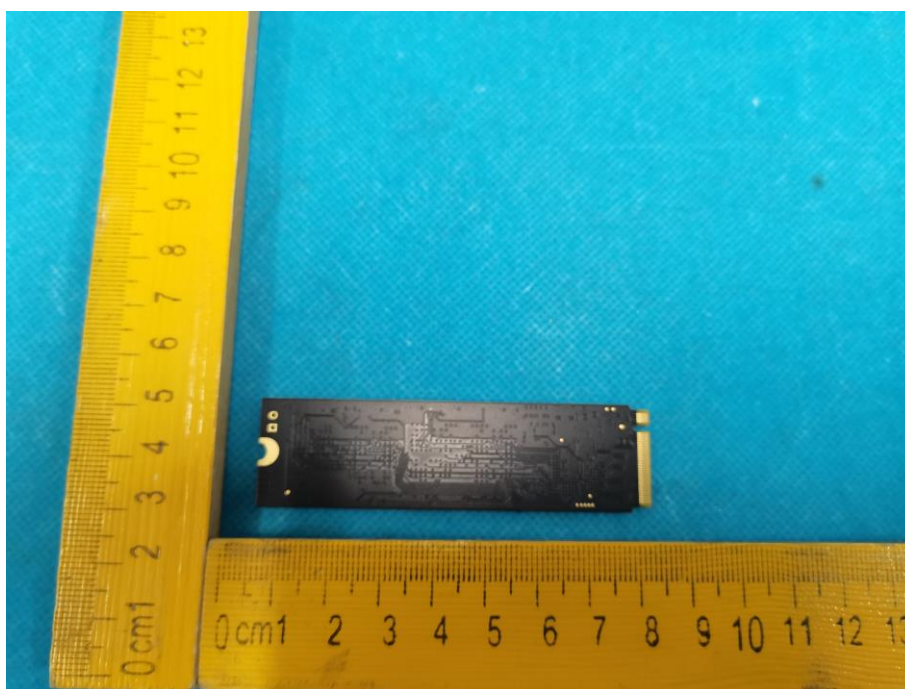
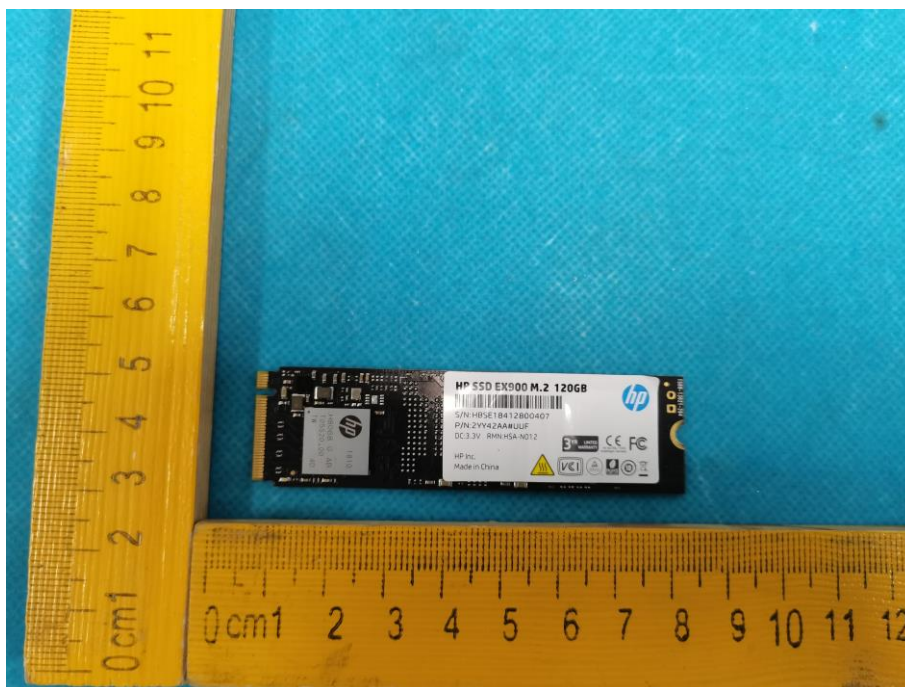


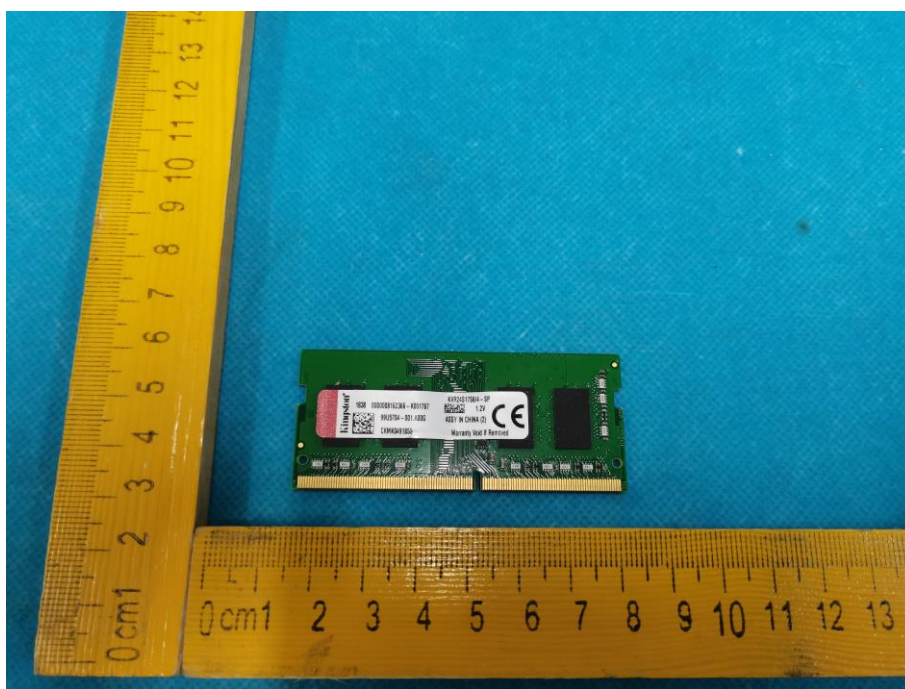
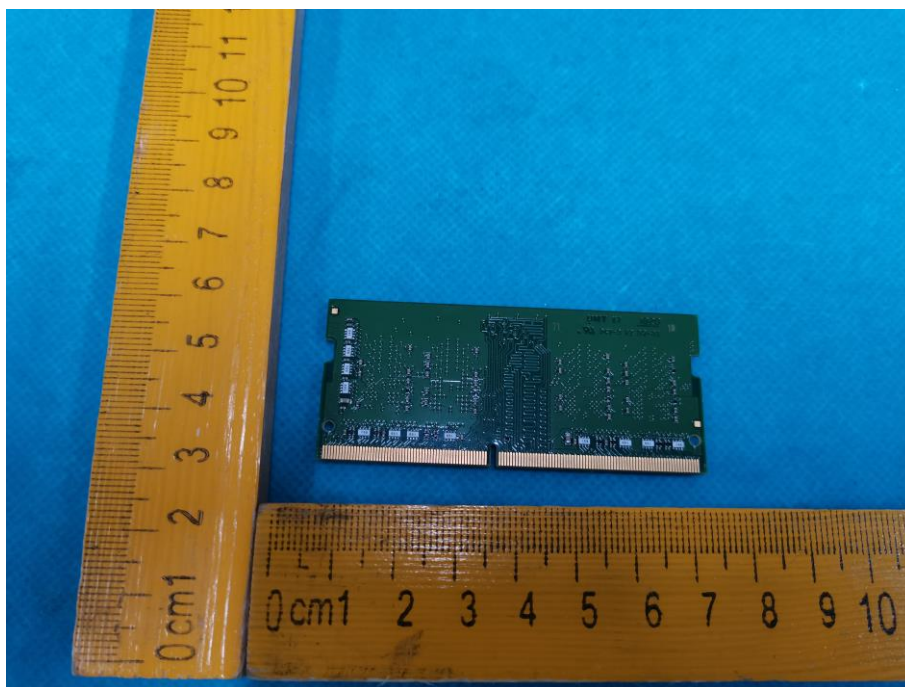


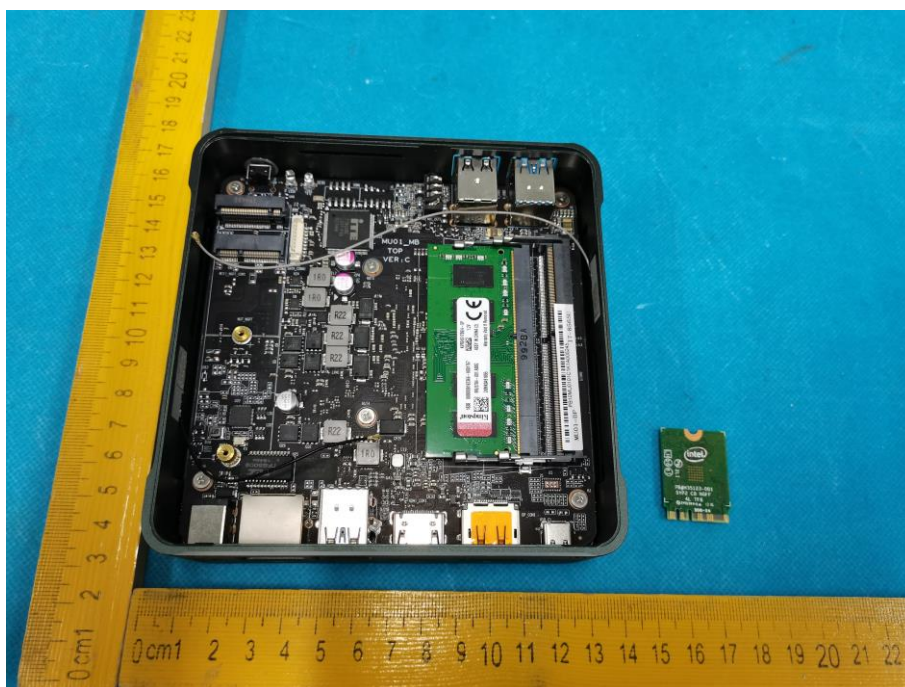


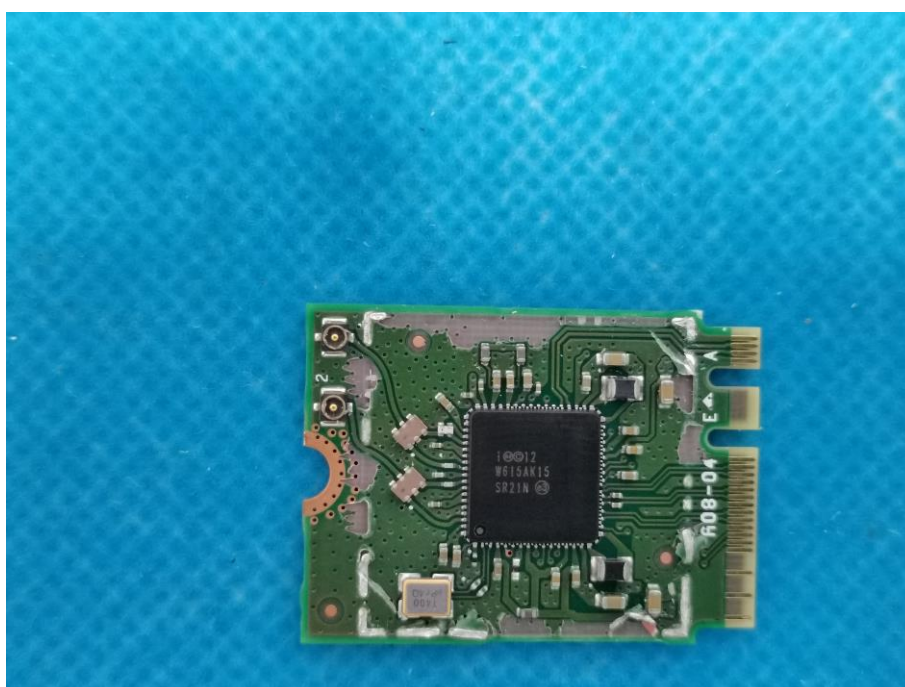
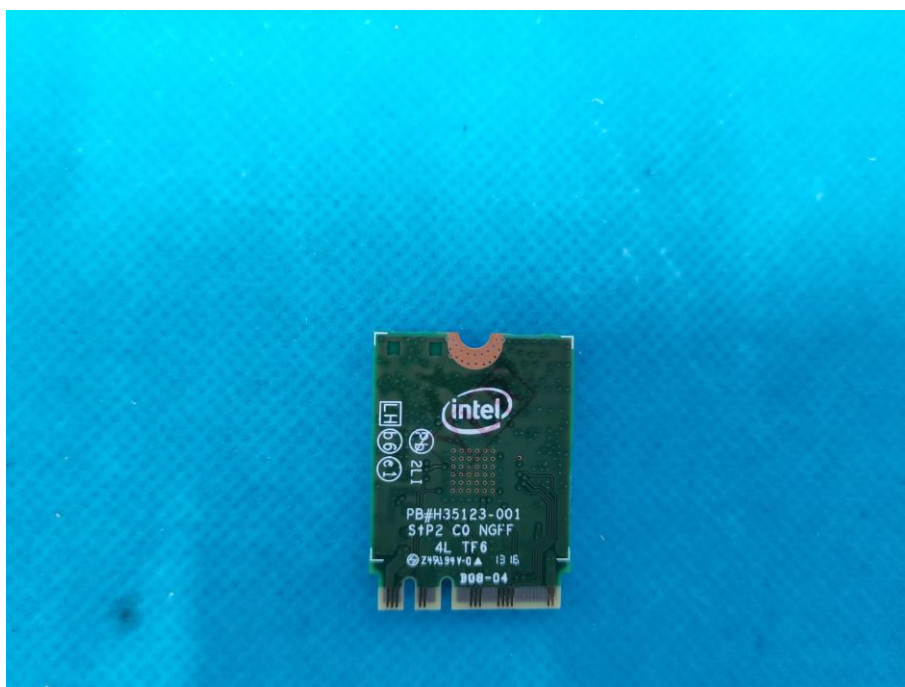
Internal Photos



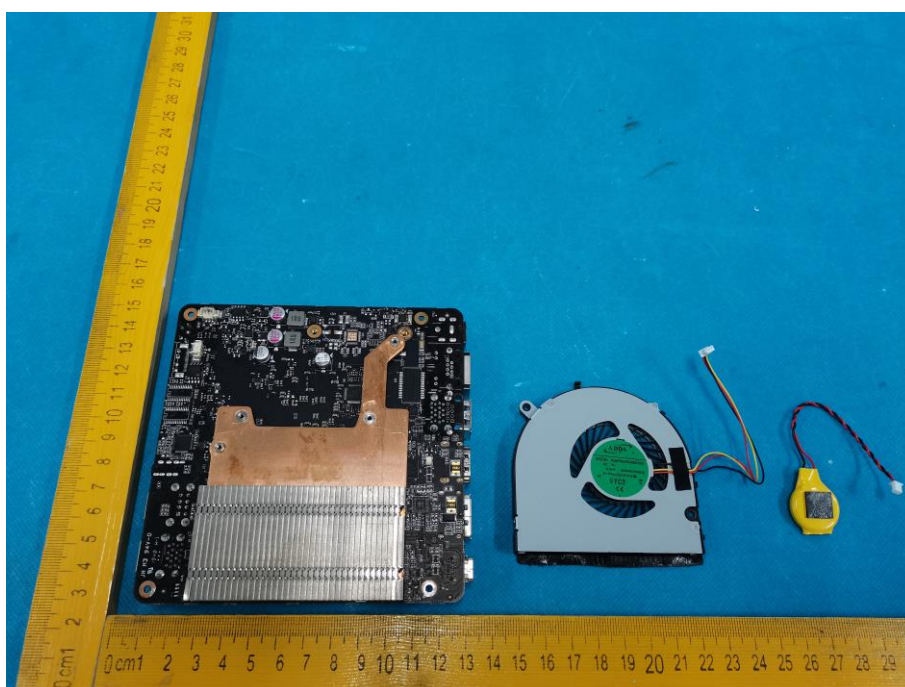


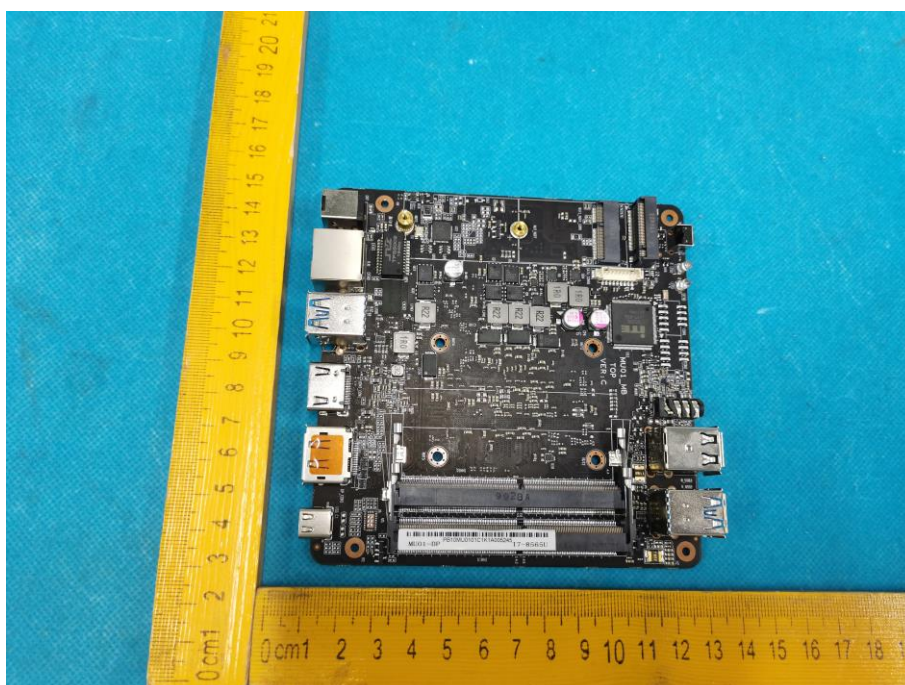
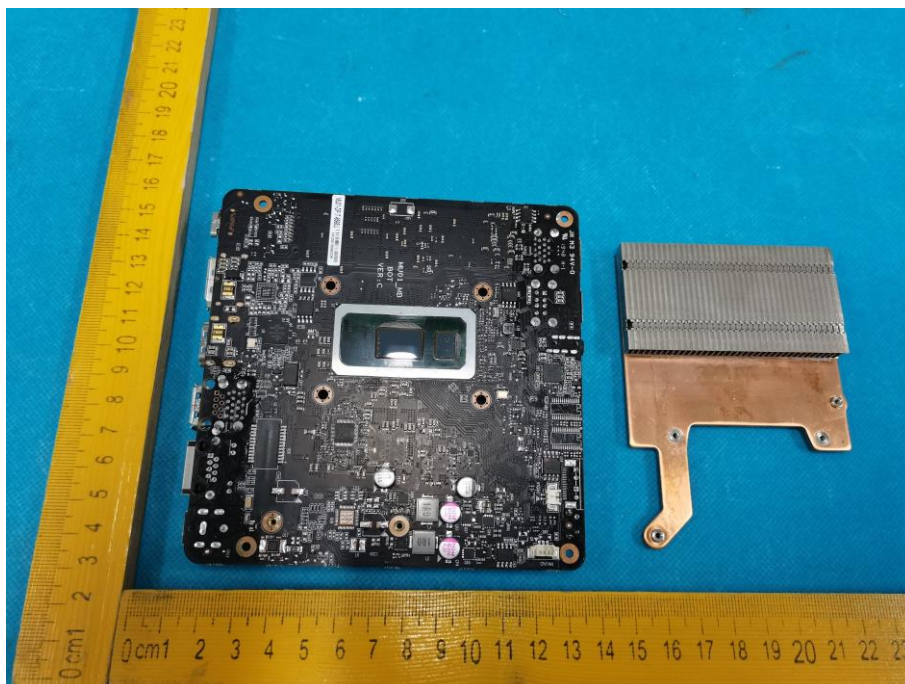






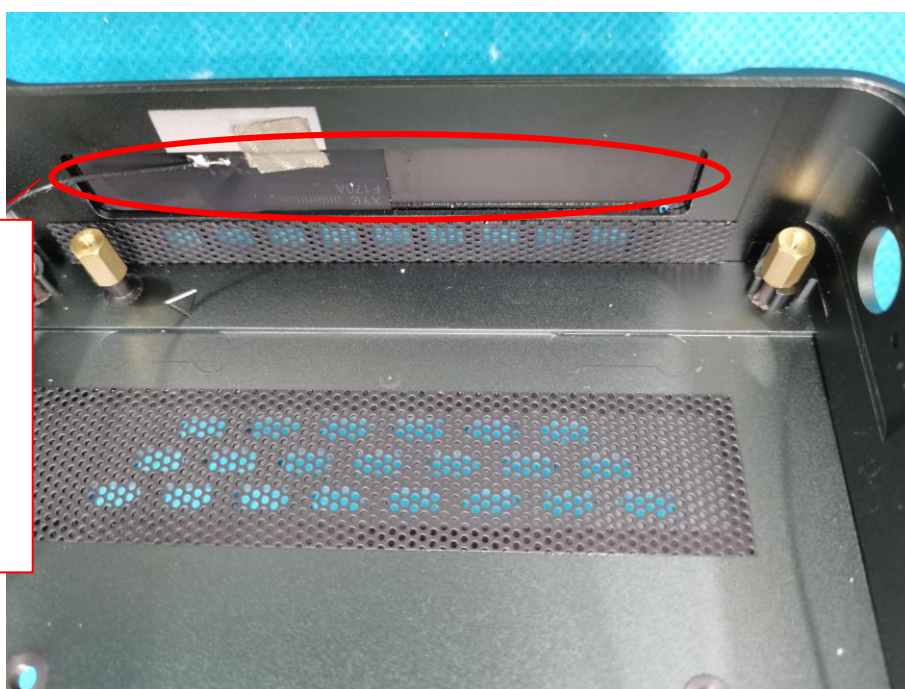


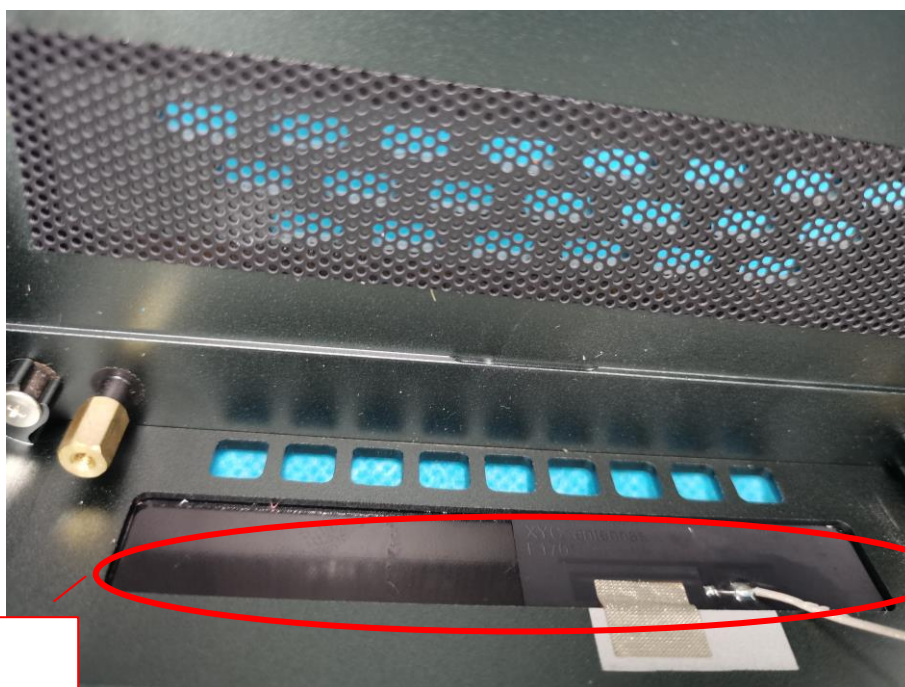






5G WIFI
Antenna





BT /
2.4G WIFI
Antenna

-----End of the report-----