



FCC TEST REPORT

FCC ID: 2A3MU-FC2

On Behalf of

Shanghai EFIX Geomatics Co., Ltd

Handheld GNSS Data Collector

Model No.: FC2

Prepared for : Shanghai EFIX Geomatics Co., Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai

Prepared By : Shenzhen Alpha Product Testing Co., Ltd.
Address : Building i, No.2, Lixin Road, Fuyong Street, Bao'an District,
518103, Shenzhen, Guangdong, China

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TEST REPORT DECLARATION

Applicant : Shanghai EFIX Geomatics Co., Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai
Manufacturer : Shanghai EFIX Geomatics Co., Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai
EUT Description : Handheld GNSS Data Collector
(A) Model No. : FC2

(B) Trademark : 

Measurement Standard Used:

FCC Rules and Regulations Part 15 Subpart C Section 15.225

RSS 210 Issue 10, RSS Gen Issue 5, ANSI C63.10:2013

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The test results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed full responsibility for the accuracy and completeness of test. Also, this report shows that the EUT is technically compliant with the FCC Part15 requirements.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tested by (name + signature).....: Lucas Pang
Project Engineer



Approved by (name + signature).....: Simple Guan
Project Manager



Date of issue.....: February 21, 2022

Revision History

Revision	Issue Date	Revisions	Revised By
V0	February 21, 2022	Initial released Issue	Lucas Pang

1. General Information

1.1. Description of Device (EUT)

EUT : Handheld GNSS Data Collector

Model No. : FC2

DIFF : N/A

Trade mark :



Power supply : DC 3.8V from battery, DC 5V from adapter

NFC

Operation frequency : 13.56MHz

Channel No. : 1 Channel

Modulation : ASK

Antenna Type : Internal antenna, Antenna gain 1.5dBi.
Antenna information is provided by applicant.

Software version : Android 8.1.0

Hardware Version/ : V1.1

FVIN

1.2. Accessories of Device (EUT)

Accessories1 : AC Adapter
Manufacturer : EDAC POWER Electronics Co., Ltd
Model : EA1012AVRU-050
Input: 100-240Vac~50/60Hz 1.0A
Ratings : Output: 5.0V=2.4A

1.3. Ancillary Equipment Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	N/A	N/A	N/A	N/A	N/A

1.4. Test Lab Information

Shenzhen Alpha Product Testing Co., Ltd
Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
Shenzhen, Guangdong, China

June 21, 2018 File on Federal Communication Commission
Registration Number: 293961

July 15, 2019 Certificated by IC
Registration Number: CN0085

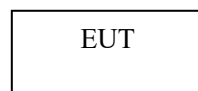
2. Summary of test

2.1. Summary of test result

Description of Test Item	Standard	Results
Conducted Emission	15.207(a)	Pass
Radiated emissions	15.209(a)&15.225	Pass
Fundamental field strength limit	15.225(a)	Pass
Frequency stability	15.225(e)	Pass
Band edge compliance	15.225	Pass
Antenna Requirement	15.203	Pass

Note: The conclusion of this test report is judged by actual test data without considering measurement uncertainty.

2.2. Block Diagram



2.3. Test mode

Tested mode, channel, and data rate information		
Mode	Channel	Frequency (MHz)
1	CH1	13.56
Note: According exploratory test, EUT will have maximum output power in those data rate. so those data rate were used for all test.		

2.4. Test Conditions

Temperature range	21-25°C
Humidity range	40-75%
Pressure range	86-106kPa

2.5. Measurement Uncertainty (95% confidence levels, k=2)

Item	Uncertainty
Uncertainty for Power point Conducted Emissions Test	2.74dB
Uncertainty for Radiation Emission test in 3m chamber (below 30MHz)	2.13 dB(Polarize: V)
	2.57dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.77dB(Polarize: V)
	3.80dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	4.16dB(Polarize: H)
	4.13dB(Polarize: V)
Uncertainty for radio frequency	5.4×10^{-8}
Uncertainty for conducted RF Power	0.37dB
Uncertainty for temperature	0.2°C
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.6. Test Equipment

Equipment	Manufacture	Model No.	Serial No.	Last cal.	Cal Interval
9*6*6 anechoic chamber	CHENYU	9*6*6	N/A	2020.09.02	3Year
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	102137	2021.08.25	1Year
Spectrum analyzer	Agilent	N9020A	MY499100060	2021.08.25	1Year
Receiver	ROHDE&SCHWARZ	ESR	1316.3003K03-10208 2-Wa	2021.08.25	1Year
Receiver	R&S	ESCI	101165	2021.08.25	1Year
Bilog Antenna	Schwarzbeck	VULB 9168	VULB9168-438	2020.04.12	2Year
Horn Antenna	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D(1201)	2020.04.12	2Year
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00059	2021.08.30	2Year
RF Cable	Resenberger	Cable 1	RE1	2021.08.25	1Year
RF Cable	Resenberger	Cable 2	RE2	2021.08.25	1Year
RF Cable	Resenberger	Cable 3	CE1	2021.08.25	1Year
Pre-amplifier	HP	HP8347A	2834A00455	2021.08.25	1Year
Pre-amplifier	Agilent	8449B	3008A02664	2021.08.25	1Year
L.I.S.N.#1	Schwarzbeck	NSLK8126	8126-466	2021.08.25	1Year
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	101043	2021.08.25	1 Year
Horn Antenna	SCHWARZBECK	BBHA9170	00946	2021.08.30	2 Year
Preamplifier	SKET	LNPA_1840 -50	SK2018101801	2021.08.25	1 Year
Power Meter	Agilent	E9300A	MY41496628	2021.08.25	1 Year
Power Sensor	DARE	RPR3006W	15100041SNO91	2021.08.25	1 Year
Temp. & Humid. Chamber	Wei Huang	WHTH-1000 -40-880	100631	2021.04.21	1 Year
Switching Mode Power Supply	JUNKE	JK12010S	20140927-6	2021.08.25	1 Year
Adjustable attenuator	MWRFTtest	N/A	N/A	N/A	N/A
10dB Attenuator	Mini-Circuits	DC-6G	N/A	N/A	N/A

Software Information			
Test Item	Software Name	Manufacturer	Version
RE	EZ-EMC	farad	Alpha-3A1
CE	EZ-EMC	farad	Alpha-3A1
RF-CE	MTS 8310	MWRFTtest	2.0.0.0

3. Occupied bandwidth and 20dB Bandwidth

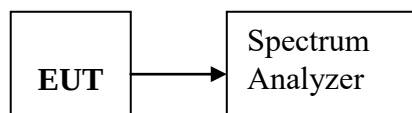
3.1. Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in FCC part 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

3.2. Test Procedure

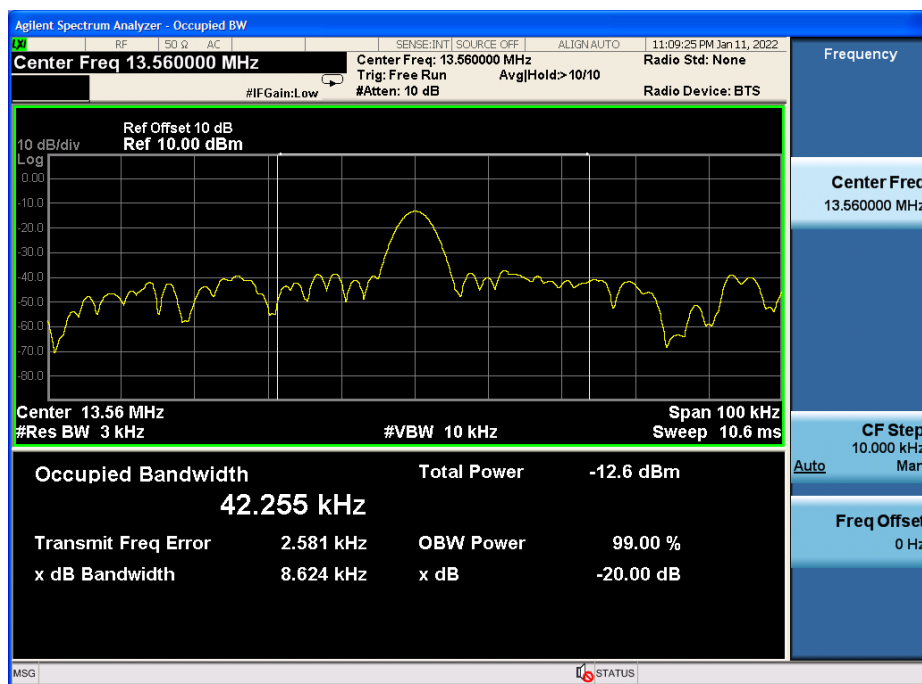
The transmitter output was directly connected to a spectrum analyzer with a 50 Ω cable. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3KHz RBW and 10kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

3.3. Test Setup



3.4. Test Result

Mode	Freq (MHz)	20dB Bandwidth (KHz)	99% Bandwidth	Limit (kHz)	Conclusion
Tx Mode	13.56	8.624	42.255	/	Pass



4. Radiated emissions

4.1. Limit

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

Note:

- a) The tighter limit applies at the band edges.

For example: F.S limit at 88MHz is 100uV/m

- b) If measurement is made at 3m distance, then F.S Limit at 3m distance is adjusted by using the formula of $L_{d1} = L_{d2} * (d2/d1)^2$.

For example:

F.S Limit at 30m(d2) distance is 30uV/m(L_{d2}), then F.S Limit at 3m(d1) distance is

$$L_{d1} = 30\text{uV/m} * (30/3)^2 = 100 * 30\text{uV/m} = 69.54 \text{ dBuV/m}$$

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

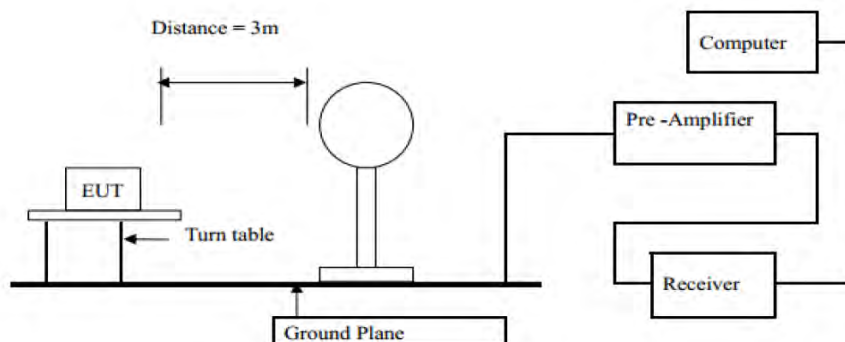
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

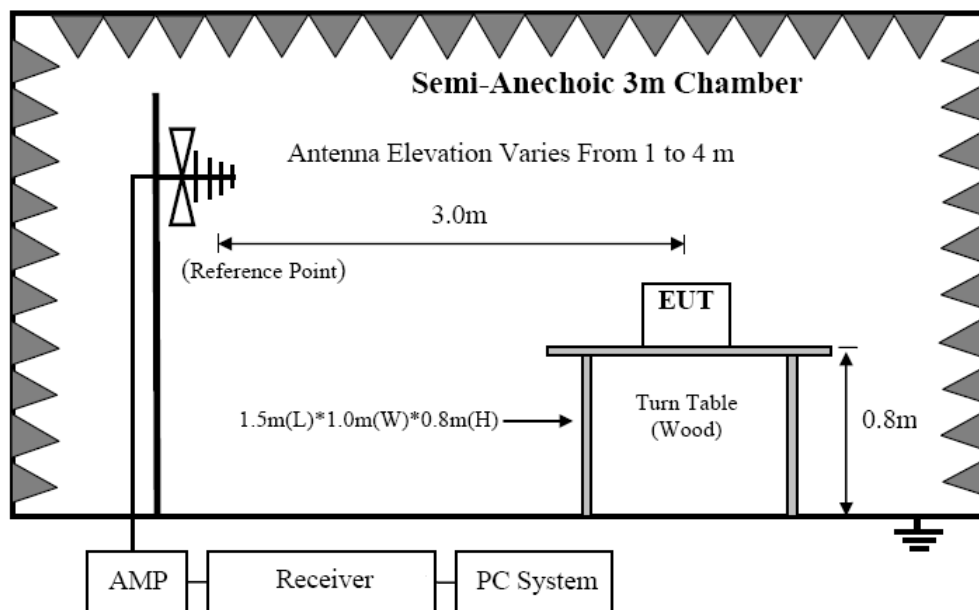
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

4.2. Block Diagram of Test setup

In 3m Anechoic Chamber Test Setup Diagram for below 30MHz



In 3m Anechoic Chamber Test Setup Diagram for frequency 30MHz-1GHz



4.3. Test Procedure

Procedure of Preliminary Test

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 4.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.

Mains cables, telephone lines or other connections to auxiliary equipment located outside the test are shall drape to the floor, be fitted with ferrite clamps or ferrite tubes placed on the floor at the point where the cable reaches the floor and then routed to the place where they leave the turntable. No extension cords shall be used to mains receptacle.

The antenna was placed at 3 meter away from the EUT as stated in ANSI C63.10:2013. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.

The Receiver quickly scanned from 9KHz to 30MHz and 30MHz to 1GHz The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

The test mode(s) described in clause 2.4 were scanned during the preliminary test:

After the preliminary scan, we found the test mode producing the highest emission level. The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission level were recorded for the final test.

Procedure of Final Test

EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test.

The Receiver scanned from 9KHz to 30MHz and 30MHz to 1GHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1

to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit and only Q.P. reading is presented.

The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 200Hz for 9 KHz to 150 KHz measure, 10 KHz for 150 KHz to 30MHz measure and 120 KHz for 30 MHz to 1GHz measure .

4.4. Test Result

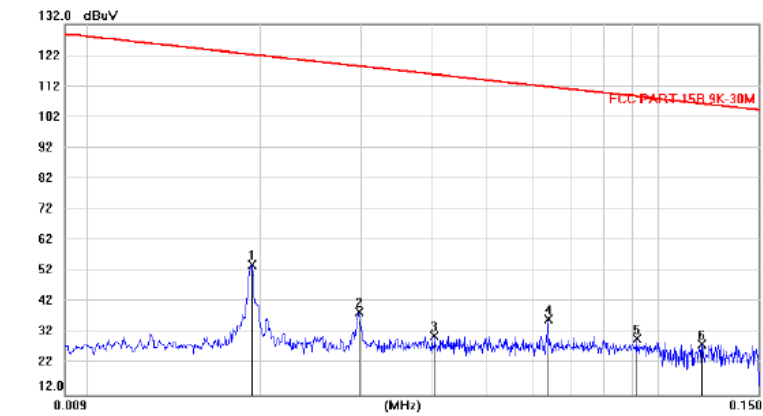
Pass. (See below detailed test result)

Detailed information please see the following page.

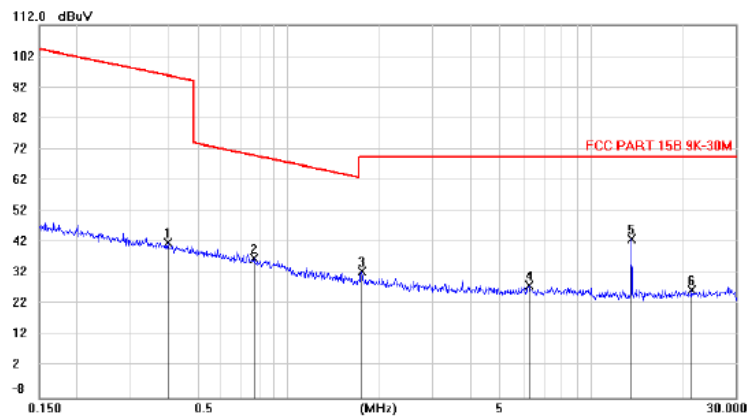
From 9KHz to 30MHz: Conclusion: Pass

Frequency Range	: 9KHz~30MHz
Test Mode	: TX: 13.56MHz
Test Results	: Pass
Note:	1. The test results are listed in next pages. 2. This mode is worst case mode, so this report only reflected the worst mode. 3. If the limits for the measurement with the average detector are met when using a receiver with a peak detector, the test unit shall be deemed to meet both limits and the measurement with the quasi-peak detector need not be carried out.

X:



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV	dBuV	dB	cm	degree	Comment
1	*	0.0192	32.83	21.27	54.10	122.2	-68.11	peak		
2		0.0297	17.73	21.00	38.73	118.4	-79.68	peak		
3		0.0403	10.73	20.43	31.16	115.7	-84.59	peak		
4		0.0639	16.36	20.11	36.47	111.7	-75.27	peak		
5		0.0916	10.14	19.88	30.02	108.6	-78.58	peak		
6		0.1192	8.48	19.79	28.27	106.3	-78.04	peak		



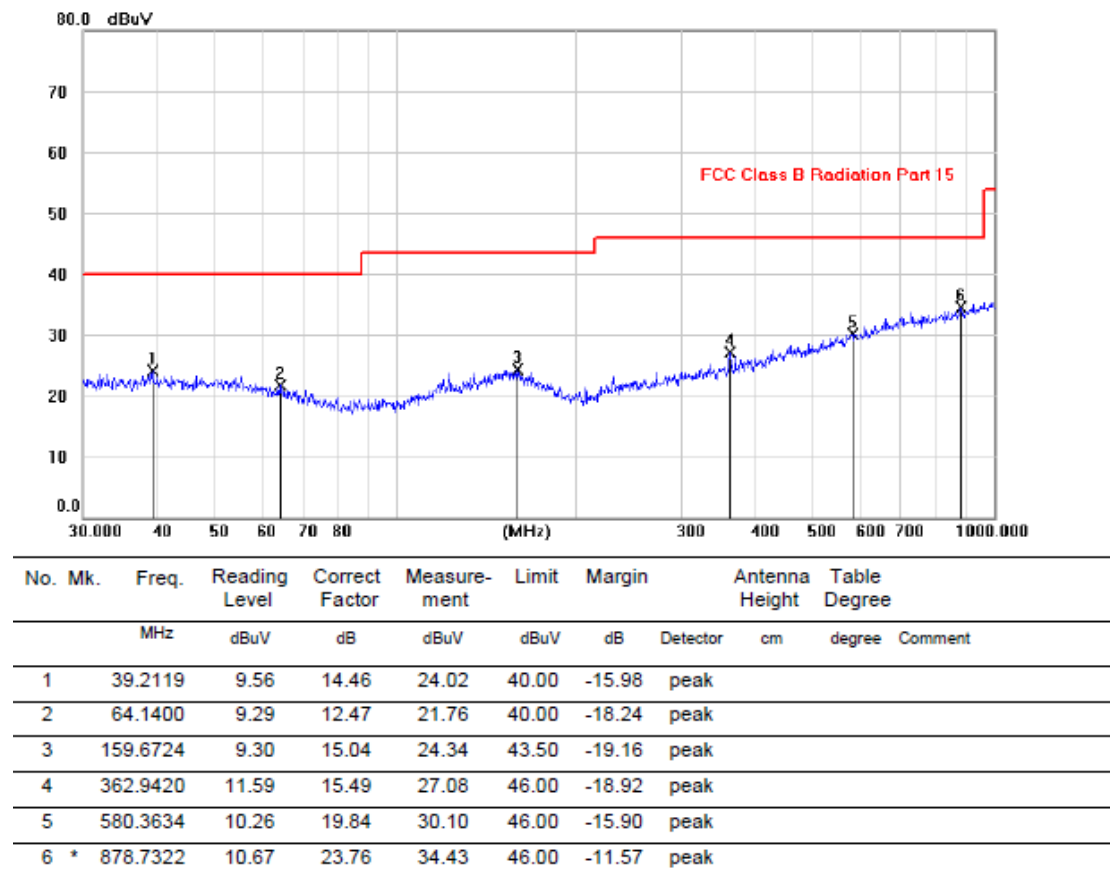
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV	dBuV	dB	cm	degree	Comment
1		0.3980	22.11	19.85	41.96	95.82	-53.86	peak		
2		0.7706	17.00	19.86	36.86	70.01	-33.15	peak		
3		1.7440	12.42	20.19	32.61	69.54	-36.93	peak		
4		6.2343	5.96	22.28	28.24	69.54	-41.30	peak		
5	*	13.5604	22.56	20.64	43.20	69.54	-26.34	peak		
6		21.4822	7.07	19.59	26.66	69.54	-42.88	peak		

*:Maximum data x:Over limit !:over margin

Note: Measurement=Reading Level+Correc Factor. Factor=(LISN or ISN or PLC or Current Probe)Factor+Cab

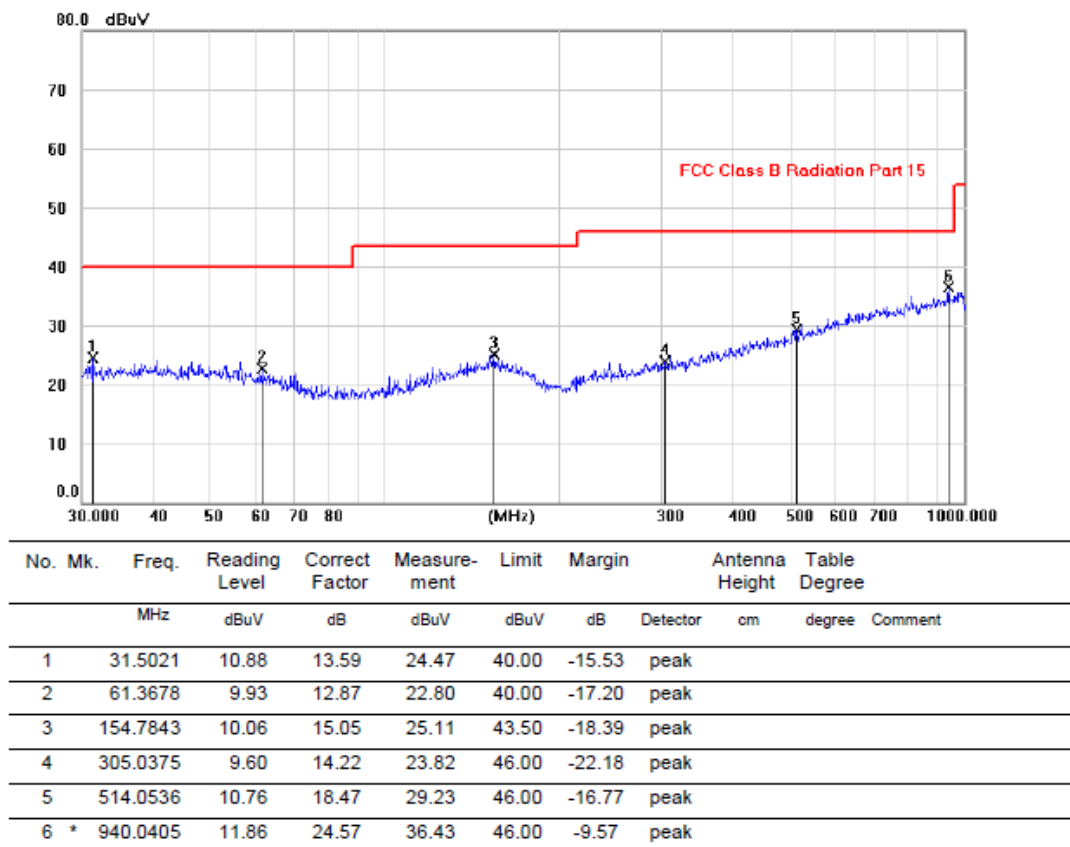
From 30MHz to 1GHz: Conclusion: Pass

Vertical:



Note: 1. *: Maximum data; x: Over limit; !: over margin.

2. Measurement = Reading Level + Correct Factor; Correct Factor = Antenna Factor + Cable Loss.

Horizontal:

Note: 1. *:Maximum data; x:Over limit; !:over margin.

2.Measurement=Reading Level+Correct Factor; Correct Factor=Antenna Factor+Cable Loss.

Field Strength Emissions Result

Temperature		24°C		Relative Humidity		56%	
Pressure		960hPa		Distance		3m	
Test Mode		TX					
Freq. (MHz)	Position H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limits 3m (dBuV/m)	Margin (dBuV/m)
13.560	H	Peak	41.79	-13.94	27.85	124	-96.15
13.560	H	AV	35.95	-13.94	22.01	104	-81.99
13.110	H	Peak	44.11	-13.94	30.17	80.5	-50.33
13.410	H	Peak	40.63	-13.94	26.69	90.5	-63.81
13.553	H	Peak	42.31	-13.94	28.37	90.5	-62.13
13.567	H	Peak	42.15	-13.93	28.22	90.5	-62.28
13.710	H	Peak	40.88	-13.93	26.95	80.5	-53.55
14.010	H	Peak	39.60	-13.93	25.67	80.5	-54.83
Freq. (MHz)	Position H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limits 3m (dBuV/m)	Margin (dBuV/m)
13.560	V	Peak	43.20	-13.94	29.26	124	-94.74
13.560	V	AV	34.68	-13.94	20.74	104	-83.26
13.110	V	Peak	43.11	-13.94	29.17	80.5	-51.33
13.410	V	Peak	39.91	-13.94	25.97	90.5	-64.53
13.553	V	Peak	42.68	-13.94	28.74	90.5	-61.76
13.567	V	Peak	42.56	-13.93	28.63	90.5	-61.87
13.710	V	Peak	41.21	-13.93	27.28	80.5	-53.22
14.010	V	Peak	39.02	-13.93	25.09	80.5	-55.41
Note:							
1: 30m to 3m correction factor calculation: 40*Log(30m/3m)=40							
2: --Means other frequency and mode comply with standard requirements and at least have 20dB margin.							
3: Correct Factor=Cable Loss+ Antenna Factor- Amplifier Gain Measurement Result=Reading + Correct Factor Margin=Measurement Result-Limit							

5. Frequency stability

5.1. Test limit

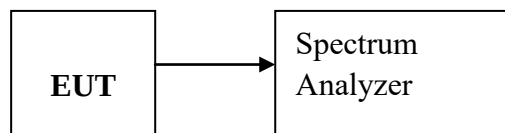
Please refer section RSS-Gen & 15.225e.

Regulation 15.225(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ (± 100 ppm) of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.2. Test Procedure

The following equipment are installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

5.3. Test Setup



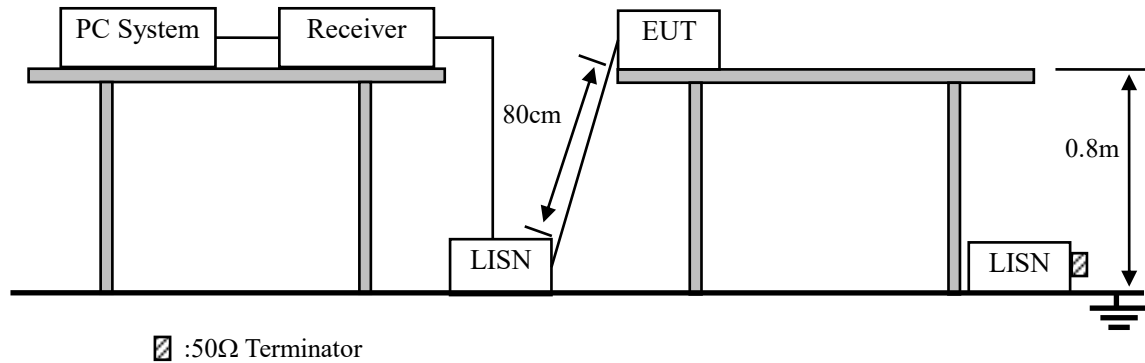
5.4. Test Results

Pass.

Detailed information please see the following page.

Assigned Frequency(MHz): 13.56MHz				
Voltage	Temperature	Measured Frequency (MHz)	Frequency stability	Limit
Low DC 3.3V	+20°C	13.560813	0.000813	±100 ppm ±0.001356MHz
Normal DC 3.80V	-10°C	13.560375	0.000375	
	-5°C	13.560725	0.000725	
	0°C	13.560561	0.000561	
	+10°C	13.560154	0.000154	
	+20°C	13.560350	0.000350	
	+30°C	13.560334	0.000334	
	+40°C	13.560650	0.000650	
	+50°C	13.560494	0.000494	
	+60°C	13.560395	0.000395	
High DC 4.4V	+20°C	13.560563	0.000563	

6. Power Line Conducted Emissions



6.1. Block Diagram of Test Setup

6.2. Limit

Frequency	Maximum RF Line Voltage	
	Quasi-Peak Level dB(μ V)	Average Level dB(μ V)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Notes: 1. * Decreasing linearly with logarithm of frequency.

2. The lower limit shall apply at the transition frequencies.

6.3. Test Procedure

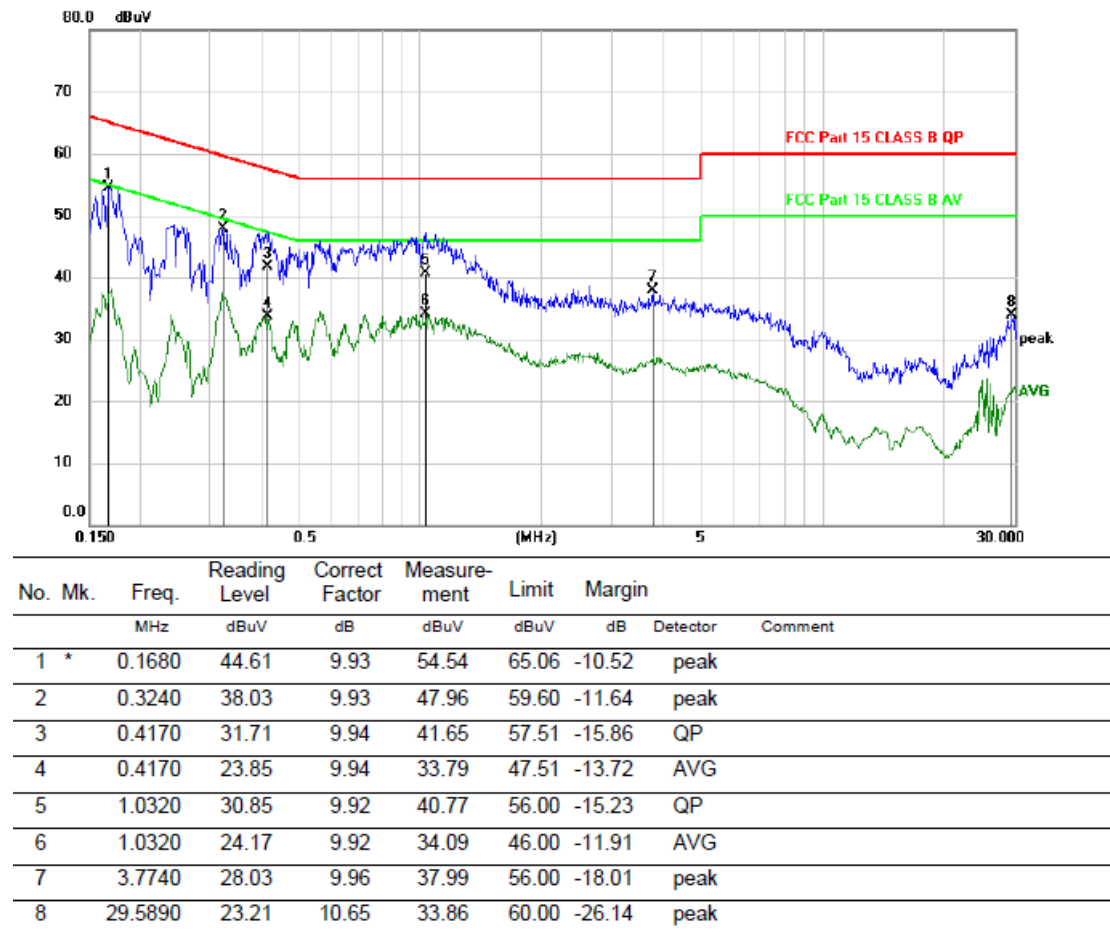
- (1) The EUT was placed on a non-metallic table, 80cm above the ground plane.
- (2) Setup the EUT and simulator as shown in 10.1
- (3) The EUT Power connected to the power mains through a power adapter and a line impedance stabilization network (L.I.S.N1). The other peripheral devices power cord connected to the power mains through a line impedance stabilization network (L.I.S.N1), this provided a 50-ohm coupling impedance for the EUT (Please refer to the block diagram of the test setup and photographs). Both sides of power line were checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C64.10:2013 on conducted Emission test.
- (4) The bandwidth of test receiver is set at 10KHz.
- (5) The frequency range from 150 KHz to 30MHz is checked.

6.4. Test Result

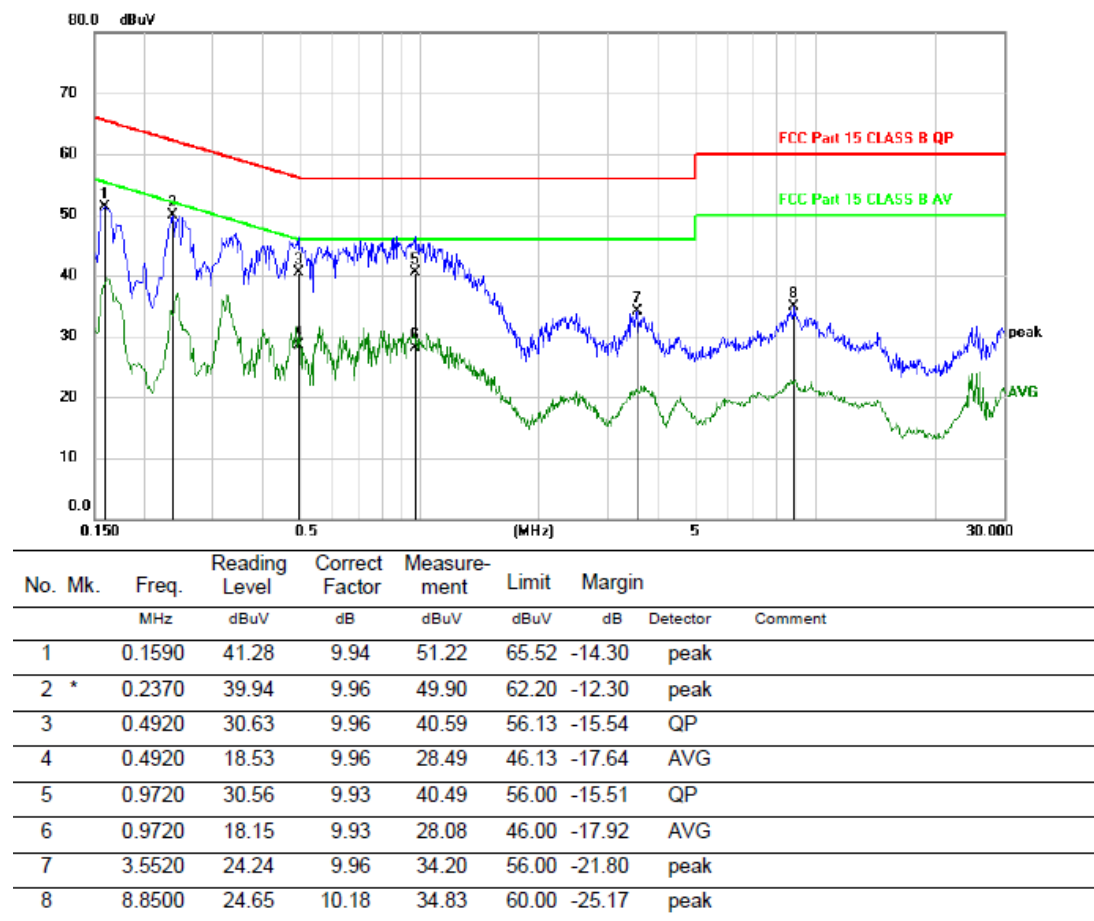
Pass. (See below detailed test data)

Note: If peak Result comply with AV limit, QP and AV Result is deemed to comply with AV limit

Line:



Note: Measurement=Reading Level+Correc Factor. Factor=(LISN or ISN or PLC or Current Probe)Factor+Cable

Neutral:

Note: Measurement=Reading Level+Correc Factor. Factor=(LISN or ISN or PLC or Current Probe)Factor+Cable

7. Antenna Requirements

7.1. Limit

For intentional device, according to RSS-Gen Section 6.8 and 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 15.209, 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.

7.2. Antenna Connected Construction

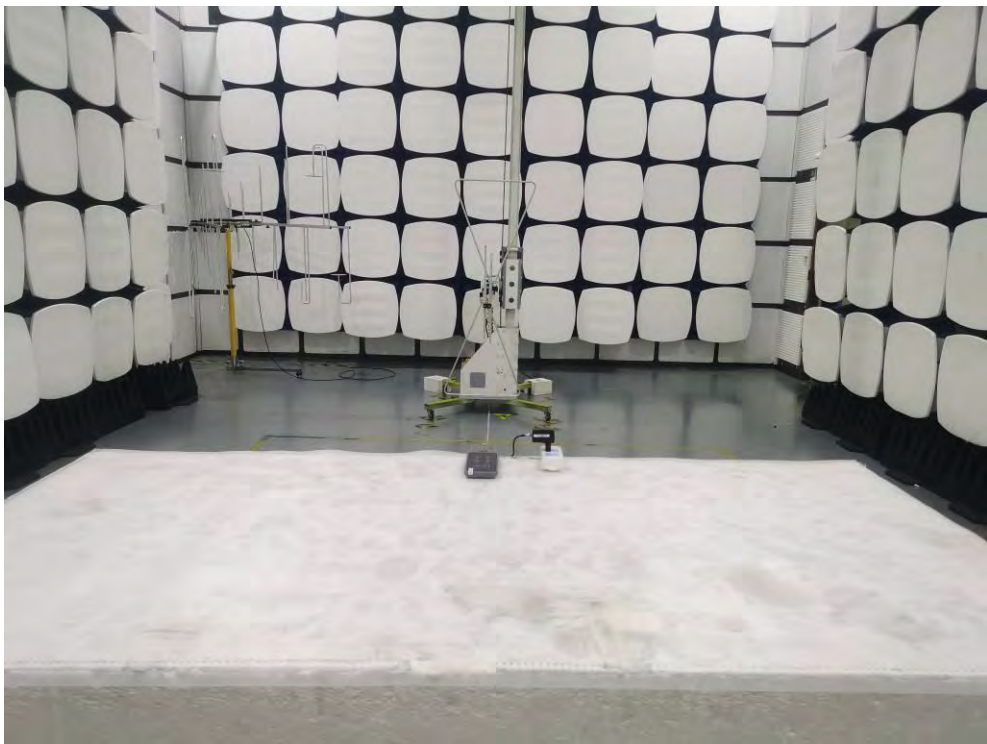
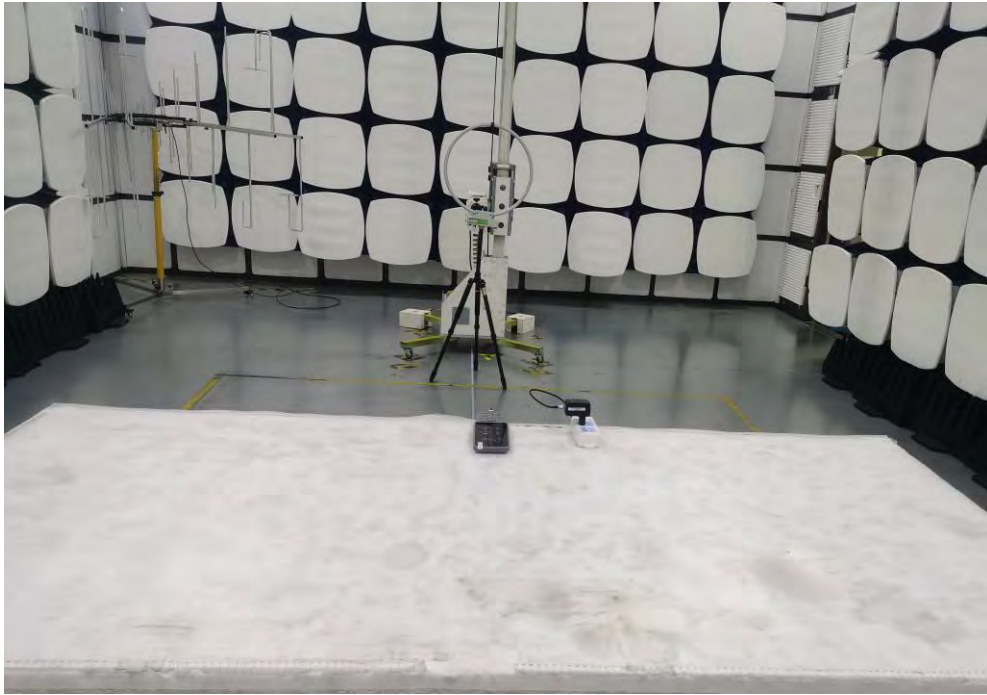
The antenna is internal antenna and no consideration of replacement. Please see EUT photo for details.

7.3. Results

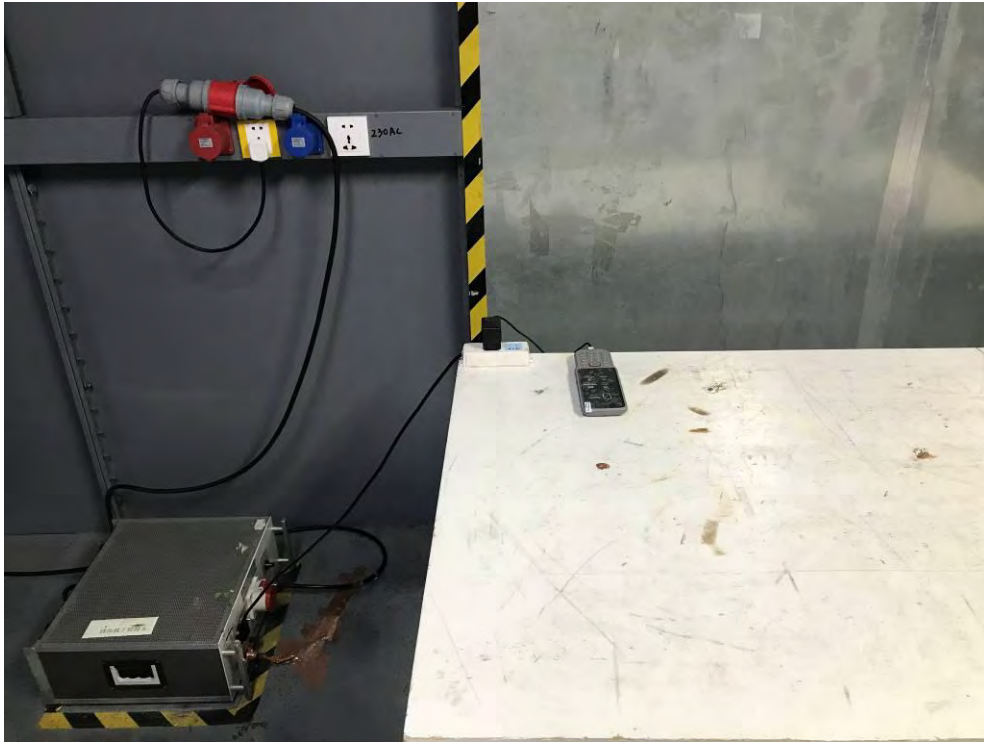
The EUT antenna is Internal Antenna. It complies with the standard requirement.

8. Test setup photo

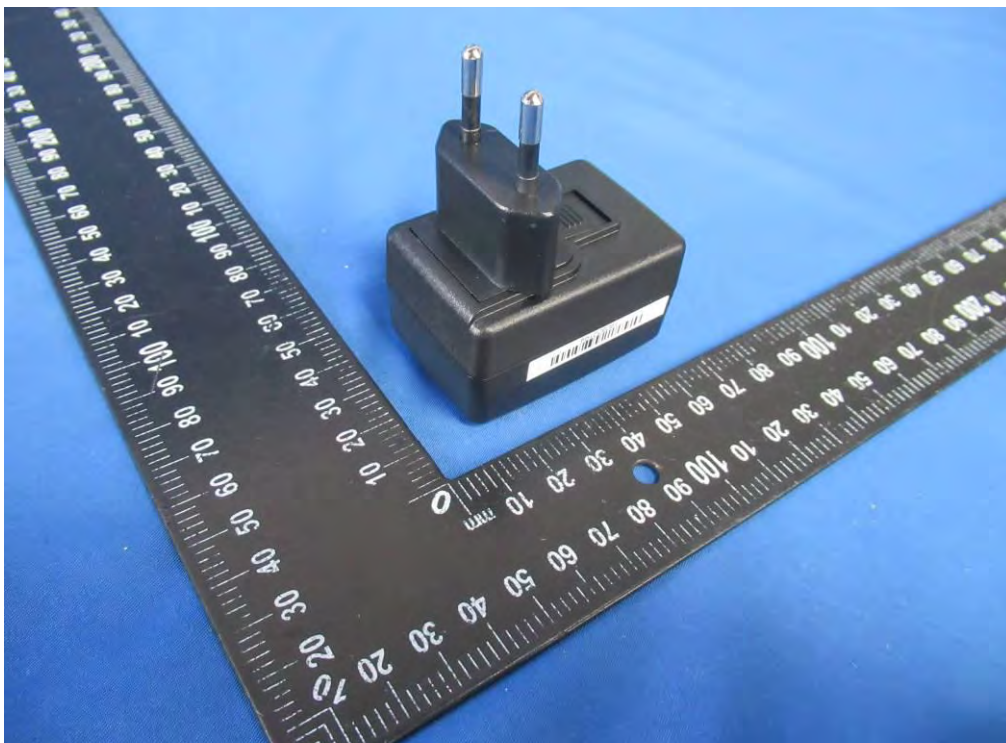
8.1. Photos of Radiated emission



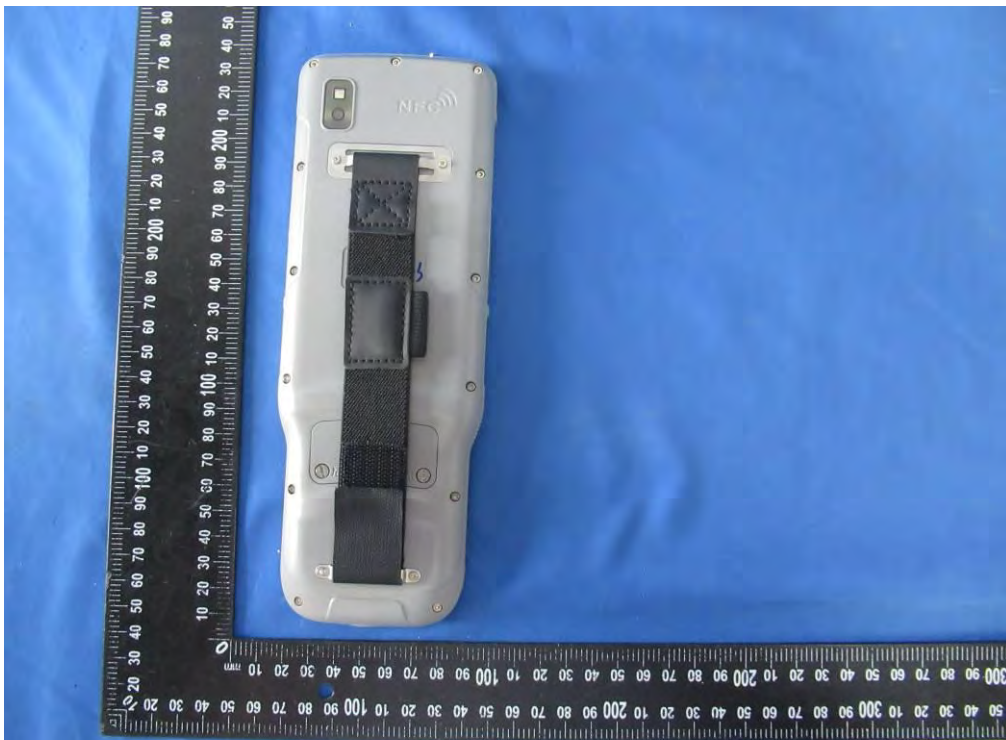
8.2. Photos of Conducted Emission test



9. Photos of EUT



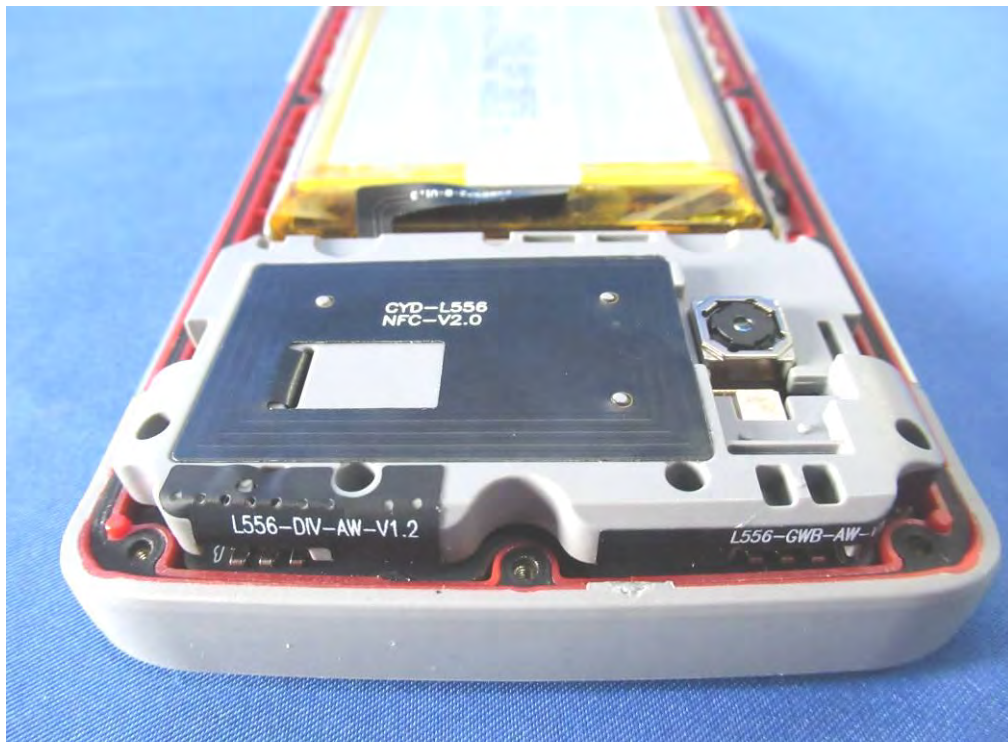
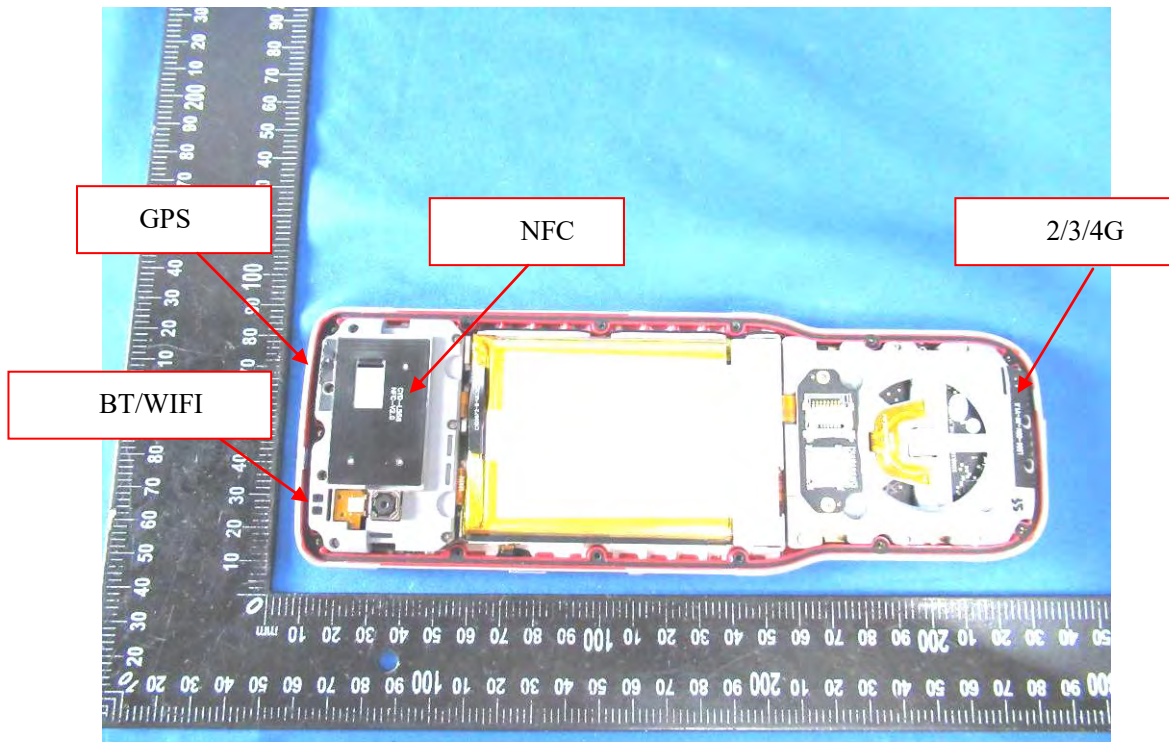


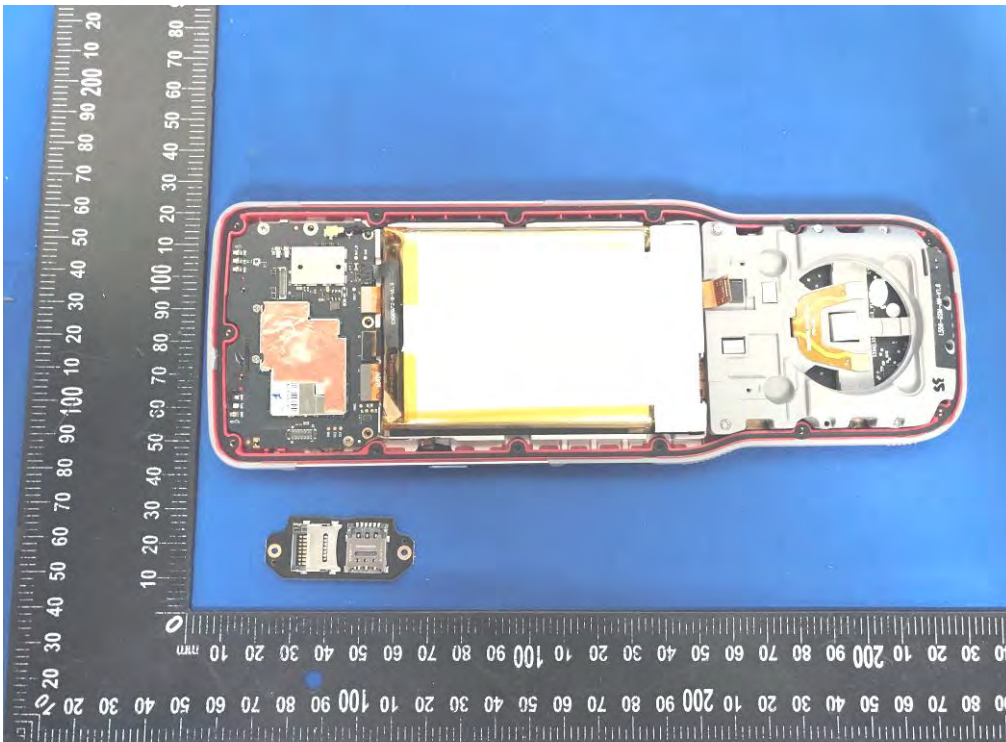


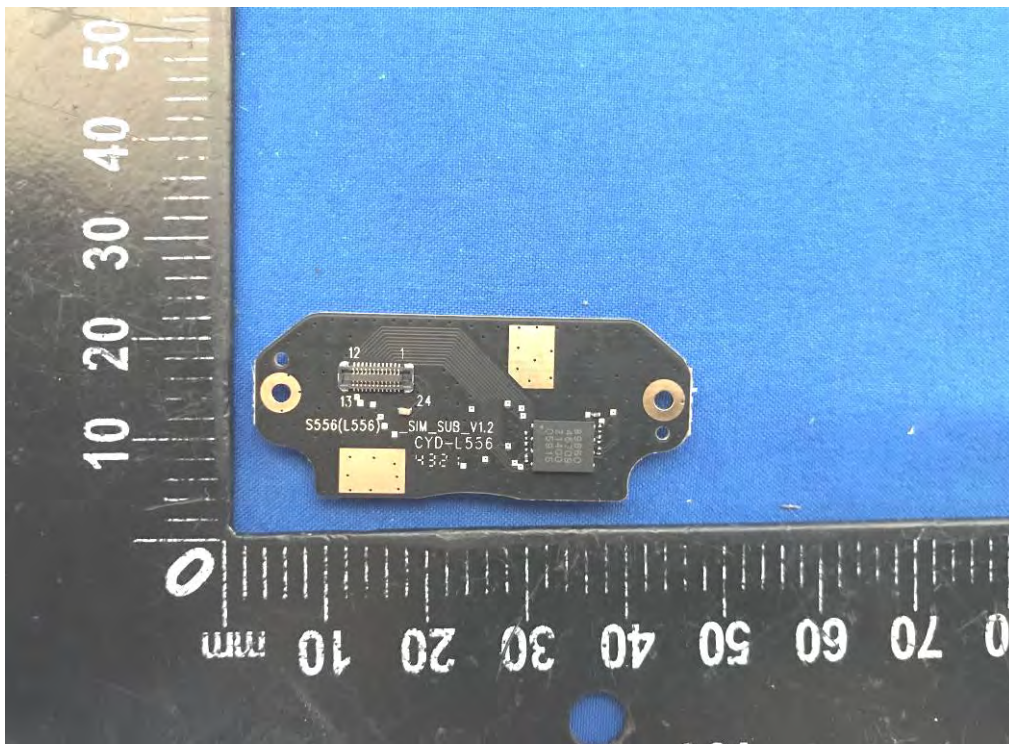
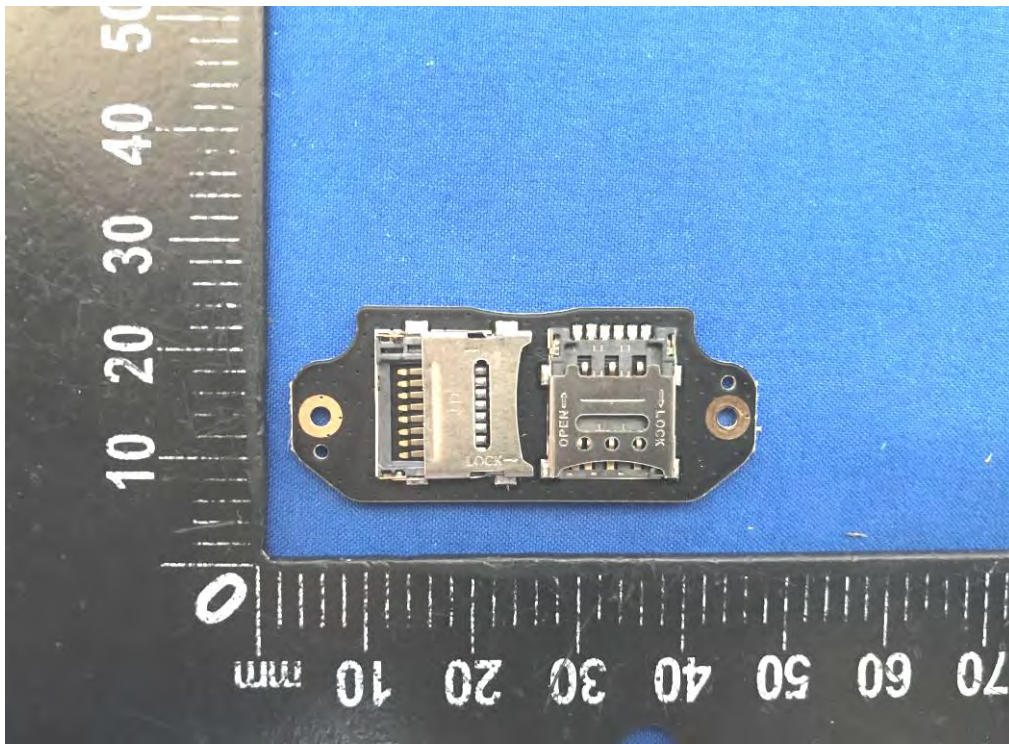


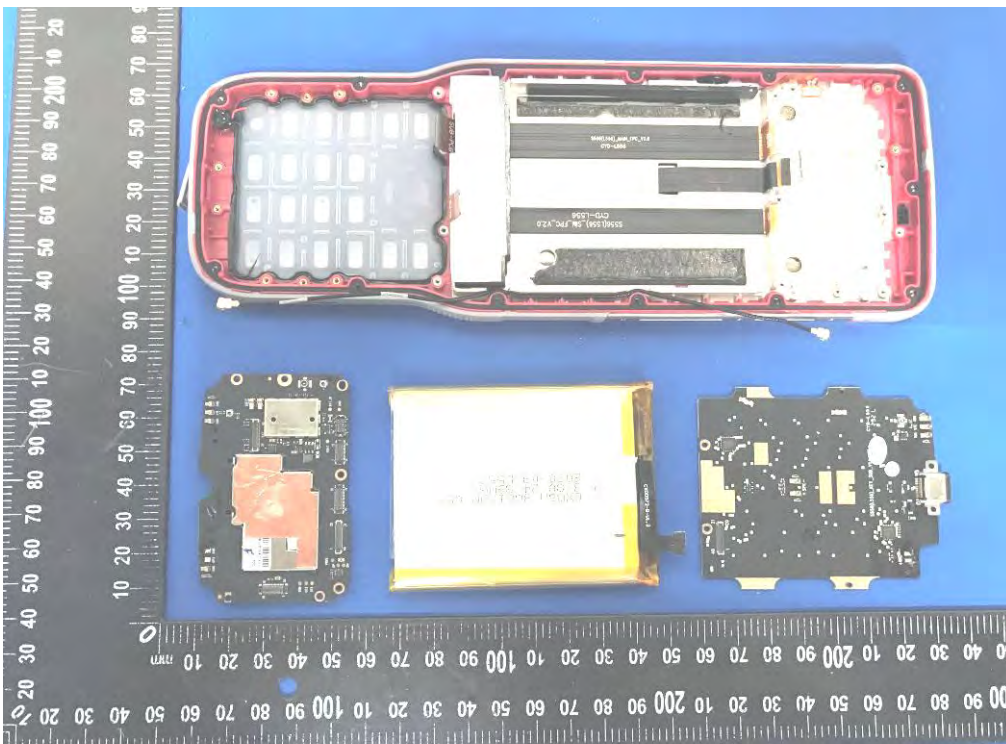
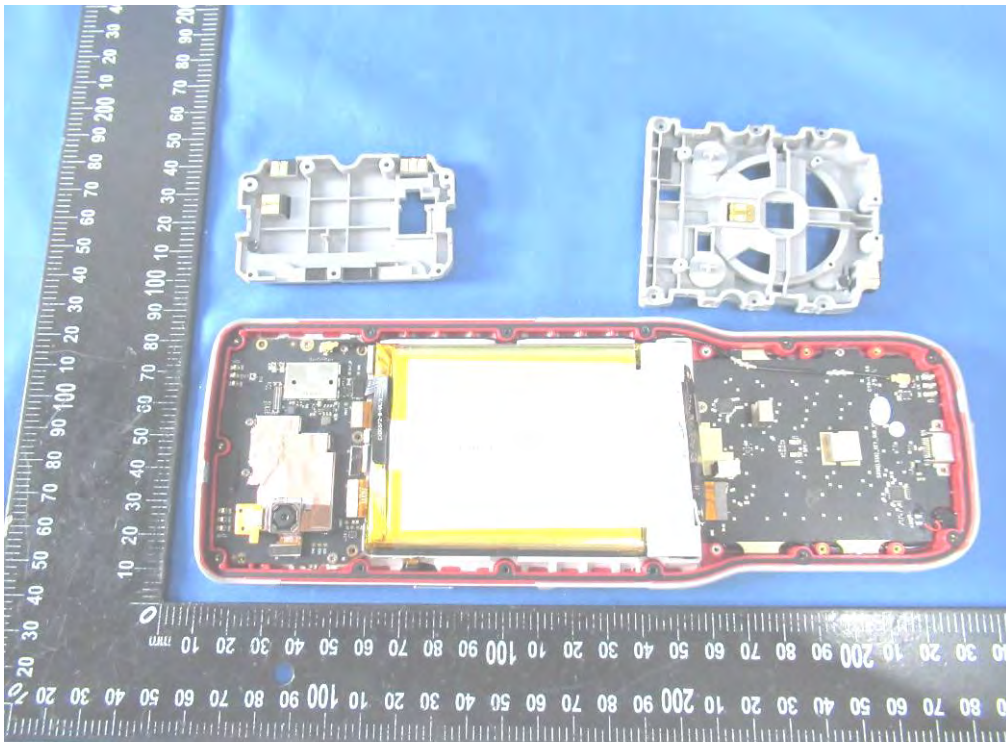


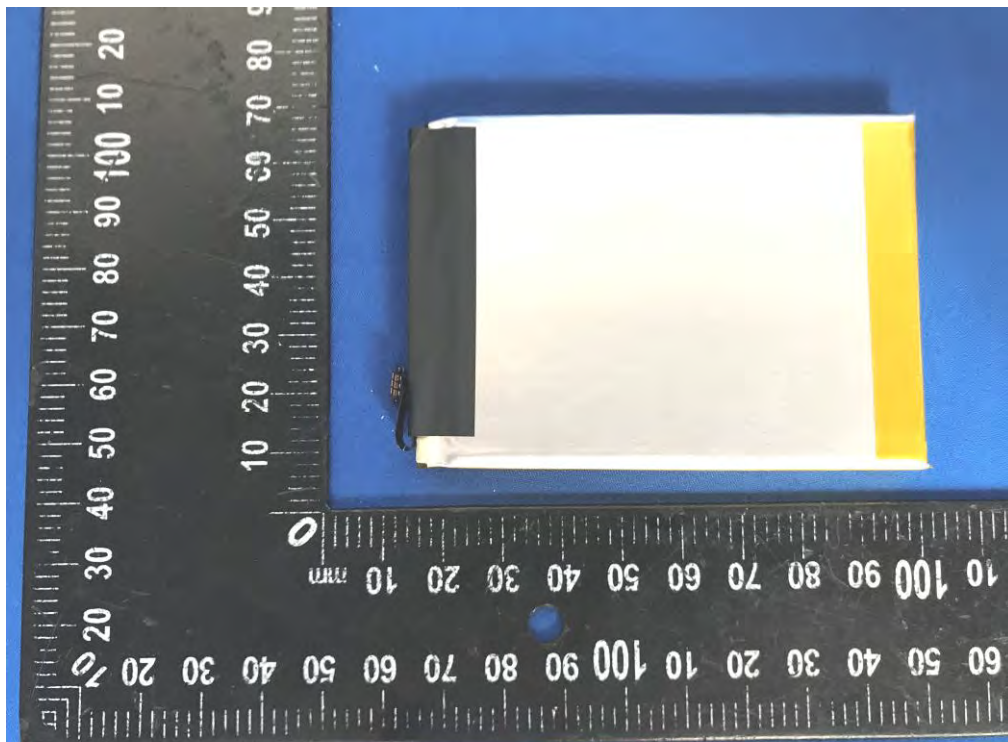
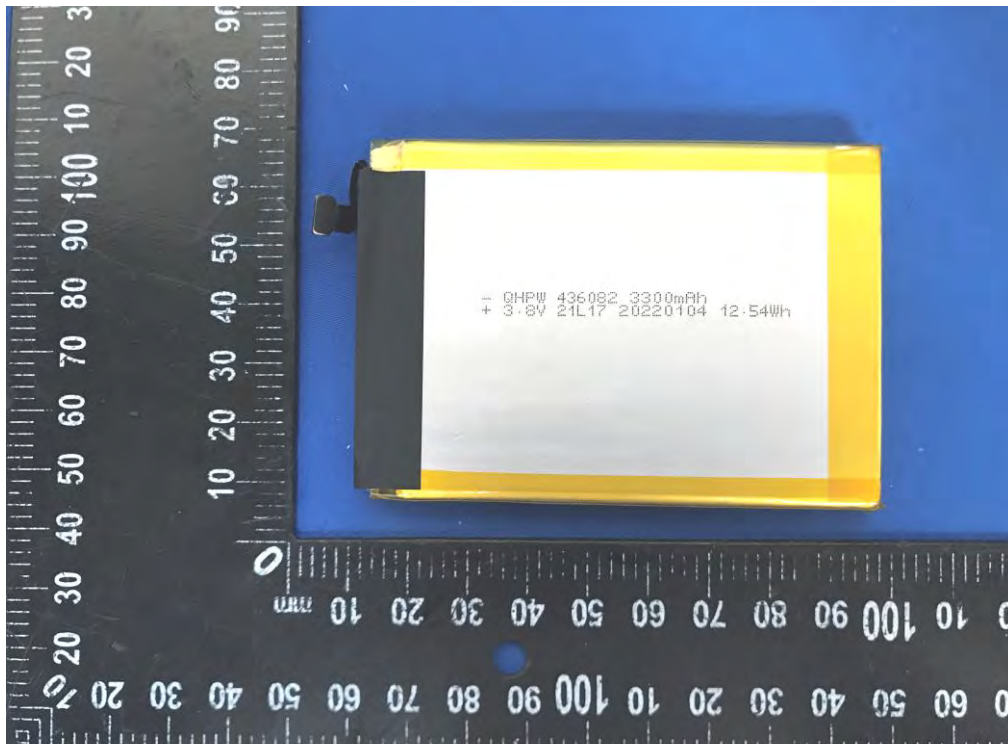


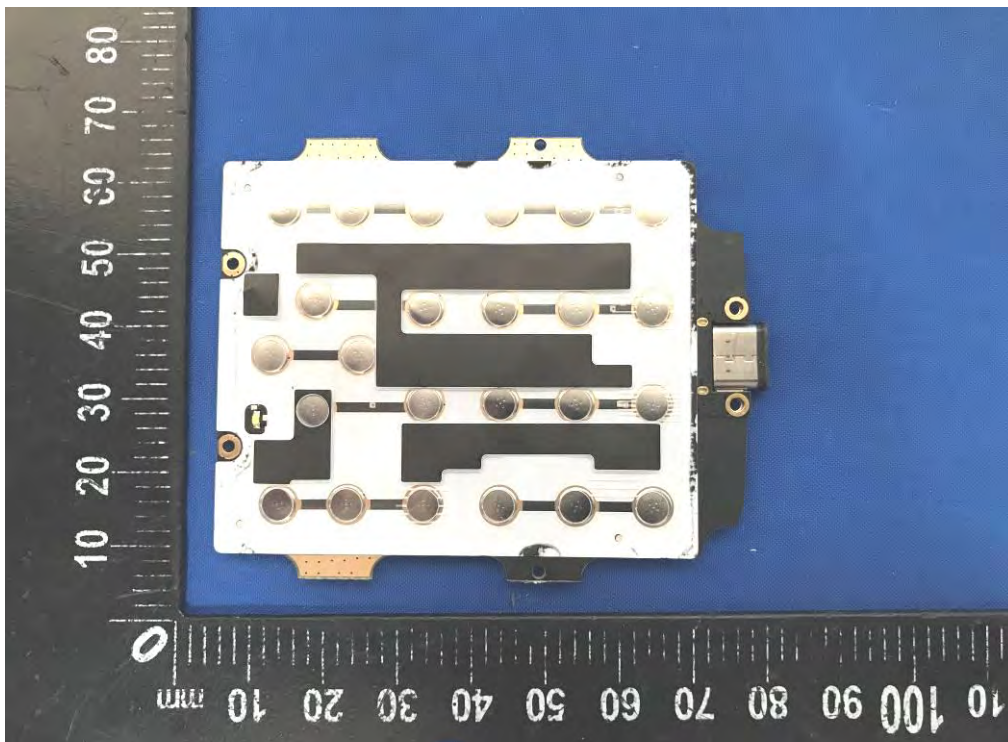
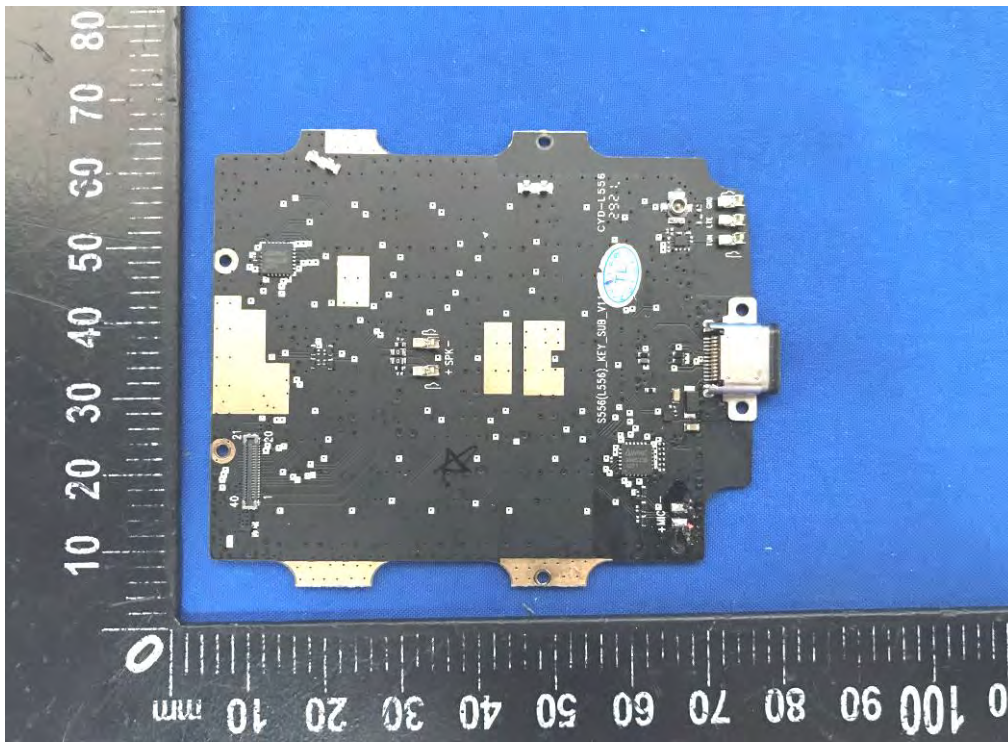


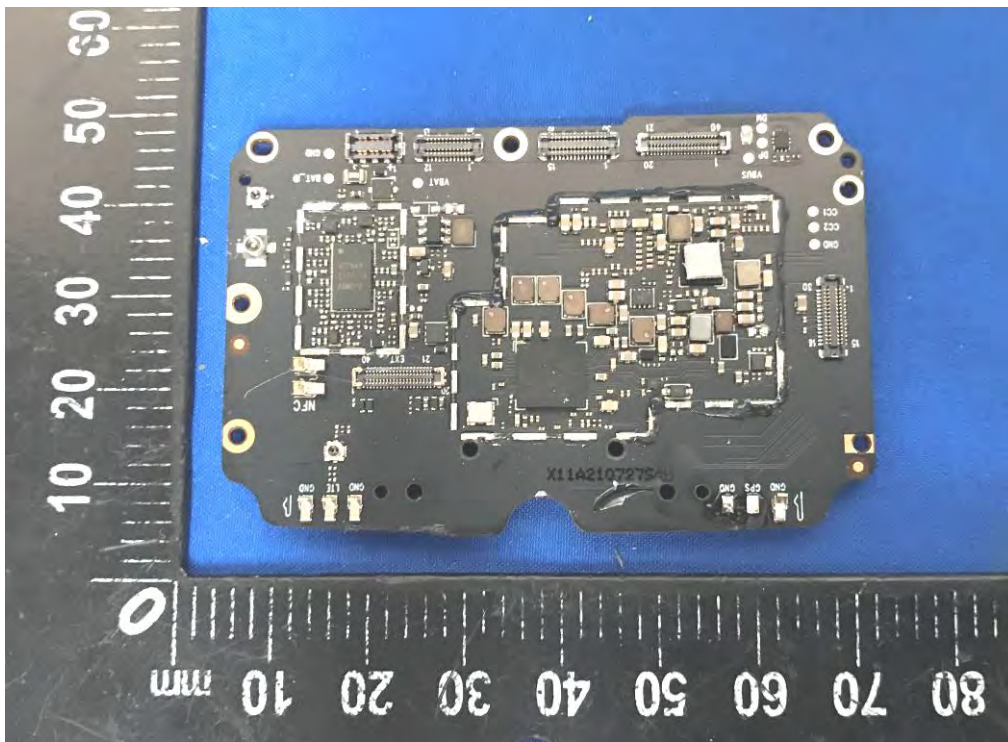
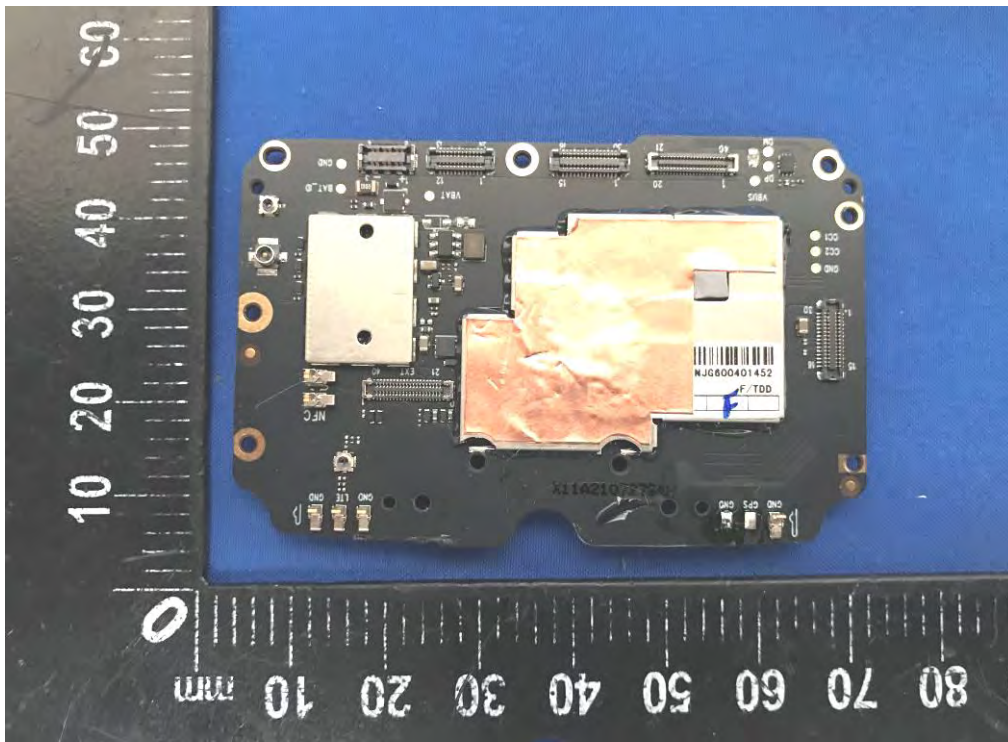


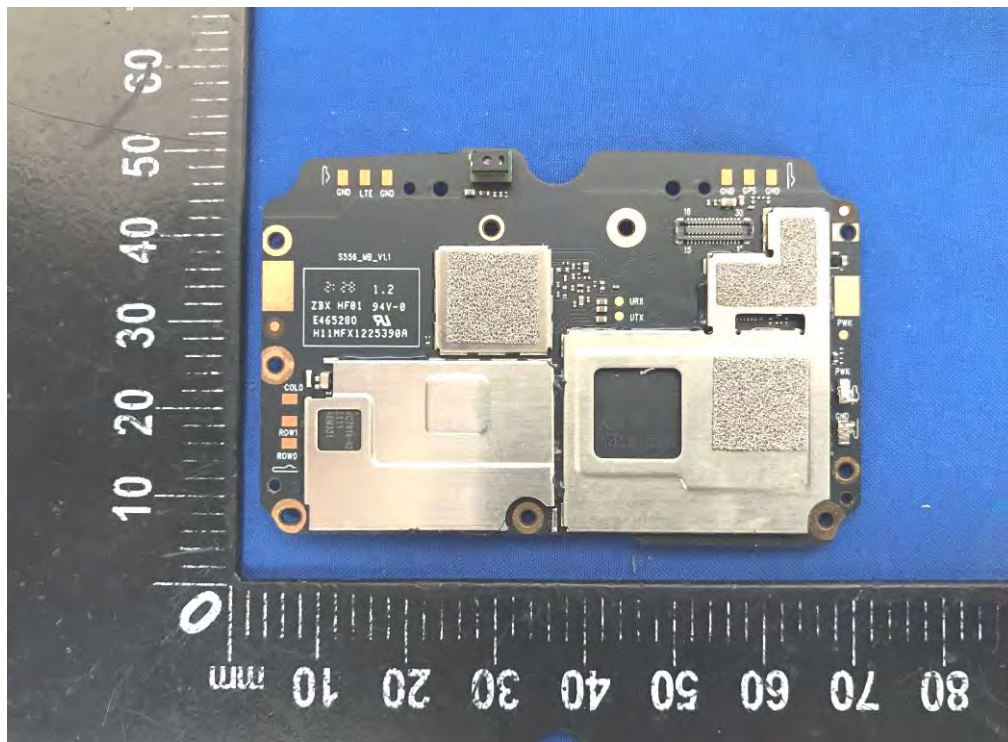
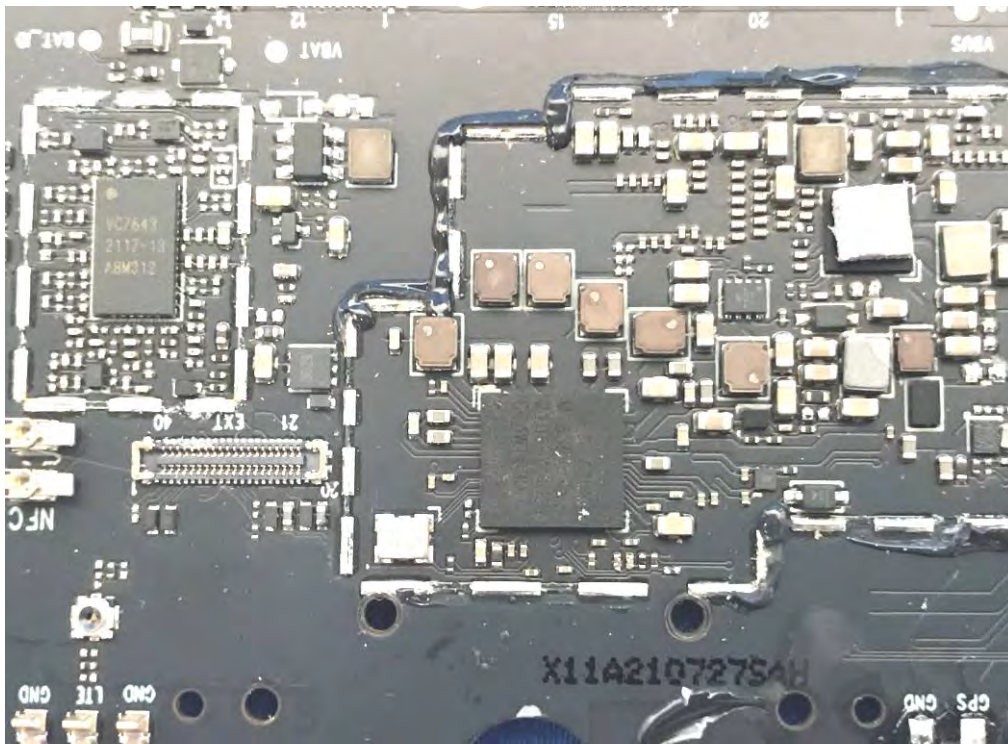


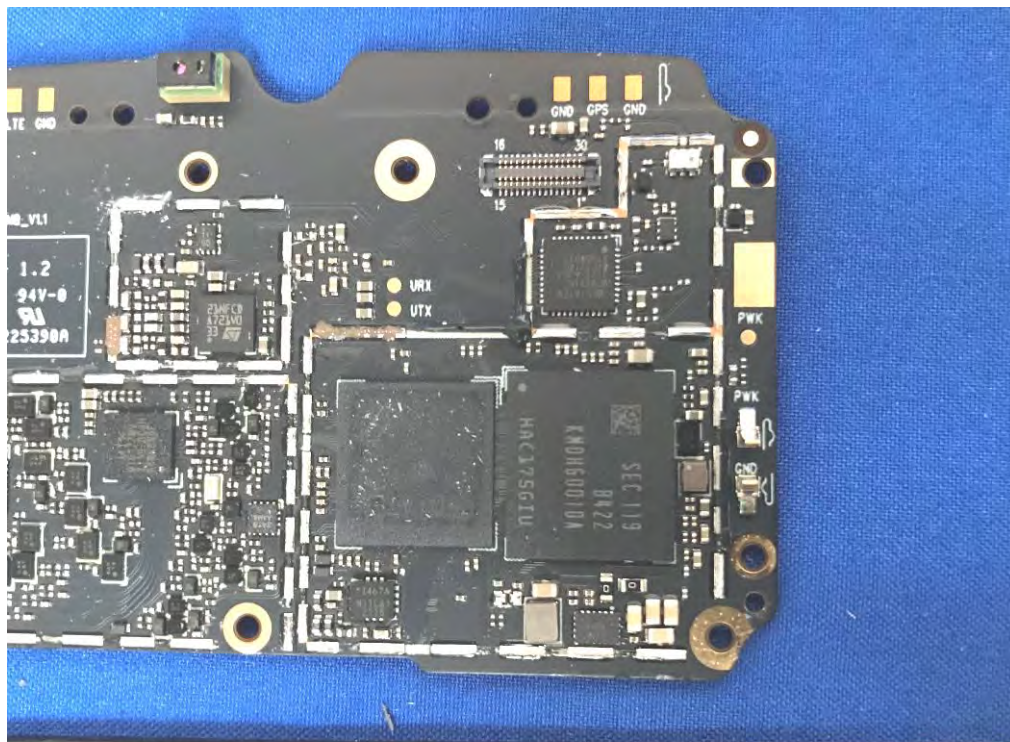
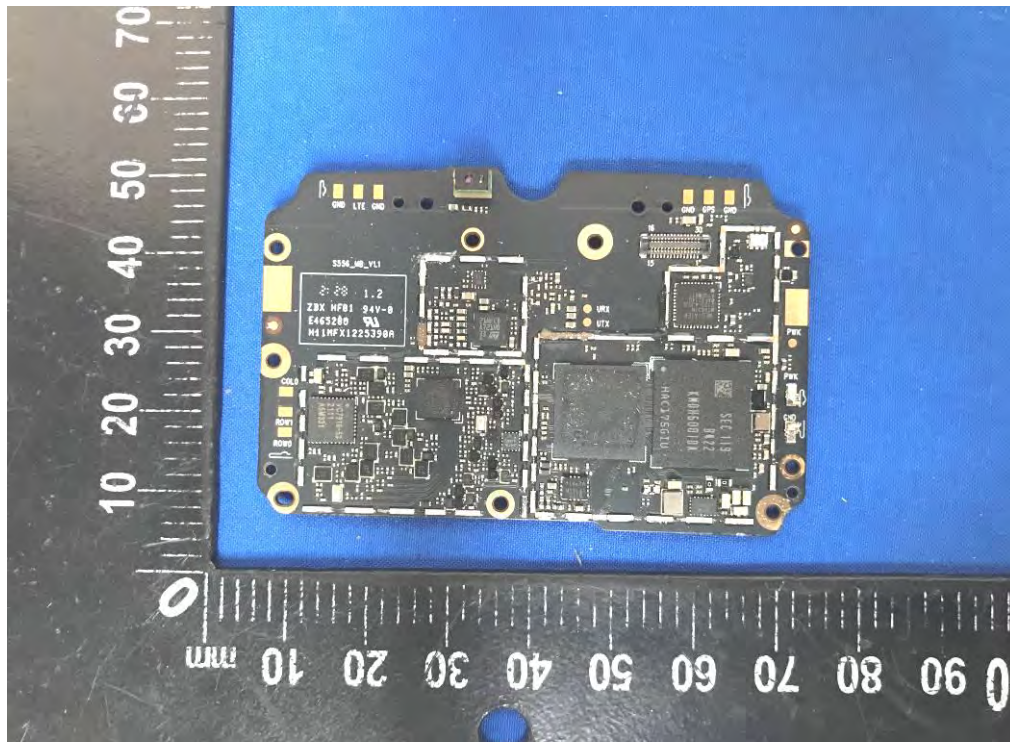












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