FCC TEST REPORT

Test report
On Behalf of
Shenzhen Jiayz photo industrial ., Ltd
For
2.4G Wireless Microphone
Model No.: Vlink2 TX+RX, Vlink2 TX+TX+RX
FCC ID: 2ARN3-VLINK2

Prepared for :	**Shenzhen Jiayz photo industrial ., Ltd** A16 Building,Intelligent Terminal Industrial Park of Silicon Valley Power, Guanlan, Longhua District, Shenzhen, China
Prepared By :	**Shenzhen Tongzhou Testing Co.,Ltd** **1th Floor, Building 1, Haomai High-tech Park, Huating Road 387, Dalang Street, Longhua, Shenzhen, China**
Date of Test:	**2020/8/02 ~ 2020/08/24**
Date of Report:	**2020/8/24**
Report Number:	**TZ200801588-E**

The test report apply only to the specific sample(s) tested under stated test conditions
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

TEST RESULT CERTIFICATION

Applicant's name ..... :	**Shenzhen Jiayz photo industrial ., Ltd**
Address ..... :	A16 Building,Intelligent Terminal Industrial Park of Silicon Valley Power, Guanlan, Longhua District, Shenzhen, China
Manufacture's Name ..... :	**Shenzhen Jiayz photo industrial ., Ltd**
Address ..... :	A16 Building,Intelligent Terminal Industrial Park of Silicon Valley Power, Guanlan, Longhua District, Shenzhen, China
Product description	
Trade Mark ..... :	Saramonic
Product name ..... :	2.4G Wireless Microphone
Model and/or type reference .. :	Vlink2 TX+RX, Vlink2 TX+TX+RX
Standards ..... :	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013

Date of Test ..... :	
Date (s) of performance of tests ..... :	2020/8/02 ~ 2020/08/24
Date of Issue ..... :	2020/8/24
Test Result ..... :	**Pass**

Testing Engineer **:** Nancy Li

(Nancy Li)

Technical Manager **:** Hugo Chen

(Hugo Chen)

Authorized Signatory **:** Andy Zhang

(Andy Zhang)

Revision History

Revision	Issue Date	Revisions	Revised By
000	2020/8/24	Initial Issue	Andy Zhang

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: 2.4G Wireless Microphone
Model Number	: Vlink2 TX+RX,Vlink2 TX+TX+RX,
Model Declaration	: All the same except for the model name
Test Model	: Vlink2 TX+RX
Power Supply	: DC 3.7V by battery and DC 5V From Adapter
Hardware version	: VLINK2_TX_MAIN_V1.0
Software version	: V1.0
Sample ID	: TZ200801588–1#
2.4G wireless technology	
Frequency band	: 2406~2474 MHz
Channel Number	: 18 Channels
Modulation Technology	: GFSK
Antenna Type And Gain	External Antenna 0.00 dBi(Max.)

Note1: Antenna position refer to EUT Photos.

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate

1.3 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

○ - supplied by the manufacturer
● - supplied by the lab

Adapter	Mode:EP-TA20CBC Input:AC100-240V-50/60Hz，0.5A Output:DC 5V,2A

1.5. Description of Test Facility

Designation Number: CN1275
Test Firm Registration Number: 167722

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010

1.6. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the Shenzhen Tongzhou Testing 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.

1.7. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.08dB	(1)
		30MHz~1000MHz	±4.42dB	(1)
		1GHz~40GHz	±4.06dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±2.23dB	(1)

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

1.8. Description of Test Modes

The EUT has been tested under operating condition.

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

Pre-test AC conducted emission at power adapter mode.

Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/60Hz, recorded worst case.

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, which was determined to be 2.4G wireless technology mode (High Channel).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be 2.4G wireless technology mode(High Channel).

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:
2474MHz,GFSK.

1.9. Frequency of Channels

2.4G wireless technology (DTS)

Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	2406	10	2442
2	2410	11	2446
3	2414	12	2450
4	2418	13	2454
5	2422	14	2458
6	2426	15	2462
7	2430	16	2466
8	2434	17	2470
9	2438	18	2474

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen Tongzhou Testing Co.,Ltd

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to FCC's request, Test Procedure KDB558074 D01 DTS Meas. Guidance v04 and KDB 662911 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

2.4. Test Sample

The application provides 1 sample to meet requirement;

Sample ID	Description
TZ200801588–1#	continuous transmit & Intermittent transmit

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by AT command provided by application.

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
/	/	/	/	/	/	/	/

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen Tongzhou Testing Co.,Ltd has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C			
FCC Rules	Description of Test	Sample ID	Result
§15.247(b)	Maximum Conducted Output Power	TZ200801588–1#	Compliant
§15.247(e)	Power Spectral Density	TZ200801588–1#	Compliant
§15.247(a)(2)	6dB Bandwidth	TZ200801588–1#	Compliant
§15.247(a)	Occupied Bandwidth	TZ200801588–1#	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	TZ200801588–1#	Compliant
§15.205	Emissions at Restricted Band	TZ200801588–1#	Compliant
§15.207(a)	Conducted Emissions	TZ200801588–1#	Compliant
§15.203	Antenna Requirements	TZ200801588–1#	Compliant
§15.247(i)§2.1093	RF Exposure	N/A	Compliant

5. TEST RESULT

5.1. Maximum Conducted Output Power Measurement

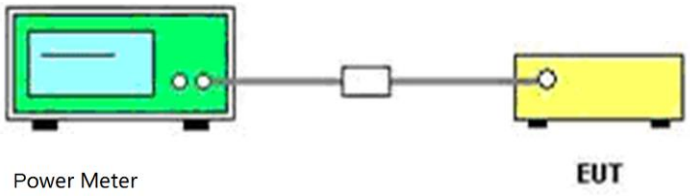
5.1.1. Standard Applicable

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.1.2. Test Procedures

According to ANSI C63.10:2013 Maximum peak conducted output power for DTS 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.

5.1.3. Test Setup Layout



5.1.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.5. Test Result of Maximum Conducted Output Power

Temperature	22.8℃	Humidity	50%
Test Engineer	Nancy Li	Configurations	BT LE

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	-4.39	30.00	Pass
	10	-3.41		
	18	-3.47		

Note: 1.The test results including the cable lose.

5.2. Power Spectral Density Measurement

5.2.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.2.3. Test Procedures

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.

2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.

3. Set the RBW = 3kHz.

4. Set the VBW ≥ 3*RBW

5. Set the span to 1.5 times the DTS channel bandwidth.

6. Detector = peak.

7. Sweep time = auto couple.

8. Trace mode = max hold.

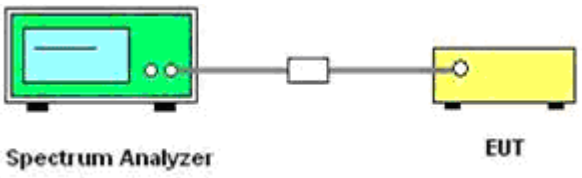
9. Allow trace to fully stabilize.

10. Use the peak marker function to determine the maximum power level.

11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

12. The resulting peak PSD level must be 8dBm.

5.2.4. Test Setup Layout



5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.6. Test Result of Power Spectral Density

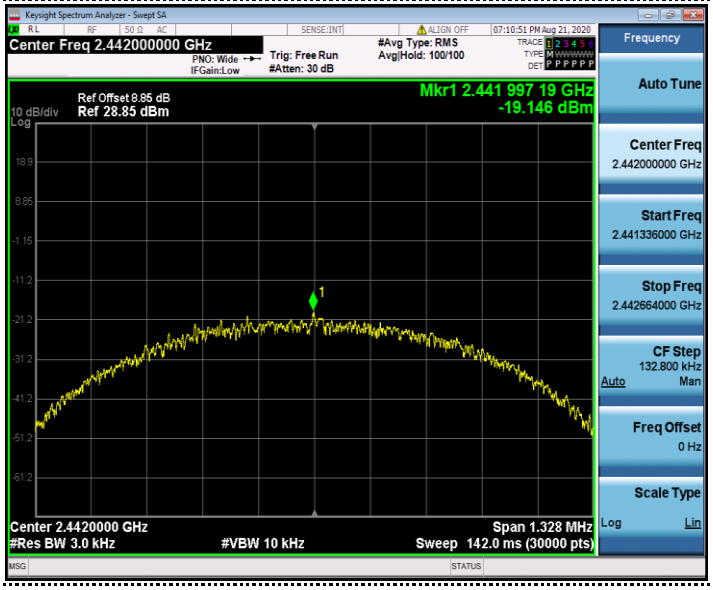
Temperature	22.8℃	Humidity	50%
Test Engineer	Nancy Li	Configurations	2.4G wireless

Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
GFSK	01	-20.26	8.00	Pass
	10	-19.15		
	18	-19.21		

Test plot as follows:

2.4G wireless

CH01



CH10


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.474000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:13:24 PM Aug 21, 2020
Ref Offset 8.85 dB
10 dB/div
Ref 28.85 dBm
Log
Mkr1 2.473 996 55 GHz
-19.211 dBm
Center 2.4740000 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 1.336 MHz
Sweep 142.0 ms (30000 pts)
Frequency
Auto Tune
Center Freq
2.474000000 GHz
Start Freq
2.473332000 GHz
Stop Freq
2.474668000 GHz
CF Step
133.600 kHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

CH18

5.3. 6 dB Spectrum Bandwidth Measurement

5.3.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.2. Measuring Instruments and Setting

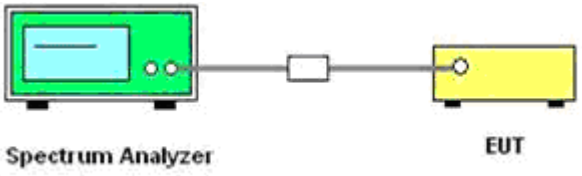
Please refer to section 6 of equipment list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> RBW
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

5.3.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

5.4.4. Test Setup Layout



5.3.5. EUT Operation during Test

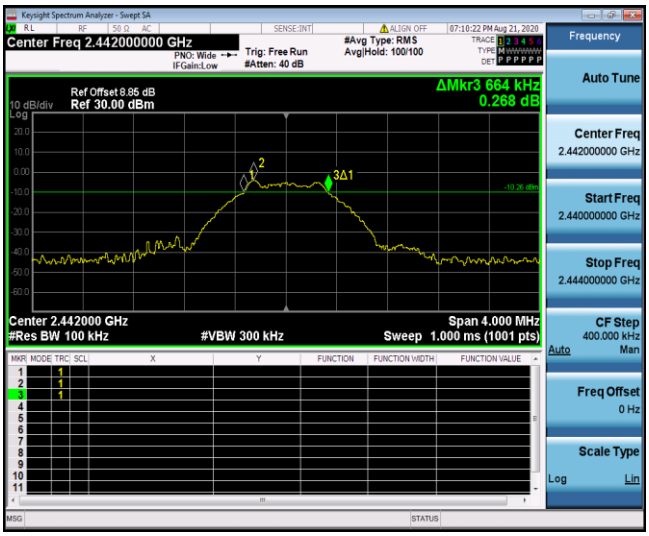
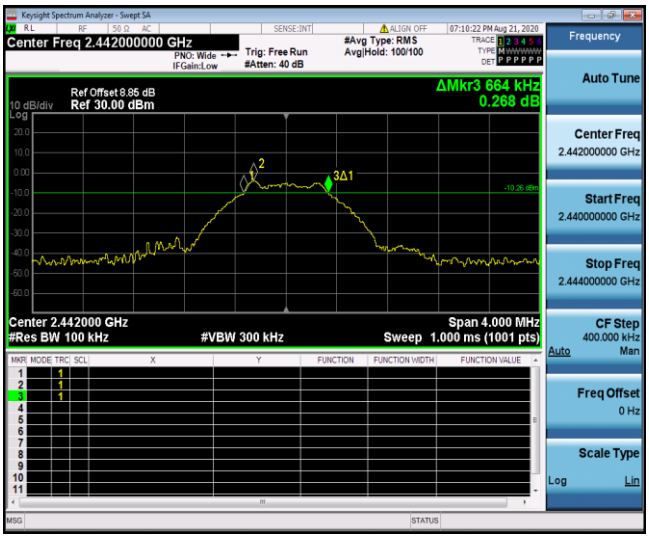
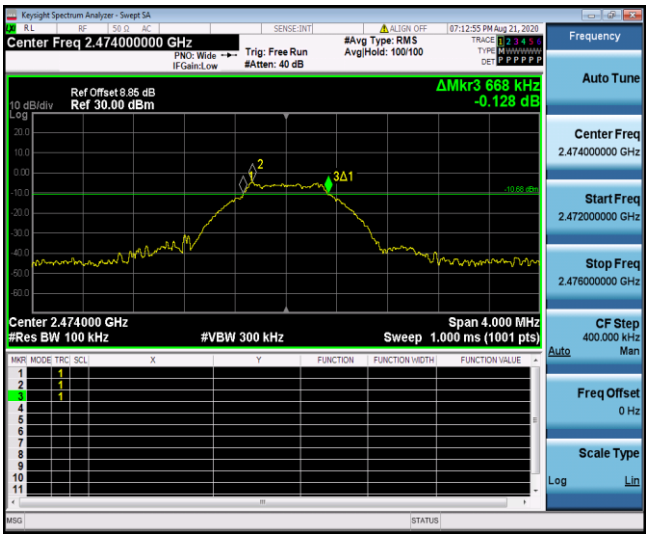
The EUT was programmed to be in continuously transmitting mode.

5.3.6. Test Result of 6dB Spectrum Bandwidth

Temperature	22.8℃	Humidity	50%
Test Engineer	Nancy Li	Configurations	2.4G wireless

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
GFSK	01	0.660	≥500	Pass
	10	0.664		
	18	0.668		

Test plot as follows:

2.4G wireless

CH01

CH10

CH18

5.4. Radiated Emissions Measurement

5.4.1. Standard Applicable

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

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

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

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

5.4.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10^{th} carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.4.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

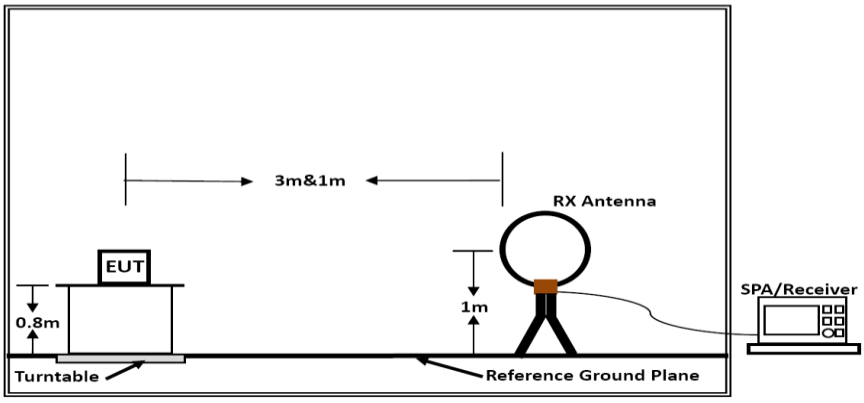
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

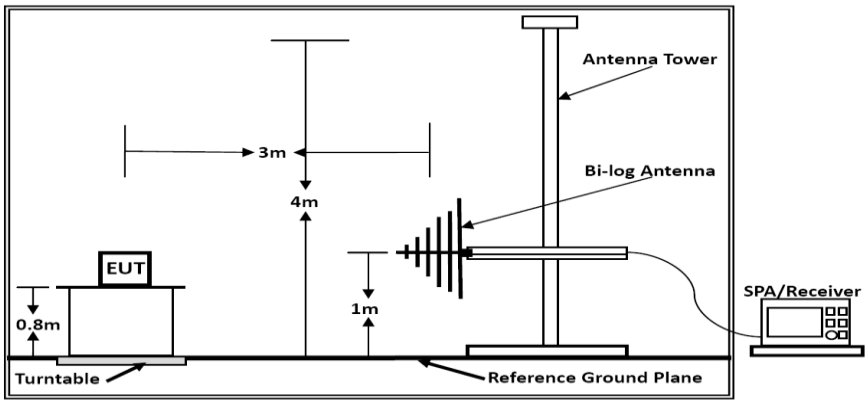
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

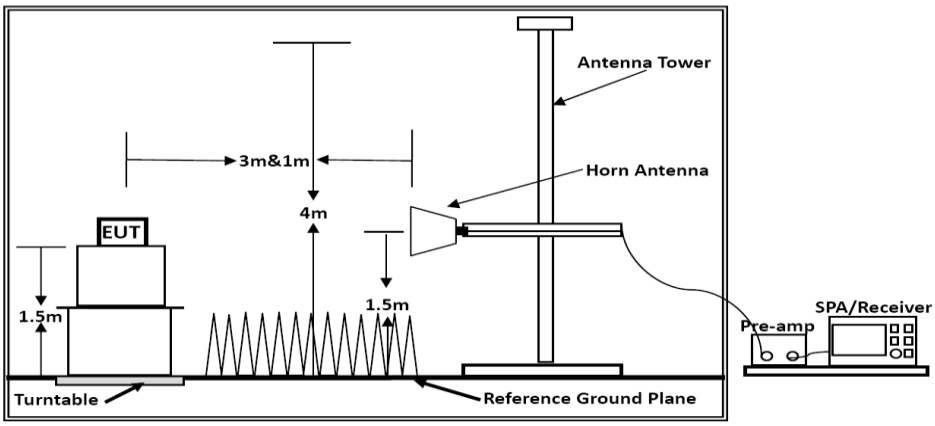
5.4.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1.5m.

Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1.5m]) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Results of Radiated Emissions (9 kHz~30MHz)

Temperature	22.5℃	Humidity	56%
Test Engineer	Nancy Li	Configurations	2.4G wireless

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.

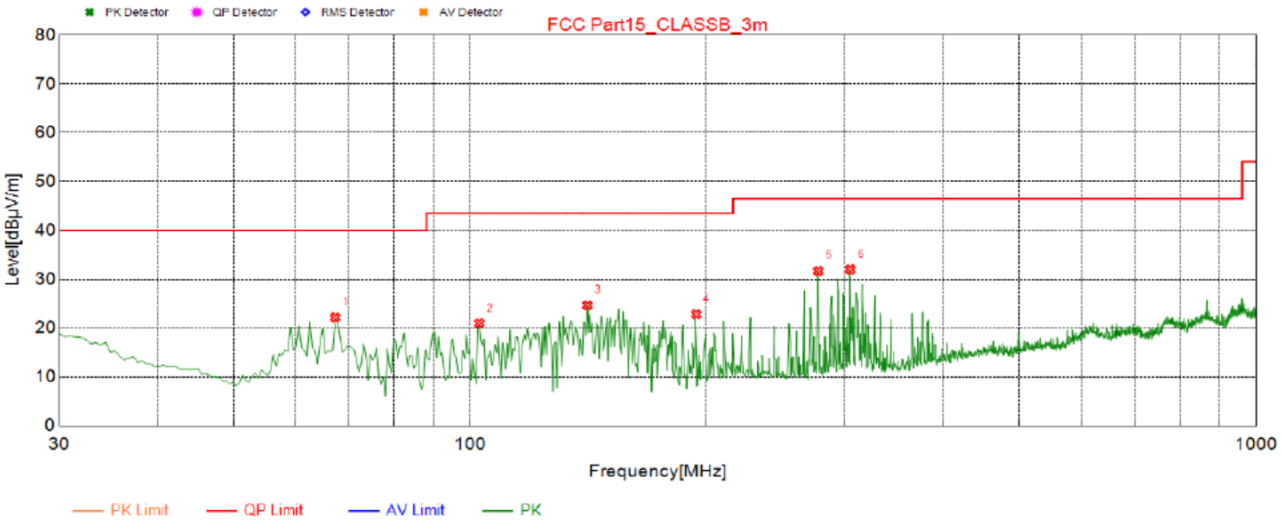
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

5.4.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	22.5℃	Humidty	56%
Test Engineer	Nancy Li	Configurations	2.4G wireless

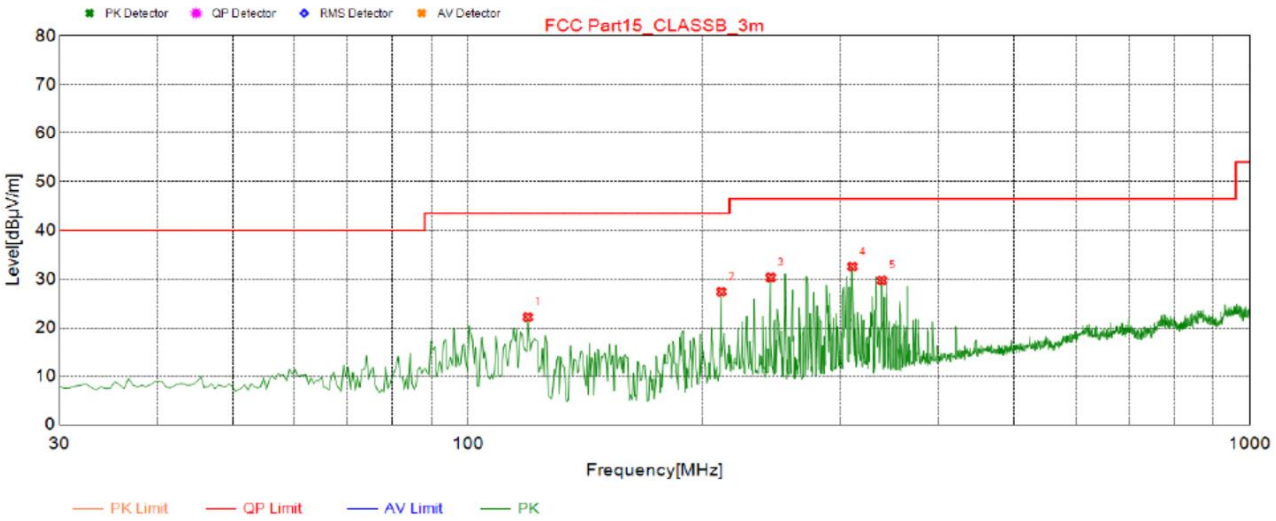
Test result for 2.4G wireless (High Channel)

Vertical:



Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	67.345	22.21	-17.53	40.00	17.79	100	168	Vertical
2	102.750	20.98	-15.99	43.50	22.52	100	230	Vertical
3	141.065	24.72	-19.45	43.50	18.78	100	211	Vertical
4	193.930	22.87	-16.06	43.50	20.63	100	165	Vertical
5	277.350	31.73	-13.28	46.50	14.77	200	259	Vertical
6	304.510	32.04	-12.68	46.50	14.46	200	278	Vertical

Horizontal:



Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	119.240	22.22	-17.52	43.50	21.28	300	47	Horizontal
2	210.905	27.43	-15.10	43.50	16.07	100	307	Horizontal
3	243.885	30.39	-14.06	46.50	16.11	100	152	Horizontal
4	310.330	32.62	-12.52	46.50	13.88	100	192	Horizontal
5	338.460	29.82	-11.75	46.50	16.68	100	83	Horizontal

Note:

1). Pre-scan all modes and recorded the worst case results in this report (BT LE (Middle CH)). Emission level (dBuV/m) = 20 log Emission level (uV/m).
2). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

5.4.8. Results for Radiated Emissions (Above 1GHz)

Channel 01 / 2406 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.
4812.00	56.25	33.07	35.05	3.94	58.21	74.00	15.79	Peak	Horizontal
4812.00	41.06	33.07	35.05	3.94	43.02	54.00	10.98	Average	Horizontal
4812.00	57.06	33.07	35.05	3.94	59.02	74.00	14.98	Peak	Vertical
4812.00	40.35	33.07	35.05	3.94	42.31	54.00	11.69	Average	Vertical

Channel 10 / 2442 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.
4884.00	55.06	33.16	35.15	3.96	57.03	74	16.97	Peak	Horizontal
4884.00	40.85	33.16	35.15	3.96	42.82	54	11.18	Average	Horizontal
4884.00	56.25	33.16	35.15	3.96	58.22	74	15.78	Peak	Vertical
4884.00	40.22	33.16	35.15	3.96	42.19	54	11.81	Average	Vertical

Channel 18 / 2474 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.
4948.00	56.85	33.27	35.16	3.98	58.94	74.00	15.06	Peak	Horizontal
4948.00	39.26	33.27	35.16	3.98	41.35	54.00	12.65	Average	Horizontal
4948.00	57.77	33.27	35.16	3.98	59.86	74.00	14.14	Peak	Vertical
4948.00	40.69	33.27	35.16	3.98	42.78	54.00	11.22	Average	Vertical

Notes:

1). Measuring frequencies from 9k~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 9k~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). Margin= Limit –(Reading Level+ Ant Fac + Cab Loss-Pre Fac)

5.5. Conducted Spurious Emissions and Band Edges Test

5.5.1. Standard Applicable

According to §15.247 (d): 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.5.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
RB / VB (Emission in restricted band)	100KHz/300KHz
RB / VB (Emission in non-restricted band)	100KHz/300KHz

5.5.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

5.5.4. Test Setup Layout

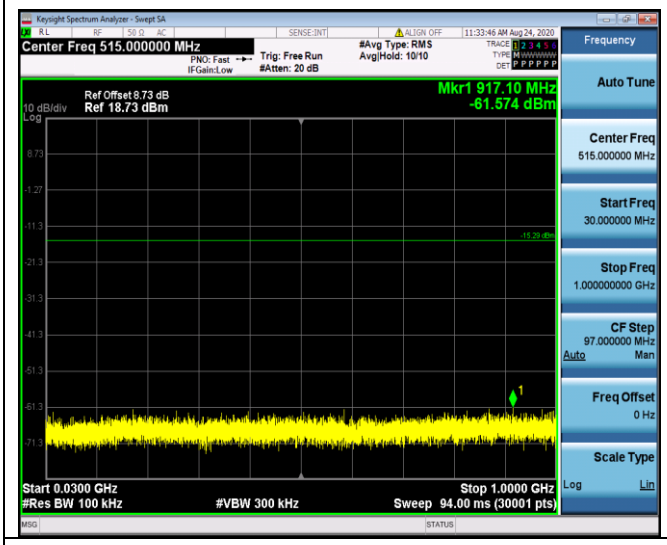
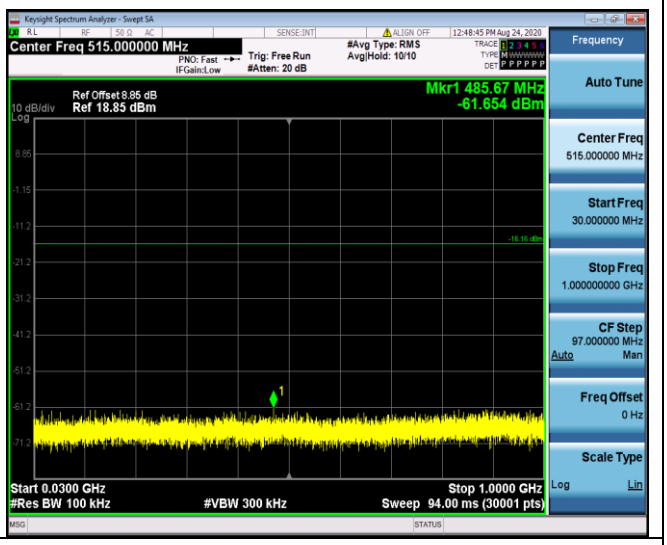
This test setup layout is the same as that shown in section 5.4.4.

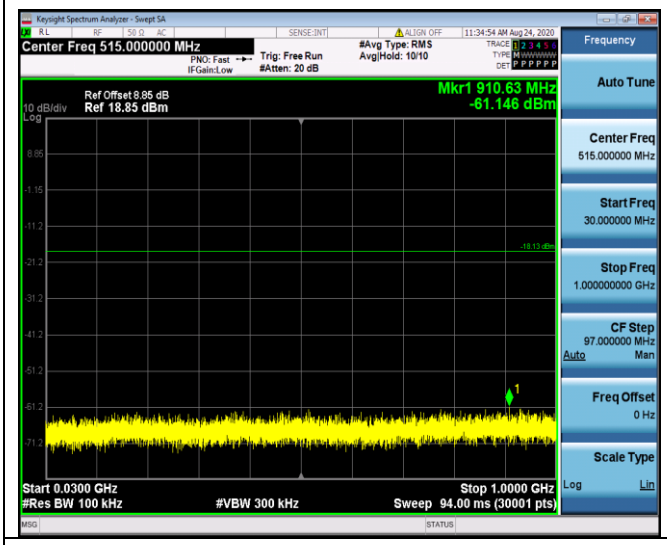
5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

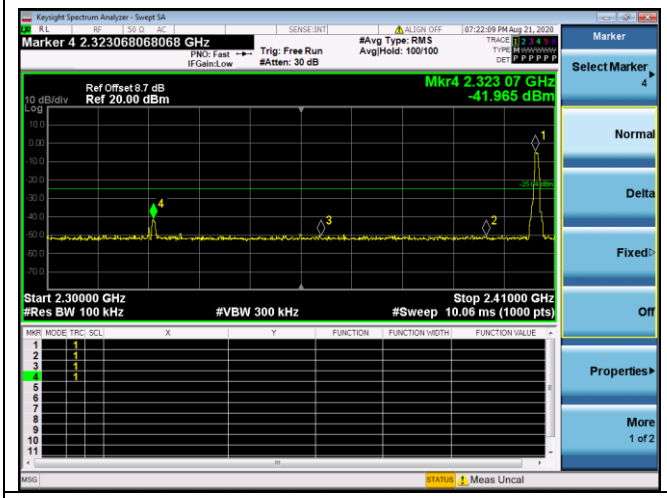
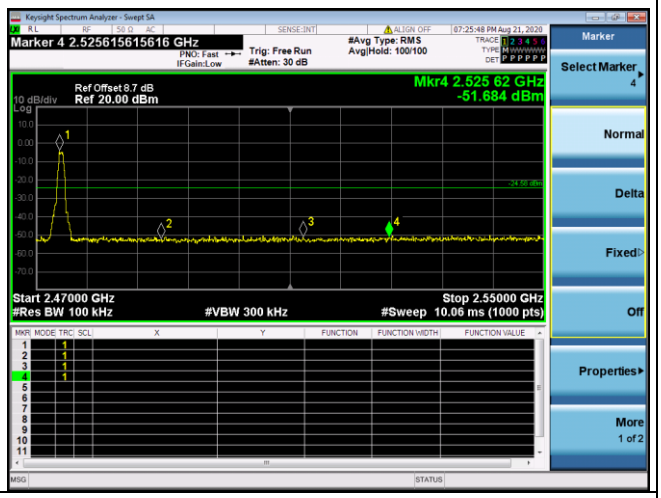
5.5.6. Test Results of Conducted Spurious Emissions

Temperature	22.8℃	Humidity	50%
Test Engineer	Nancy Li	Configurations	2.4G wireless

GFSK CH01	*GFSK CH10*
	
reference	reference
	
30MHz-1GHz	30MHz-1GHz
	
1GHz-26.5GHz	1GHz-26.5GHz

GFSK CH18	
	
reference	
	
30MHz-1GHz	
	
1GHz-26.5GHz	

Band-edge Measurements for RF Conducted Emissions:

GFSK	
	
Left Band edge hoping off	Right Band edge hoping off

5.6. AC Power line conducted emissions

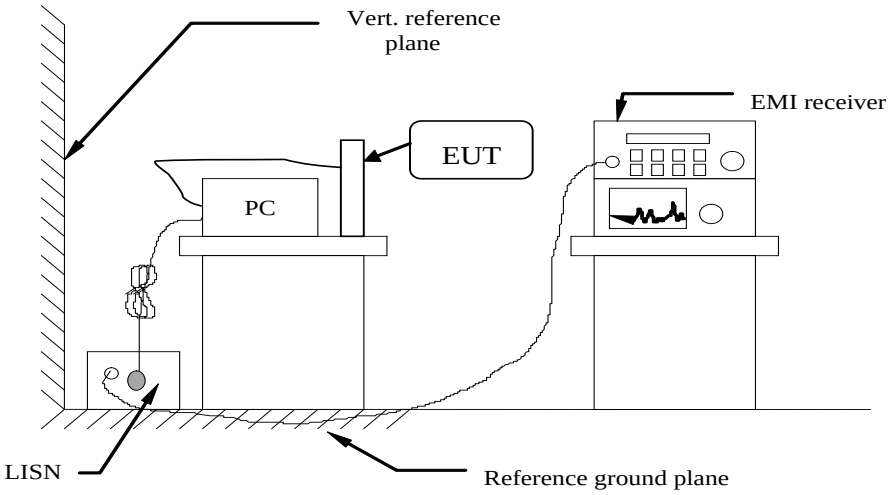
5.6.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which 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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.6.2 Block Diagram of Test Setup



5.6.3 Test Results

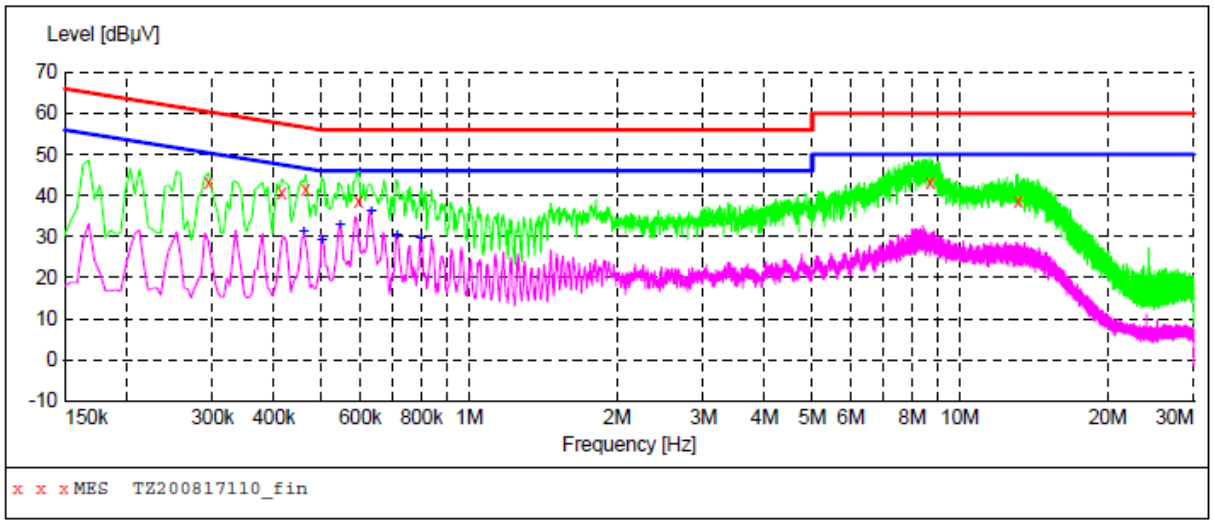
Remark:

1. GFSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

Temperature	22.8℃	Humidity	50%
Test Engineer	Nancy Li	Configurations	2.4G wireless

Power supply:	DC 5V from Adapter AC 120V/60Hz）	Polarization	L

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "TZ200817110_fin"

8/17/2020 4:59PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.294000	43.00	10.2	60	17.4	QP	L1	GND
0.415500	40.80	10.0	58	16.7	QP	L1	GND
0.465000	41.50	10.0	57	15.1	QP	L1	GND
0.595500	38.60	9.9	56	17.4	QP	L1	GND
8.704500	43.00	9.8	60	17.0	QP	L1	GND
13.146000	38.70	9.9	60	21.3	QP	L1	GND

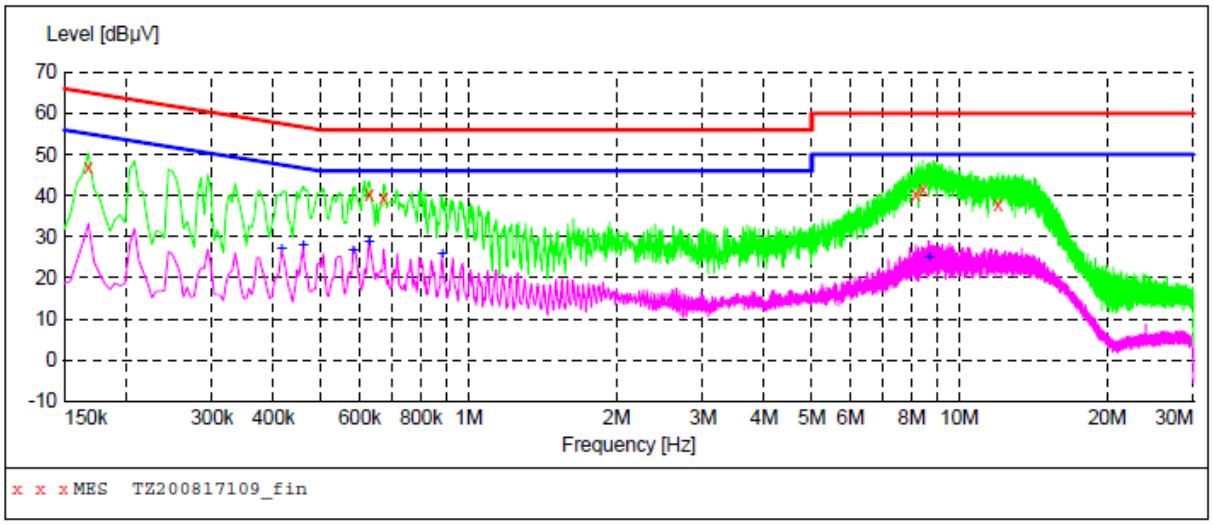
MEASUREMENT RESULT: "TZ200817110_fin2"

8/17/2020 4:59PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.460500	31.20	10.0	47	15.5	AV	L1	GND
0.501000	29.10	9.9	46	16.9	AV	L1	GND
0.546000	32.70	9.9	46	13.3	AV	L1	GND
0.631500	36.20	9.9	46	9.8	AV	L1	GND
0.712500	30.50	9.9	46	15.5	AV	L1	GND
0.798000	29.30	9.8	46	16.7	AV	L1	GND

Power supply:	DC 5V from Adapter AC 120V/60Hz）	Polarization	N

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "TZ200817109_fin"

8/17/2020 4:56PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.168000	47.10	10.1	65	18.0	QP	N	GND
0.627000	40.40	9.9	56	15.6	QP	N	GND
0.672000	39.60	9.9	56	16.4	QP	N	GND
8.146500	40.20	9.8	60	19.8	QP	N	GND
8.430000	41.50	9.8	60	18.5	QP	N	GND
11.989500	37.90	9.8	60	22.1	QP	N	GND

MEASUREMENT RESULT: "TZ200817109_fin2"

8/17/2020 4:56PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.415500	27.20	10.0	48	20.3	AV	N	GND
0.460500	27.80	10.0	47	18.9	AV	N	GND
0.582000	26.40	9.9	46	19.6	AV	N	GND
0.627000	28.80	9.9	46	17.2	AV	N	GND
0.883500	25.80	9.8	46	20.2	AV	N	GND
8.682000	25.00	9.8	50	25.0	AV	N	GND

Note:

1). Pre-scan all modes and recorded the worst case results in this report

2). Emission level (dBuV) = 20 log Emission level (uV).

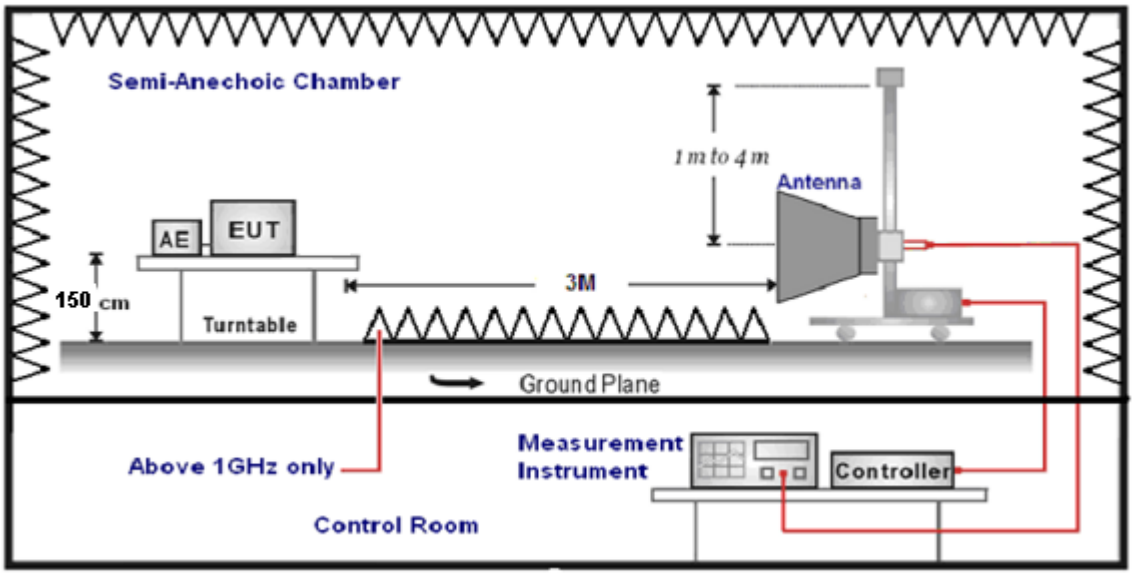
3). Margin=Limit-Level

5.7. Band-edge measurements for radiated emissions

5.7.1 Standard Applicable

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)).

5.7.2. Test Setup Layout



5.7.3. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

1.7.4.Test Procedures

According to KDB 412172 section 1.1 Field Strength Approach (linear terms):

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=10Hz, Sweep time=Auto	Peak

5.7.5 Test Results

Operation Mode: GFSK TX Low channel(2406MHz)
Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	62.86	-5.68	57.18	74	-16.82	peak
2390	48.12	-5.68	42.44	54	-11.56	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier； Margin= Limit -Emission Level.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	64.69	-5.68	59.01	74	-14.99	peak
2390	49.05	-5.68	43.37	54	-10.63	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier； Margin= Limit -Emission Level.						

Operation Mode: GFSK TX High channel (2474MHz)
Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.5	62.25	-5.42	56.83	74	-17.17	peak
2483.5	43.95	-5.42	38.53	54	-15.47	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier； Margin= Limit -Emission Level.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.5	65.72	-5.42	60.3	74	-13.7	peak
2483.5	45.16	-5.42	39.74	54	-14.26	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier； Margin= Limit -Emission Level.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Remark:

1. *The other emission levels were very low against the limit.*
2. *The average measurement was not performed when the peak measured data under the limit of average detection.*
3. *Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;*

5.8. Antenna Requirements

5.8.1 Standard Applicable

According to antenna requirement of §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

5.8.2 Antenna Connected Construction

5.8.2.1. Standard Applicable

According to § 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.

5.8.2.2. Antenna Connector Construction

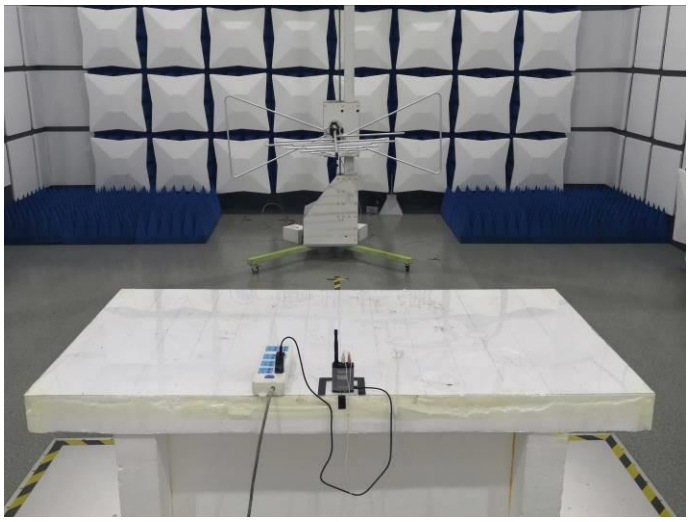
The directional gains of antenna refer to section 1.1, and the antenna is an Internal antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

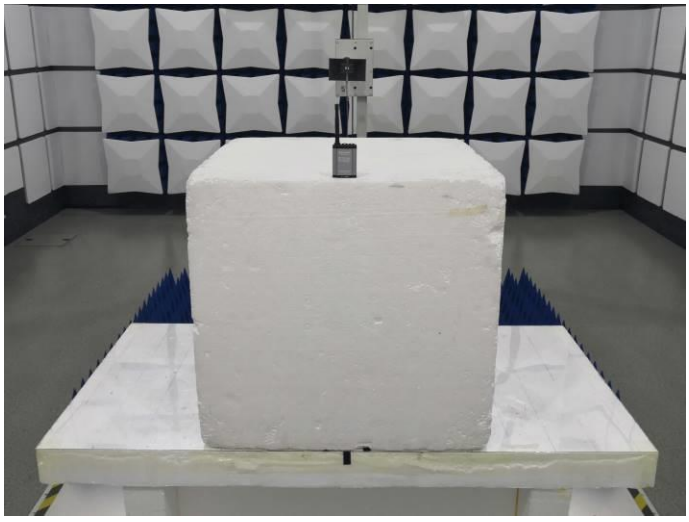
5.9.2.3. Results: Compliance.

6. LIST OF MEASURING EQUIPMENTS

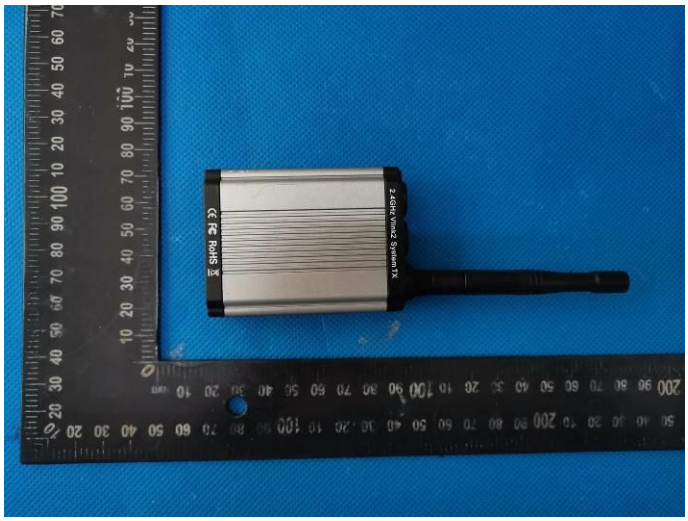
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	MXA Signal Analyzer	Keysight	N9020A	MY52091623	2020/1/2	2021/1/1
2	Power Sensor	Agilent	U2021XA	MY5365004	2020/1/2	2021/1/1
3	Power Meter	Agilent	U2531A	TW53323507	2020/1/2	2021/1/1
4	Wideband Antenna	schwarzbeck	VULB 9163	958	2019/11/16	2022/11/15
5	Horn Antenna	schwarzbeck	9120D-1141	1574	2019/11/16	2022/11/15
6	EMI Test Receiver	R&S	ESCI	100849/003	2020/1/2	2021/1/1
7	Controller	MF	MF7802	N/A	N/A	N/A
8	Amplifier	schwarzbeck	BBV 9743	209	2020/1/2	2021/1/1
9	Amplifier	Tonscend	TSAMP-0518 SE	--	2020/1/2	2021/1/1
10	RF Cable(below 1GHz)	HUBER+SUHNER	RG214	N/A	2020/1/2	2021/1/1
11	RF Cable(above 1GHz)	HUBER+SUHNER	RG214	N/A	2020/1/2	2021/1/1
12	Artificial Mains	ROHDE & SCHWARZ	ENV 216	101333-IP	2020/1/2	2021/1/1
12	EMI Test Software	ROHDE & SCHWARZ	ESK1	V1.71	N/A	N/A
14	RE test software	Tonscend	JS32-RE	V2.0.2.0	N/A	N/A
15	Test Software	Tonscend	JS1120-3	V2.5.77.0418	N/A	N/A
16	Horn Antenna	A-INFO	LB-180400-KF	J211020657	2019/11/16	2022/11/15
17	Amplifier	SKET	LNPA_1840-50	SK2018101801	2019/10/22	2020/10/21

7. TEST SETUP PHOTOGRAPHS OF EUT

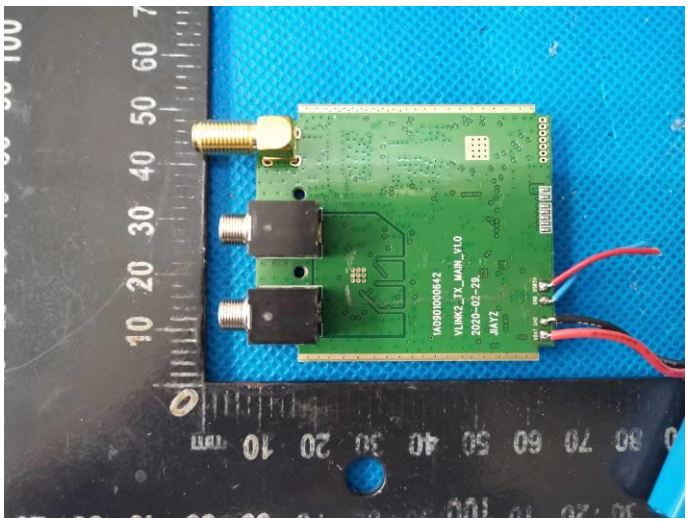


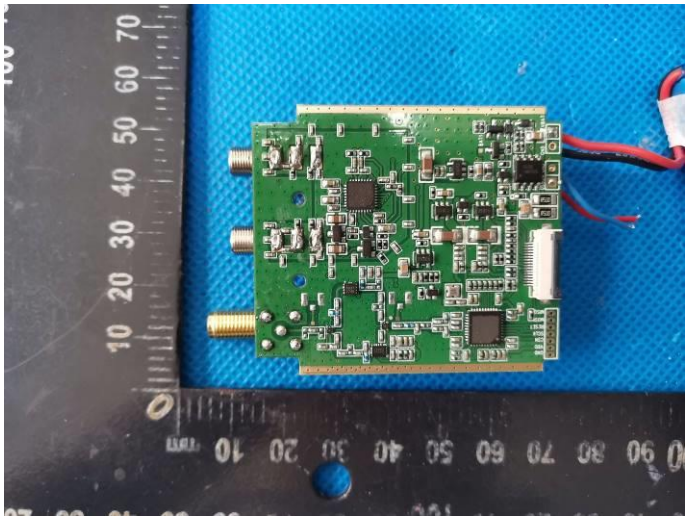


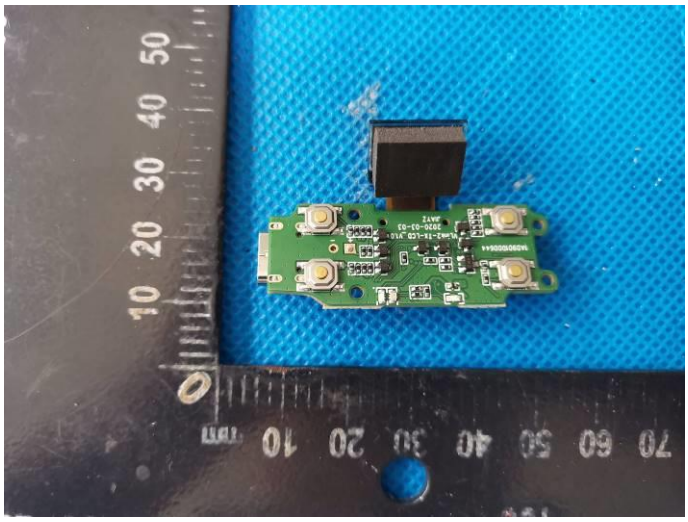
8. EXTERIOR PHOTOGRAPHS OF THE EUT

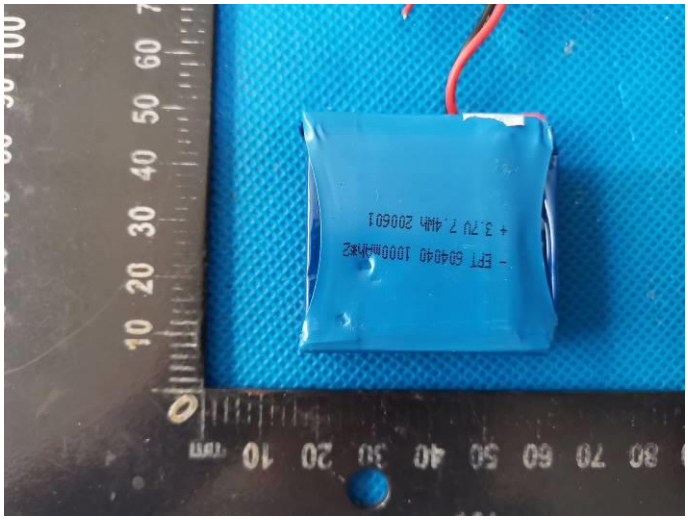


9. INTERIOR PHOTOGRAPHS OF THE EUT









----------THE END OF REPORT----------