

FCC REPORT

Applicant: Shenzhen Hangshi Technology Co., Ltd

Address of Applicant: Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China

Manufacturer/Factory: Shenzhen Hangshi Technology Co., Ltd

Address of Manufacturer/Factory: Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China

Equipment Under Test (EUT)

Product Name: 2.4G Keyboard

Model No: HW197-3-L, HW197-2-L, HW198-2-L, HW198-3-L

FCC ID: 2AKHJHW197-3-L

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249

Date of sample receipt: June 12, 2018

Date of Test: June 13-24, 2018

Date of report issued: June 25, 2018

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:




Robinson Lo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

| Version No. | Date | Description |
|-------------|---------------|-------------|
| 00 | June 25, 2018 | Original |
| | | |
| | | |
| | | |
| | | |

Prepared By:

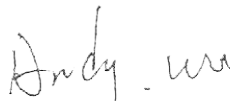


Date:

June 25, 2018

Project Engineer

Check By:



Date:

June 25, 2018

Reviewer

3 Contents

| | Page |
|---|------|
| 1 COVER PAGE..... | 1 |
| 2 VERSION..... | 2 |
| 3 CONTENTS | 3 |
| 4 TEST SUMMARY | 4 |
| 4.1 MEASUREMENT UNCERTAINTY | 4 |
| 5 GENERAL INFORMATION..... | 5 |
| 5.1 GENERAL DESCRIPTION OF EUT | 5 |
| 5.2 TEST MODE | 7 |
| 5.3 DESCRIPTION OF SUPPORT UNITS | 7 |
| 5.4 TEST FACILITY..... | 7 |
| 5.5 TEST LOCATION | 7 |
| 5.6 OTHER INFORMATION REQUESTED BY THE CUSTOMER | 7 |
| 5.7 ADDITIONAL INSTRUCTIONS..... | 8 |
| 6 TEST INSTRUMENTS LIST | 9 |
| 7 TEST RESULTS AND MEASUREMENT DATA..... | 10 |
| 7.1 ANTENNA REQUIREMENT | 10 |
| 7.2 CONDUCTED EMISSIONS | 11 |
| 7.3 RADIATED EMISSION METHOD | 14 |
| 7.3.1 <i>Field Strength of The Fundamental Signal</i> | 17 |
| 7.3.2 <i>Spurious emissions</i> | 18 |
| 7.3.3 <i>Bandedge emissions</i> | 23 |
| 7.4 20dB OCCUPY BANDWIDTH | 25 |
| 8 TEST SETUP PHOTO | 27 |
| 9 EUT CONSTRUCTIONAL DETAILS | 29 |

4 Test Summary

| Test Item | Section in CFR 47 | Result |
|--|-----------------------|--------|
| Antenna requirement | 15.203 | Pass |
| AC Power Line Conducted Emission | 15.207 | Pass |
| Field strength of the fundamental signal | 15.249 (a) | Pass |
| Spurious emissions | 15.249 (a) (d)/15.209 | Pass |
| Band edge | 15.249 (d)/15.205 | Pass |
| 20dB Occupied Bandwidth | 15.215 (c) | Pass |

Pass: The EUT complies with the essential requirements in the standard.

Remark: Test according to ANSI C63.10: 2013 and ANSI C63.4: 2014.

4.1 Measurement Uncertainty

| Test Item | Frequency Range | Measurement Uncertainty | Notes |
|----------------------------------|-----------------|-------------------------|-------|
| Radiated Emission | 9kHz ~ 30MHz | ± 4.34dB | (1) |
| Radiated Emission | 30MHz ~ 1000MHz | ± 4.24dB | (1) |
| Radiated Emission | 1GHz ~ 26.5GHz | ± 4.68dB | (1) |
| AC Power Line Conducted Emission | 0.15MHz ~ 30MHz | ± 3.45dB | (1) |

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

| | |
|--|---|
| Product Name: | 2.4G Keyboard |
| Model No.: | HW197-3-L,HW197-2-L,HW198-2-L,HW198-3-L |
| Test Model No: | HW197-3-L |
| <i>Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are color and model name for commercial purpose.</i> | |
| Serial No.: | HSHW1973L00001 |
| Test sample(s) ID: | GTS201806000132-1 |
| Sample(s) Status | Engineer sample |
| Hardware: | V 1.0 |
| Software: | V 1.0 |
| Operation Frequency: | 2405MHz~2470MHz |
| Channel numbers: | 8 |
| Modulation type: | GFSK |
| Antenna Type: | PCB antenna |
| Antenna gain: | -1.2dBi |
| Power supply: | DC 3.7V (Li-ON batteries) |

| Operation Frequency each of channel | | | |
|-------------------------------------|-----------|---------|-----------|
| Channel | Frequency | Channel | Frequency |
| 01 | 2405MHz | 05 | 2440MHz |
| 02 | 2413MHz | 06 | 2450MHz |
| 03 | 2422MHz | 07 | 2460MHz |
| 04 | 2430MHz | 08 | 2470MHz |

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|---------------------|-----------|
| The lowest channel | 2405MHz |
| The middle channel | 2430MHz |
| The Highest channel | 2470MHz |

5.2 Test mode

| | |
|---|---|
| Transmitting mode | Keep the EUT in continuously transmitting mode. |
| <i>Remark: During the test, the dutycycle >98%, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.</i> | |

| Per-test mode. | | | |
|---|-------|-------|-------|
| We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which was shown in this test report and defined as follows: | | | |
| Axis | X | Y | Z |
| Field Strength(dBuV/m) | 86.52 | 88.71 | 87.06 |

5.3 Description of Support Units

| |
|-------|
| None. |
|-------|

5.4 Test Facility

| |
|---|
| <p>The test facility is recognized, certified, or accredited by the following organizations:</p> <ul style="list-style-type: none"> ● FCC —Registration No.: 381383 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383, January 08, 2018. ● Industry Canada (IC) —Registration No.: 9079A-2 The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2, August 15, 2016 |
|---|

5.5 Test Location

| |
|--|
| All tests were performed at: |
| <p>Global United Technology Services Co., Ltd. Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960</p> |

5.6 Other Information Requested by the Customer

| |
|-------|
| None. |
|-------|

5.7 Additional instructions

Software (Used for test) from client

| | |
|------|--|
| Mode | Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually. |
|------|--|

| Power level setup in software | | | |
|--|-------------|-----------------|-------------------|
| Test Software Name | N/A | | |
| Test Software Version | N/A | | |
| Support Units (Software installation media) | Description | Manufacturer | Model |
| | N/A | N/A | N/A |
| Mode | Channel | Frequency (MHz) | Soft Set |
| GFSK | CH01 | 2405 | TX LEVEL: Default |
| | CH04 | 2430 | |
| | CH08 | 2470 | |

Run Software

NO

6 Test Instruments list

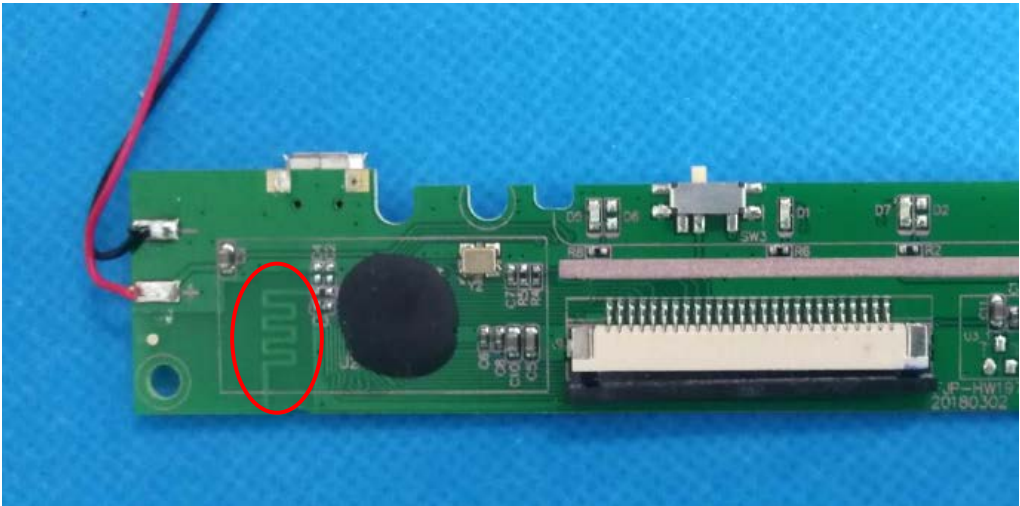
| Radiated Emission: | | | | | | |
|--------------------|-------------------------------|--------------------------------|-----------------------------|---------------|---------------------|-------------------------|
| Item | Test Equipment | Manufacturer | Model No. | Inventory No. | Cal.Date (mm-dd-yy) | Cal.Due date (mm-dd-yy) |
| 1 | 3m Semi- Anechoic Chamber | ZhongYu Electron | 9.2(L)*6.2(W)* 6.4(H) | GTS250 | July 03 2015 | July 02 2020 |
| 2 | Control Room | ZhongYu Electron | 6.2(L)*2.5(W)* 2.4(H) | GTS251 | N/A | N/A |
| 3 | Spectrum Analyzer | Agilent | E4440A | GTS533 | June 28 2017 | June 27 2018 |
| 4 | EMI Test Receiver | Rohde & Schwarz | ESU26 | GTS203 | June 28 2017 | June 27 2018 |
| 5 | BiConiLog Antenna | SCHWARZBECK MESS-ELEKTRONIK | VULB9163 | GTS214 | June 28 2017 | June 27 2018 |
| 6 | Double -ridged waveguide horn | SCHWARZBECK MESS-ELEKTRONIK | 9120D-829 | GTS208 | June 28 2017 | June 27 2018 |
| 7 | Horn Antenna | ETS-LINDGREN | 3160 | GTS217 | June 28 2017 | June 27 2018 |
| 8 | EMI Test Software | AUDIX | E3 | N/A | N/A | N/A |
| 9 | Coaxial Cable | GTS | N/A | GTS213 | June 28 2017 | June 27 2018 |
| 10 | Coaxial Cable | GTS | N/A | GTS211 | June 28 2017 | June 27 2018 |
| 11 | Coaxial cable | GTS | N/A | GTS210 | June 28 2017 | June 27 2018 |
| 12 | Coaxial Cable | GTS | N/A | GTS212 | June 28 2017 | June 27 2018 |
| 13 | Amplifier(100kHz-3GHz) | HP | 8347A | GTS204 | June 28 2017 | June 27 2018 |
| 14 | Amplifier(2GHz-20GHz) | HP | 8349B | GTS206 | June 28 2017 | June 27 2018 |
| 15 | Amplifier (18-26GHz) | Rohde & Schwarz | AFS33-18002 650-30-8P-44 | GTS218 | June 28 2017 | June 27 2018 |
| 16 | Band filter | Amindeon | 82346 | GTS219 | June 28 2017 | June 27 2018 |
| 17 | Power Meter | Anritsu | ML2495A | GTS540 | June 28 2017 | June 27 2018 |
| 18 | Power Sensor | Anritsu | MA2411B | GTS541 | June 28 2017 | June 27 2018 |
| 19 | Loop Antenna | ZHINAN | ZN30900A | GTS534 | June 28 2017 | June 27 2018 |

| Conducted Emission: | | | | | | |
|---------------------|--------------------------|---------------------|----------------------|---------------|---------------------|-------------------------|
| Item | Test Equipment | Manufacturer | Model No. | Inventory No. | Cal.Date (mm-dd-yy) | Cal.Due date (mm-dd-yy) |
| 1 | Shielding Room | ZhongYu Electron | 7.3(L)x3.1(W)x2.9(H) | GTS252 | May.16 2014 | May.15 2019 |
| 2 | EMI Test Receiver | R&S | ESCI 7 | GTS552 | June 28 2017 | June 27 2018 |
| 3 | Coaxial Switch | ANRITSU CORP | MP59B | GTS225 | June 28 2017 | June 27 2018 |
| 4 | Artificial Mains Network | SCHWARZBECK MESS | NSLK8127 | GTS226 | June 28 2017 | June 27 2018 |
| 5 | Coaxial Cable | GTS | N/A | GTS227 | N/A | N/A |
| 6 | EMI Test Software | AUDIX | E3 | N/A | N/A | N/A |
| 7 | Thermo meter | KTJ | TA328 | GTS233 | June 28 2017 | June 27 2018 |

| General used equipment: | | | | | | |
|-------------------------|----------------|--------------|-----------|---------------|---------------------|-------------------------|
| Item | Test Equipment | Manufacturer | Model No. | Inventory No. | Cal.Date (mm-dd-yy) | Cal.Due date (mm-dd-yy) |
| 1 | Barometer | ChangChun | DYM3 | GTS257 | June 28 2017 | June 27 2018 |

7 Test results and Measurement Data

7.1 Antenna requirement

| | |
|---|-----------------------------|
| Standard requirement: | FCC Part15 C Section 15.203 |
| <p>15.203 requirement:</p> <p>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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</p> | |
| EUT Antenna: | |
| <p><i>The antenna is PCB antenna, the best case gain of the antenna is -1.2dBi.</i></p>  | |

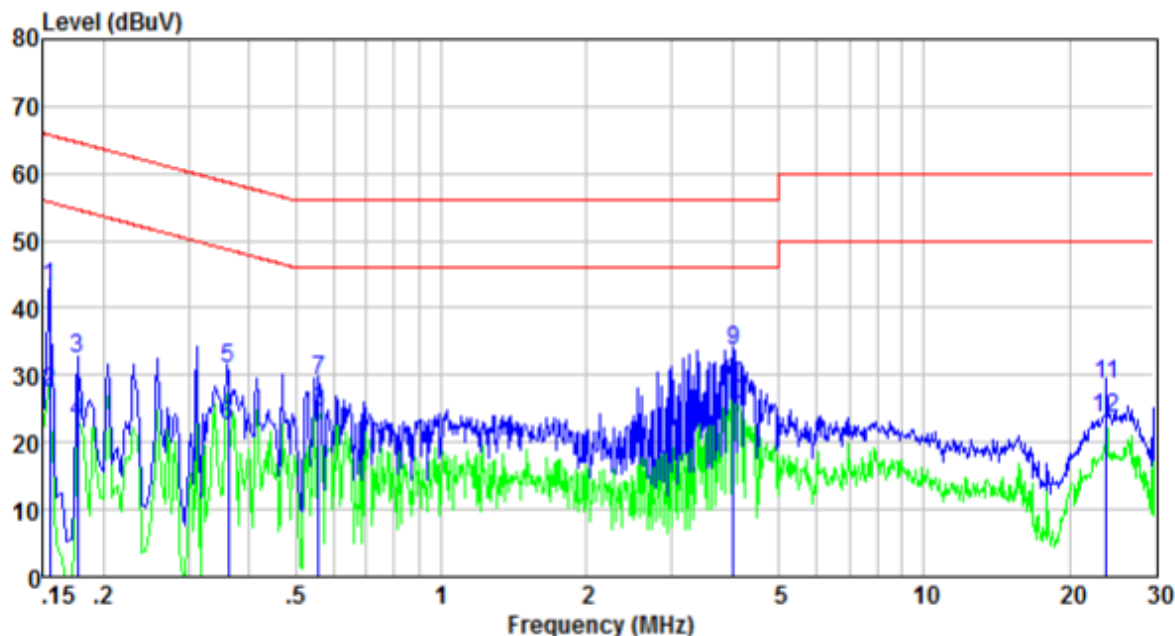
7.2 Conducted Emissions

| Test Requirement: | FCC Part15 C Section 15.207 | | | | | | | | | | | | | | |
|-----------------------|---|-----------------------|--------------|--|------------|---------|----------|-----------|-----------|-------|----|----|------|----|----|
| Test Method: | ANSI C63.10:2013 | | | | | | | | | | | | | | |
| Test Frequency Range: | 150KHz to 30MHz | | | | | | | | | | | | | | |
| Class / Severity: | Class B | | | | | | | | | | | | | | |
| Receiver setup: | RBW=9KHz, VBW=30KHz, Sweep time=auto | | | | | | | | | | | | | | |
| Limit: | <table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>0.15-0.5</td> <td>66 to 56*</td> <td>56 to 46*</td> </tr> <tr> <td>0.5-5</td> <td>56</td> <td>46</td> </tr> <tr> <td>5-30</td> <td>60</td> <td>50</td> </tr> </tbody> </table> <p>* Decreases with the logarithm of the frequency.</p> | Frequency range (MHz) | Limit (dBuV) | | Quasi-peak | Average | 0.15-0.5 | 66 to 56* | 56 to 46* | 0.5-5 | 56 | 46 | 5-30 | 60 | 50 |
| Frequency range (MHz) | Limit (dBuV) | | | | | | | | | | | | | | |
| | Quasi-peak | Average | | | | | | | | | | | | | |
| 0.15-0.5 | 66 to 56* | 56 to 46* | | | | | | | | | | | | | |
| 0.5-5 | 56 | 46 | | | | | | | | | | | | | |
| 5-30 | 60 | 50 | | | | | | | | | | | | | |
| Test setup: | <p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p> | | | | | | | | | | | | | | |
| Test procedure: | <ol style="list-style-type: none"> 1. The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement. | | | | | | | | | | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | | | | | | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | | | | | | | | | | |
| Test results: | Pass | | | | | | | | | | | | | | |

Measurement data

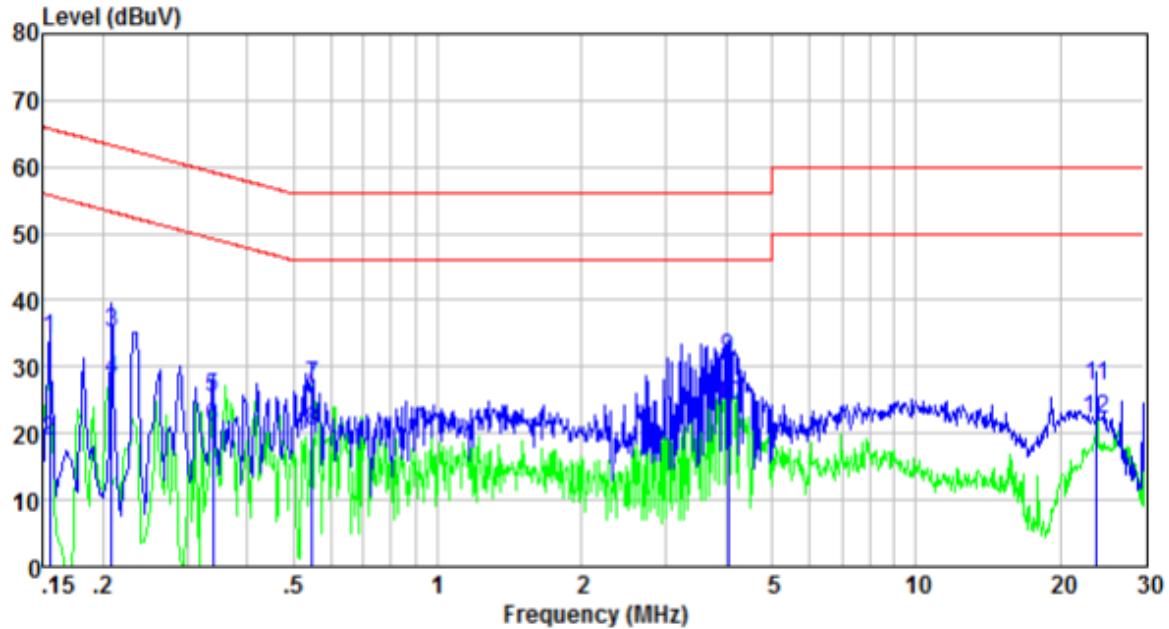
Test voltage: AC120V 60Hz

| | | | |
|-------------------------|--------------------------|-----------------|--------------|
| Mode: | Transmitting mode | Test by: | Jason |
| Temp./Hum.(%RH): | 26°C/56%RH | Probe: | Line |



| Freq MHz | Reading level dBuV | LISN/ISN factor dB | Cable loss dB | level dBuV | Limit level dBuV | Over limit dB | Remark |
|-------------|--------------------------|--------------------------|---------------------|---------------|------------------------|---------------------|---------|
| 0.155 | 33.51 | 9.54 | 0.06 | 43.11 | 65.74 | -22.63 | QP |
| 0.155 | 18.00 | 9.54 | 0.06 | 27.60 | 55.74 | -28.14 | Average |
| 0.177 | 22.90 | 9.55 | 0.04 | 32.49 | 64.64 | -32.15 | QP |
| 0.177 | 13.51 | 9.55 | 0.04 | 23.10 | 54.64 | -31.54 | Average |
| 0.361 | 21.49 | 9.58 | 0.02 | 31.09 | 58.69 | -27.60 | QP |
| 0.361 | 12.90 | 9.58 | 0.02 | 22.50 | 48.69 | -26.19 | Average |
| 0.558 | 19.51 | 9.58 | 0.02 | 29.11 | 56.00 | -26.89 | QP |
| 0.558 | 14.80 | 9.58 | 0.02 | 24.40 | 46.00 | -21.60 | Average |
| 4.027 | 23.90 | 9.63 | 0.03 | 33.56 | 56.00 | -22.44 | QP |
| 4.027 | 16.04 | 9.63 | 0.03 | 25.70 | 46.00 | -20.30 | Average |
| 23.888 | 18.60 | 9.85 | 0.04 | 28.49 | 60.00 | -31.51 | QP |
| 23.888 | 13.81 | 9.85 | 0.04 | 23.70 | 50.00 | -26.30 | Average |

| | | | |
|------------------------|--------------------------|-----------------|----------------|
| Mode: | Transmitting mode | Test by: | Jason |
| Temp./Hum.(%H): | 26°C/56%RH | Probe: | Neutral |



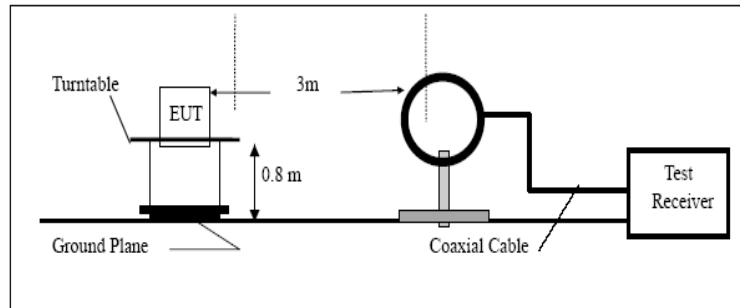
| Freq MHz | Reading level dBuV | LISN/ISN factor dB | Cable loss dB | level dBuV | Limit level dBuV | Over limit dB | Remark |
|-------------|--------------------------|--------------------------|---------------------|---------------|------------------------|---------------------|---------|
| 0.155 | 24.51 | 9.54 | 0.06 | 34.11 | 65.74 | -31.63 | QP |
| 0.155 | 9.30 | 9.54 | 0.06 | 18.90 | 55.74 | -36.84 | Average |
| 0.208 | 25.52 | 9.57 | 0.01 | 35.10 | 63.27 | -28.17 | QP |
| 0.208 | 18.52 | 9.57 | 0.01 | 28.10 | 53.27 | -25.17 | Average |
| 0.339 | 15.67 | 9.61 | 0.02 | 25.30 | 59.22 | -33.92 | QP |
| 0.339 | 11.47 | 9.61 | 0.02 | 21.10 | 49.22 | -28.12 | Average |
| 0.546 | 17.65 | 9.63 | 0.02 | 27.30 | 56.00 | -28.70 | QP |
| 0.546 | 10.75 | 9.63 | 0.02 | 20.40 | 46.00 | -25.60 | Average |
| 4.049 | 21.69 | 9.68 | 0.03 | 31.40 | 56.00 | -24.60 | QP |
| 4.049 | 14.49 | 9.68 | 0.03 | 24.20 | 46.00 | -21.80 | Average |
| 23.888 | 17.12 | 9.94 | 0.04 | 27.10 | 60.00 | -32.90 | QP |
| 23.888 | 12.02 | 9.94 | 0.04 | 22.00 | 50.00 | -28.00 | Average |

7.3 Radiated Emission Method

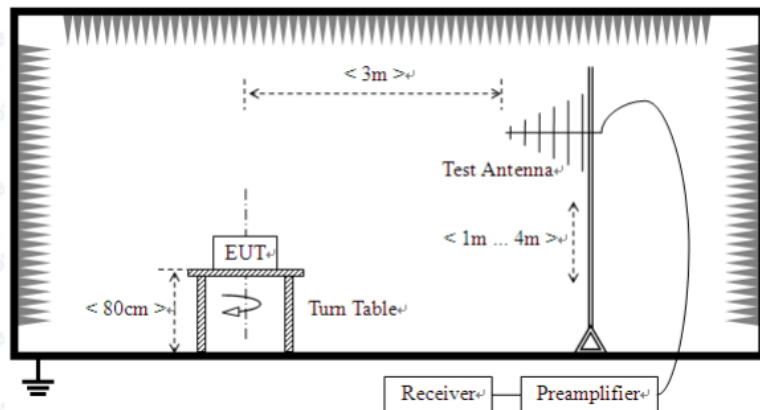
| | | | | | |
|--|--|--------------------|---------|----------------------|------------|
| Test Requirement: | FCC Part15 C Section 15.209 | | | | |
| Test Method: | ANSI C63.10:2013 | | | | |
| Test Frequency Range: | 9kHz to 25GHz | | | | |
| Test site: | Measurement Distance: 3m | | | | |
| Receiver setup: | Frequency | Detector | RBW | VBW | Value |
| | 9KHz-150KHz | Quasi-peak | 200Hz | 600Hz | Quasi-peak |
| | 150KHz-30MHz | Quasi-peak | 9KHz | 30KHz | Quasi-peak |
| | 30MHz-1GHz | Quasi-peak | 100KHz | 300KHz | Quasi-peak |
| | Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| Peak | | 1MHz | 10Hz | Average | |
| Limit: (Field strength of the fundamental signal) | Frequency | Limit (dBuV/m @3m) | | Remark | |
| | 2400MHz-2483.5MHz | 94.00 | | Average Value | |
| | | 114.00 | | Peak Value | |
| Limit: (Spurious Emissions) | Frequency | Limit (uV/m) | Value | Measurement Distance | |
| | 0.009MHz-0.490MHz | 2400/F(KHz) | QP | 300m | |
| | 0.490MHz-1.705MHz | 24000/F(KHz) | QP | 300m | |
| | 1.705MHz-30MHz | 30 | QP | 30m | |
| | 30MHz-88MHz | 100 | QP | 3m | |
| | 88MHz-216MHz | 150 | QP | | |
| | 216MHz-960MHz | 200 | QP | | |
| | 960MHz-1GHz | 500 | QP | | |
| | Above 1GHz | 500 | Average | | |
| 5000 | | Peak | | | |
| Limit: (band edge) | Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation. | | | | |

Test setup:

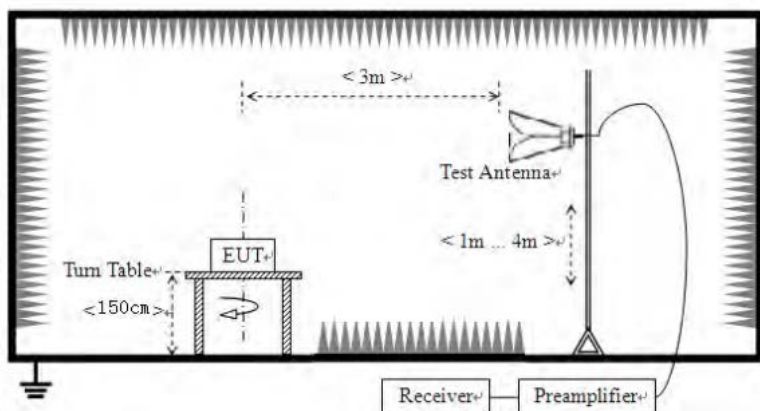
Below 30MHz



Below 1GHz



Above 1GHz



| | |
|-------------------|--|
| Test Procedure: | <ol style="list-style-type: none"> 1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. |
| Test Instruments: | Refer to section 6.0 for details |
| Test mode: | Refer to section 5.2 for details |
| Test results: | Pass |
| Test voltage: | DC3.7V |

Measurement data:

7.3.1 Field Strength of The Fundamental Signal

Peak value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------|---------------------|-----------------|--------------|
| 2405.00 | 88.40 | 27.15 | 3.65 | 36.12 | 83.08 | 114.00 | -30.92 | Vertical |
| 2405.00 | 94.03 | 27.15 | 3.65 | 36.12 | 88.71 | 114.00 | -25.29 | Horizontal |
| 2430.00 | 90.98 | 27.22 | 3.66 | 36.19 | 85.67 | 114.00 | -28.33 | Vertical |
| 2430.00 | 93.96 | 27.22 | 3.66 | 36.19 | 88.65 | 114.00 | -25.35 | Horizontal |
| 2470.00 | 93.54 | 27.32 | 3.67 | 36.29 | 88.24 | 114.00 | -25.76 | Vertical |
| 2470.00 | 92.98 | 27.32 | 3.67 | 36.29 | 87.68 | 114.00 | -26.32 | Horizontal |

Average value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------|---------------------|-----------------|--------------|
| 2405.00 | 86.21 | 27.15 | 3.65 | 36.12 | 80.89 | 94.00 | -13.11 | Vertical |
| 2405.00 | 91.90 | 27.15 | 3.65 | 36.12 | 86.58 | 94.00 | -7.42 | Horizontal |
| 2430.00 | 88.79 | 27.22 | 3.66 | 36.19 | 83.48 | 94.00 | -10.52 | Vertical |
| 2430.00 | 91.66 | 27.22 | 3.66 | 36.19 | 86.35 | 94.00 | -7.65 | Horizontal |
| 2470.00 | 91.37 | 27.32 | 3.67 | 36.29 | 86.07 | 94.00 | -7.93 | Vertical |
| 2470.00 | 90.77 | 27.32 | 3.67 | 36.29 | 85.47 | 94.00 | -8.53 | Horizontal |

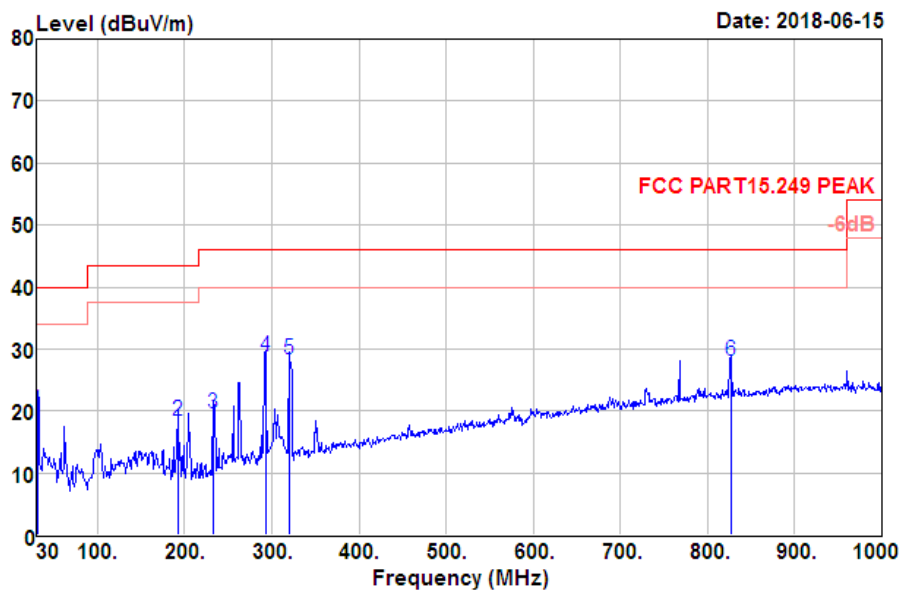
7.3.2 Spurious emissions

■ 9 kHz ~ 30 MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

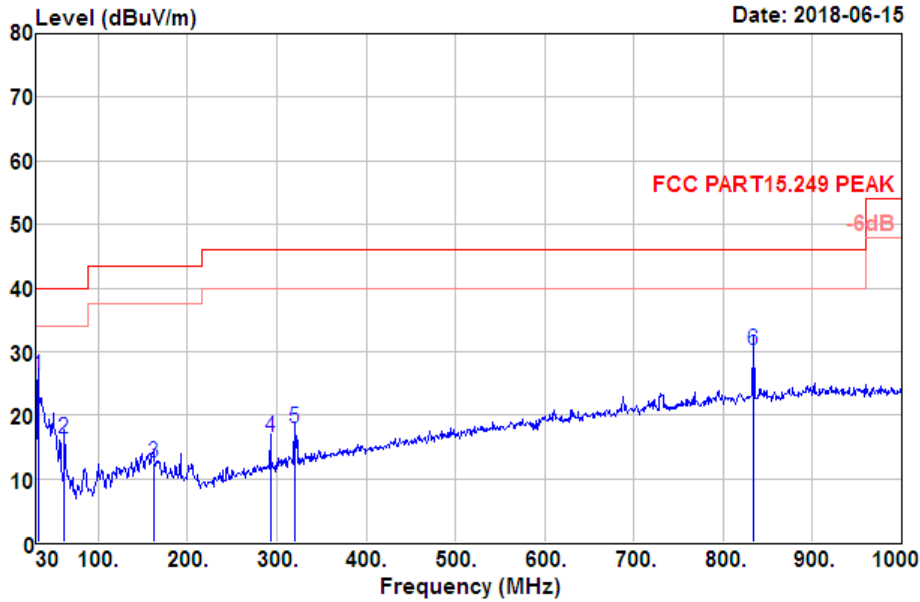
■ Below 1GHz

| | | | |
|-------------------------|--------------------------|----------------------|-------------------|
| Mode: | Transmitting mode | Test by: | Jason |
| Temp./Hum.(%RH): | 26°C/56%RH | Polarization: | Horizontal |



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|--------|
| 31.940 | 38.20 | 13.28 | 1.00 | 32.53 | 19.95 | 40.00 | -20.05 | QP |
| 191.990 | 37.80 | 10.38 | 2.78 | 32.54 | 18.42 | 43.50 | -25.08 | QP |
| 233.700 | 38.10 | 10.91 | 3.02 | 32.54 | 19.49 | 46.00 | -26.51 | QP |
| 292.870 | 45.29 | 12.69 | 3.42 | 32.52 | 28.88 | 46.00 | -17.12 | QP |
| 320.030 | 43.90 | 13.28 | 3.56 | 32.51 | 28.23 | 46.00 | -17.77 | QP |
| 826.370 | 33.60 | 21.04 | 6.05 | 32.50 | 28.19 | 46.00 | -17.81 | QP |

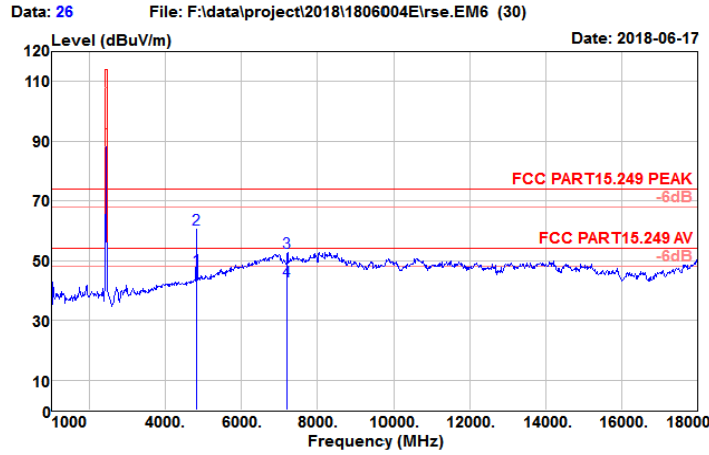
| | | | |
|-------------------------|--------------------------|----------------------|-----------------|
| Mode: | Transmitting mode | Test by: | Jason |
| Temp./Hum.(%RH): | 26°C/56%RH | Polarization: | Vertical |



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|--------|
| 32.910 | 44.30 | 13.32 | 1.04 | 32.53 | 26.13 | 40.00 | -13.87 | QP |
| 62.010 | 35.09 | 12.32 | 1.52 | 32.54 | 16.39 | 40.00 | -23.61 | QP |
| 161.920 | 28.60 | 14.01 | 2.49 | 32.52 | 12.58 | 43.50 | -30.92 | QP |
| 292.870 | 32.89 | 12.69 | 3.42 | 32.52 | 16.48 | 46.00 | -29.52 | QP |
| 320.030 | 33.60 | 13.28 | 3.56 | 32.51 | 17.93 | 46.00 | -28.07 | QP |
| 834.130 | 35.60 | 21.11 | 6.02 | 32.45 | 30.28 | 46.00 | -15.72 | QP |

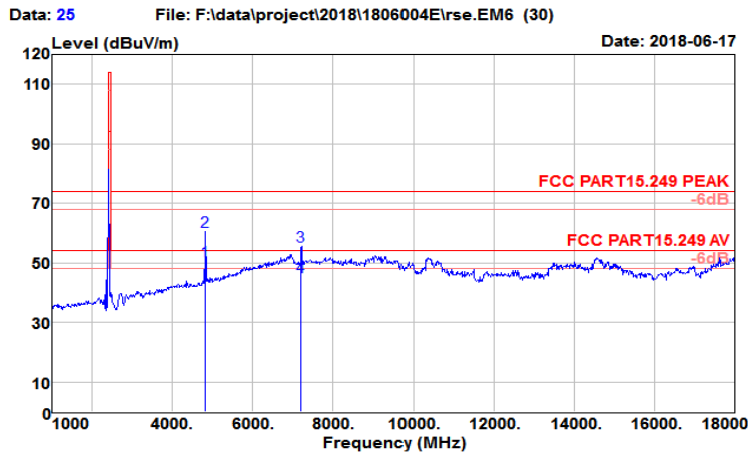
■ Above 1GHz

| | |
|---------------|----------------|
| Test channel: | Lowest channel |
|---------------|----------------|



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 4810.000 | 46.74 | 31.24 | 5.44 | 36.27 | 47.15 | 54.00 | -6.85 | Average |
| 4812.000 | 59.97 | 31.25 | 5.44 | 36.27 | 60.39 | 74.00 | -13.61 | Peak |
| 7214.000 | 44.15 | 35.89 | 6.96 | 34.25 | 52.75 | 74.00 | -21.25 | Peak |
| 7215.000 | 34.48 | 35.89 | 6.96 | 34.25 | 43.08 | 54.00 | -10.92 | Average |

Horizontal



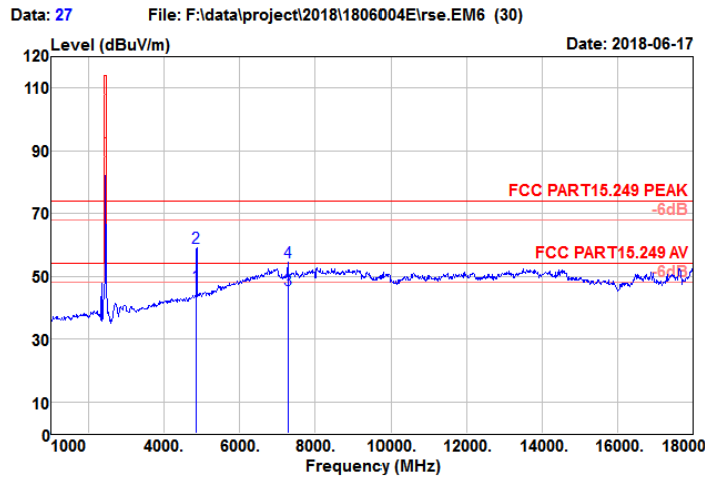
| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 4810.000 | 50.25 | 31.24 | 5.44 | 36.27 | 50.66 | 54.00 | -3.34 | Average |
| 4810.000 | 60.06 | 31.24 | 5.44 | 36.27 | 60.47 | 74.00 | -13.53 | Peak |
| 7214.000 | 47.04 | 35.89 | 6.96 | 34.25 | 55.64 | 74.00 | -18.36 | Peak |
| 7215.000 | 36.83 | 35.89 | 6.96 | 34.25 | 45.43 | 54.00 | -8.57 | Average |

Vertical

Remark:

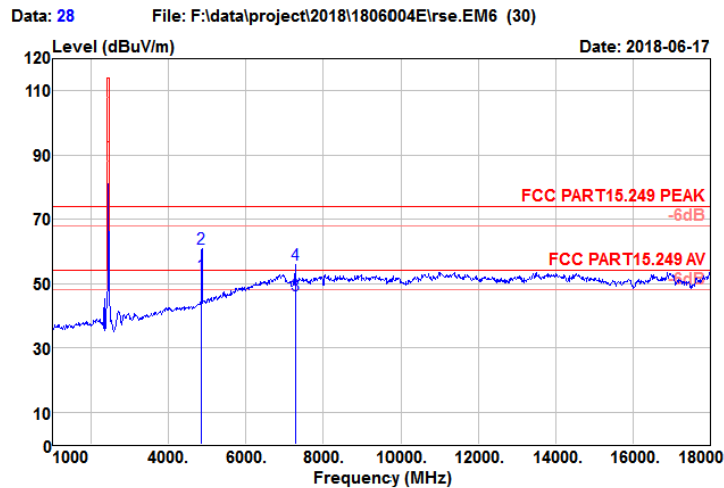
1. Final Level = Receiver Read level + Antenna Factor + Cable Loss - Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

| | |
|---------------|--------|
| Test channel: | Middle |
|---------------|--------|



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 4860.000 | 46.50 | 31.36 | 5.42 | 36.25 | 47.03 | 54.00 | -6.97 | Average |
| 4860.000 | 58.44 | 31.36 | 5.42 | 36.25 | 58.97 | 74.00 | -15.03 | Peak |
| 7290.000 | 36.58 | 36.07 | 7.18 | 34.33 | 45.50 | 54.00 | -8.50 | Average |
| 7292.000 | 45.47 | 36.07 | 7.19 | 34.33 | 54.40 | 74.00 | -19.60 | Peak |

Horizontal



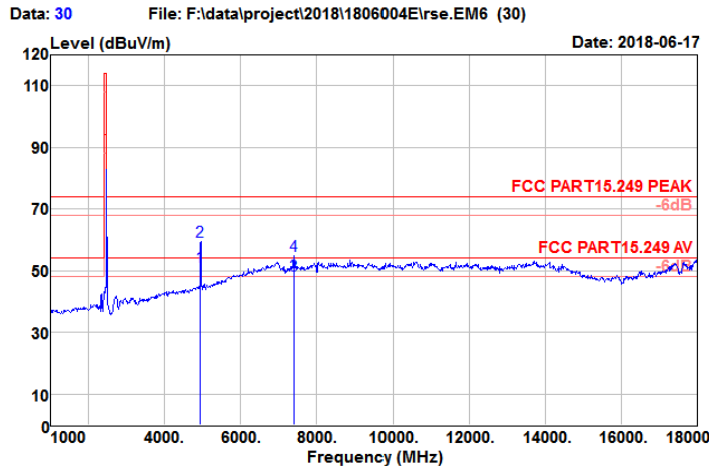
| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 4860.000 | 52.10 | 31.36 | 5.42 | 36.25 | 52.63 | 54.00 | -1.37 | Average |
| 4862.000 | 60.27 | 31.37 | 5.42 | 36.25 | 60.81 | 74.00 | -13.19 | Peak |
| 7290.000 | 37.46 | 36.07 | 7.18 | 34.33 | 46.38 | 54.00 | -7.62 | Average |
| 7292.000 | 46.93 | 36.07 | 7.19 | 34.33 | 55.86 | 74.00 | -18.14 | Peak |

Vertical

Remark:

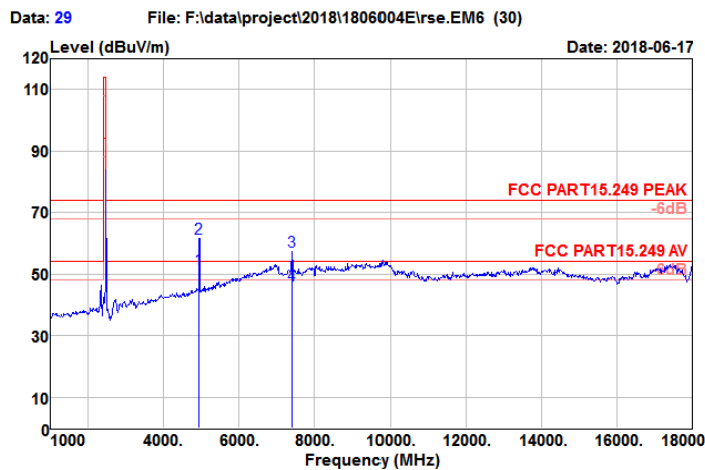
- Final Level = Receiver Read level + Antenna Factor + Cable Loss – Pre-amplifier Factor
- The emission levels of other frequencies are very lower than the limit and not show in test report.

| | |
|---------------|---------|
| Test channel: | Highest |
|---------------|---------|



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|---------|
| 4940.000 | 50.60 | 31.56 | 5.37 | 36.22 | 51.31 | 54.00 | -2.69 | Average |
| 4942.000 | 58.75 | 31.56 | 5.37 | 36.22 | 59.46 | 74.00 | -14.54 | Peak |
| 7410.000 | 39.12 | 36.34 | 7.49 | 34.44 | 48.51 | 54.00 | -5.49 | Average |
| 7412.000 | 45.38 | 36.35 | 7.48 | 34.44 | 54.77 | 74.00 | -19.23 | Peak |

Horizontal



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|---------|
| 4940.000 | 51.12 | 31.56 | 5.37 | 36.22 | 51.83 | 54.00 | -2.17 | Average |
| 4942.000 | 61.01 | 31.56 | 5.37 | 36.22 | 61.72 | 74.00 | -12.28 | Peak |
| 7409.000 | 48.14 | 36.34 | 7.49 | 34.44 | 57.53 | 74.00 | -16.47 | Peak |
| 7410.000 | 36.85 | 36.34 | 7.49 | 34.44 | 46.24 | 54.00 | -7.76 | Average |

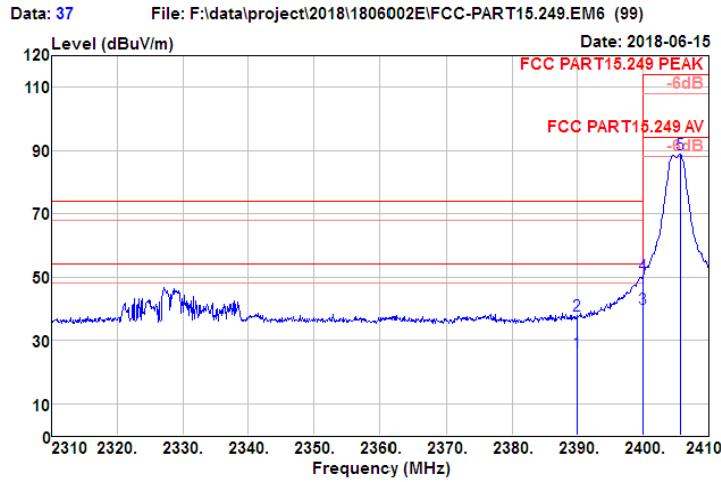
Vertical

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

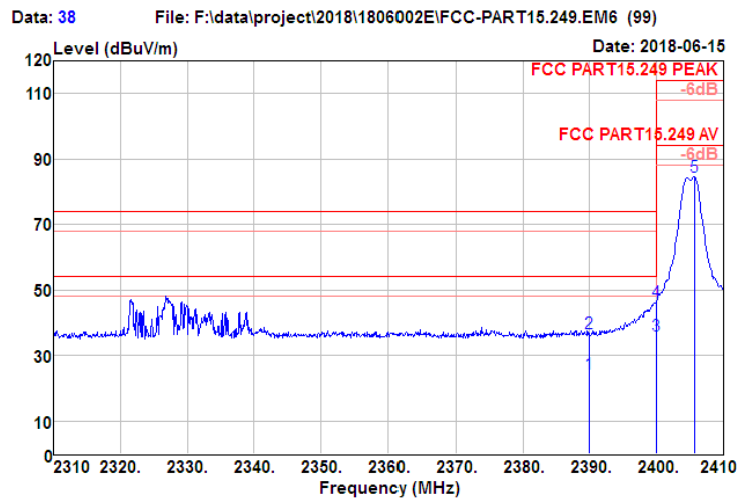
7.3.3 Bandedge emissions

| | |
|---------------|----------------|
| Test channel: | Lowest channel |
|---------------|----------------|



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 2390.000 | 31.47 | 27.11 | 3.64 | 36.08 | 26.14 | 54.00 | -27.86 | Average |
| 2390.000 | 43.24 | 27.11 | 3.64 | 36.08 | 37.91 | 74.00 | -36.09 | Peak |
| 2400.000 | 45.32 | 27.14 | 3.65 | 36.11 | 40.00 | 54.00 | -14.00 | Average |
| 2400.000 | 55.84 | 27.14 | 3.65 | 36.11 | 50.52 | 74.00 | -23.48 | Peak |
| 2405.600 | 94.06 | 27.15 | 3.65 | 36.12 | 88.74 | 114.00 | -25.26 | Peak |

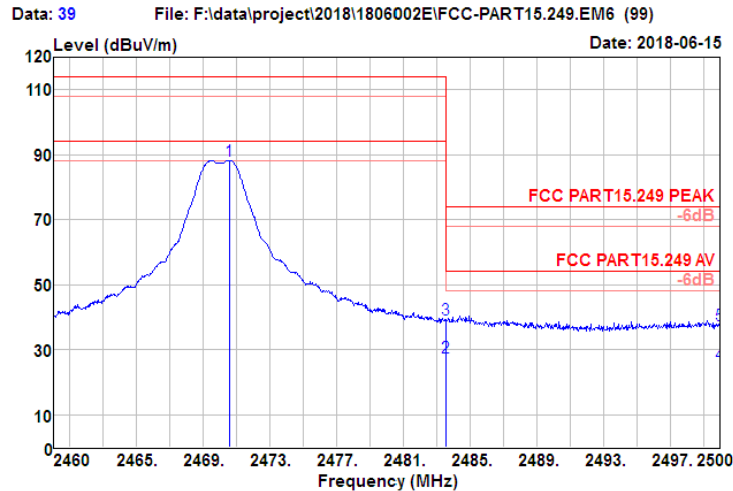
HORIZONTAL



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|----------|--------------------|---------------------|---------------|------------------|------------|--------------------|---------------|---------|
| 2390.000 | 29.75 | 27.11 | 3.64 | 36.08 | 24.42 | 54.00 | -29.58 | Average |
| 2390.000 | 42.00 | 27.11 | 3.64 | 36.08 | 36.67 | 74.00 | -37.33 | Peak |
| 2400.000 | 41.46 | 27.14 | 3.65 | 36.11 | 36.14 | 54.00 | -17.86 | Average |
| 2400.000 | 51.65 | 27.14 | 3.65 | 36.11 | 46.33 | 74.00 | -27.67 | Peak |
| 2405.600 | 89.83 | 27.15 | 3.65 | 36.12 | 84.51 | 114.00 | -29.49 | Peak |

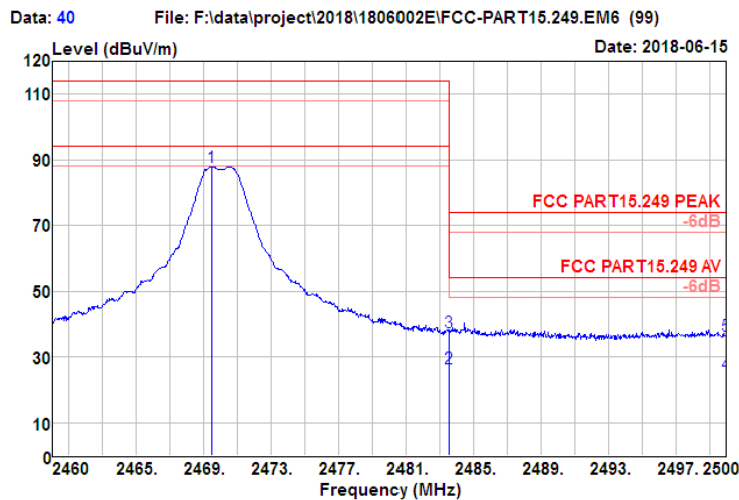
VERTICAL

| | |
|---------------|-----------------|
| Test channel: | Highest channel |
|---------------|-----------------|



| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|---------|
| 2470.560 | 93.60 | 27.32 | 3.67 | 36.29 | 88.30 | 114.00 | -25.70 | Peak |
| 2483.500 | 32.89 | 27.36 | 3.68 | 36.33 | 27.60 | 54.00 | -26.40 | Average |
| 2483.520 | 44.56 | 27.36 | 3.68 | 36.33 | 39.27 | 74.00 | -34.73 | Peak |
| 2500.000 | 30.67 | 27.40 | 3.68 | 36.37 | 25.38 | 54.00 | -28.62 | Average |
| 2500.000 | 42.79 | 27.40 | 3.68 | 36.37 | 37.50 | 74.00 | -36.50 | Peak |

HORIZONTAL



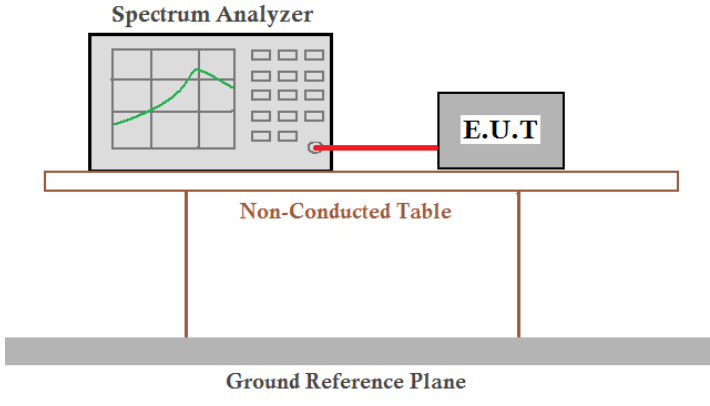
| Freq MHz | Reading level dBuV | Antenna factor dB/m | Cable loss dB | Preamp factor dB | level dBuV | Limit level dBuV/m | Over limit dB | Remark |
|-------------|--------------------------|---------------------------|---------------------|------------------------|---------------|--------------------------|---------------------|---------|
| 2469.480 | 93.26 | 27.32 | 3.67 | 36.29 | 87.96 | 114.00 | -26.04 | Peak |
| 2483.500 | 31.73 | 27.36 | 3.68 | 36.33 | 26.44 | 54.00 | -27.56 | Average |
| 2483.520 | 42.99 | 27.36 | 3.68 | 36.33 | 37.70 | 74.00 | -36.30 | Peak |
| 2500.000 | 30.11 | 27.40 | 3.68 | 36.37 | 24.82 | 54.00 | -29.18 | Average |
| 2500.000 | 41.89 | 27.40 | 3.68 | 36.37 | 36.60 | 74.00 | -37.40 | Peak |

VERTICAL

Remark:

- Final Level = Receiver Read level + Antenna Factor + Cable Loss - Pre-amplifier Factor

7.4 20dB Occupy Bandwidth

| | |
|-------------------|---|
| Test Requirement: | FCC Part15 C Section 15.249/15.215 |
| Test Method: | ANSI C63.10:2013 |
| Limit: | Operation Frequency range 2400MHz~2483.5MHz |
| Test setup: |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both are placed on a Non-Conducted Table, which is supported by a Ground Reference Plane.</p> |
| Test Instruments: | Refer to section 6.0 for details |
| Test mode: | Refer to section 5.2 for details |
| Test results: | Pass |

Measurement Data

| Test channel | 20dB bandwidth(MHz) | Result |
|--------------|---------------------|--------|
| Lowest | 2.545 | Pass |
| Middle | 2.545 | Pass |
| Highest | 2.569 | Pass |

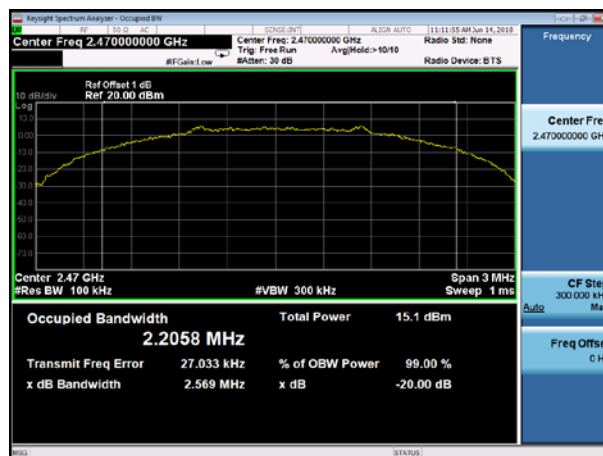
Test plot as follows:



Lowest channel



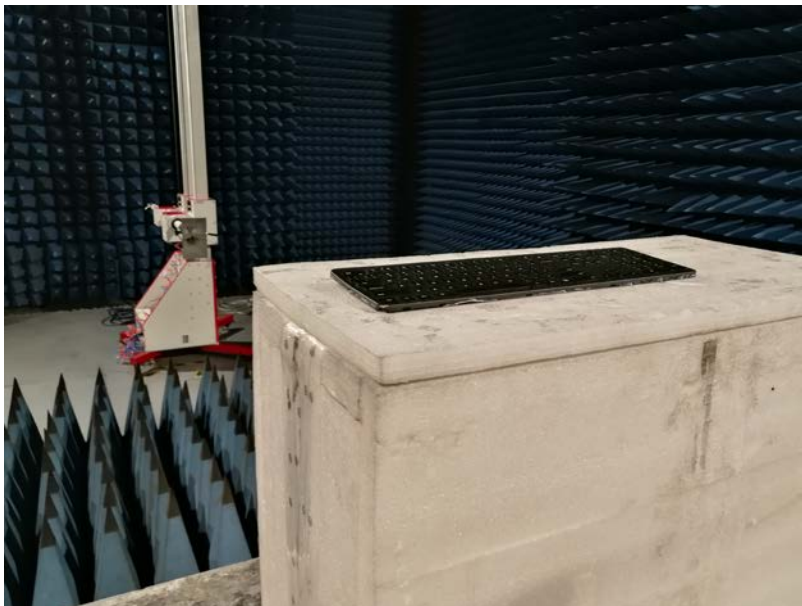
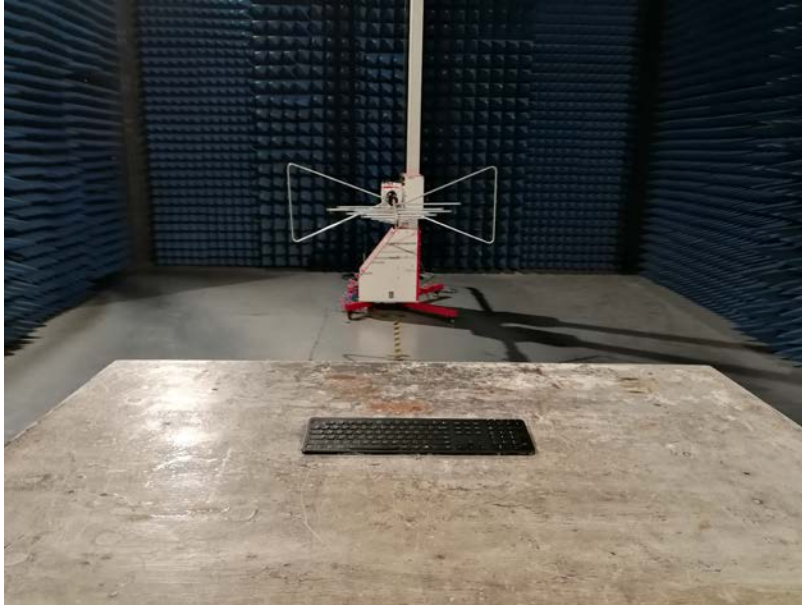
Middle channel



Highest channel

8 Test Setup Photo

Radiated Emission



Conducted Emission



9 EUT Constructional Details

Test Model No.: HW197-3-L



Model No.: HW197-2-L



Model No.: HW198-3-L

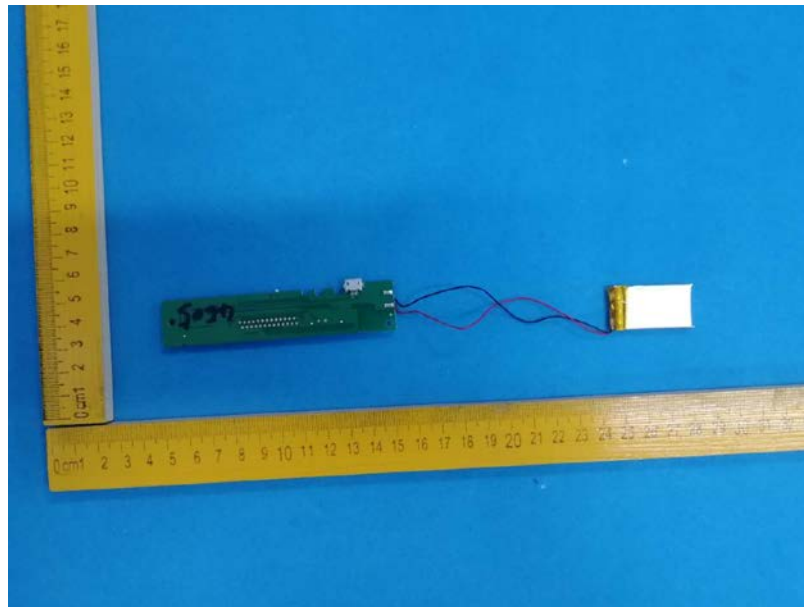
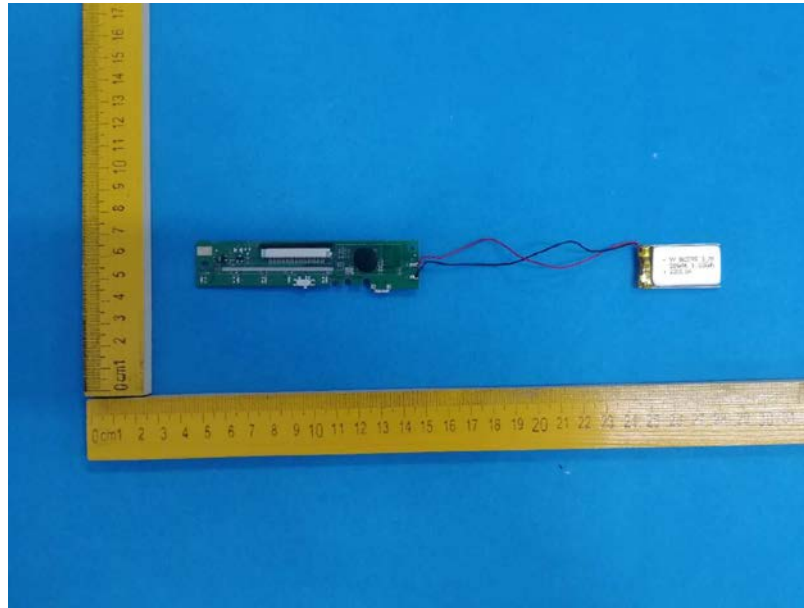


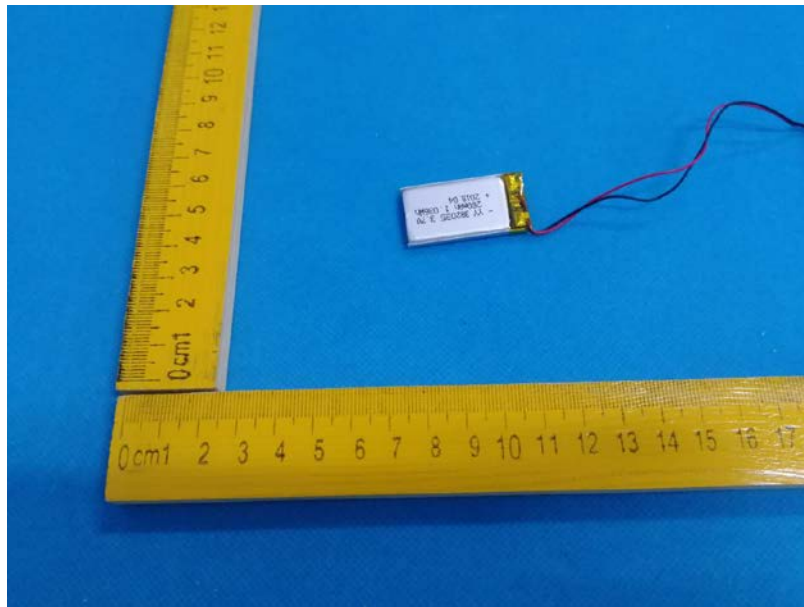
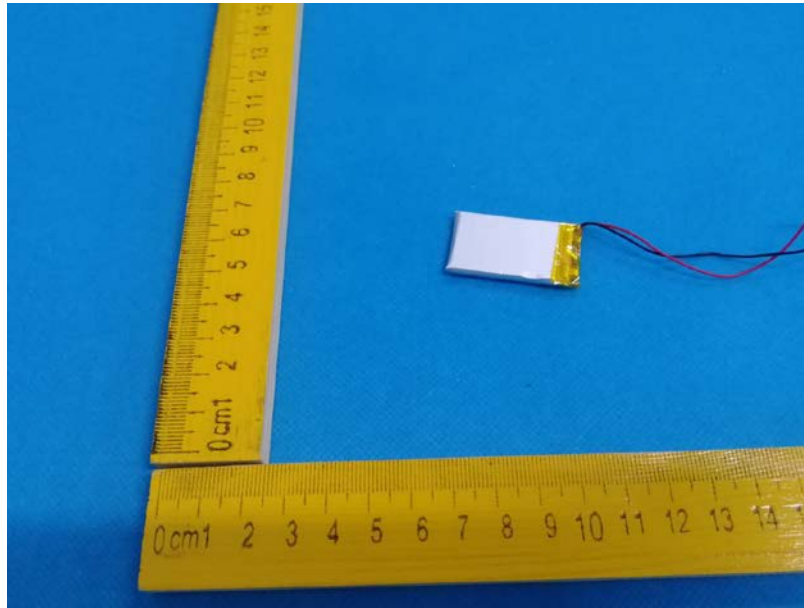
Model No.: HW198-2-L

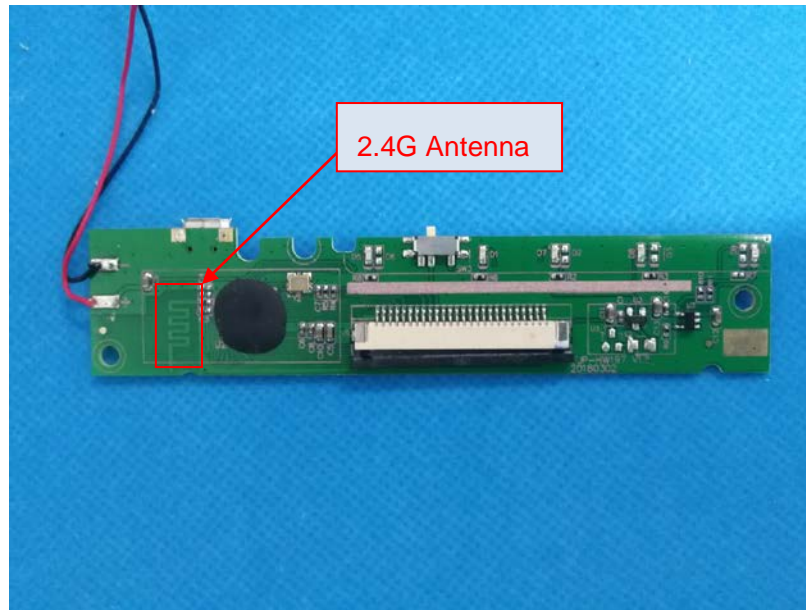


Test Model No.: HW197-3-L









-----End-----