Shenzhen CTL Testing Technology Co., Ltd.
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# TEST REPORT

## 47 CFR FCC Part 15 Subpart C 15.231

**Report Reference No**. .....: **CTL1711097026-WF**

| | | |
|---|---|---|
| Compiled by:<br>( position+printed name+signature) | Allen Wang<br>(File administrators) | Allen Wang |
| Tested by:<br>( position+printed name+signature) | Nice Nong<br>(Test Engineer) | Nice Nong |
| Approved by:<br>( position+printed name+signature) | Ivan Xie<br>(Manager) | Ivan Xie |

| | |
|---|---|
| **Product Name**.....: | T series Barcode scanner |
| **Model/Type reference** .....: | T2-RU |
| **Trade Mark**.....: | FINDO |
| **FCC ID**.....: | 2AKX5-T2-RU |
| **Applicant's name** .....: | **Shenzhen Findo Technology Co., LTD** |
| **Address of applicant** .....: | 1B302, GuangHui Technology Park, MinQing Road, Longhua District, Shenzhen, China |
| **Test Firm** .....: | **Shenzhen CTL Testing Technology Co., Ltd.** |
| **Address of Test Firm** .....: | Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055 |
| **Test specification**.....: | |
| Standard.....: | **47 CFR FCC Part 15 Subpart C 15.231** |
| TRF Originator .....: | Shenzhen CTL Testing Technology Co., Ltd. |
| Master TRF .....: | Dated 2011-01 |
| **Date of Receipt**.....: | Dec. 10, 2017 |
| **Date of Test Date**.....: | Dec. 10, 2017 –Dec. 20, 2017 |
| **Data of Issue**.....: | Dec. 20, 2017 |
| **Result**.....: | Pass |

# TEST REPORT

| Test Report No. : | CTL1711097026-WF | Dec. 20, 2017<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | T series Barcode scanner |
| Model /Type | : | T2-RU |
| **Applicant** | : | **Shenzhen Findo Technology Co., LTD** |
| Address | : | 1B302, GuangHui Technology Park, MinQing Road, Longhua District, Shenzhen, China |
| **Manufacturer** | : | **Shenzhen Findo Technology Co., LTD** |
| Address | : | 1B302, GuangHui Technology Park, MinQing Road, Longhua District, Shenzhen, China |

| **Test result** | **Pass *** |
|---|---|

* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

# ** Modified History **

| Version | Description | Issued Data | Report No. | Remark |
|---|---|---|---|---|
| Version 1.0 | Initial Test Report Release | 2017-12-20 | CTL1711097026-WF | Tracy Qi |
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## Table of Contents Page

# 1. SUMMARY

## 1.1. Test Standards

The tests were performed according to following standards:

**FCC Rules Part 15.231:** Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

**ANSI C63.10:2013 :** American National Standard for Testing Unlicensed Wireless Devices

## 1.2. Test Description

| FCC and IC Requirements | | |
|---|---|---|
| FCC Part 15.207 | Conducted Emission | PASS |
| FCC Part 15.231(e) | Duration of Transmission and Silent Period | PASS |
| FCC Part 15.231(b) | Electric Field Strength of Fundamental Emission | PASS |
| FCC Part 15.205 &15.209& 15.231(e) | Electric Field Strength of Spurious Emission | PASS |
| FCC Part 15.231(c) | -20dB bandwidth | PASS |

Remark: The measurement uncertainty is not included in the test result.

## 1.3. Test Facility

### 1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

### 1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

**IC Registration No.: 9618B**

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

**FCC-Registration No.: 399832**

Shenzhen CTL Testing Technology Co., Ltd. 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 our files. Registration 399832, December 08, 2017.

## 1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to 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 CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

| Test | Measurement Uncertainty | Notes |
|---|---|---|
| Transmitter power conducted | ±0.57 dB | (1) |
| Transmitter power Radiated | ±2.20 dB | (1) |
| Conducted spurious emission 9KHz-40 GHz | ±2.20 dB | (1) |
| Occupied Bandwidth | ±0.01ppm | (1) |
| Radiated Emission 30~1000MHz | ±4.10dB | (1) |
| Radiated Emission Above 1GHz | ±4.32dB | (1) |
| Conducted Disturbance0.15~30MHz | ±3.20dB | (1) |

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

# 2. GENERAL INFORMATION

## 2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Normal Temperature: | 25°C |
| Relative Humidity: | 55 % |
| Air Pressure: | 101 kPa |

## 2.2. General Description of EUT

| | |
|---|---|
| Product Name: | T series Barcode scanner |
| Model/Type reference: | T2-RU |
| Power supply: | DC 3.7V from battery, charged by DC 5V from USB |
| Modulation: | ASK |
| Operation frequency: | 433.92MHz |
| Channel number: | 1 |
| Antenna type: | Internal antenna |
| Antenna gain: | 0dBi |

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

## 2.3. Equipments Used during the Test

| Test Equipment | Manufacturer | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| LISN | R&S | ENV216 | 3560.6550.12 | 2017/06/02 | 2018/06/01 |
| LISN | R&S | ESH2-Z5 | 860014/010 | 2017/06/02 | 2018/06/01 |
| Bilog Antenna | Sunol Sciences Corp. | JB1 | A061713 | 2017/06/02 | 2018/06/01 |
| EMI Test Receiver | R&S | ESCI | 103710 | 2017/06/02 | 2018/06/01 |
| Spectrum Analyzer | Agilent | N9020 | US46220290 | 2017/01/17 | 2018/01/16 |
| Controller | EM Electronics | Controller EM 1000 | N/A | 2017/05/21 | 2018/05/20 |
| Horn Antenna | Sunol Sciences Corp. | DRH-118 | A062013 | 2017/05/19 | 2018/05/18 |
| Active Loop Antenna | SCHWARZBECK | FMZB1519 | 1519-037 | 2017/05/19 | 2018/05/18 |
| Amplifier | Agilent | 8349B | 3008A02306 | 2017/05/19 | 2018/05/18 |
| Amplifier | Agilent | 8447D | 2944A10176 | 2017/05/19 | 2018/05/18 |
| Temperature/Humidity Meter | Gangxing | CTH-608 | 02 | 2017/05/20 | 2018/05/19 |
| High-Pass Filter | K&L | 9SH10-2700/X12750-O/O | N/A | 2017/05/20 | 2018/05/19 |
| High-Pass Filter | K&L | 41H10-1375/U12750-O/O | N/A | 2017/05/20 | 2018/05/19 |

| | | | | | |
|---|---|---|---|---|---|
| Coaxial Cables | HUBER+SUHNER | SUCOFLEX 104PEA-10M | 10m | 2017/06/02 | 2018/06/01 |
| Coaxial Cables | HUBER+SUHNER | SUCOFLEX 104PEA-3M | 3m | 2017/06/02 | 2018/06/01 |
| Coaxial Cables | HUBER+SUHNER | SUCOFLEX 104PEA-3M | 3m | 2017/06/02 | 2018/06/01 |
| RF Cable | Megalon | RF-A303 | N/A | 2017/06/02 | 2018/06/01 |

The calibration interval was one year

## 2.4. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.231 of the FCC Part 15, Subpart C Rules.

## 2.5. Modifications

No modifications were implemented to meet testing criteria.

# 3. TEST CONDITIONS AND RESULTS

## 3.1. Conducted Emission (AC Main)

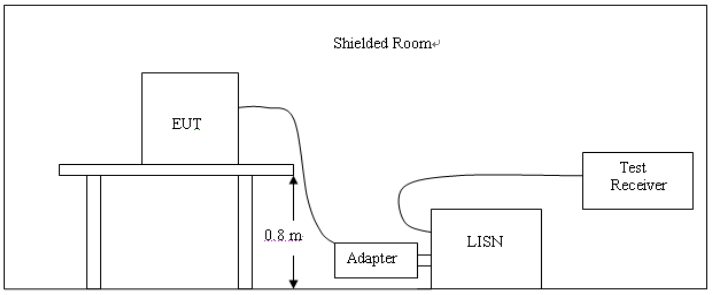
**LIMIT**

FCC CFR Title 47 Part 15 Subpart C Section 15.207

| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**TEST CONFIGURATION**



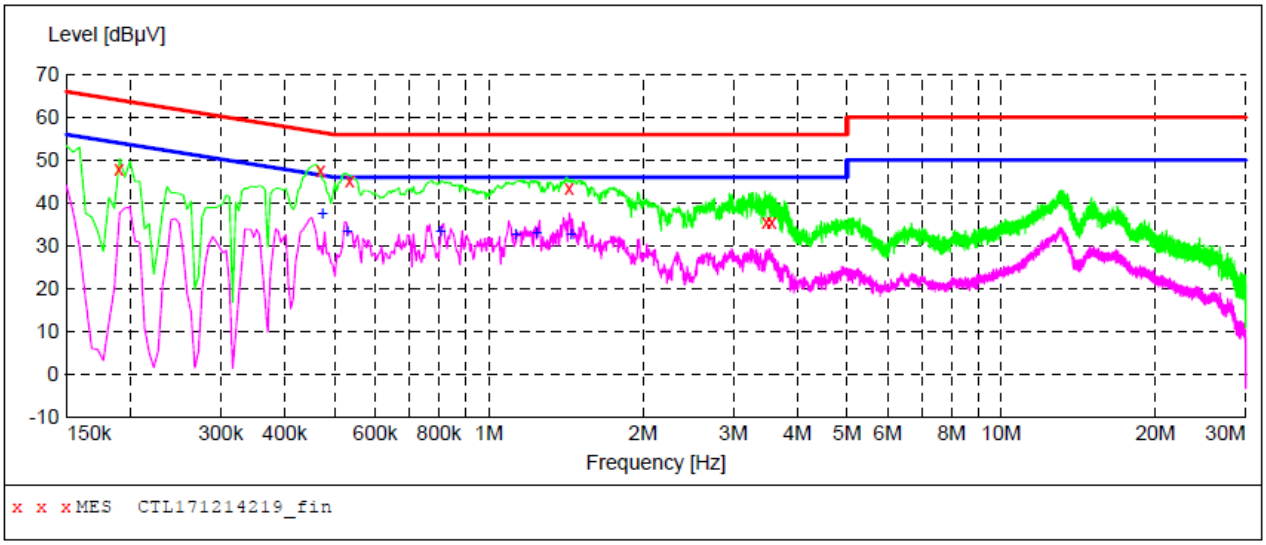

**TEST PROCEDURE**

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a flood stand system; a wooden table with a height of 0.1 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

**TEST RESULTS**

***SCAN TABLE: "Voltage (9K-30M)FIN"***

Short Description: 150K-30M Voltage




***MEASUREMENT RESULT: "CTL171214219_fin"***

14/12/2017 17:16

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.190000 | 48.10 | 10.2 | 64 | 15.9 | QP | L1 | GND |
| 0.470000 | 47.50 | 10.2 | 57 | 9.0 | QP | L1 | GND |
| 0.536000 | 45.10 | 10.2 | 56 | 10.9 | QP | L1 | GND |
| 1.436000 | 43.30 | 10.3 | 56 | 12.7 | QP | L1 | GND |
| 3.482000 | 35.50 | 10.4 | 56 | 20.5 | QP | L1 | GND |
| 3.572000 | 35.50 | 10.4 | 56 | 20.5 | QP | L1 | GND |

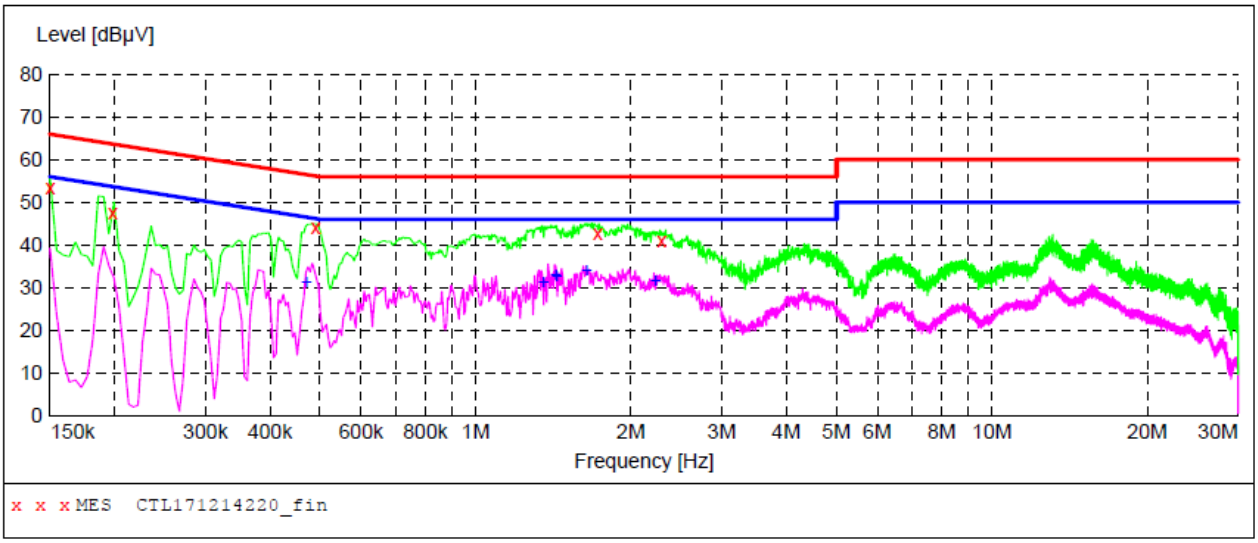
***MEASUREMENT RESULT: "CTL171124219_fin2"***

14/12/2017 17:16

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.474000 | 37.70 | 10.2 | 46 | 8.7 | AV | L1 | GND |
| 0.530000 | 33.30 | 10.2 | 46 | 12.7 | AV | L1 | GND |
| 0.806000 | 33.60 | 10.2 | 46 | 12.4 | AV | L1 | GND |
| 1.130000 | 32.60 | 10.3 | 46 | 13.4 | AV | L1 | GND |
| 1.238000 | 33.00 | 10.3 | 46 | 13.0 | AV | L1 | GND |
| 1.448000 | 32.60 | 10.3 | 46 | 13.4 | AV | L1 | GND |

***SCAN TABLE: "Voltage (9K-30M)FIN"***

Short Description: 150K-30M Voltage




***MEASUREMENT RESULT: "CTL171214220_fin"***

14/12/2017 17:19

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.150000 | 53.50 | 10.2 | 66 | 12.5 | QP | N | GND |
| 0.198000 | 47.70 | 10.2 | 64 | 16.0 | QP | N | GND |
| 0.490000 | 44.00 | 10.2 | 56 | 12.2 | QP | N | GND |
| 1.724000 | 42.80 | 10.3 | 56 | 13.2 | QP | N | GND |
| 2.294000 | 41.00 | 10.4 | 56 | 15.0 | QP | N | GND |

***MEASUREMENT RESULT: "CTL171214220_fin2"***

14/12/2017 17:19

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.470000 | 31.50 | 10.2 | 47 | 15.0 | AV | N | GND |
| 1.352000 | 31.50 | 10.3 | 46 | 14.5 | AV | N | GND |
| 1.430000 | 33.00 | 10.3 | 46 | 13.0 | AV | N | GND |
| 1.436000 | 32.70 | 10.3 | 46 | 13.3 | AV | N | GND |
| 1.640000 | 34.00 | 10.3 | 46 | 12.0 | AV | N | GND |
| 2.228000 | 31.60 | 10.4 | 46 | 14.4 | AV | N | GND |

## 3.2. Radiated Emission

**Limit**

For intentional device, according to 15.209(a) the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table.

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

In addition to the provisions of 15.231(b), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

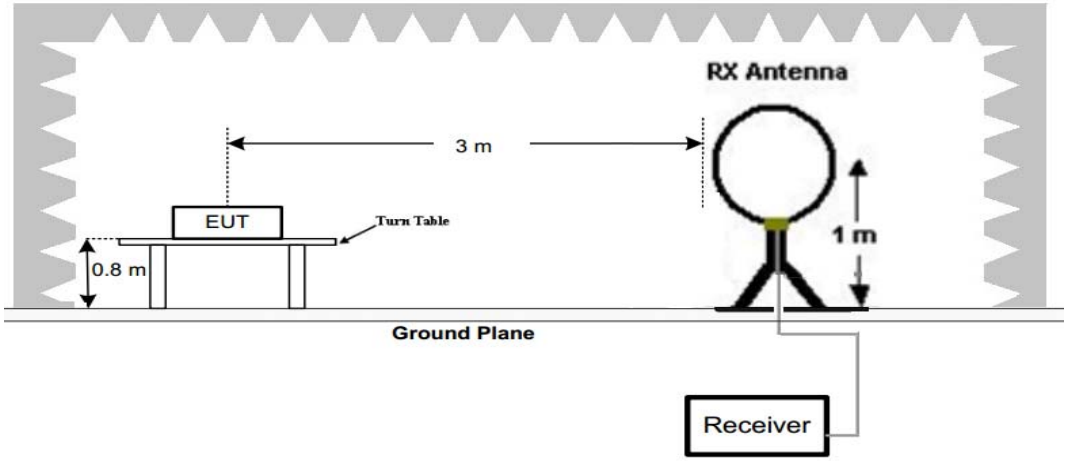
| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emissions (microvolts/meter) |
|---|---|---|
| 40.66–40.70. | 2,250 | 225 |
| 70–130 | 1,250 | 125 |
| 130–174 | [1] 1,250 to 3,750 | [1] 125 to 375 |
| 174–260 | 3,750 | 375 |
| 260–470 | [1] 3,750 to 12,500 | [1] 375 to 1,250 |
| Above 470 | 12,500 | 1,250 |

[1] Linear interpolations.

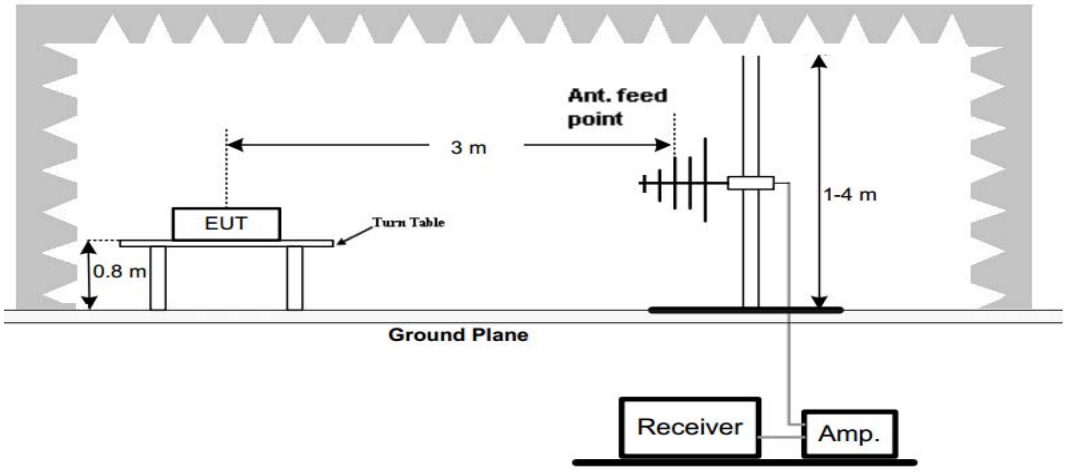
[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 260-470 MHz, μV/m at 3 meters =41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

**TEST CONFIGURATION**

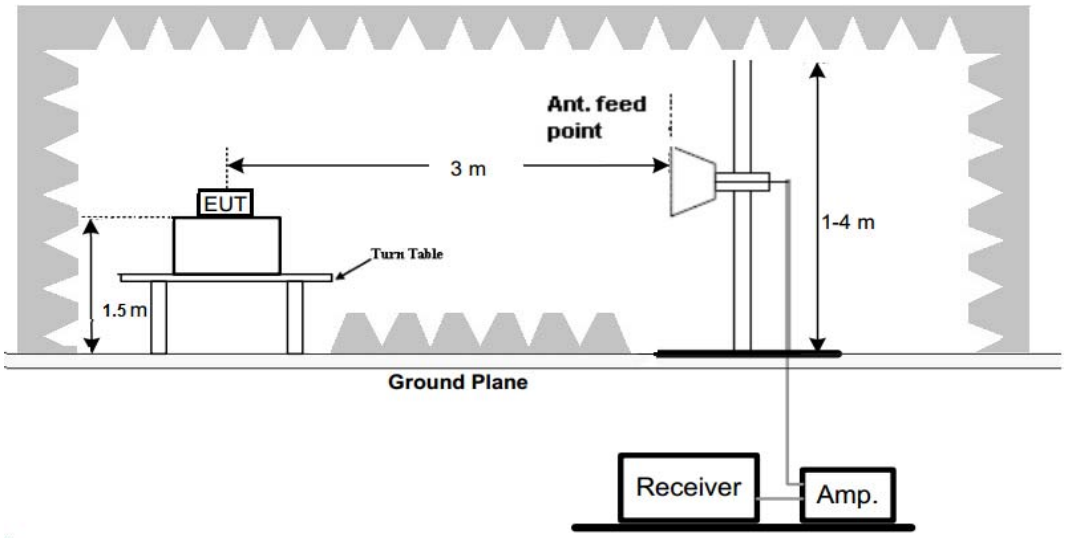
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz




(B) Radiated Emission Test Set-Up, Frequency below 1000MHz




(C) Radiated Emission Test Set-Up, Frequency above 1000MHz




**Test Procedure**

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent 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.

**TEST RESULTS**

The emissions from 30MHz to 5GHz are measured peak and average level, below 1 GHz measured QP level, detailed test data please see below. Besides, we tested 3 directions and recorded the worst data.

| Emission Styles | Frequency (MHz) | Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Direction (H/V) |
|---|---|---|---|---|---|---|
| Fundamental | 433.92 | 85.33 | 95.62 | 10.29 | PK | H |
| Spurious | 435.14 | 60.28 | 75.62 | 15.34 | PK | H |
| Harmonics | 867.84 | 63.01 | 75.62 | 12.61 | PK | H |
| Harmonics | 1735.68 | 62.74 | 75.62 | 12.88 | PK | H |
| -- | -- | -- | -- | -- | -- | -- |
| Fundamental | 433.92 | 84.79 | 95.62 | 10.83 | PK | V |
| Spurious | 435.14 | 61.52 | 75.62 | 14.10 | PK | V |
| Harmonics | 867.84 | 62.80 | 75.62 | 12.82 | PK | V |
| Harmonics | 1735.68 | 61.63 | 75.62 | 13.99 | PK | V |
| -- | -- | -- | -- | -- | -- | -- |

| Emission Styles | Frequency (MHz) | PK Level (dBuV/m) | AV Factor (dB/m) | AV Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Direction (H/V) |
|---|---|---|---|---|---|---|---|
| Fundamental | 433.92 | 85.33 | -22.16 | 63.17 | 75.62 | 12.45 | H |
| Spurious | 435.14 | 60.28 | -22.16 | 38.12 | 55.62 | 17.50 | H |
| Harmonics | 867.84 | 63.01 | -22.16 | 40.85 | 55.62 | 14.77 | H |
| Harmonics | 1735.68 | 62.74 | -22.16 | 40.58 | 55.62 | 15.04 | H |
| -- | -- | -- | -- | -- | -- | -- | -- |
| Fundamental | 433.92 | 84.79 | -22.16 | 62.63 | 75.62 | 12.99 | V |
| Spurious | 435.14 | 61.52 | -22.16 | 39.36 | 55.62 | 16.26 | V |
| Harmonics | 867.84 | 62.80 | -22.16 | 40.64 | 55.62 | 14.98 | V |
| Harmonics | 1735.68 | 61.63 | -22.16 | 39.47 | 55.62 | 16.15 | V |
| -- | -- | -- | -- | -- | -- | -- | -- |

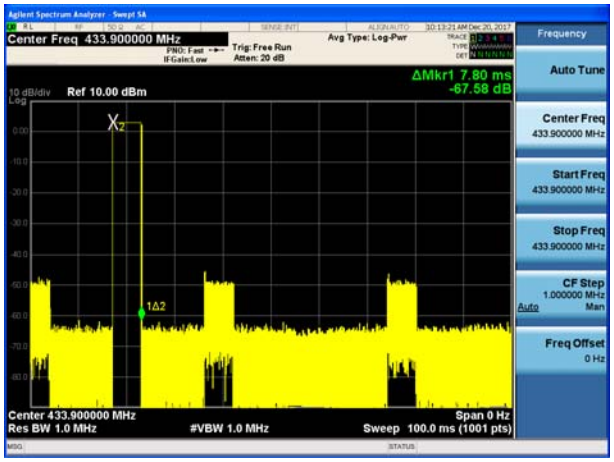
Note:

1. AV Level (dBuV/m)= PK Level (dBuV/m)+ AV Factor(dB)
2. In 100ms period found 6ms burst 3pcs the Duty Cycle can calculate as below:

   Duty Cycle= 7.8/100=0.078

   AV Factor=20*log(Duty Cycle)=20*log(0.078)=-22.16

(The plot of Duty Cycle See the follow page)



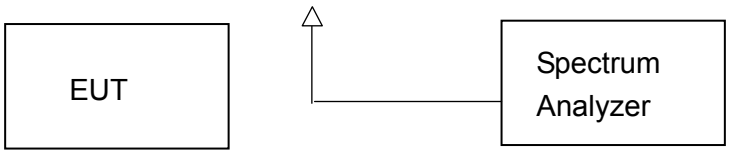

(Total Bursts in100ms)

## 3.3. 20dB Bandwidth

### Limit

According to 47 CFR 15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the centre frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier.

### Test Configuration




### Test Procedure

The 20dB bandwidth and 99% bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

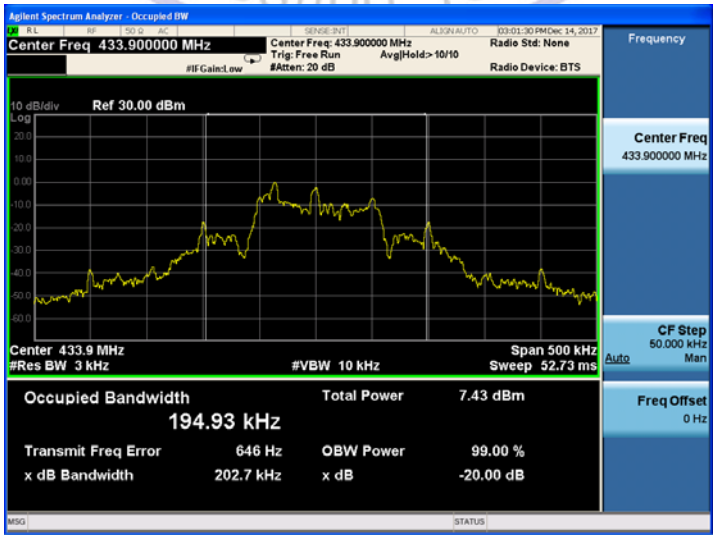
The occupied bandwidth (OBW), that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

### Test Results

| Modulation | Channel Frequency (MHz) | 99% OBW (KHz) | 20dB bandwidth (KHz) | Limit (KHz) | Result |
|---|---|---|---|---|---|
| ASK | 433.92 | 194.93 | 202.70 | 0.25%*433.92=1084.8 | Pass |

**Test plot as follows:**

*ASK Modulation*



## 3.4. Duration of Transmission and Silent Period

**Measurement Procedure**

According To FCC Part 15 Section 15.231(e).

1. Set SPA Center Frequency = Fundamental frequency, RBW = 100 kHz, VBW =300 kHz, Span = 0Hz. Sweep time =20seconds.

2. Set EUT as normal operation and press Transmitter button.

3. Set SPA View. Delta Mark time.

**Limits**

devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

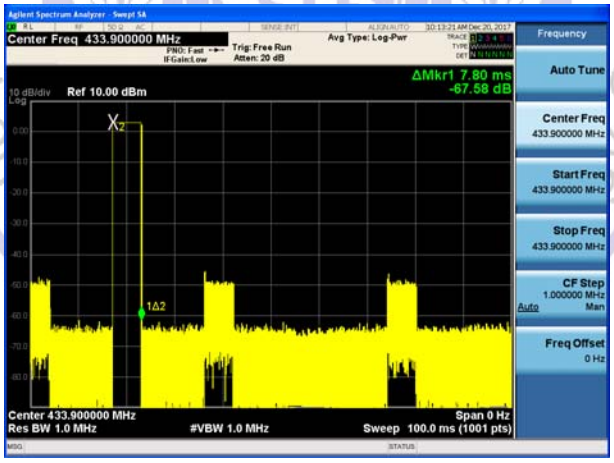
**TEST RESULTS**

duration of each transmission=7.8ms<1s PASS

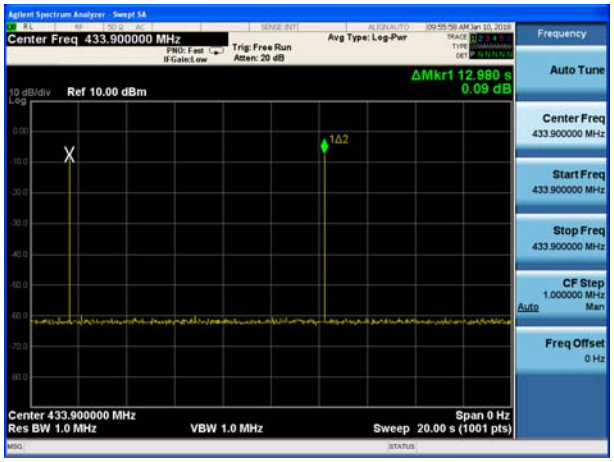
Silent period between transmissions=12.98s>10s PASS

30 times the duration of the transmission=0.234s<11.48s PASS

Duration of Each Transmission




Silent Period Between Transmissions



## 3.5. Antenna Requirement

**Standard Applicable**

According to FCC Part 15C 15.203

a) An intentional radiator shall be de-signed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

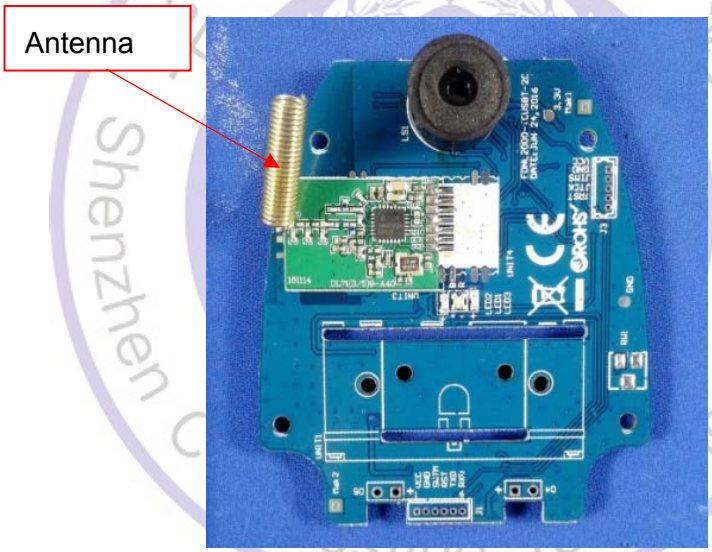
b) The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

**Refer to statement below for compliance.**

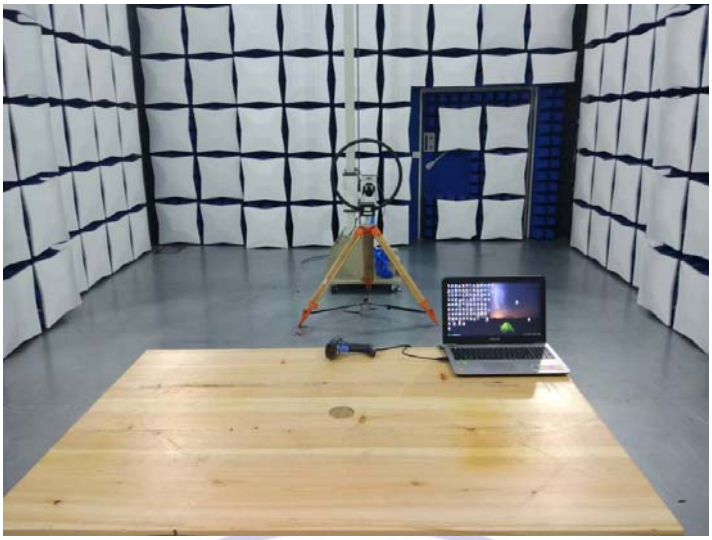
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

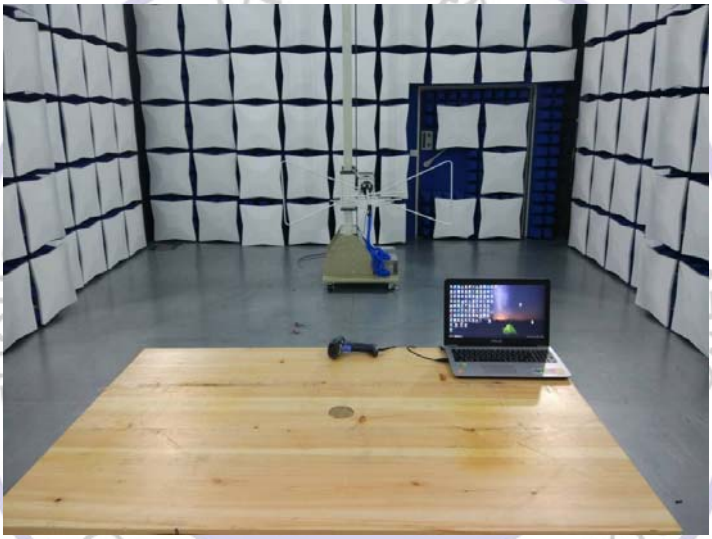
**Antenna Connected Construction**

The antenna used in this product is an internal Antenna, The directional gains of antenna used for transmitting is 0 dBi.



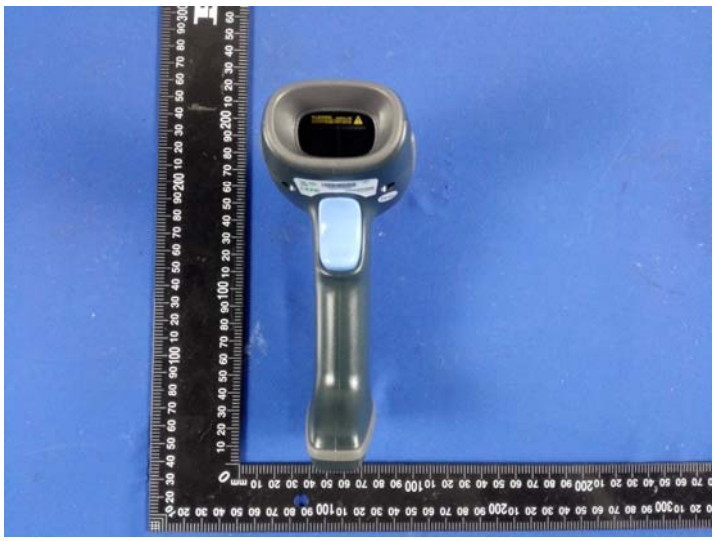
# 4. Test Setup Photos of the EUT



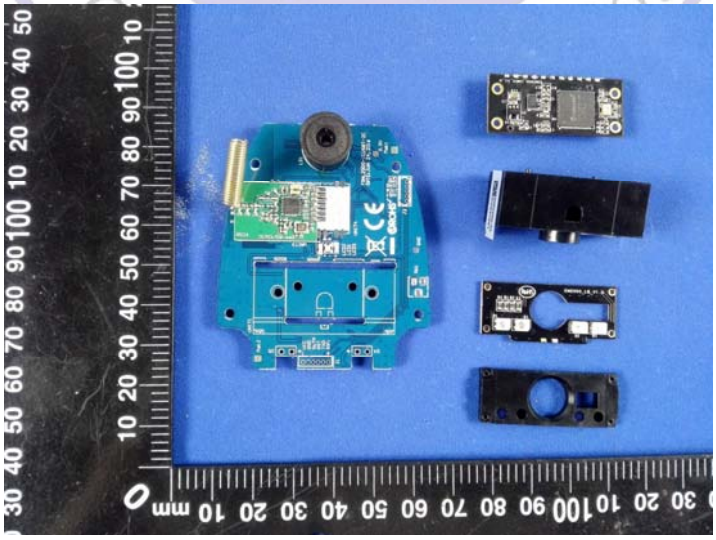


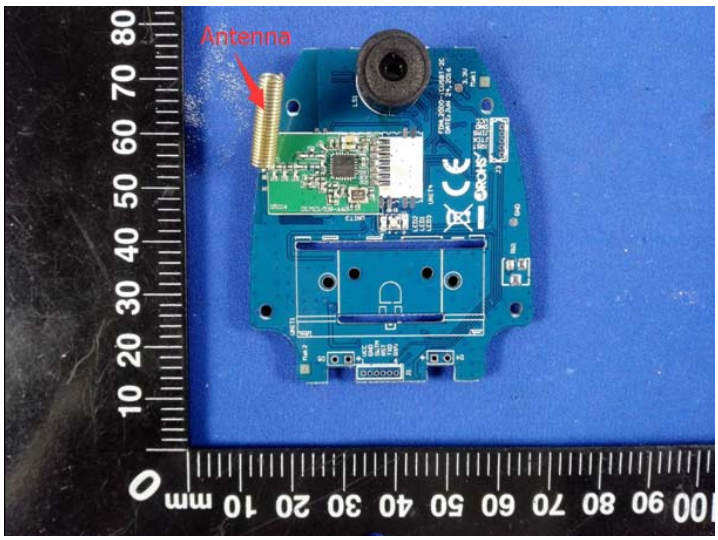
# 5. External and Internal Photos of the EUT

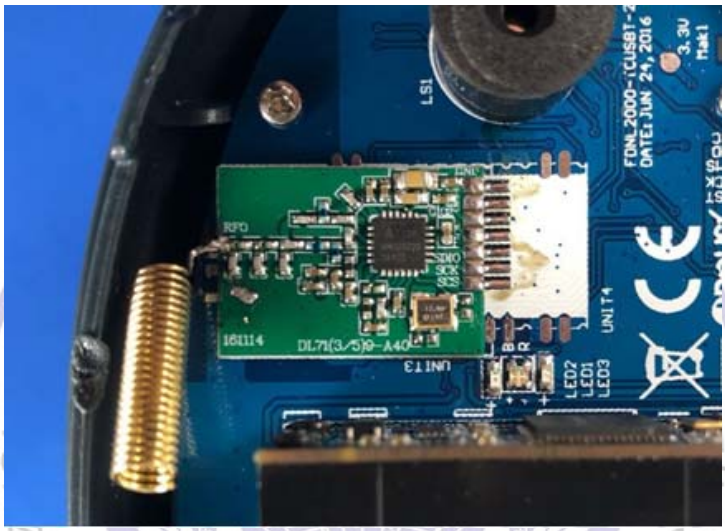
**External Photos of EUT**

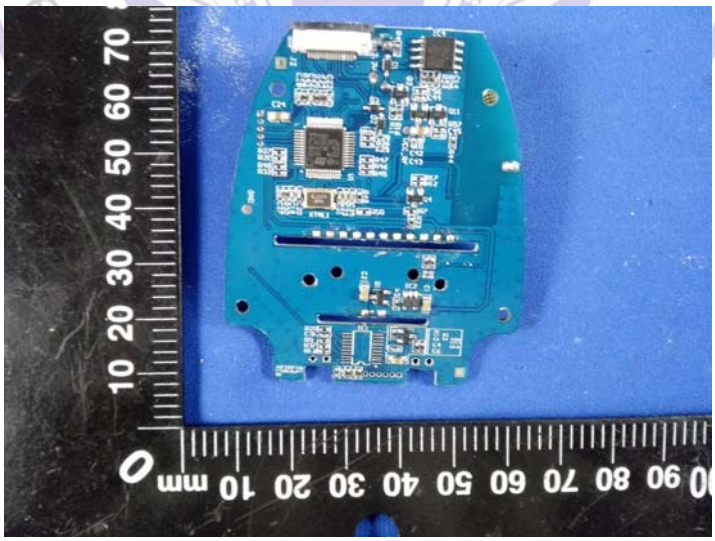


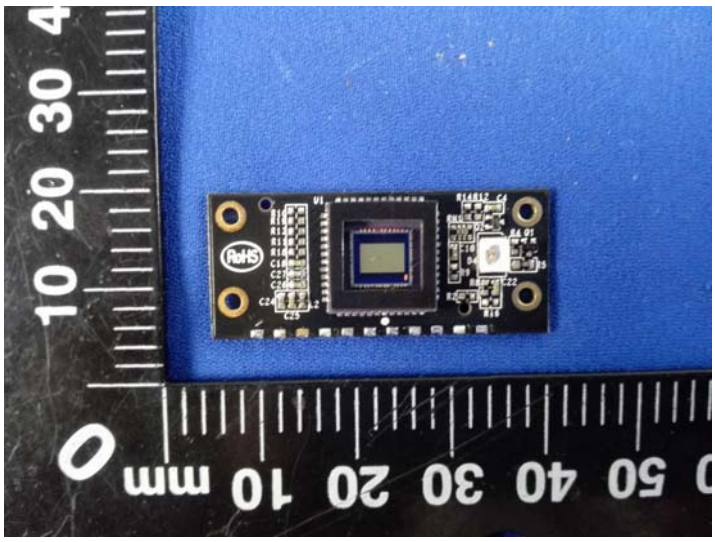
**Internal Photos of EUT**

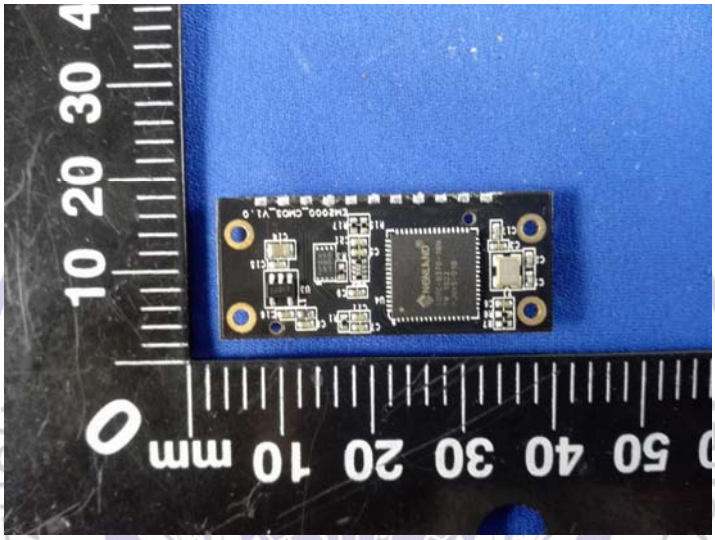


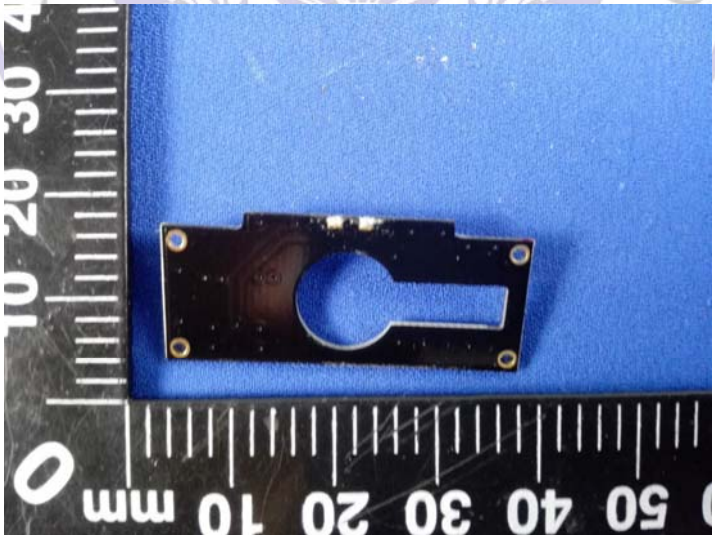

Antenna

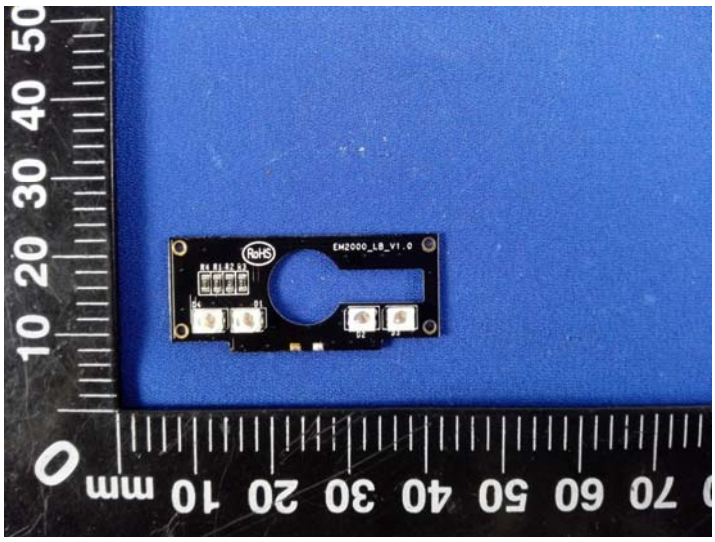

LS1
RFD
UNIT4
LED2
LED1
LED3
UNIT3

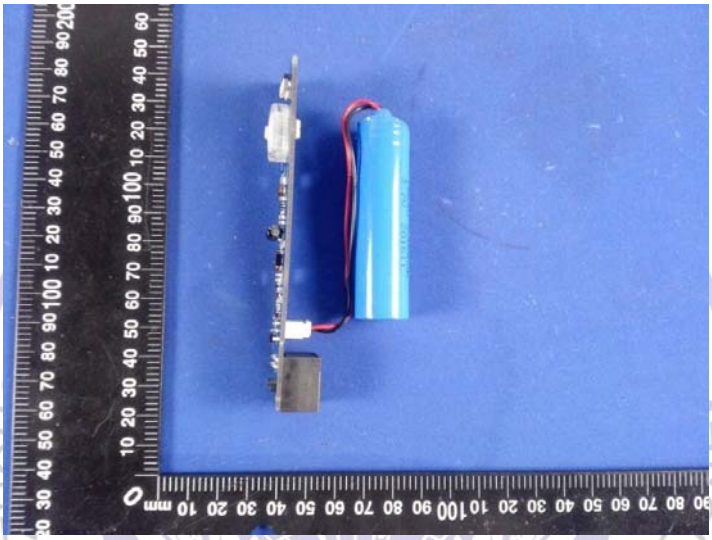


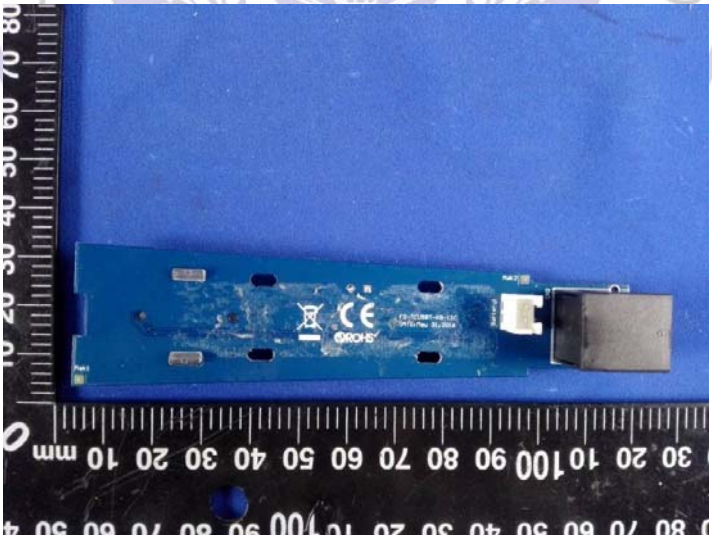


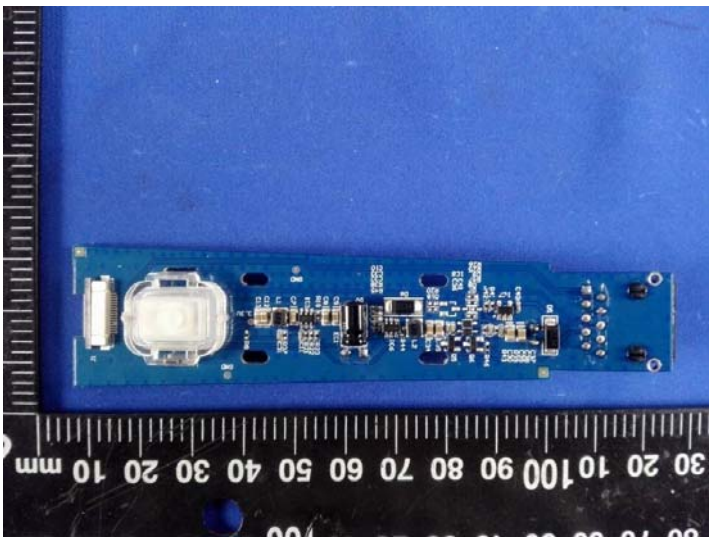


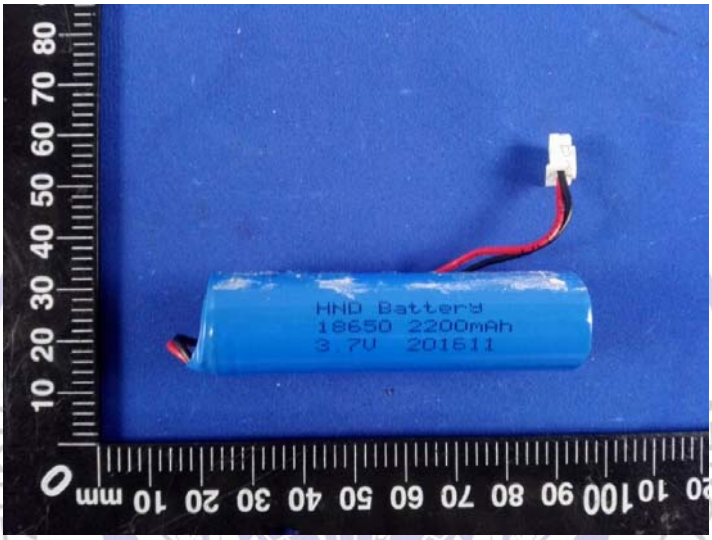













********** End of Report **********