# TEST REPORT

| | | |
|---|---|---|
| **Reference No.**..... | : | WTS17S0579239E |
| **FCC ID**..... | : | 2AL7Q-EE0354 |
| **Applicant**..... | : | ShenZhen EBELONG Technology Co., Ltd |
| **Address**..... | : | ShenZhen Wisdom Innovation Center Suite A. 607, Qianjin 2nd Road, Baoan District, ShenZhen, GuangDong, China |
| **Manufacturer**..... | : | The same as above |
| **Address**..... | : | The same as above |
| **Product Name**..... | : | Wireless Kinetic Energy Switch |
| **Model No.** ..... | : | EQ0114, EQ0122, EE0154, EQ0214, EQ0222, EE0254, EQ0314, EQ0322, EE0354 |
| **Standards**..... | : | FCC CFR47 Part 15 Section C 15.231: 2016 |
| **Date of Receipt sample**.... | : | May 15, 2017 |
| **Date of Test**..... | : | May 16–Jun. 04, 2017 |
| **Date of Issue**..... | : | Jun. 05, 2017 |
| **Test Result**..... | : | **Pass** |

Remarks:
The 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.


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# 2 Contents

# 3 Report Revision History

| Test report No. | Date of Receipt sample | Date of Test | Date of Issue | Purpose | Comment | Approved |
|---|---|---|---|---|---|---|
| WTS17S0579239E | May 15, 2017 | May 16– Jun. 04, 2017 | Jun. 05, 2017 | original | - | Valid |

# 4 General Information

## 4.1 General Description of E.U.T.

| | |
|---|---|
| Product Name | Wireless Kinetic Energy Switch |
| Model No. | EQ0114, EQ0122, EE0154, EQ0214, EQ0222, EE0254, EQ0314, EQ0322, EE0354 |

Model Difference:

| Product Name | Model No. | Number of Keys | Difference Description |
|---|---|---|---|
| Wireless Kinetic Energy Switch | EQ0114 | 1 key | Only the model name is difference |
| | EQ0122 | | |
| | EE0154 | | |
| | EQ0214 | 2 key | Only the model name is difference |
| | EQ0222 | | |
| | EE0254 | | |
| | EQ0314 | 3 key | Only the model name is difference |
| | EQ0322 | | |
| | EE0354 | | |
| For all above models are the same radio module and antenna, only the number of keys is difference. The model EE0354 is the tested sample. | | | |

Type of Modulation : FSK

Frequency Range : 433.30 MHz

The Lowest Oscillator : 12.80 MHz

Antenna installation : Single whip antenna

## 4.2 Details of E.U.T.

Technical Data : Energy Harvesting from self-generating.

## 4.3 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode | High channel |
|---|---|
| Transmitting | 433.30MHz |

## 4.4 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

  Waltek Services (Shenzhen) Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, October 15, 2015

- **FCC Test Site– Registration No.: 328995**

  Waltek Services(Shenzhen) 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 328995, December 3, 2014.

# 5 Equipment Used during Test

## 5.1 Equipments List

| 3m Semi-anechoic Chamber for Radiation Emissions | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1 | Spectrum Analyzer | R&S | FSP | 100091 | Apr. 29, 2017 | Apr. 28, 2018 |
| 2 | Amplifier | Agilent | 8447D | 2944A10178 | Jan. 12, 2017 | Jan. 11, 2018 |
| 3 | Active Loop Antenna | Beijing Dazhi | ZN30900A | 0703 | Oct. 17, 2016 | Oct. 16, 2017 |
| 4 | Trilog Broadband Antenna | SCHWARZBECK | VULB9163 | 336 | Apr. 07, 2017 | Apr. 06, 2018 |
| 5 | Coaxial Cable (below 1GHz) | Top | TYPE16(13M) | - | Sep.12, 2016 | Sep.11, 2017 |
| 6 | Broad-band Horn Antenna | SCHWARZBECK | BBHA 9120 D | 667 | Apr. 07, 2017 | Apr. 06, 2018 |
| 7 | Broadband Preamplifier | COMPLIANCE DIRECTION | PAP-1G18 | 2004 | Apr. 07, 2017 | Apr. 06, 2018 |
| 8 | Coaxial Cable (above 1GHz) | Top | 1GHz-18GHz | EW02014-7 | Apr. 07, 2017 | Apr. 06, 2018 |
| 9 | Test Receiver | R&S | ESCI | 101296 | Apr. 06, 2017 | Apr. 05, 2018 |
| 10 | Trilog Broadband Antenna | SCHWARZBECK | VULB9160 | 9160-3325 | Apr. 07, 2017 | Apr. 06, 2018 |
| 11 | Amplifier | ANRITSU | MH648A | M43381 | Apr. 07, 2017 | Apr. 06, 2018 |
| 12 | Cable | HUBER+SUHNER | CBL2 | 525178 | Apr. 07, 2017 | Apr. 06, 2018 |
| **RF Conducted Testing** | | | | | | |
| **Item** | **Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Last Calibration Date** | **Calibration Due Date** |
| 1. | EMC Analyzer (9k~26.5GHz) | Agilent | E7405A | MY45114943 | Sep.12, 2016 | Sep.11, 2017 |
| 2. | Spectrum Analyzer (9k-6GHz) | R&S | FSL6 | 100959 | Sep.12, 2016 | Sep.11, 2017 |
| 3. | Signal Analyzer (9k~26.5GHz) | Agilent | N9010A | MY50520207 | Sep.12, 2016 | Sep.11, 2017 |

## 5.2 Measurement Uncertainty

| Test Item | Frequency Range | Uncertainty | Note |
|---|---|---|---|
| Conducted Emissions | 150kHz~30MHz | ±3.64dB | (1) |
| Radiated Spurious Emissions | 30MHz~1000MHz | ±5.03dB | (1) |
| | 1000M~6000MHz | ± 5.47 dB | (1) |

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

## 5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

# 6 Test Summary

| Test Items | Test Requirement | Result |
|---|---|---|
| Conducted Emissions | 15.207 | N/A |
| Radiated Spurious Emissions | 15.205(a)<br>15.209<br>15.231(a) | C |
| Periodic Operation | 15.231(a) | C |
| Emission Bandwidth | 15.231(c) | C |
| Antenna Requirement | 15.203 | C |
| SAR | 1.1307(b)(1) | C |
| Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable | | |

# 7 Radiated Spurious Emissions

Test Requirement: FCC Part15 Paragraph 15.231(a)

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

| Fundamental Frequency (MHz) | Field Strength of Fundamental (uV/m) | Field Strength of Fundamental (dBuV/m) | Field Strength of Spurious Emission (uV/m) | Field Strength of Spurious Emission (dBuV/m) |
|---|---|---|---|---|
| 44.66-40.70 | 2250 | 67 | 225 | 47 |
| 70-130 | 1250 | 62 | 125 | 42 |
| 130-174 | 1250 to 3750 | 62 to 71.48 | 125 to 375 | 42 to 51.48 |
| 174-260 | 3750 | 71.48 | 375 | 51.48 |
| 260-470 | 3750 to 12500 | 71.48 to 81.94 | 375 to 1250 | 51.48 to 61.94 |
| Above 470 | 12500 | 81.94 | 1250 | 61.94 |
| aa** linear interpolations | | | | |

## 7.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

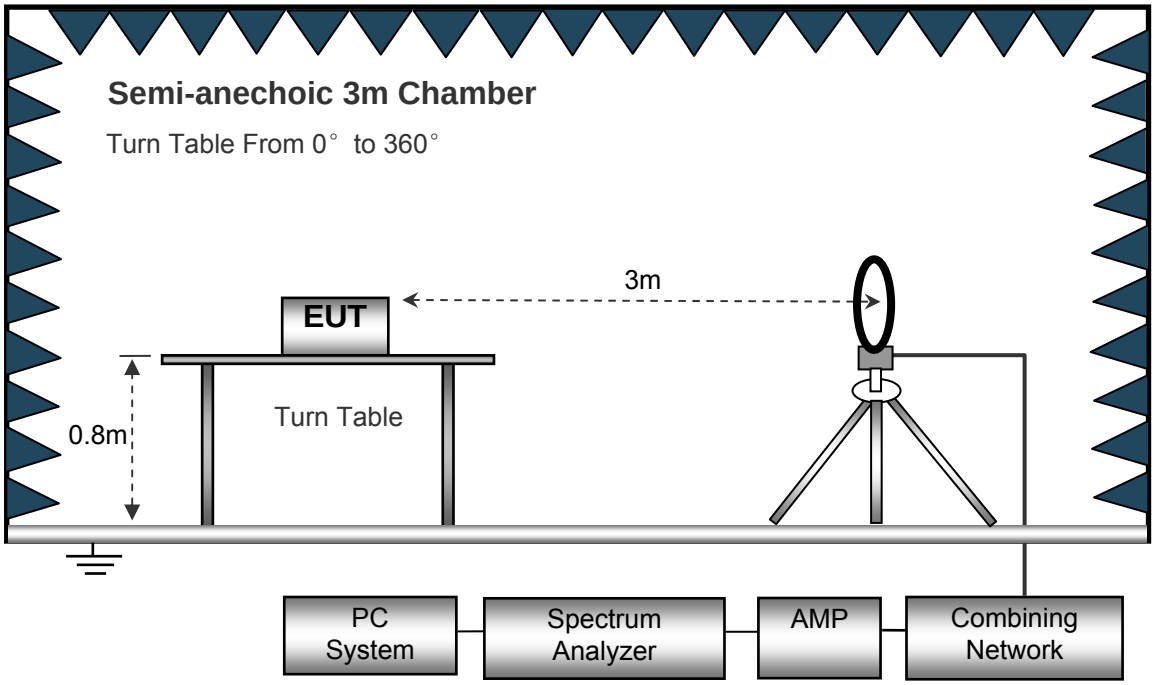
EUT Operation **:**

The test was performed in transmitting mode, the test data were shown in the report.

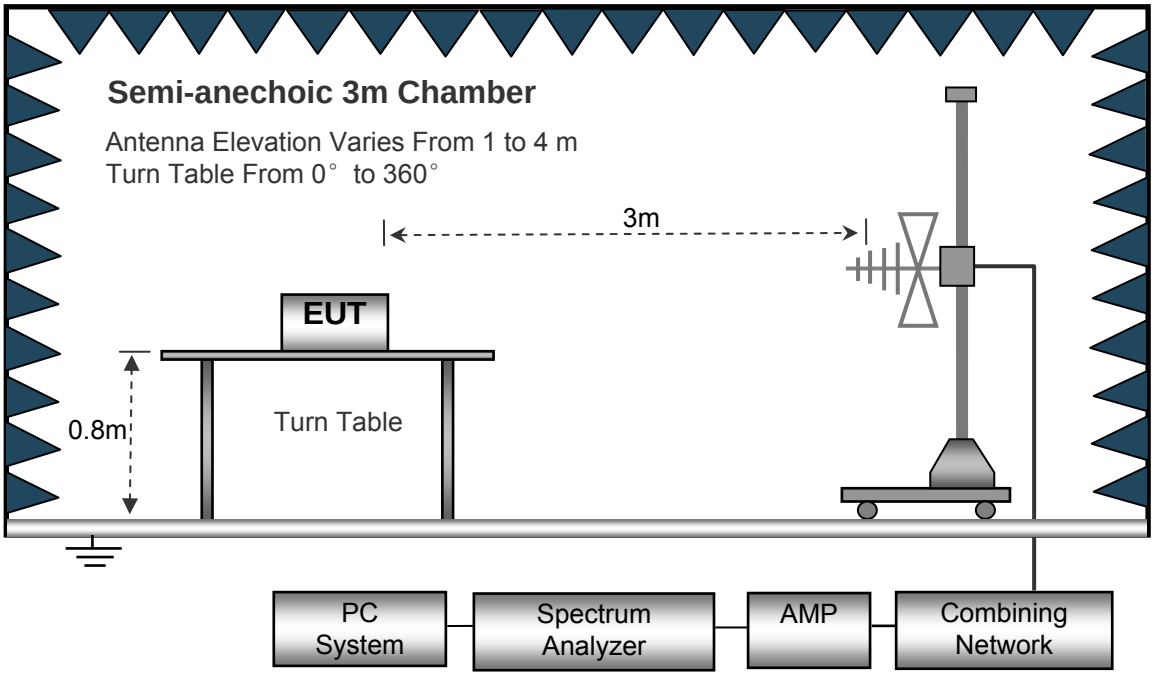
## 7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

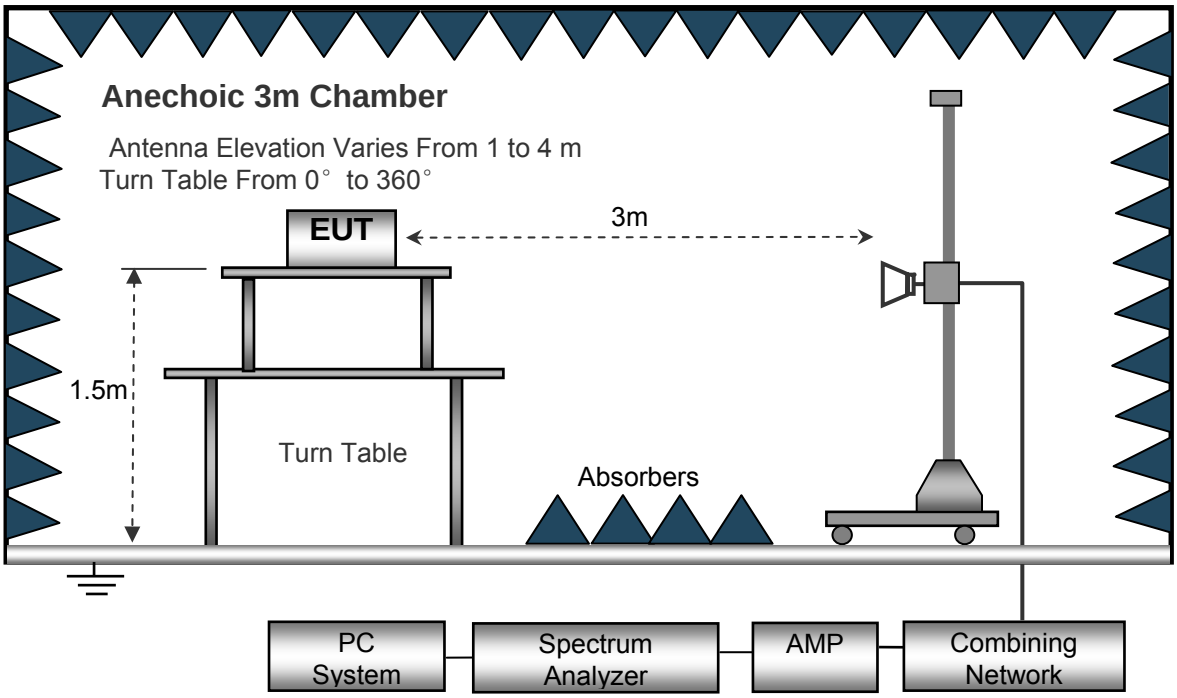
The test setup for emission measurement below 30MHz.




The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.




## 7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz

## 7.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above1GHz, the EUT is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

## 7.5 Summary of Test Results

**Test Frequency: 9 KHz~30 MHz**

The measurements were more than 20 dB below the limit and not reported.

**Test Frequency: 30MHz ~ 5GHz**

**High channel: 433.30MHz**

| Frequency | Receiver Reading (PK) | Turn table Angle | RX Antenna | | Corrected Factor | Corrected Amplitude (PK) | FCC Part 15.231/15.209/205 | |
|---|---|---|---|---|---|---|---|---|
| | | | Height | Polar | | | Limit | Margin |
| (MHz) | (dBμV) | Degree | (m) | (H/V) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) |
| 433.30 | 99.75 | 129 | 1.1 | H | -7.11 | 92.64 | 100.80 | -8.16 |
| 433.30 | 100.12 | 132 | 1.7 | V | -7.11 | 93.01 | 100.80 | -7.79 |
| 866.60 | 71.23 | 269 | 1.6 | H | 0.04 | 71.27 | 80.80 | -9.53 |
| 866.60 | 72.35 | 51 | 1.7 | V | 0.04 | 72.39 | 80.80 | -8.41 |
| 1913.25 | 65.34 | 208 | 1.9 | H | -16.38 | 48.96 | 74.00 | -25.04 |
| 1913.25 | 65.12 | 342 | 1.6 | V | -16.38 | 48.74 | 74.00 | -25.26 |
| 2347.12 | 59.31 | 278 | 1.5 | H | -14.87 | 44.44 | 74.00 | -29.56 |
| 2347.12 | 58.68 | 270 | 2.0 | V | -14.87 | 43.81 | 74.00 | -30.19 |

**AV = Peak +20Log$_{10}$ (duty cycle) =PK+ (-19.17)** [refer to section 8 for more detail]

| Frequency | PK | RX Antenna Polar | Duty cycle Factor | Calculated AV | FCC Part 15.231/209/205 | |
|---|---|---|---|---|---|---|
| | | | | | Limit | Margin |
| (MHz) | (dBμV/m) | (H/V) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| 433.30 | 92.64 | H | -19.17 | 73.47 | 80.80 | -7.33 |
| 433.30 | 93.01 | V | -19.17 | 73.84 | 80.80 | -6.96 |
| 866.60 | 71.27 | H | -19.17 | 52.10 | 60.80 | -8.70 |
| 866.60 | 72.39 | V | -19.17 | 53.22 | 60.80 | -7.58 |
| 1913.25 | 48.96 | H | -19.17 | 29.79 | 54.00 | -24.21 |
| 1913.25 | 48.74 | V | -19.17 | 29.57 | 54.00 | -24.43 |
| 2347.12 | 44.44 | H | -19.17 | 25.27 | 54.00 | -28.73 |
| 2347.12 | 43.81 | V | -19.17 | 24.64 | 54.00 | -29.36 |

# 8 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, The duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle (%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

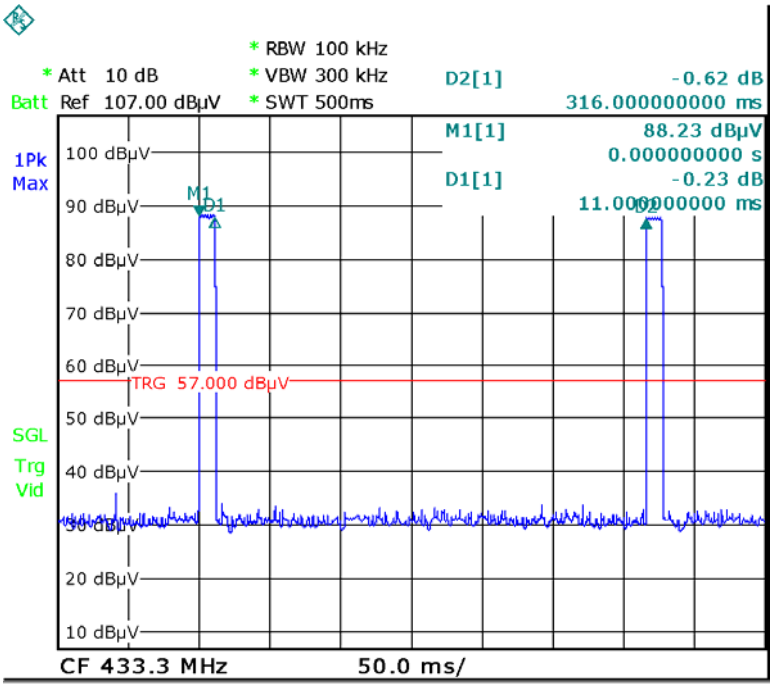
Duty Cycle Correction Factor (dB) =20 * $Log_{10}$ (Duty Cycle (%))

Pulse-repetition frequency (Hz) =1/ Pulse duration(s)

| | |
|---|---|
| Total transmission time(ms) | 11.0 |
| Pulse duration(s) | 0.305 |
| Pulse-repetition frequency(Hz) | 3.28 |
| Length of a complete transmission period(ms) | 100* |
| Duty Cycle (%) | 11.0 |
| Duty Cycle Correction Factor(dB) | -19.17 |

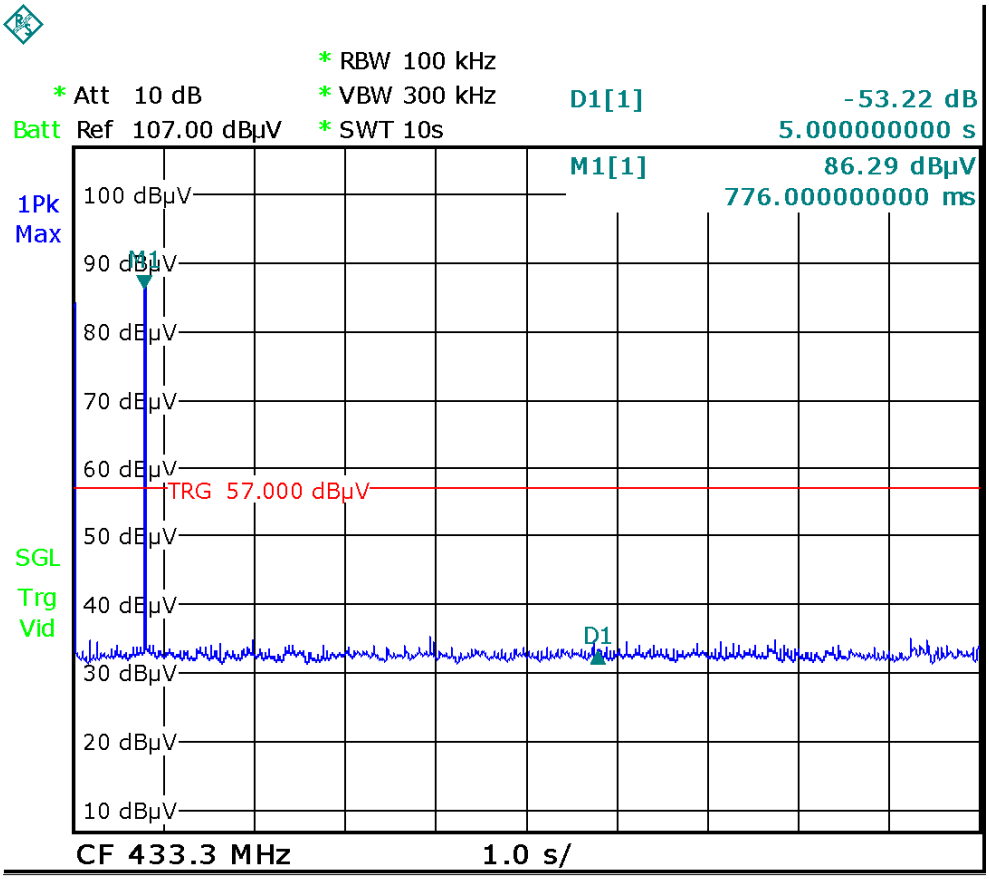
(* Note: the transmitter operates for longer than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. So the Length of a complete transmission period=100ms)

Refer to the duty cycle plot (as below),



FCC Part15.231 (a) (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.



# 9 Emission Bandwidth

Test Requirement: FCC Part15.231(c)

Test Method: FCC Part15.231(c)

Limit The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

## 9.1 Test Procedure

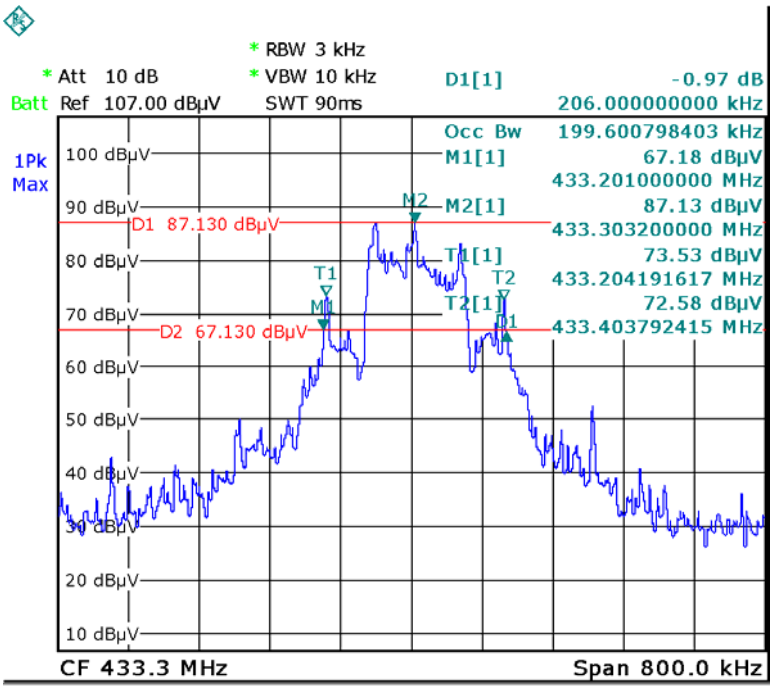
1. The transmitter output (antenna port) was connected to the spectrum analyzer.EUT and its simulators are placed on a table, let EUT working in test mode, then test it.
2. The bandwidth of the fundamental frequency was measure by spectrum analyser with 3 kHz RBW and 10 kHz VBW. The 20 dB bandwidth was recorded.

## 9.2 Test Result

| Frequency (MHz) | 20dB Bandwidth Emission(KHz) | 99% Bandwidth Emission(KHz) | Limit (KHz) | Result |
|---|---|---|---|---|
| 433.30 | 206.00 | 199.60 | 1083.25 | Compliance |

Limit=Center Frequency*0.25%

Test Plot



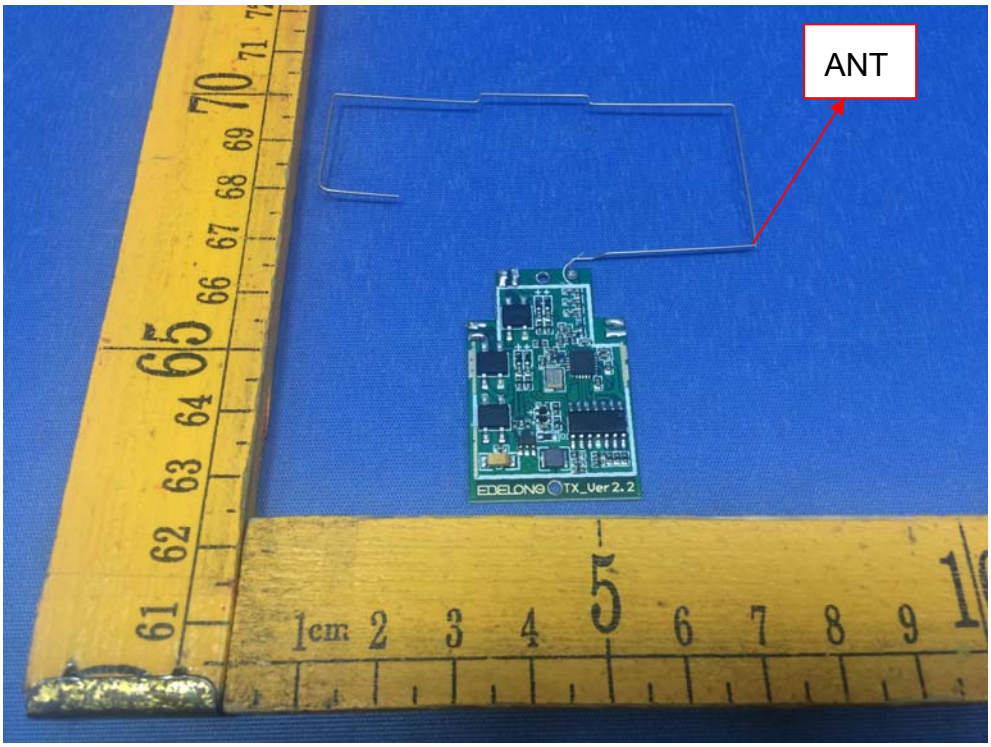
# 10 Antenna Requirement

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 replaced 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 §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 §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.

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Result:

The EUT has oneSingle whip antenna, the gain is 2 dBi. meets the requirements of FCC 15.203.



# 11 SAR Evaluation

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part2.1093 & 447498 D01 General RF Exposure Guidance v06

## 11.1 Requirements

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√f(GHz)] ≤3.0 for 1-g SAR and ≤7.5 for 10-g extremity SAR where

1. f(GHz) is the RF channel transmit frequency in GHz
2. Power and distance are rounded to the nearest mW and mm before calculation
3. The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

## 11.2 The procedures / limit

| Source-based time-averaged maximum output power(dBm) | Source-based time-averaged maximum output power(mW) | Minimum test separation distance required for the exposure conditions(mm) | SAR Test Exclusion Thresholds(mW) | Evaluation Result |
|---|---|---|---|---|
| -2.19 | 0.604 | 5 | 22.80 | Compliance |

Note: the following is Source-based time-averaged maximum output power Calculation

| Frequency | Source-based time-averaged maximum output power | Substituted (0dBm) | Source-based time-averaged maximum output power |
|---|---|---|---|
| (MHz) | (dBμV/m) | (dBμV/m) | (dBm) |
| 433.30 | 93.01 | 95.20 | -2.19 |

## 11.3 Result: Compliance

No SAR measurement is required.

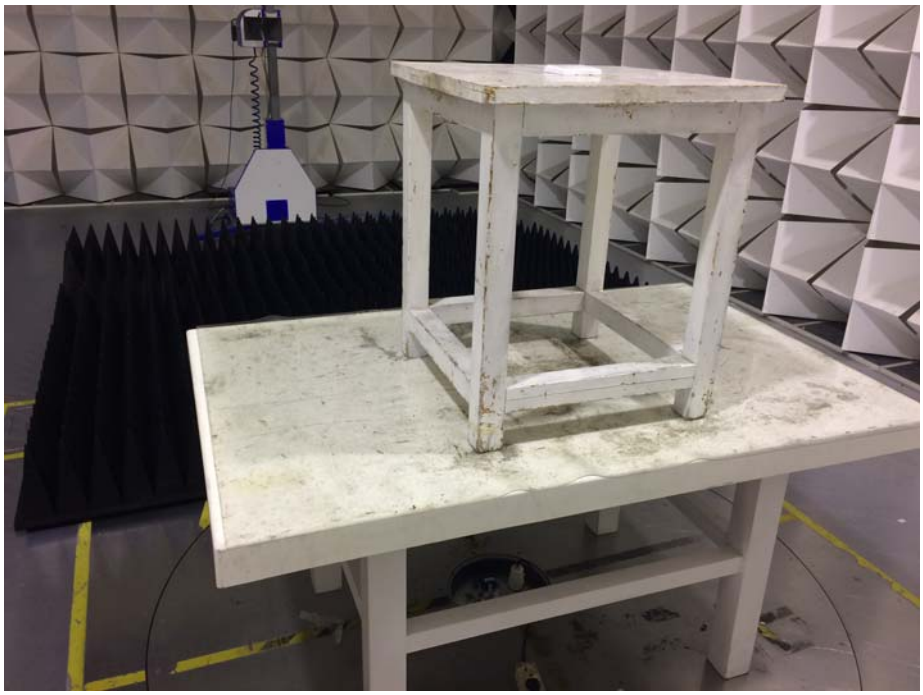
# 12 Photographs – Model EE0354 Test Setup

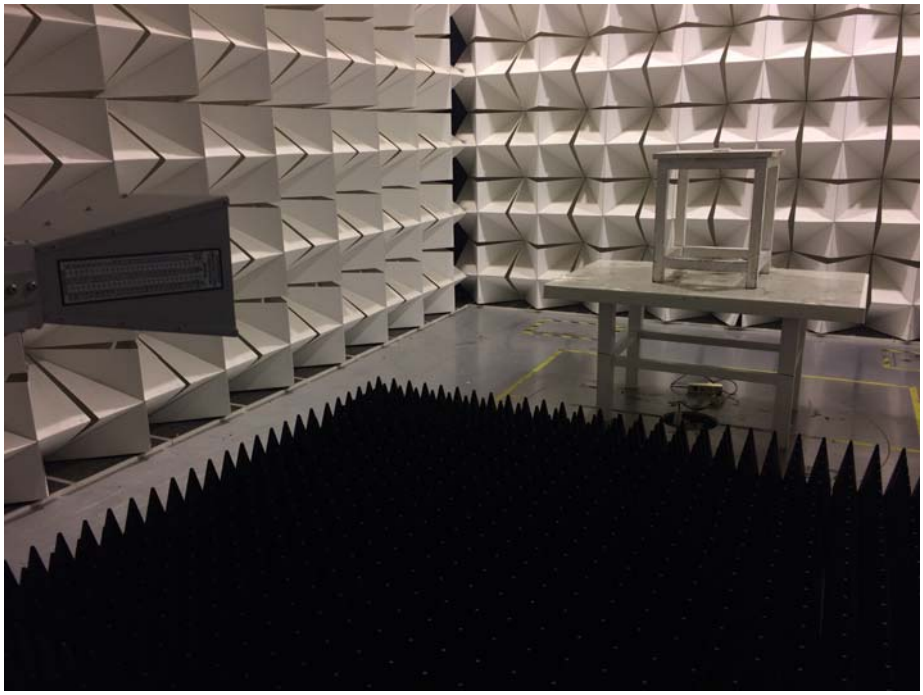
## 12.1 Photograph – Radiation Spurious Emission Test Setup

From 9KHz to 30MHz

From 30MHz to 1GHz

From 1GHz to 5GHz

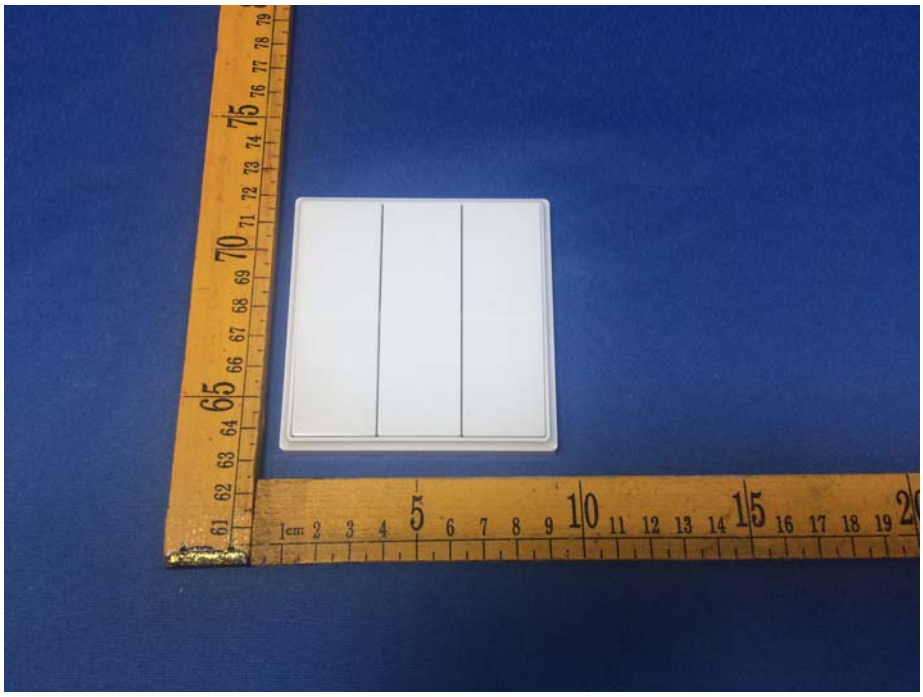


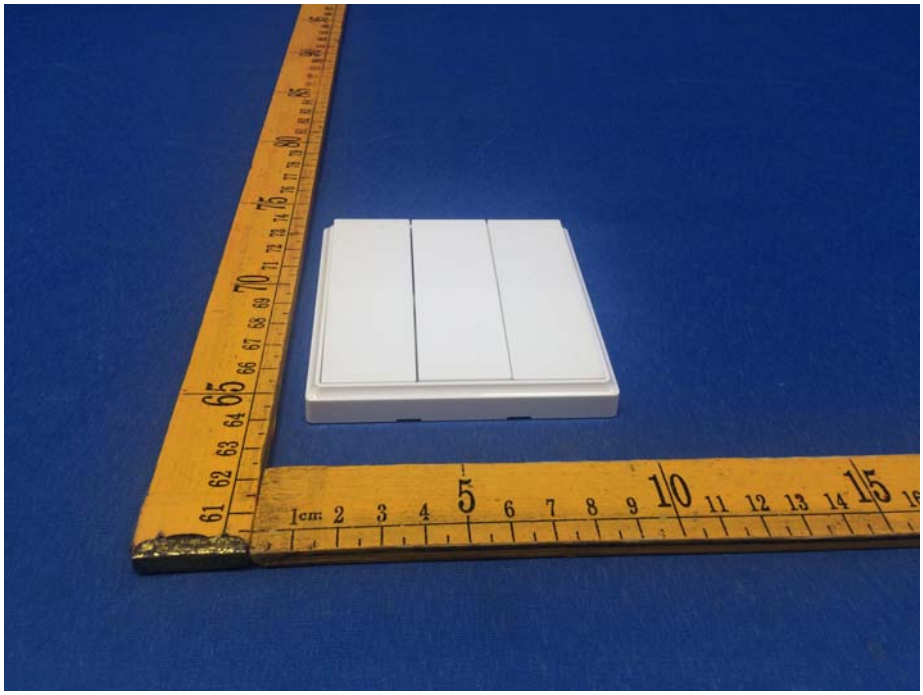


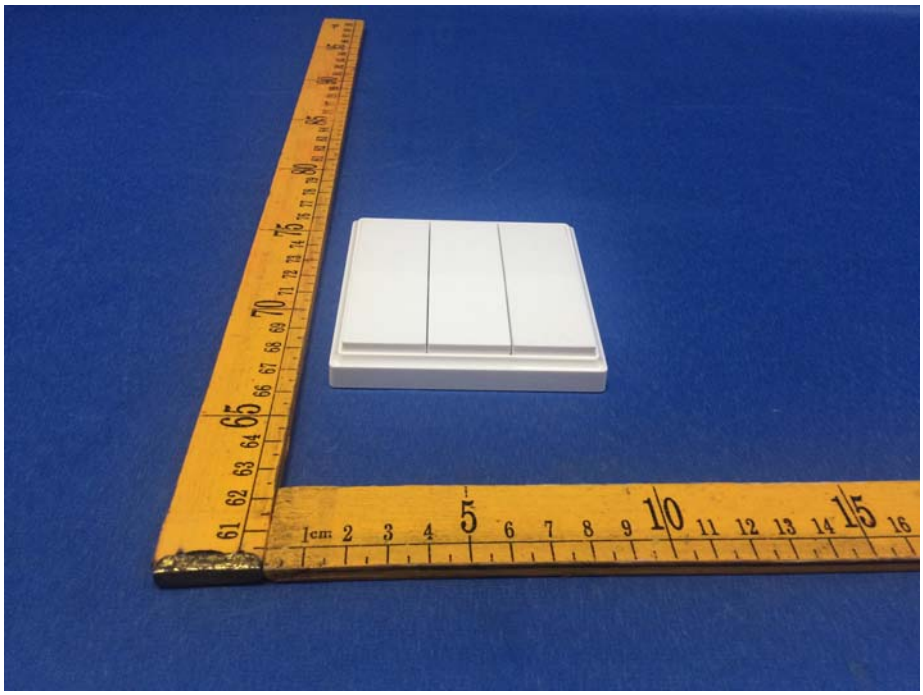
# 13 Photographs - Constructional Details

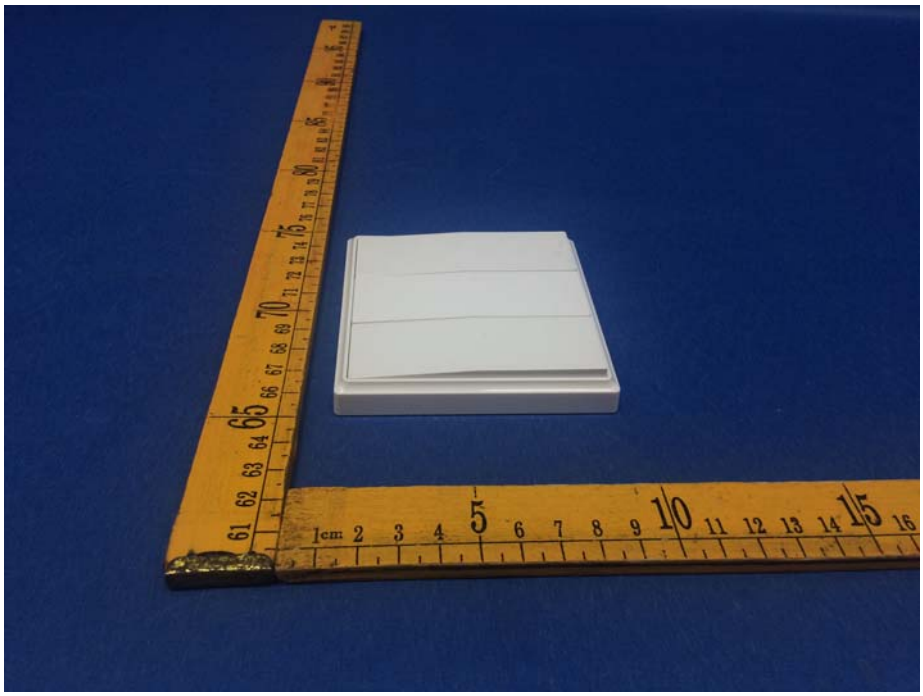
## 13.1 EUT- External Photos

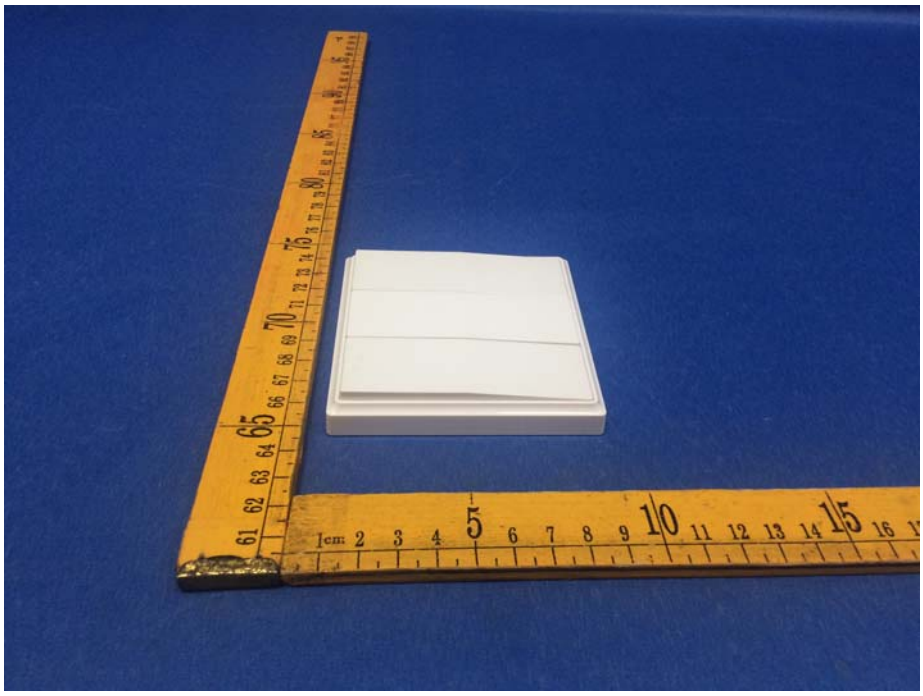
Model: EE0354

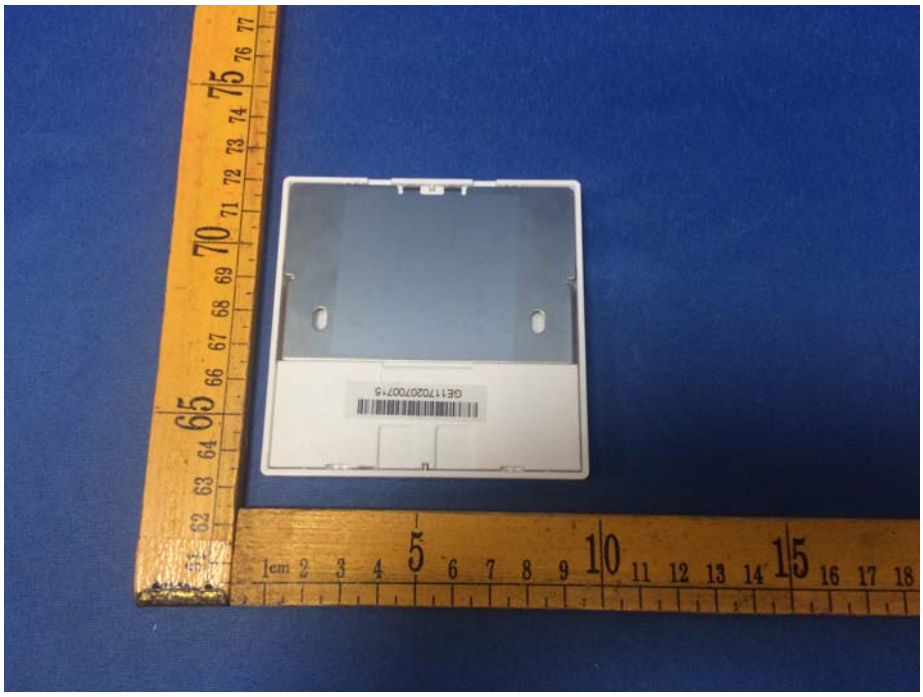




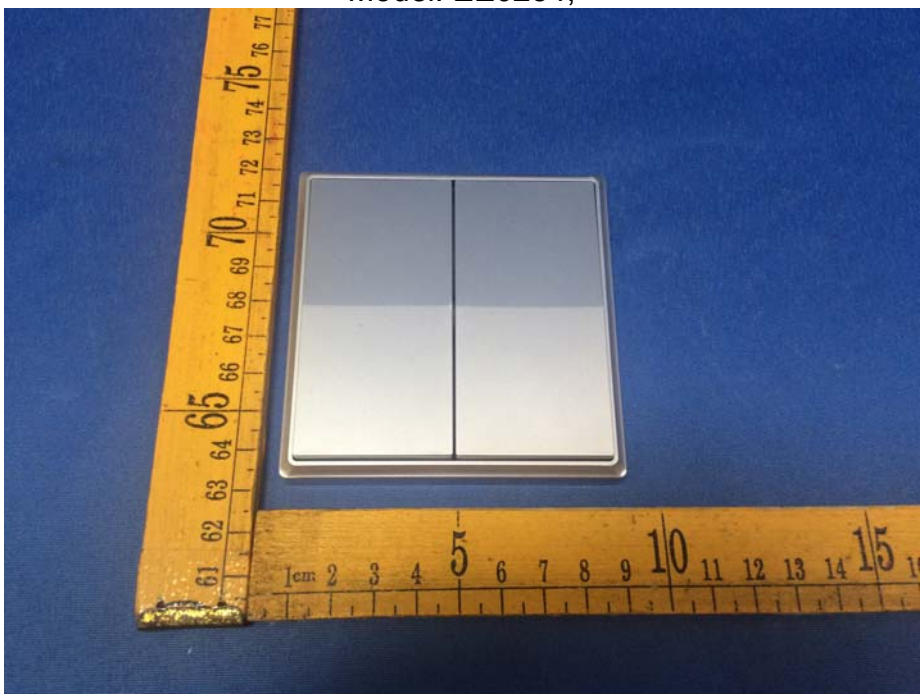


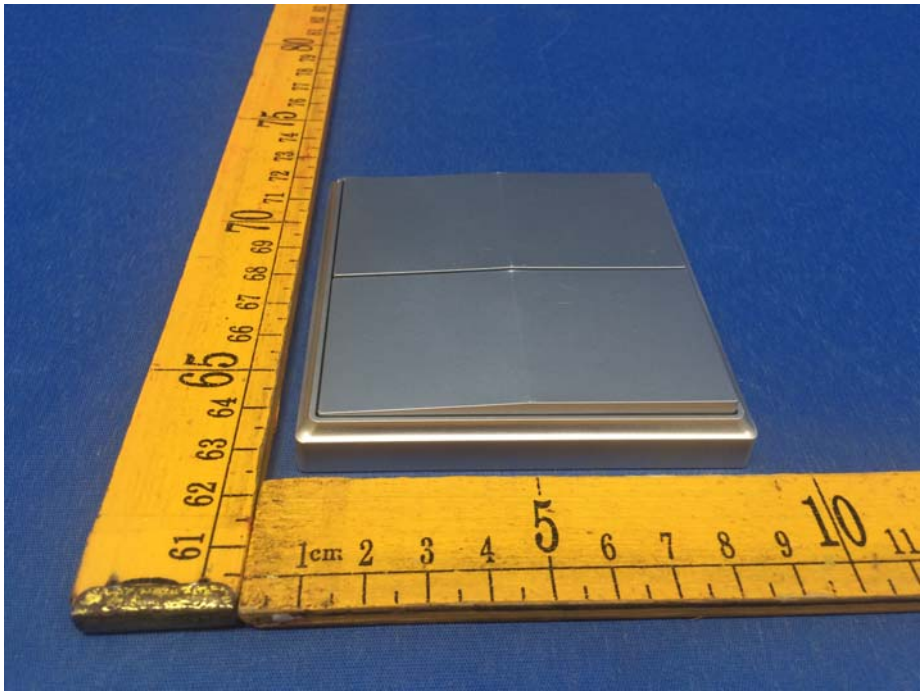


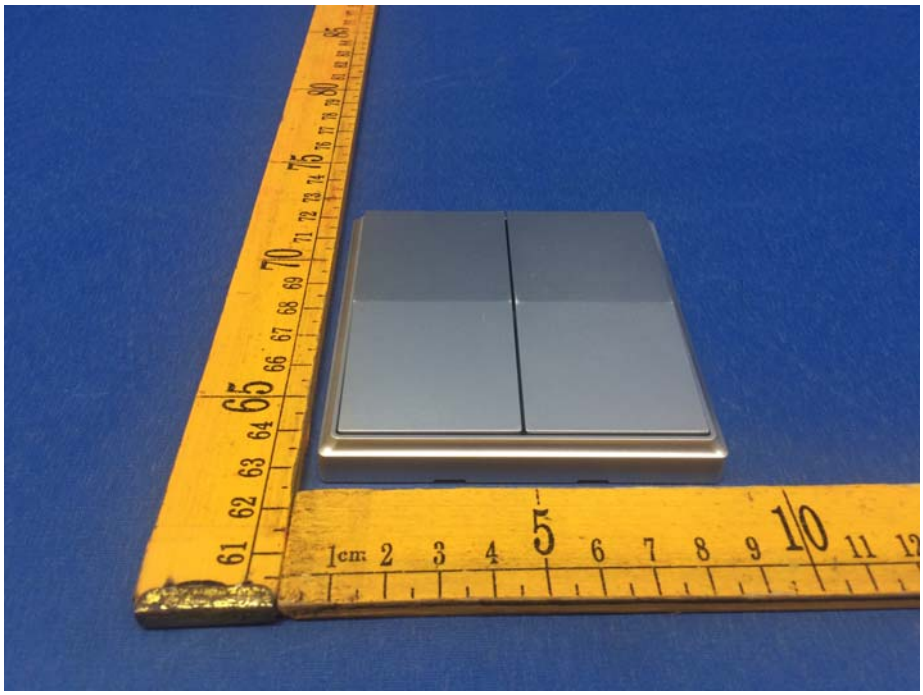


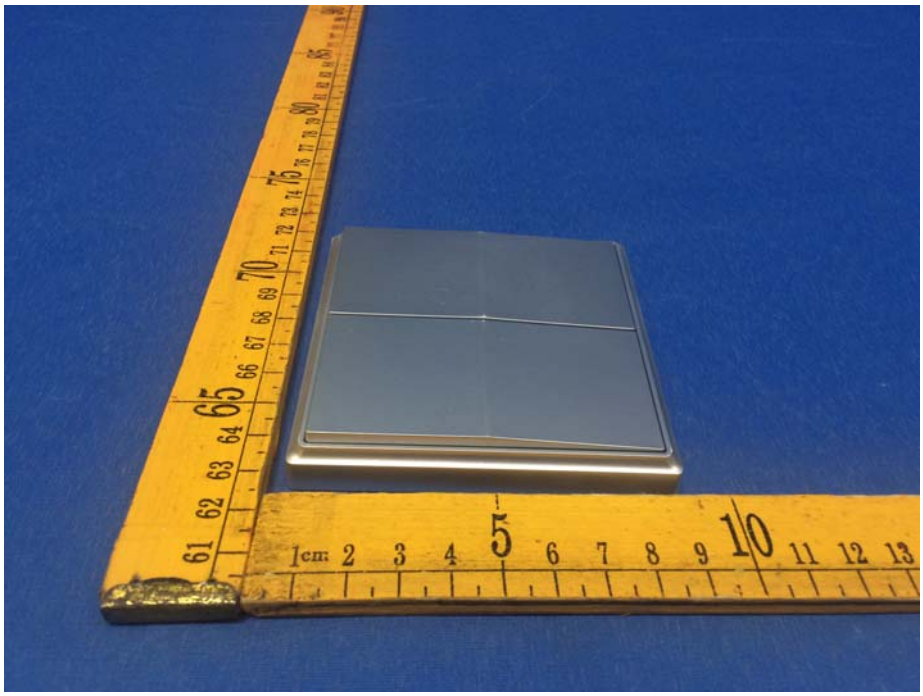


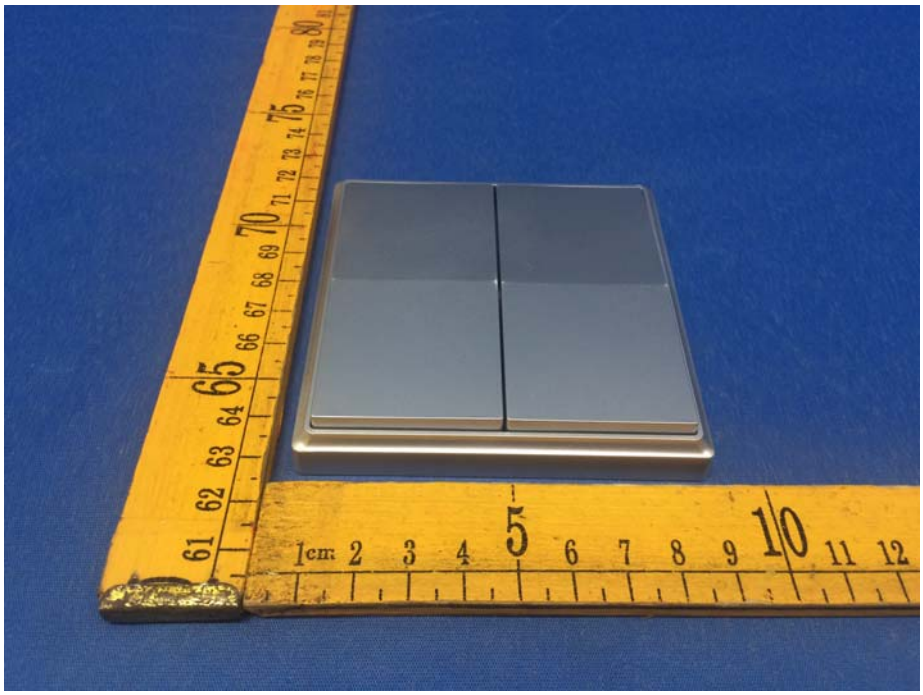
Model: EE0254,

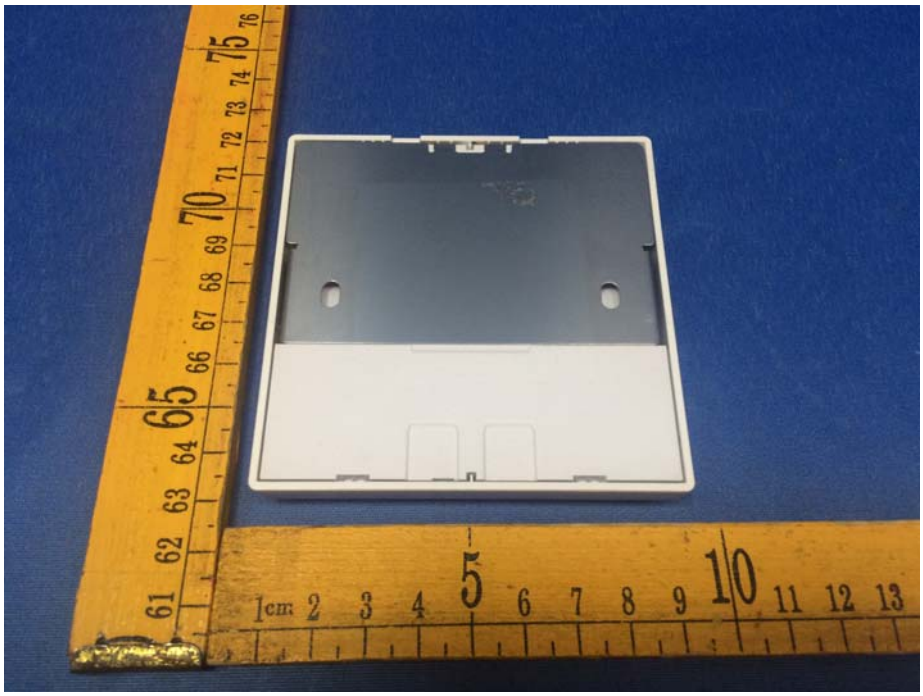




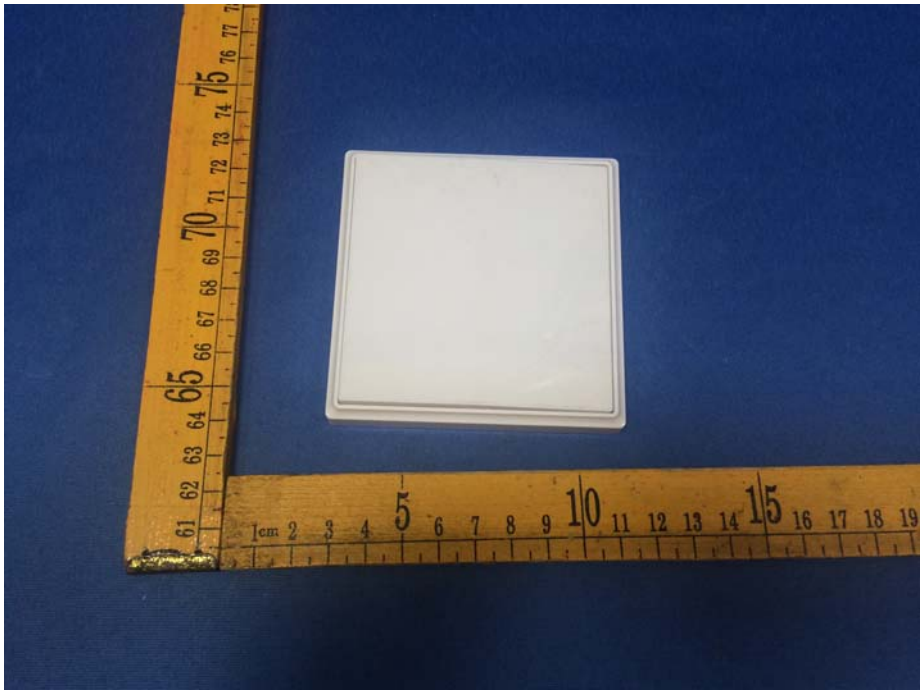


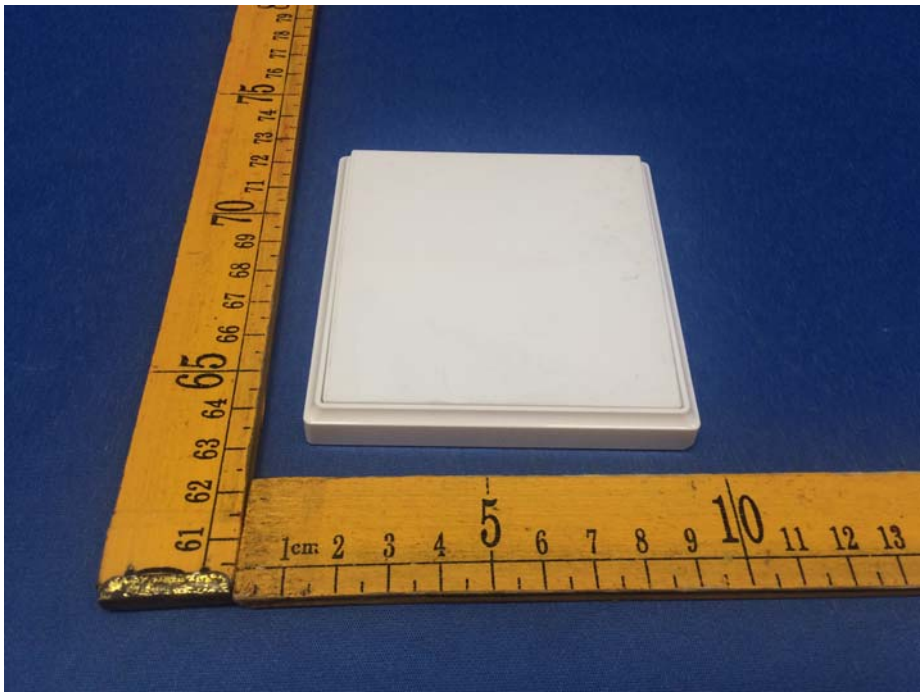


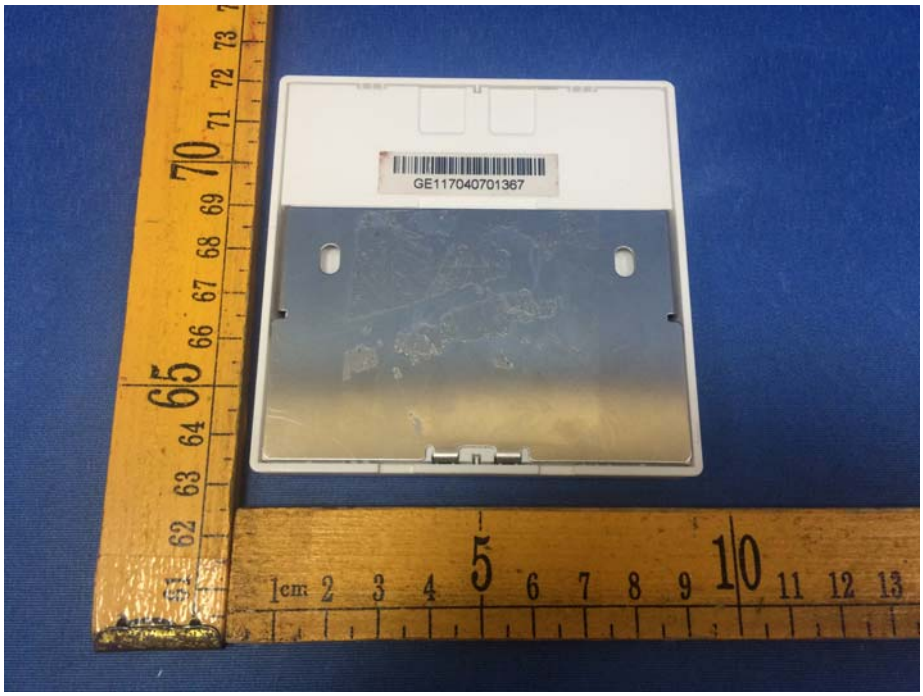




Model:EE0154






GE117040701367

## 13.2 EUT- Internal Photos

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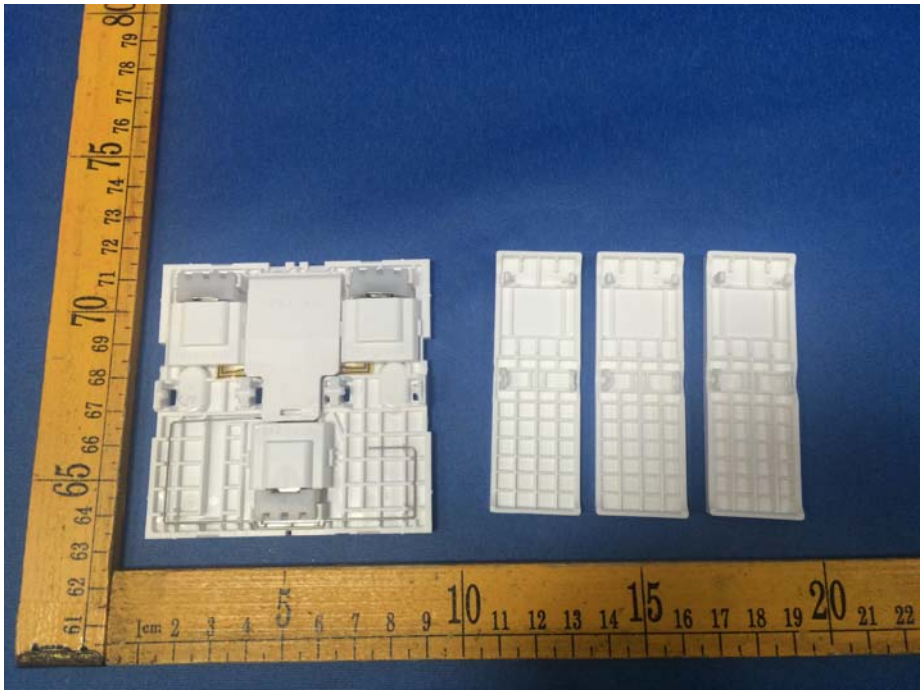
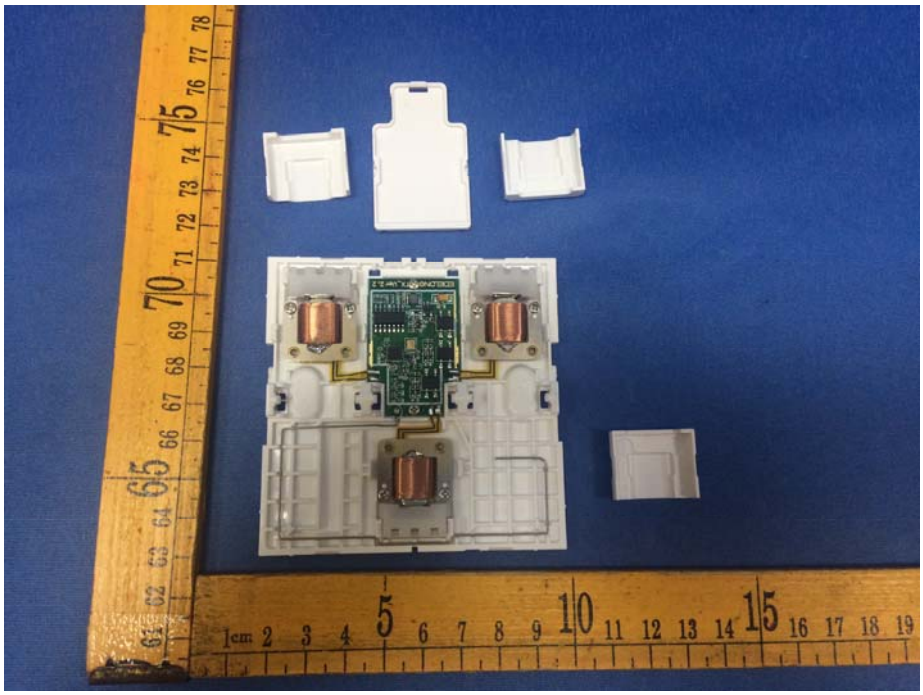
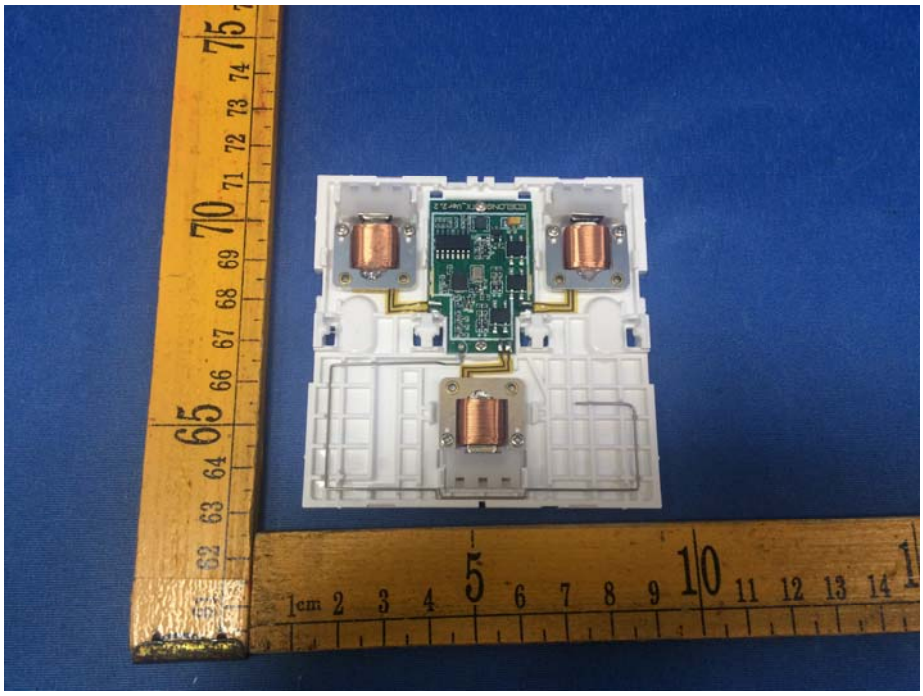
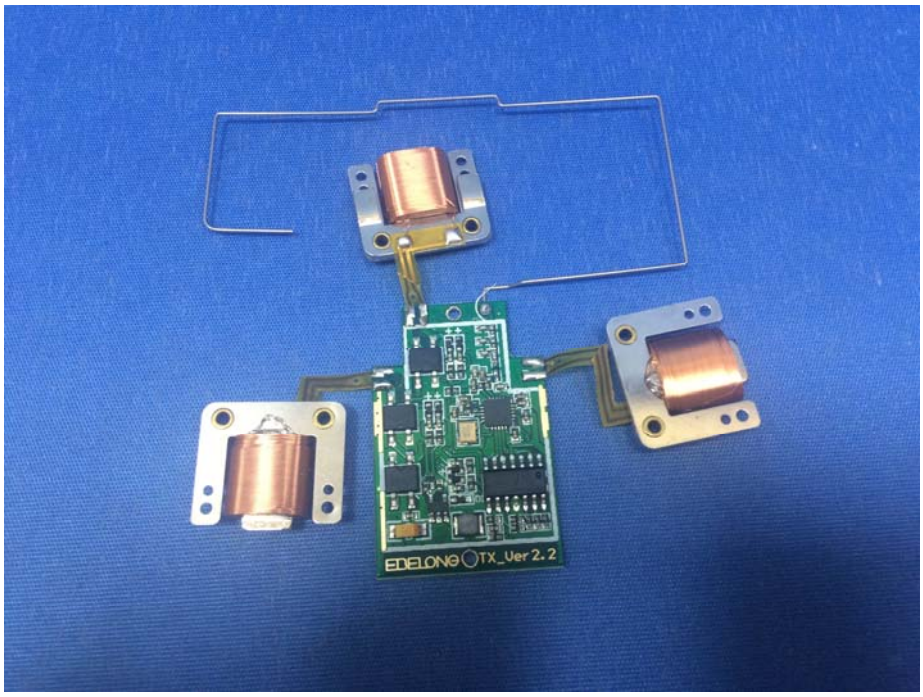
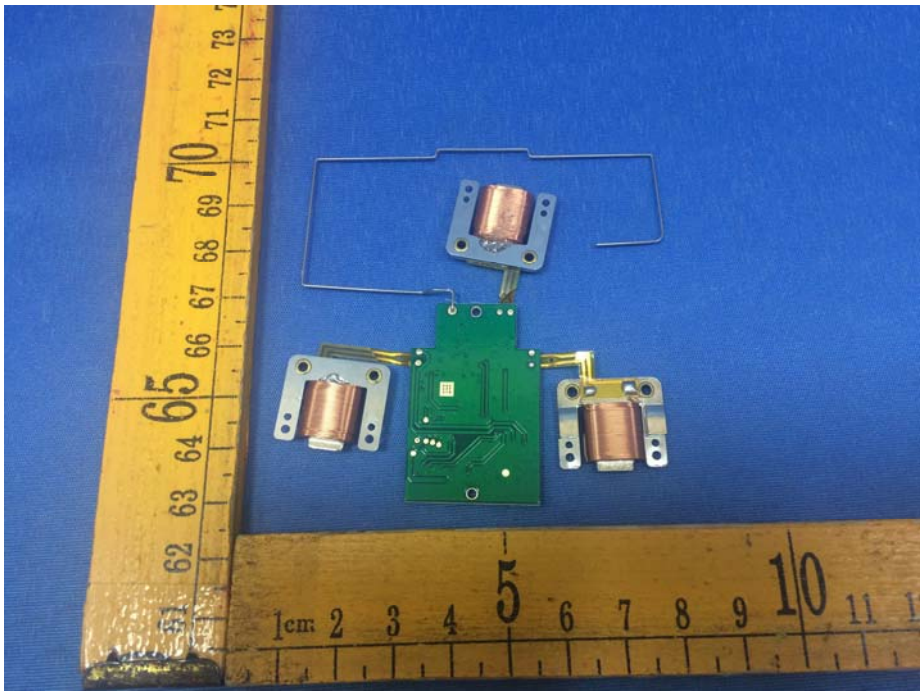
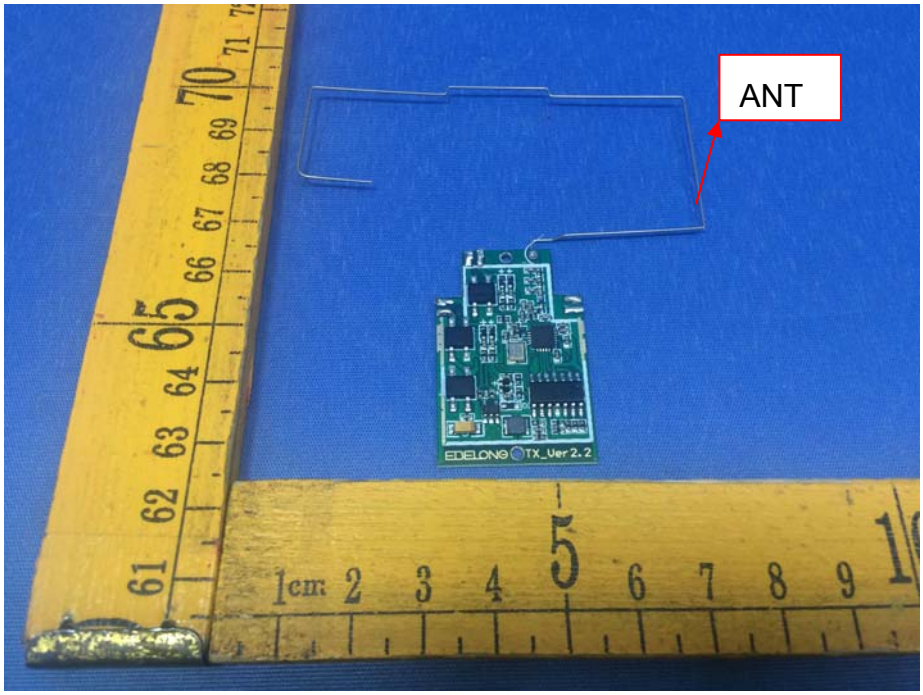







EDELONG TX_Ver 2.2

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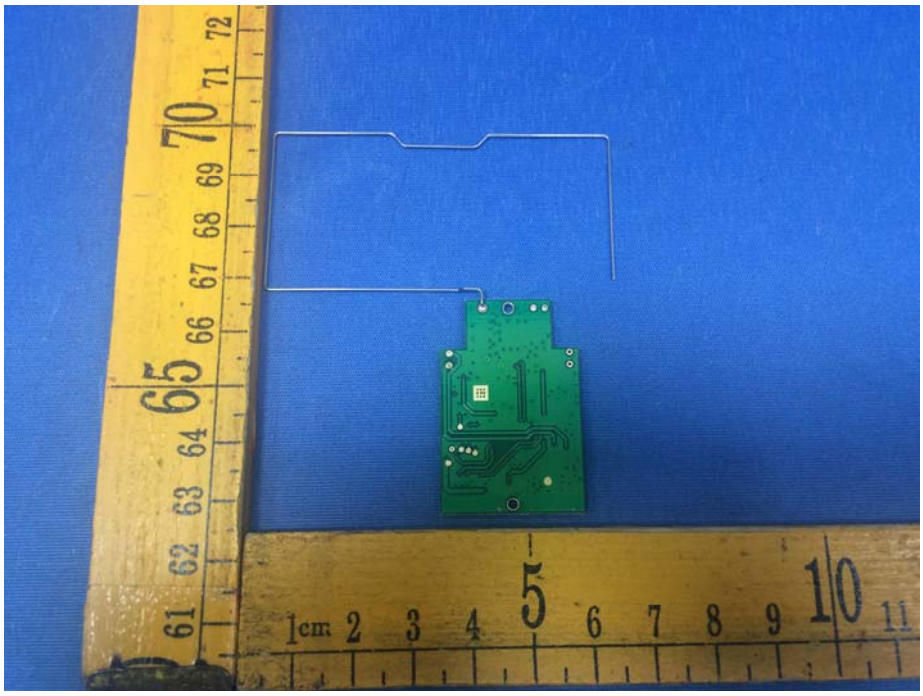
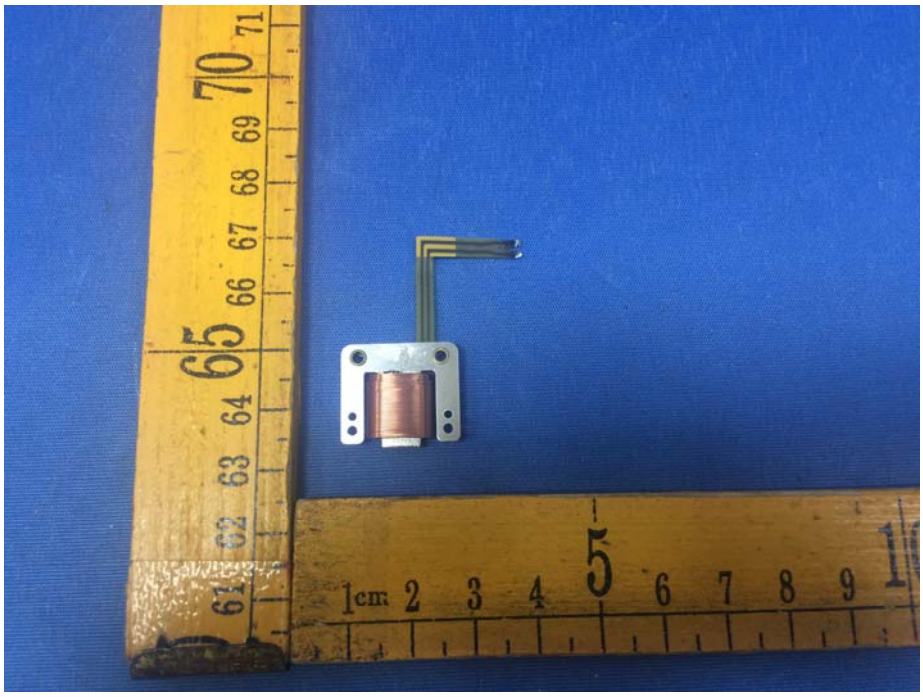
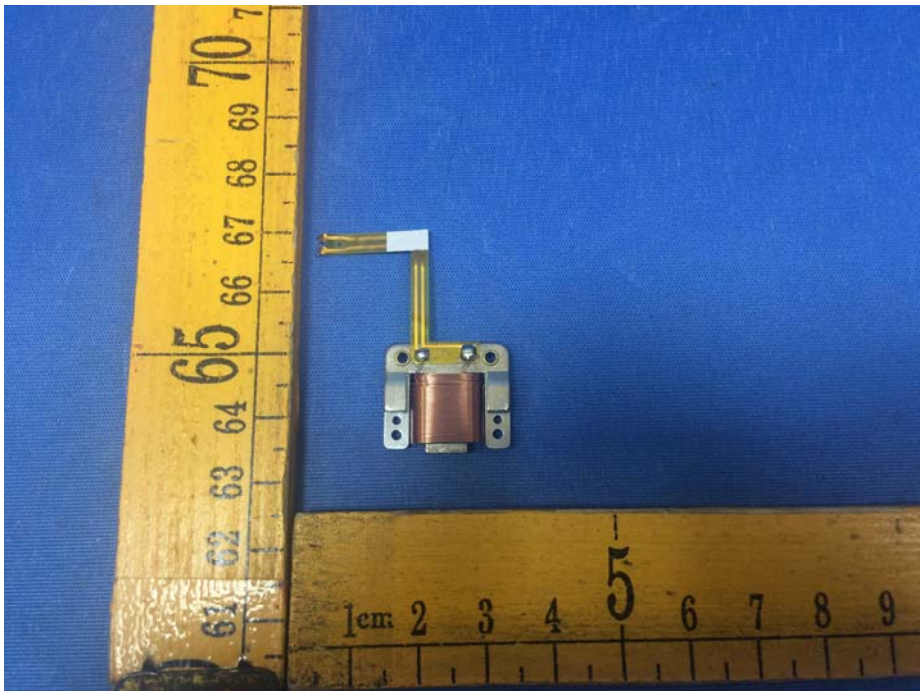
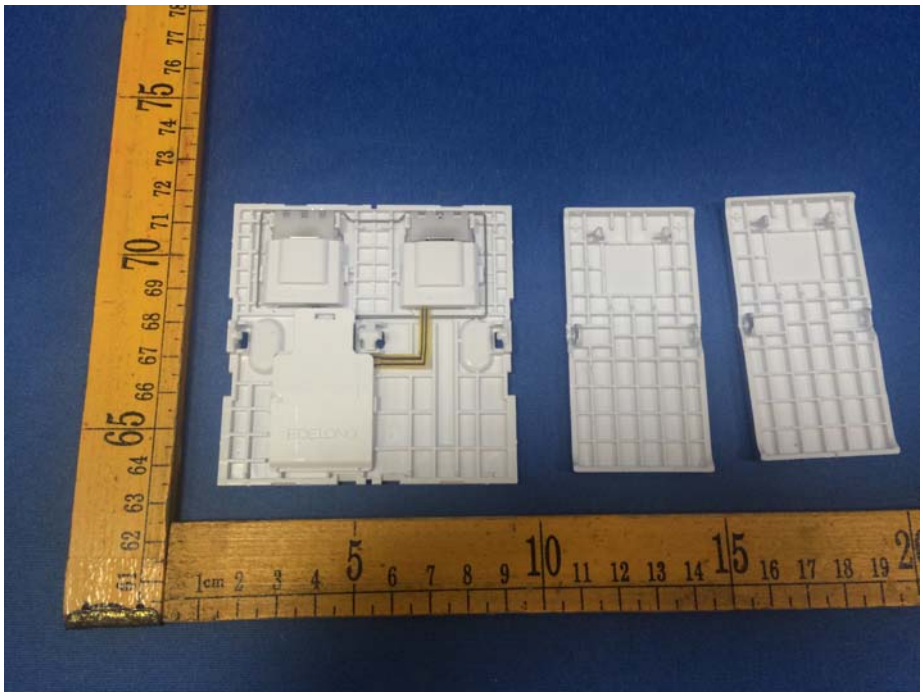
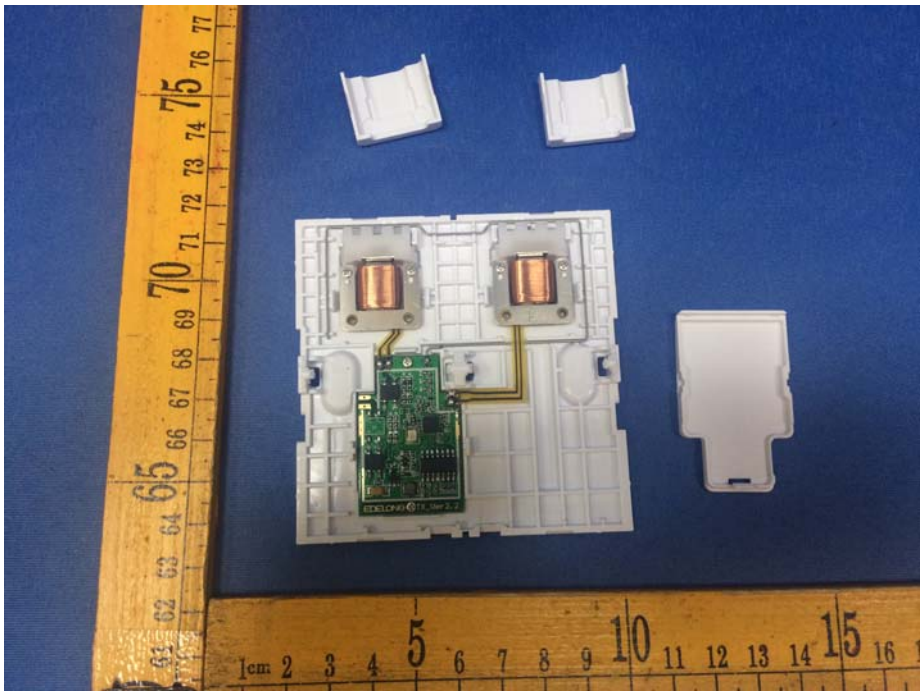


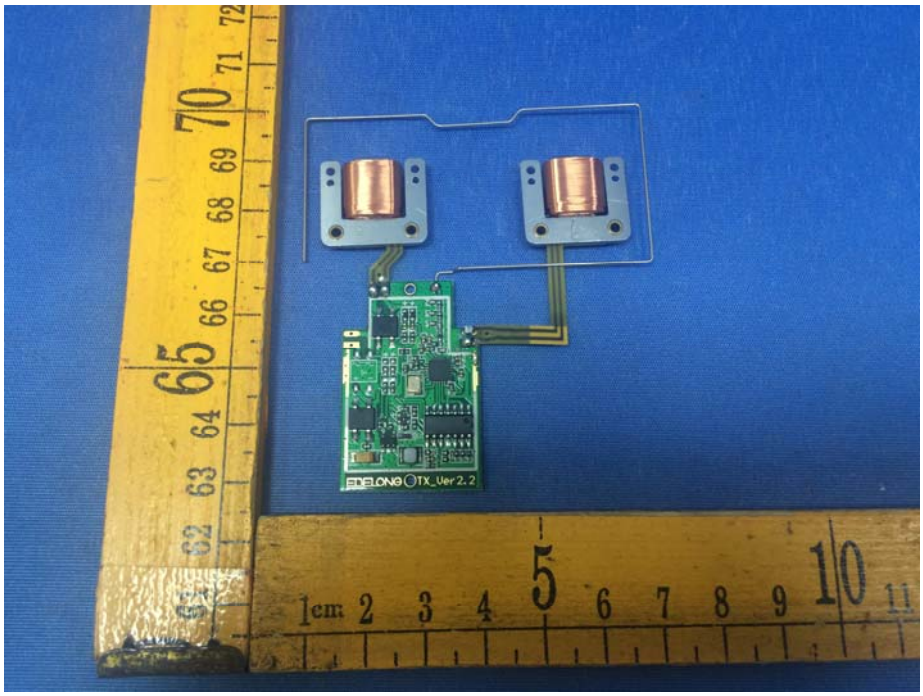




Model: EE0254



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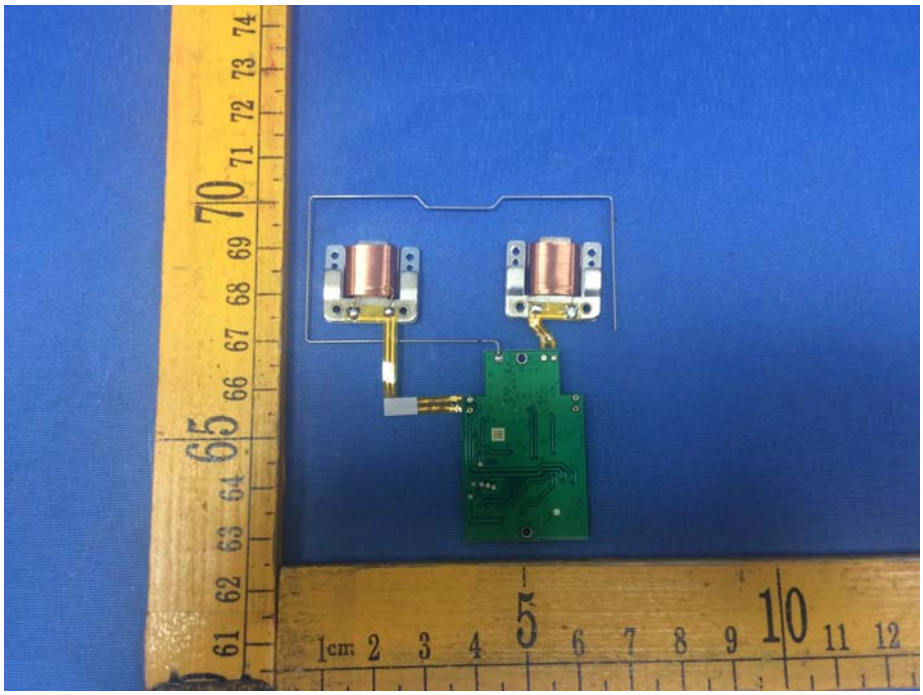

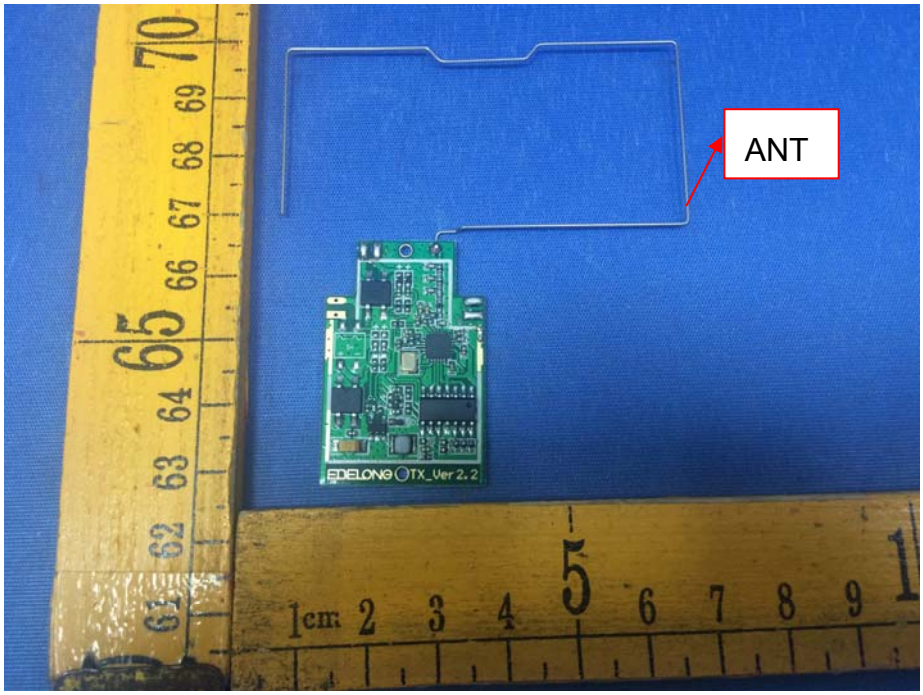
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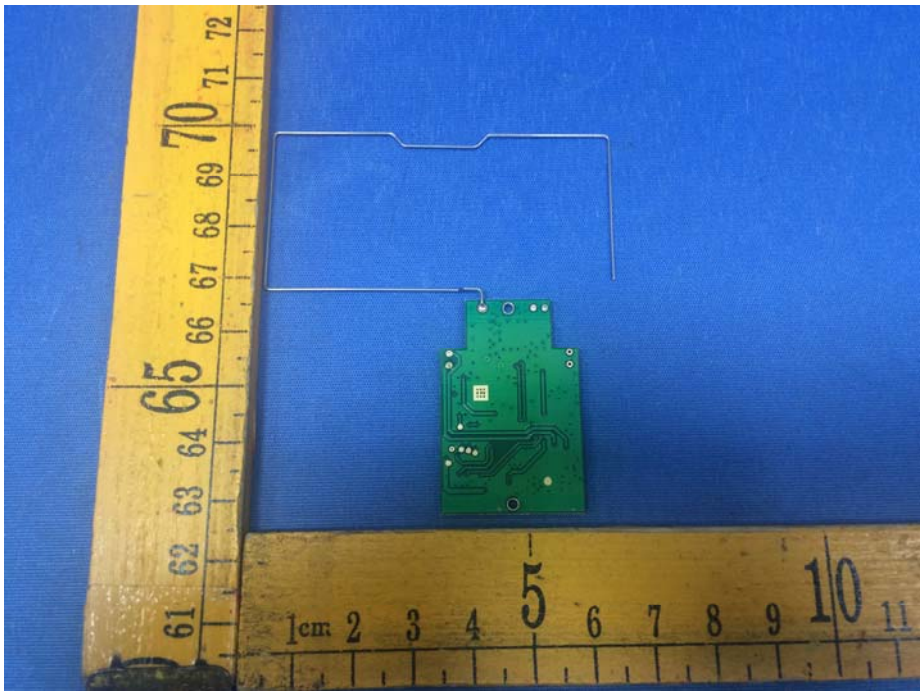

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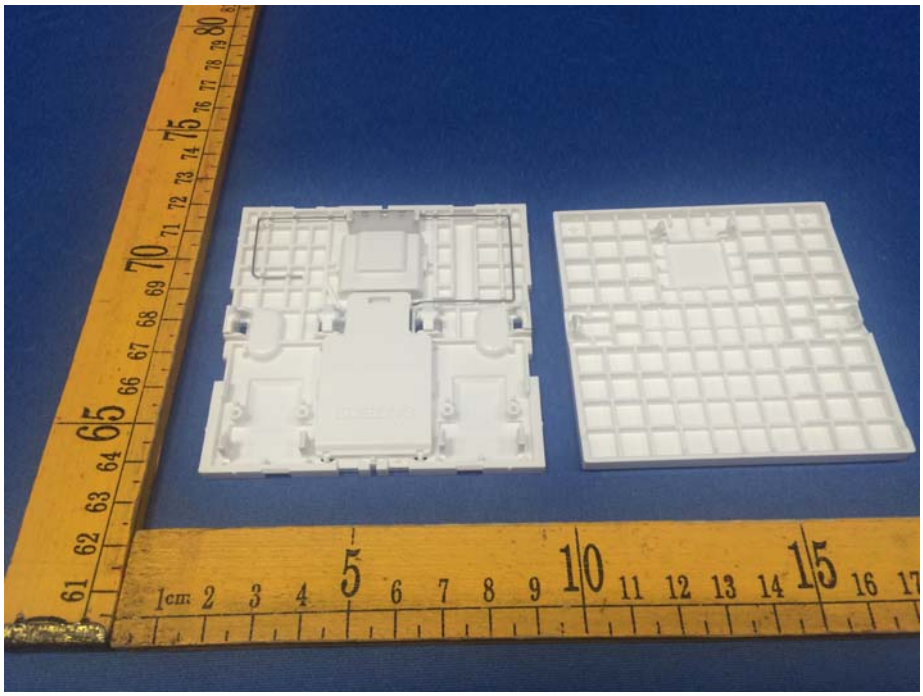

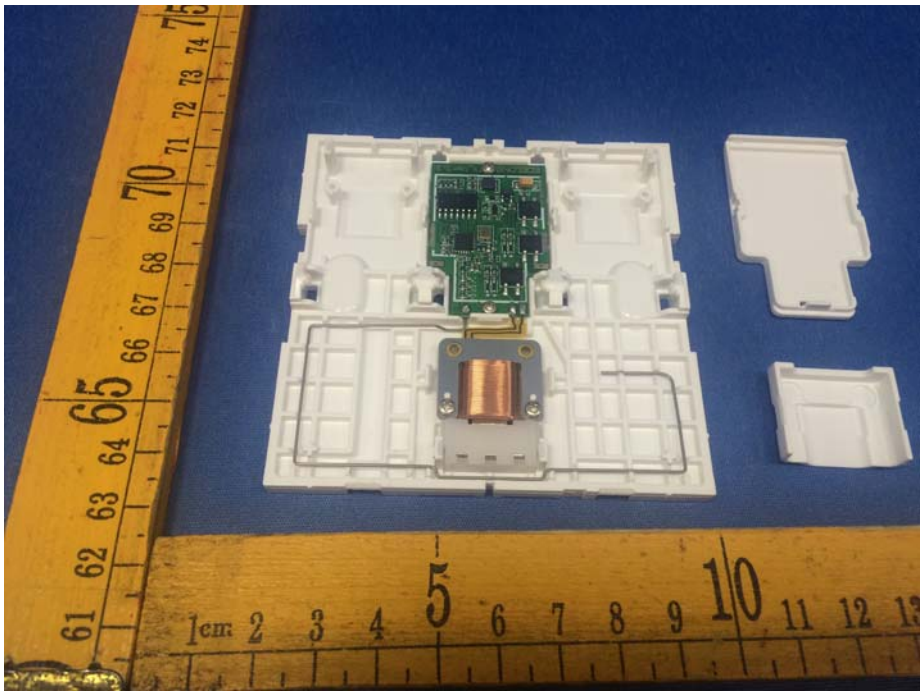

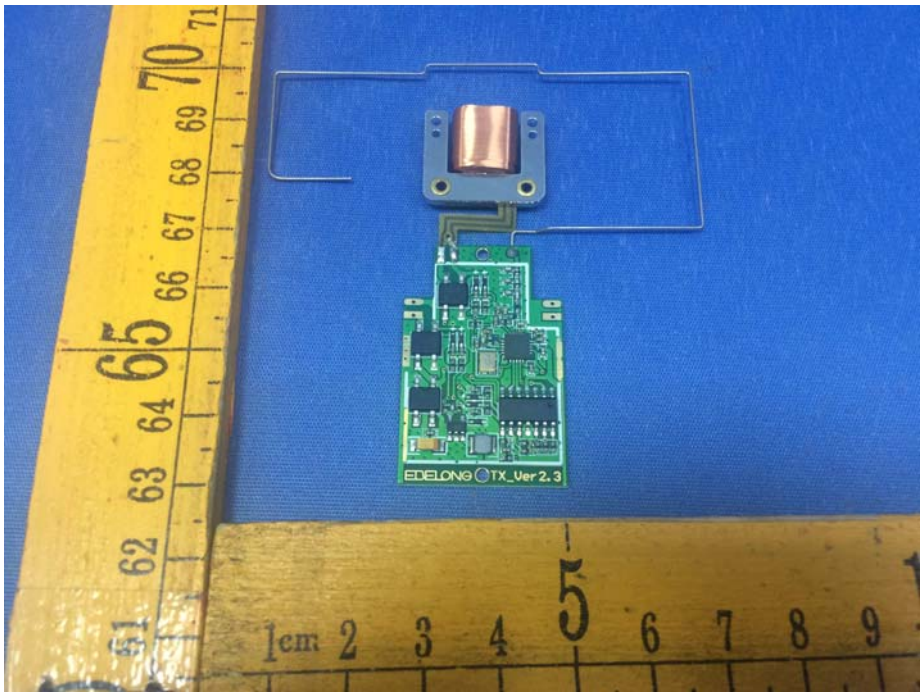
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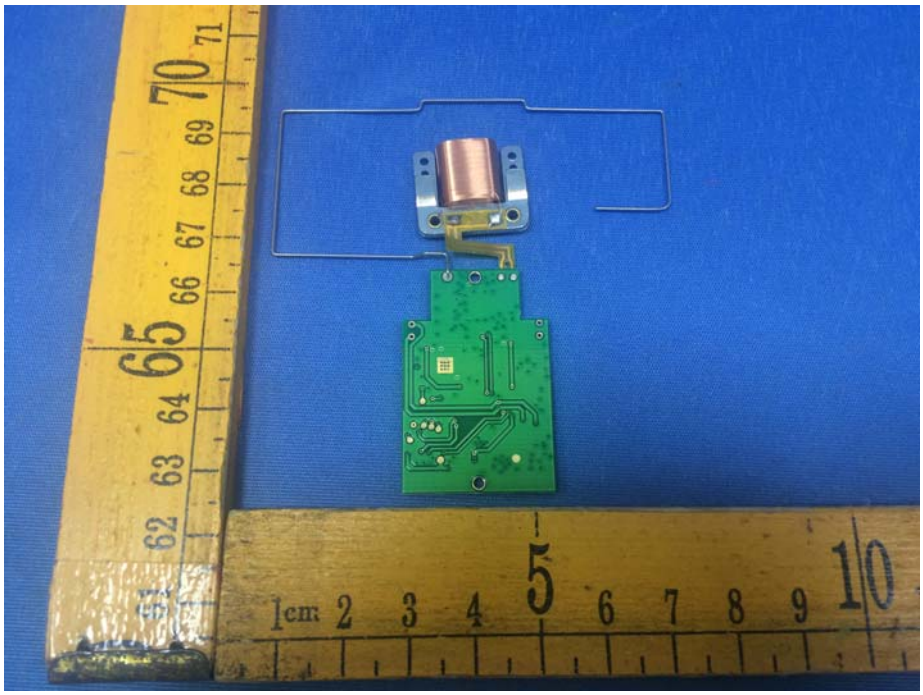

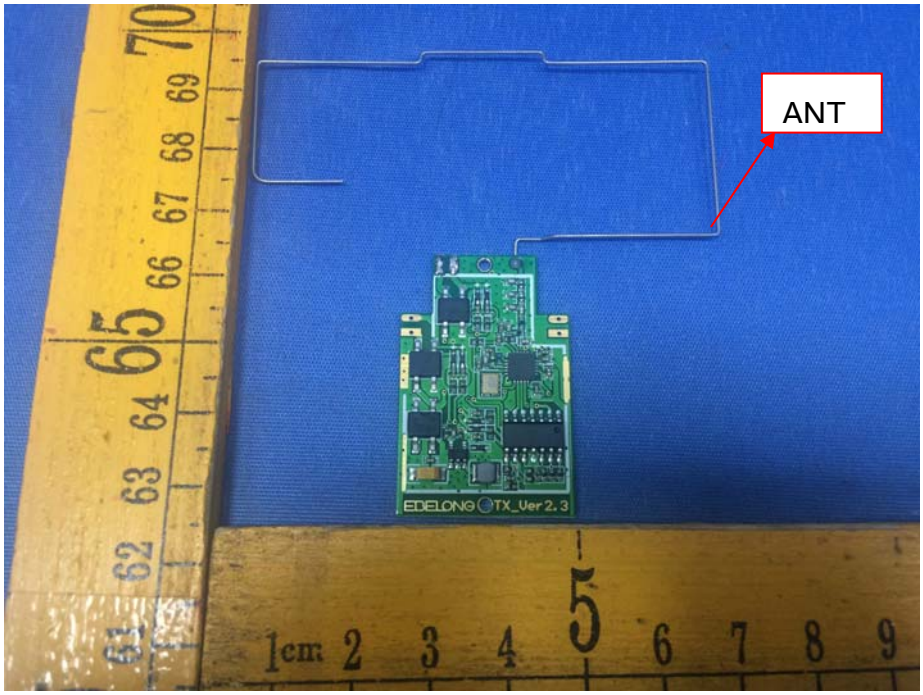
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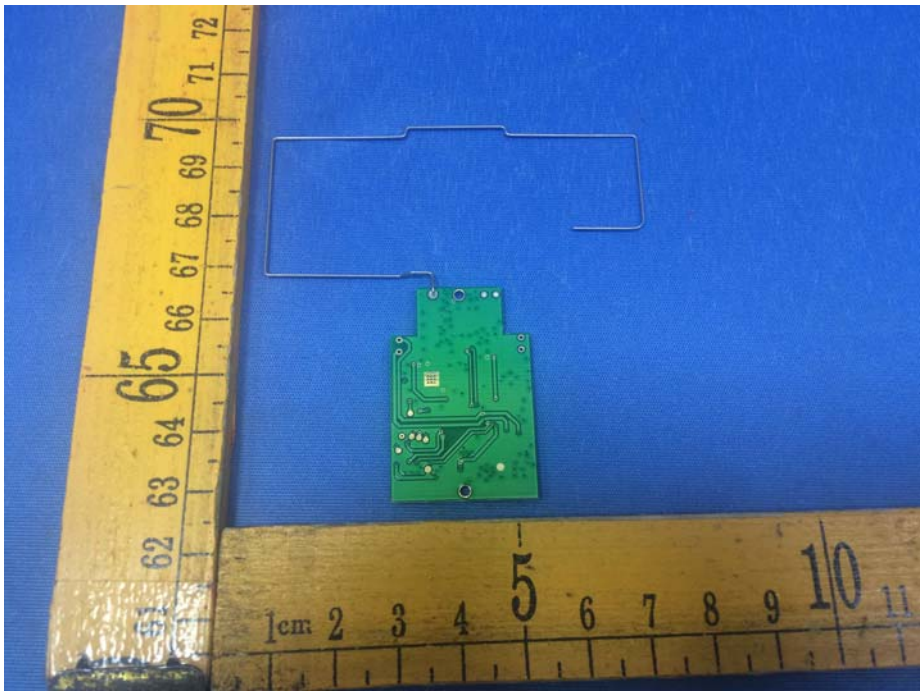


======End of Report======