

# TEST REPORT

Reference No. .... : WTS16S0654636E  
FCC ID ..... : 2AI4Y-TYD2496B1RF  
Applicant ..... : Shenzhen TaiYuan star technology Co., LTD.  
Address ..... : Baoan shajing industrial 2 shun jie industrial park of mountain king  
Manufacturer ..... : Shenzhen TaiYuan star technology Co., LTD.  
Address ..... : Baoan shajing industrial 2 shun jie industrial park of mountain king  
Product Name ..... : 2.4G Wireless module  
Model No ..... : TYD-2496B-1-RF  
Standards ..... : FCC CFR47 Part 15 Section 15.249: 2015  
Date of Receipt sample .... : Jun. 30, 2016  
Date of Test ..... : Jul. 02 – 06, 2016  
Date of Issue ..... : Jul. 13, 2016  
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.

## Prepared By:

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## 2 Test Summary

| Test Items              | Test Requirement                 | Result |
|-------------------------|----------------------------------|--------|
| Conducted Emissions     | 15.207                           | PASS   |
| Radiated Emission       | 15.249(a)<br>15.209<br>15.205(a) | PASS   |
| Periodic Operation      | 15.35(c)                         | PASS   |
| Outside Restricted band | 15.249<br>15.205<br>15.209       | PASS   |
| 20dB Bandwidth          | 15:215(c)                        | PASS   |
| Antenna Requirement     | 15.203                           | PASS   |

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## 4 General Information

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

|                        |  |
|------------------------|--|
| Product Name:          | 2.4G Wireless module                       |
| Model No.:             | TYD-2496B-1-RF                             |
| Model Differences:     | N/A  |
| Host Name:             | Controller                                 |
| Host Model No.:        | B  |
| Host Brand:            | TYD  |
| Host Manufacturer:     | Shenzhen TaiYuan star technology Co., LTD. |
| Type of Modulation:    | GFSK                                       |
| Frequency Range:       | 2444MHz                                    |
| The Lowest Oscillator: | 16MHz                                      |
| Antenna installation:  | PCB Printed Antenna                        |

### 4.2 Details of E.U.T.

|                 |                    |
|-----------------|--------------------|
| Technical Data: | DC 3.0V by battery |
|-----------------|--------------------|

### 4.3 Channel List

| Channel No. | Frequency (MHz) |
|-------------|-----------------|
| 1           | 2444            |

### 4.4 Test Facility

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

- **IC – Registration No.:7760A-1**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory 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 number 7760A-1, Oct 15, 2015.

- **FCC Test Site 1#– Registration No.: 880581**

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 880581, April 29, 2014.

- **FCC Test Site 2#– 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.

#### 4.4.1 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    | Lower channel | Middle channel | Upper channel |
|--------------|---------------|----------------|---------------|
| Transmitting | N/A           | 2444MHz        | N/A           |

## 5 Equipment Used during Test

### 5.1 Equipments List

| 3m Semi-anechoic Chamber for Radiation Emissions Test site 1# |                              |                                  |               |            |                       |                      |
|---|------------------------------|----------------------------------|---------------|------------|-----------------------|----------------------|
| Item  | Equipment                    | Manufacturer                     | Model No.     | Serial No. | Last Calibration Date | Calibration Due Date |
| 1   | EMC Analyzer                 | Agilent                          | E7405A        | MY45114943 | Sep.14,2015           | Sep.13,2016          |
| 2   | Active Loop Antenna          | Beijing Dazhi                    | ZN30900A      | -          | Sep.14,2015           | Sep.13,2016          |
| 3   | Trilog Broadband Antenna     | SCHWARZBECK                      | VULB9163      | 336        | Apr.18,2016           | Apr.17,2017          |
| 4   | Coaxial Cable (below 1GHz)   | Top                              | TYPE16(13M)   | -          | Sep.14,2015           | Sep.13,2016          |
| 5   | Broad-band Horn Antenna      | SCHWARZBECK                      | BBHA 9120 D   | 667        | Apr.18,2016           | Apr.17,2017          |
| 6   | Broad-band Horn Antenna      | SCHWARZBECK                      | BBHA 9170     | 335        | Apr.18,2016           | Apr.17,2017          |
| 7   | Broadband Preamplifier       | COMPLIANCE DIRECTION             | PAP-1G18      | 2004       | Mar.16,2016           | Mar.15,2017          |
| 8   | Coaxial Cable (above 1GHz)   | Top                              | 1GHz-25GHz    | EW02014-7  | Apr.09,2016           | Apr.08,2017          |
| 3m Semi-anechoic Chamber for Radiation Emissions Test site 2# |                              |                                  |               |            |                       |                      |
| Item  | Equipment                    | Manufacturer                     | Model No.     | Serial No  | Last Calibration Date | Calibration Due Date |
| 1   | Test Receiver                | R&S                              | ESCI          | 101296     | Sep.14,2015           | Sep.13,2016          |
| 2   | Trilog Broadband Antenna     | SCHWARZBECK                      | VULB9160      | 9160-3325  | Sep.14,2015           | Sep.13,2016          |
| 3   | Amplifier                    | Compliance pirection systems inc | PAP-0203      | 22024      | Sep.14,2015           | Sep.13,2016          |
| 4   | Cable                        | HUBER+SUHNER                     | CBL2          | 525178     | Sep.14,2015           | Sep.13,2016          |
| 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.14,2015           | Sep.13,2016          |
| 2.  | Spectrum Analyzer (9k-6GHz)  | R&S                              | FSL6          | 100959     | Sep.14,2015           | Sep.13,2016          |
| 3.  | Signal Analyzer (9k~26.5GHz) | Agilent                          | N9010A        | MY50520207 | Sep.14,2015           | Sep.13,2016          |
| 4.  | Humidity Chamber             | GF                               | GTH-225-40-1P | IAA061213  | Sep.14,2015           | Sep.13,2016          |

## 5.2 Measurement Uncertainty

| Parameter                           | Uncertainty                                    |
|-------------------------------------|--|
| Radio Frequency                     | $\pm 1 \times 10^{-6}$                         |
| RF Power                            | $\pm 1.0$ dB                                   |
| RF Power Density                    | $\pm 2.2$ dB                                   |
| Radiated Spurious<br>Emissions test | $\pm 5.03$ dB<br>(Bilog antenna 30M~1000MHz)   |
|                                     | $\pm 5.47$ dB<br>(Horn antenna 1000M~25000MHz) |

## 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 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

| Fundamental frequency | Field strength of fundamental |        | Field strength of harmonics |        |
|-----------------------|-------------------------------|--------|-----------------------------|--------|
|                       | mV/m                          | dBuV/m | uV/m                        | dBuV/m |
| 902-928 MHz           | 50                            | 94     | 500                         | 54     |
| 2400-2483.5 MHz       | 50                            | 94     | 500                         | 54     |
| 5725-5875 MHz         | 50                            | 94     | 500                         | 54     |
| 24.0-24.25 GHz        | 250                           | 108    | 2500                        | 68     |

15.209 Limit:

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

**Note:** RF Voltage(dBuV)=20 log<sub>10</sub> RF Voltage(uV)

### 6.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

EUT Operation :

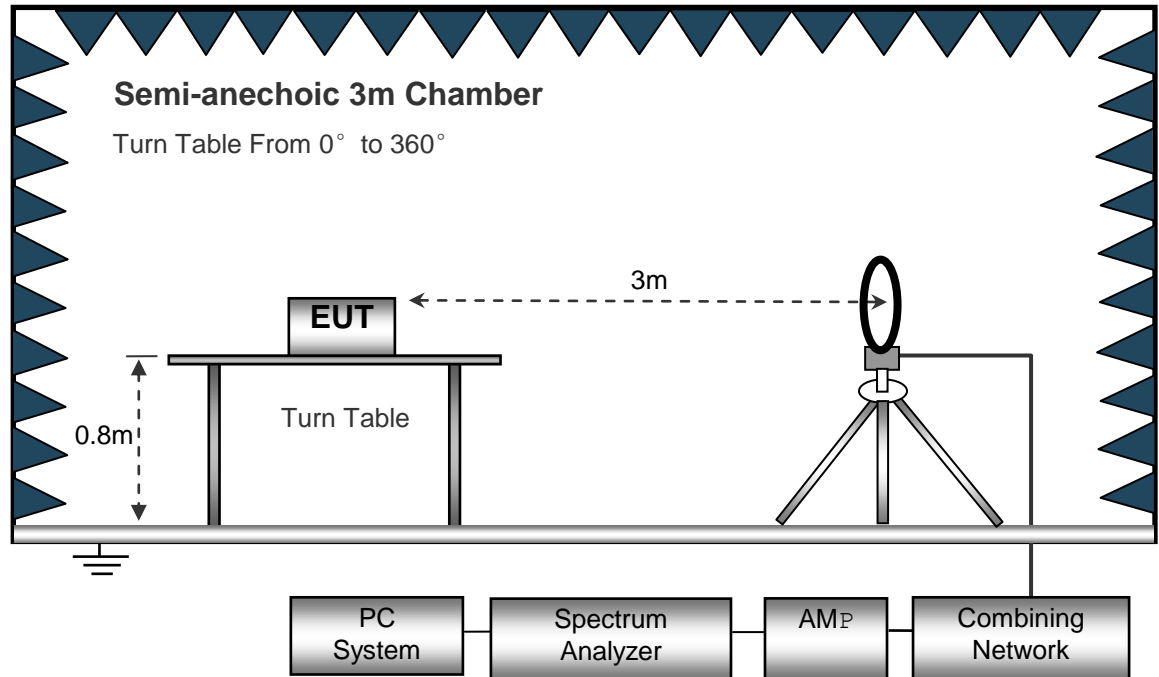
The test was performed in transmitting mode, the test data were shown in the report.



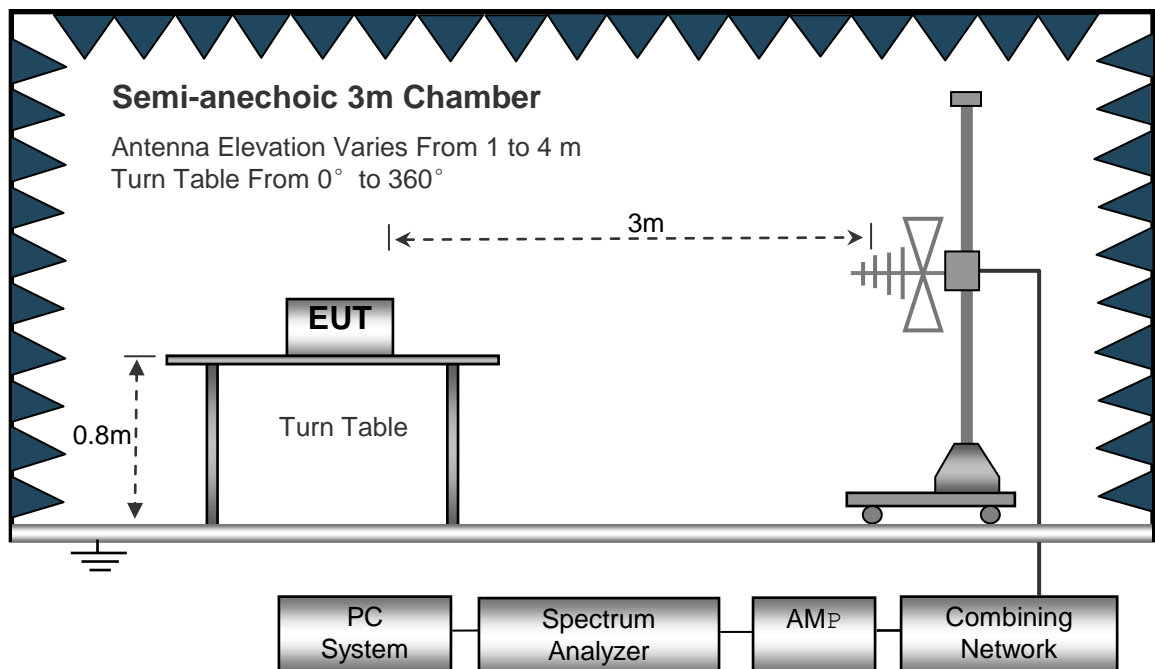
## 6.2 Test Setup

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

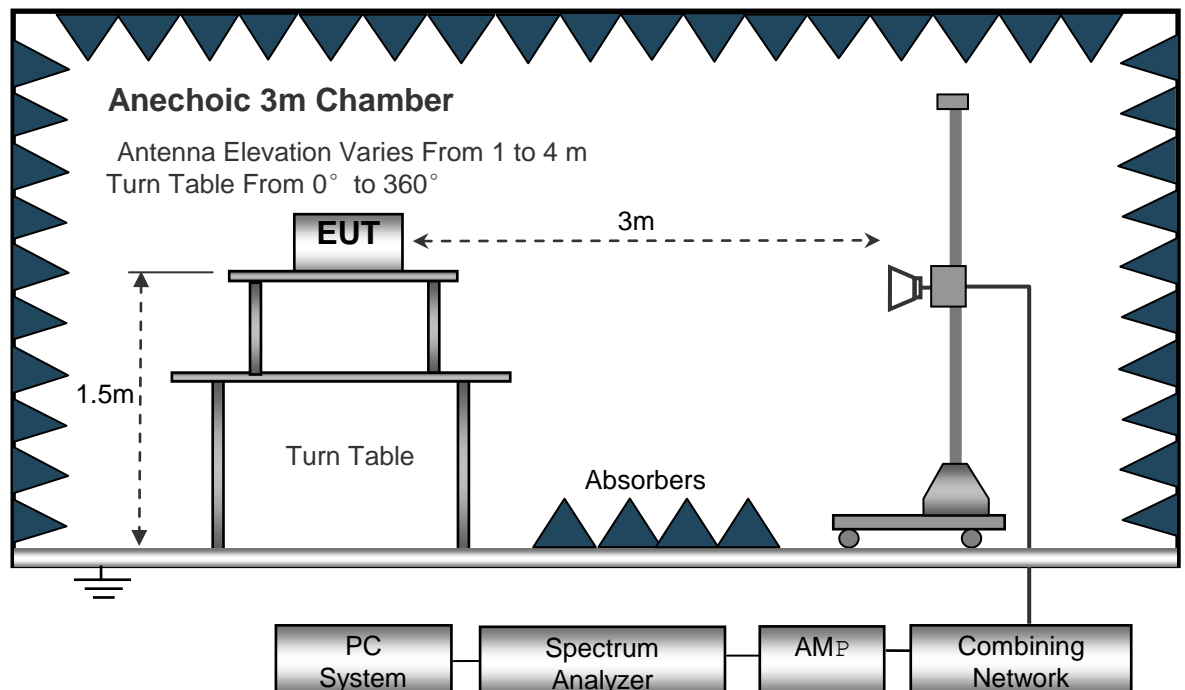
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



## 2.1 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  
 Detector Ave.  
 Resolution Bandwidth ..... 1MHz  
 Video Bandwidth ..... 10Hz

### 6.3 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m above 1GHz.
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.

## 6.4 Test Result

Test Frequency : 16MHz~30MHz

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

Test Frequency: 30MHz ~ 18GHz

| Frequency | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | FCC Part 15.231/209/205 |        |
|-----------|------------------|-------------|------------------|------------|-------|------------------|---------------------|-------------------------|--------|
|           |                  |             |                  | Height     | Polar |                  |                     | Limit                   | Margin |
| (MHz)     | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB/m)           | (dBμV/m)            | (dBμV/m)                | (dB)   |
| 2444.00   | 73.69            | PK          | 262              | 1.0        | H     | -13.08           | 60.61               | 114.00                  | -53.39 |
| 2444.00   | 51.09            | PK          | 98               | 1.5        | V     | -13.08           | 38.01               | 114.00                  | -75.99 |
| 4888.00   | 58.21            | PK          | 119              | 1.5        | H     | 0.09             | 58.30               | 74.00                   | -15.70 |
| 4888.00   | 53.62            | PK          | 255              | 1.4        | V     | 0.09             | 53.71               | 74.00                   | -20.29 |
| 7332.00   | 55.32            | PK          | 323              | 1.5        | H     | 3.01             | 58.33               | 74.00                   | -15.67 |
| 7332.00   | 52.39            | PK          | 274              | 1.6        | V     | 3.01             | 55.40               | 74.00                   | -18.60 |
| 9776.00   | 49.74            | PK          | 170              | 1.5        | H     | 5.39             | 55.13               | 74.00                   | -18.87 |
| 9776.00   | 49.36            | PK          | 250              | 1.3        | V     | 5.39             | 54.75               | 74.00                   | -19.25 |

AV = Peak +20Log10(duty cycle) =PK+(-0.72) [refer to section 8 for more detail]

| Frequency | PK       | Turn<br>table<br>Angle | RX Antenna |       | Duty<br>cycle<br>Factor | AV       | FCC Part<br>15.231/209/205 |        |
|-----------|----------|------------------------|------------|-------|-------------------------|----------|----------------------------|--------|
|           |          |                        | Height     | Polar |                         |          | Limit                      | Margin |
| (MHz)     | (dBμV/m) | Degree                 | (m)        | (H/V) | (dB)                    | (dBμV/m) | (dBμV/m)                   | (dB)   |
| 2444.00   | 60.61    | 262                    | 1.0        | H     | -9.51                   | 51.10    | 94.00                      | -42.90 |
| 2444.00   | 38.01    | 98                     | 1.5        | V     | -9.51                   | 28.50    | 94.00                      | -65.50 |
| 4888.00   | 58.30    | 119                    | 1.5        | H     | -9.51                   | 48.79    | 54.00                      | -5.21  |
| 4888.00   | 53.71    | 255                    | 1.4        | V     | -9.51                   | 44.20    | 54.00                      | -9.80  |
| 7332.00   | 58.33    | 323                    | 1.5        | H     | -9.51                   | 48.82    | 54.00                      | -5.18  |
| 7332.00   | 55.40    | 274                    | 1.6        | V     | -9.51                   | 45.89    | 54.00                      | -8.11  |
| 9776.00   | 55.13    | 170                    | 1.5        | H     | -9.51                   | 45.62    | 54.00                      | -8.38  |
| 9776.00   | 54.75    | 250                    | 1.3        | V     | -9.51                   | 45.24    | 54.00                      | -8.76  |

## 7 Periodic Operation

The duty cycle was determined by the following equation:

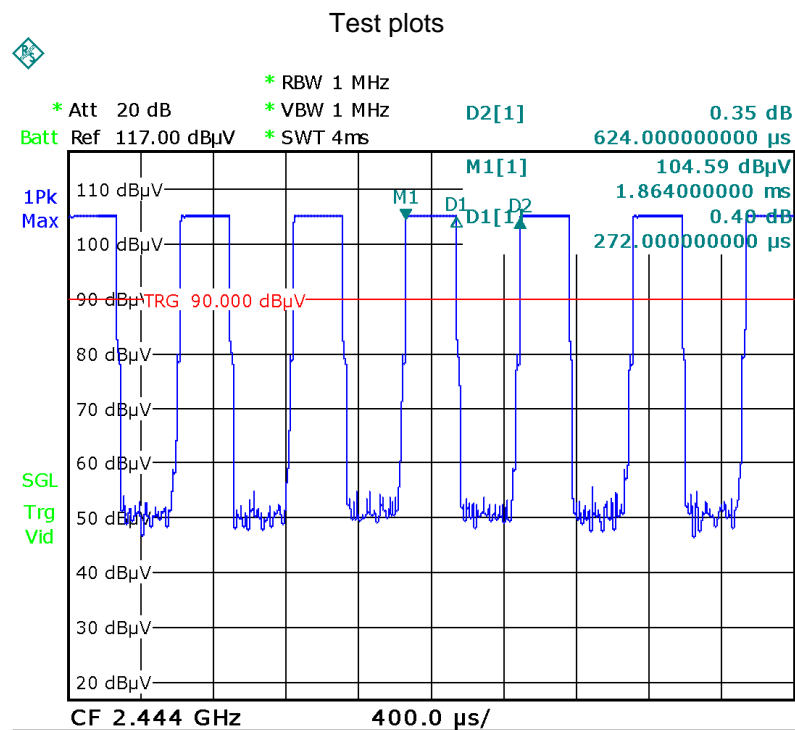
To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

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

Duty Cycle Correction Factor(dB)=20 \* Log<sub>10</sub>(Duty Cycle)

|  |        |
|--|--------|
| Total transmission time(ms)                  | 0.624  |
| Length of a complete transmission period(ms) | 1.864  |
| Duty Cycle(%)                                | 33.47% |
| Duty Cycle Correction Factor(dB)             | -9.51  |

Refer to the duty cycle plot (as below)



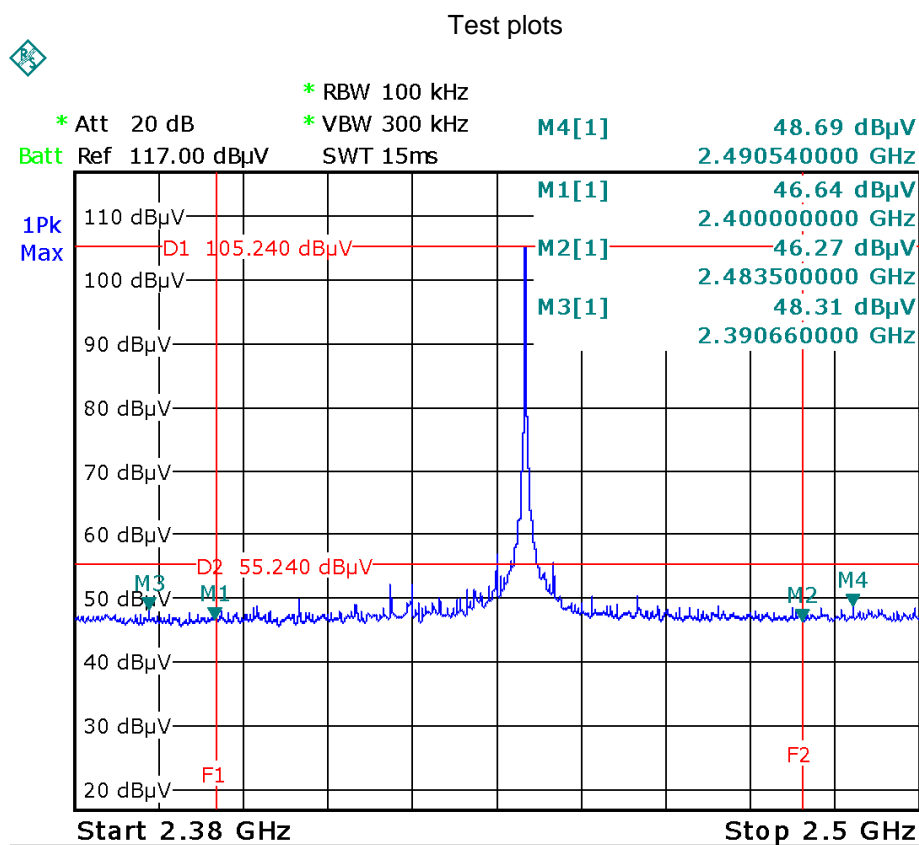
## 8 Outside of Band Emission

|                   |   |
|-------------------|---|
| Test Requirement: | 15.249(d):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 §15.209, whichever is the lesser attenuation. |
| Test Method:      | ANSI C63.10:2013  |
| Test Mode:        | Transmitting  |

### 8.1 Test Procedure

Refer to section 7.4 of this test report.

### 8.2 Test Result



## 9 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.215(c)

Test Method: ANSI C63.10:2013

Test Mode: Transmitting

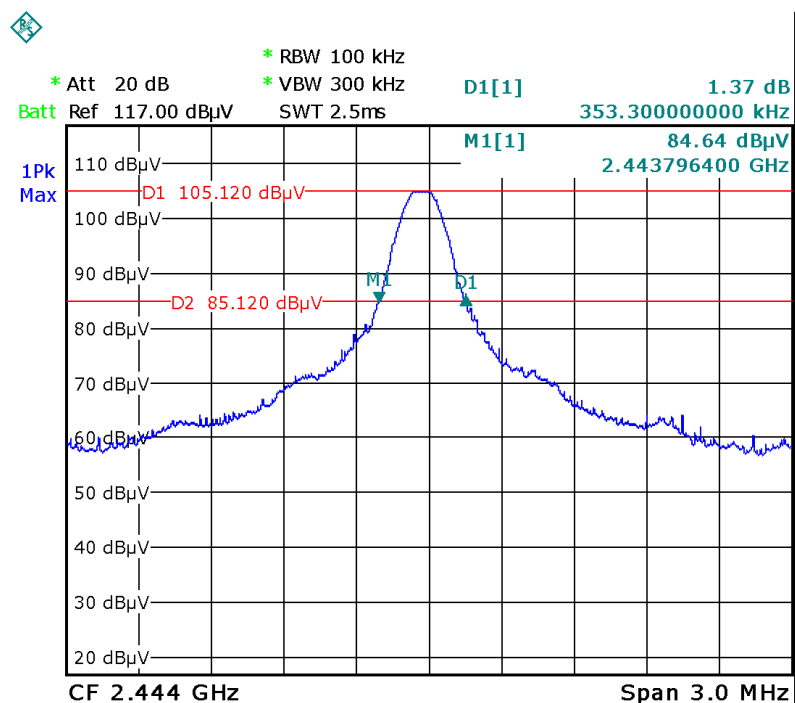
### 9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 1MHz, VBW = 3MHz

### 9.2 Test Result

| Frequency<br>(MHz) | Bandwidth Emission<br>(MHz) |
|--------------------|-----------------------------|
| 2444               | 0.353                       |

Test plots





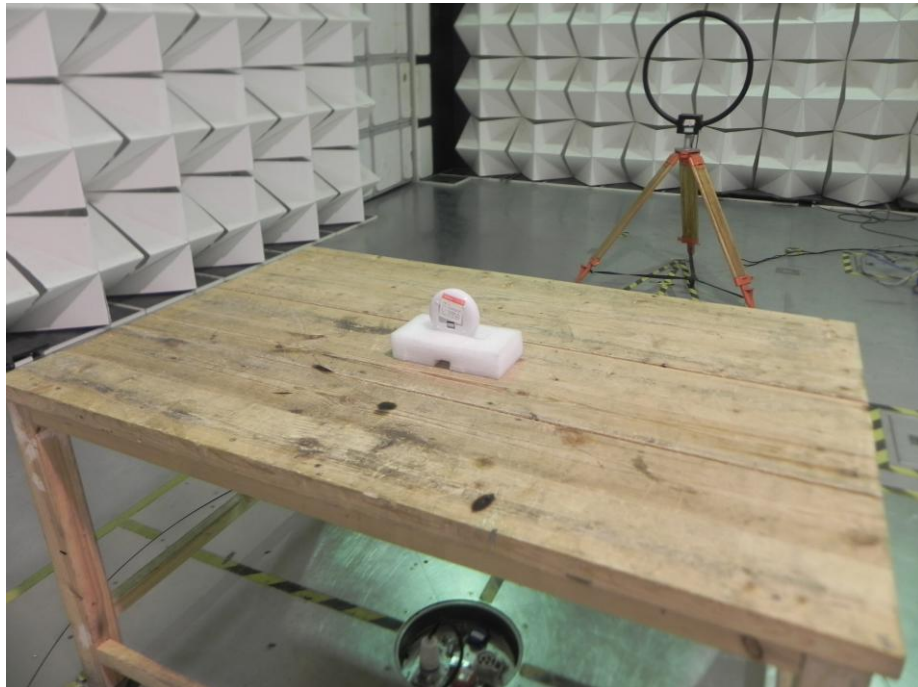
## **10 Antenna Requirement**

According to the FCC Part 15 Paragraph 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. This product has a PCB Printed Antenna , fulfil the requirement of this section.

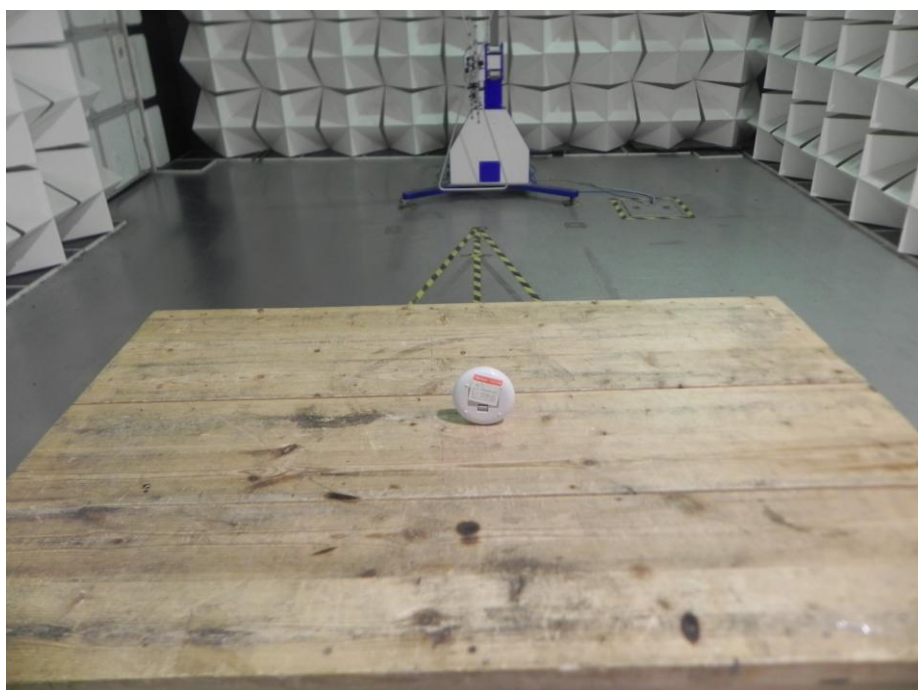
## 11 Photographs-Model TYD-2496B-1-RF With Host Test Setup Photos

### 11.1 Photograph – Radiation Emission

Test frequency from 9KHz to 30MHz at test site 2#



Test frequency from 30MHz to 1GHz at test site 2#



Test frequency above 1GHz at test site 1#



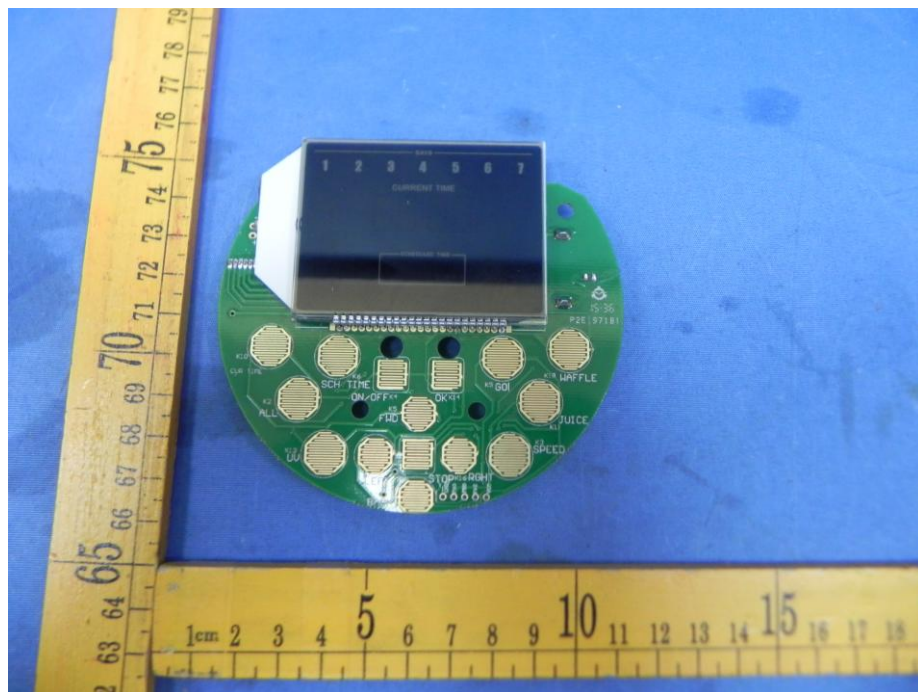
## 12 Photographs - Constructional Details

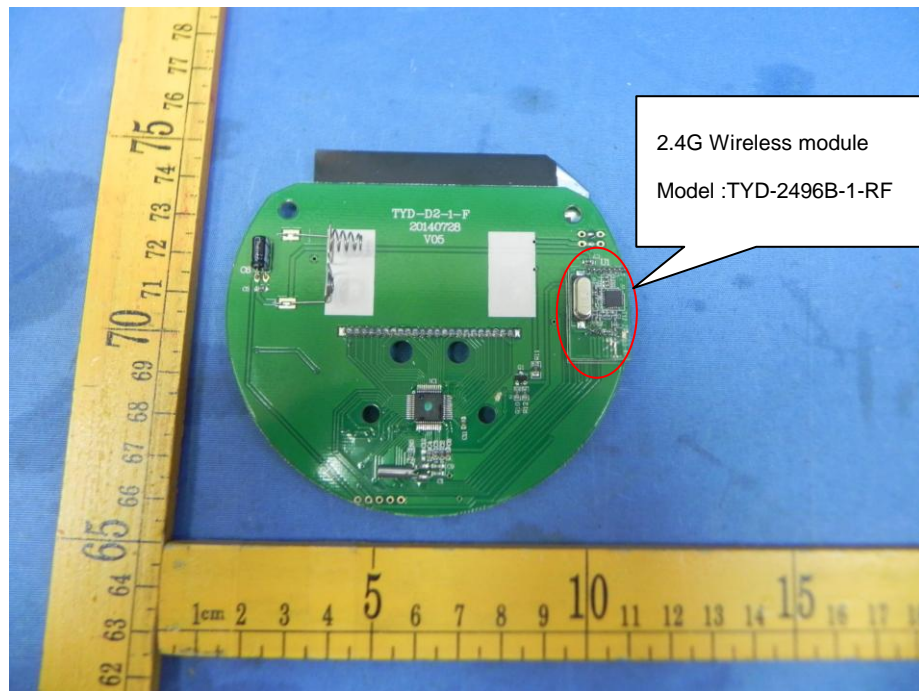
### 12.1 Photographs- Host External Photos



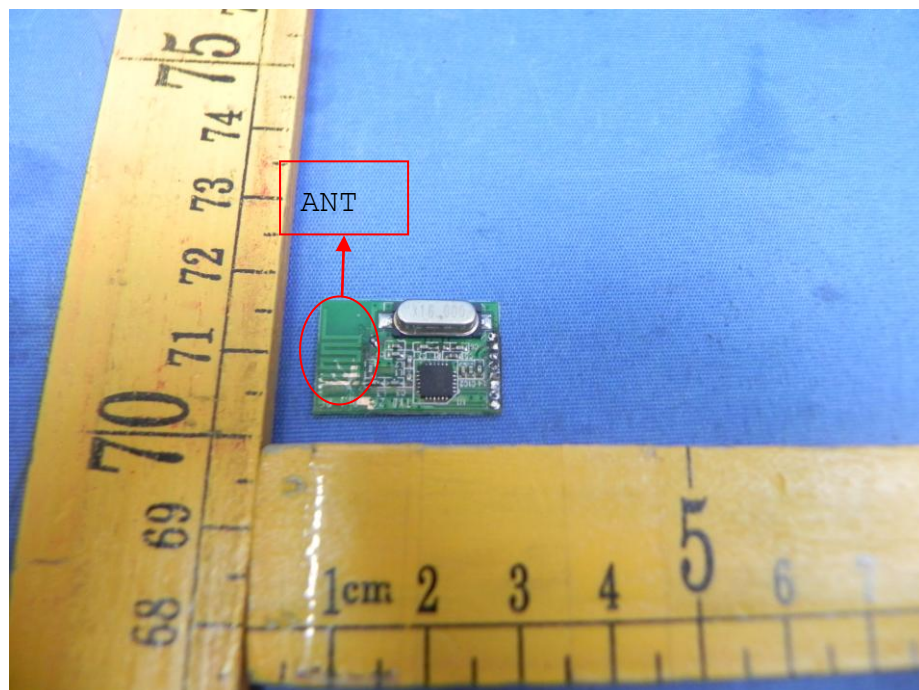


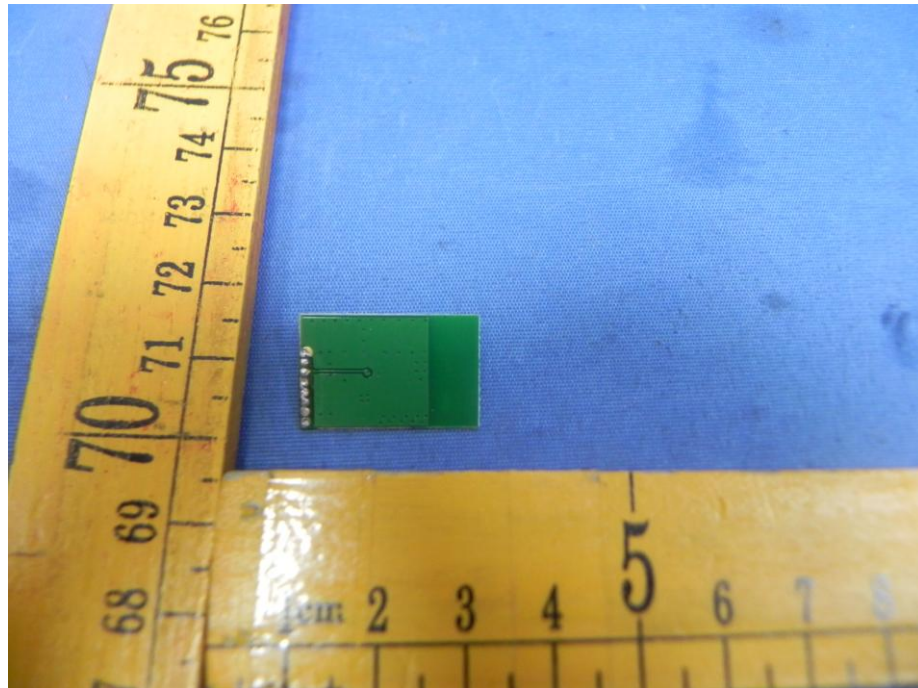
## 12.2 Photographs- Host Internal Photos





### 12.3 Photographs- Model TYD-2496B-1-RF Photos





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