

TEST REPORT

Reference No..... : WTS16S0755618E
FCC ID..... : 2AI4YTYDARF2498
Applicant..... : Shenzhen TaiYuan star technology Co., LTD.
Address..... : Baoan shajing industrial 2 shun jie industrial park of mountain king,
Shenzhen 518103,China
Manufacturer : The same as above
Address..... : The same as above
Product Name..... : 2.4G Wireless module
Model No..... : TYD-ARF2498
Standards..... : FCC CFR47 Part 15 Section 15.249: 2015
ANSI C63.10: 2013;ANSI C63.4: 2014
Date of Receipt sample..... : Jul. 12, 2016
Date of Test..... : Jul. 14 – 22, 2016
Date of Issue..... : Jul. 27, 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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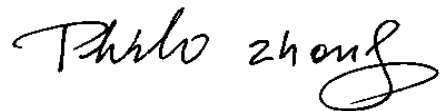
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Approved by:



Philo Zhong / Manager

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS16S0755618E	Jul. 12, 2016	Jul. 14 – 22, 2016	Jul. 27, 2016	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name	: 2.4G Wireless module
Model No.	: TYD-ARF2498
Model Differences	: N/A
Host Model Name	: controller
Host Model No.	: B3C
Host Brand:	: TYD
Host Manufacturer	: Shenzhen TaiYuan star technology Co., LTD.
Type of Modulation	: GFSK
Frequency Range	: 2468MHz
The Lowest Oscillator	: 16MHz
Antenna installation	: PCB printed antenna

4.2 Details of E.U.T.

Technical Data	: Power supply(+1.9Vdc~+3.6Vdc)
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4.3 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.

4.3.1 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	2468MHz	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.15,2015	Sep.14,2016
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2015	Sep.14,2016
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2016	Apr.18,2017
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2015	Sep.14,2016
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2016	Apr.18,2017
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2016	Apr.18,2017
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2016	Mar.16,2017
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2016	Apr.09,2017
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.15,2015	Sep.14,2016
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Sep.15,2015	Sep.14,2016
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	Sep.15,2015	Sep.14,2016
4	Cable	HUBER+SUHNER	CBL2	525178	Sep.15,2015	Sep.14,2016
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.15,2015	Sep.14,2016
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.15,2015	Sep.14,2016
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.15,2015	Sep.14,2016

5.2 Measurement Uncertainty

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

Test Items	Test Requirement	Result
Conducted Emissions	15.207	N/A
Radiated Emission	15.249(a) 15.209 15.205(a)	C
Periodic Operation	15.35(c)	C
Outside of Band Emission	15.249 15.205 15.209	C
20dB Bandwidth	15.215(c)	C
Antenna Requirement	15.203	C
Note: C=Compliance;NC=Not Compliance;NT=Not Tested; N/A=Not Applicable		

7 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.10:2013;ANSI C63. 4:2014
Test Result:	N/A
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Remark	The device is powered by battery, it is not application for this test.

8 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2010;ANSI 63.4: 2014

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 (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (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 log₁₀ RF Voltage(uV)

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

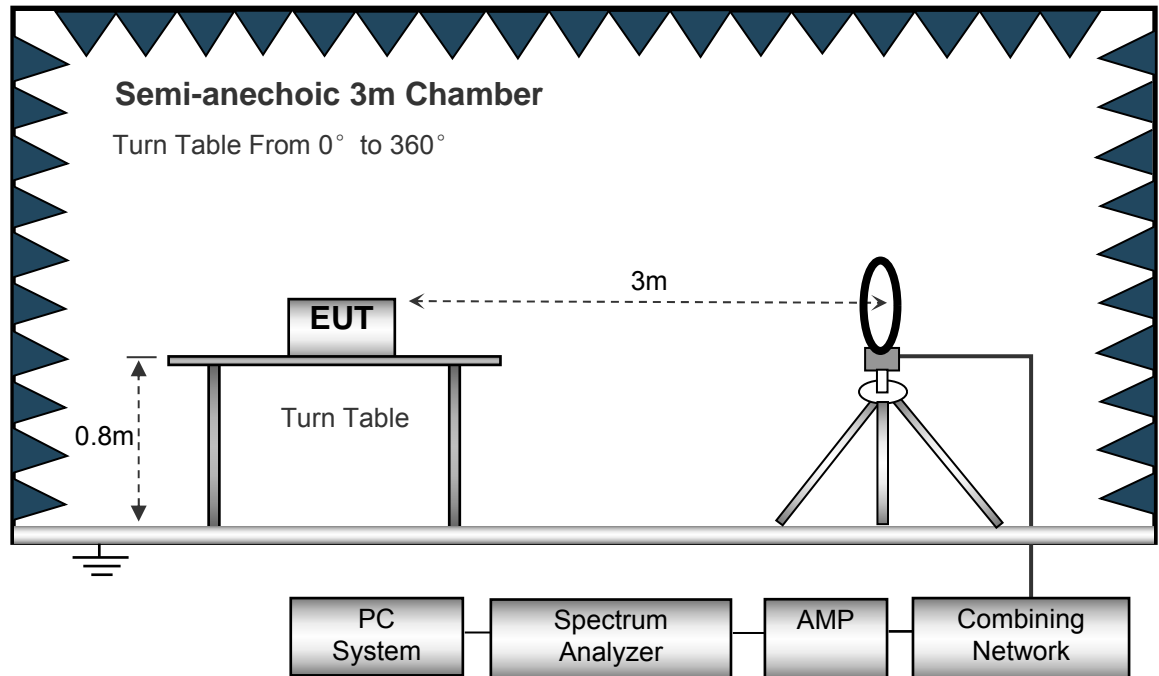
EUT Operation :

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

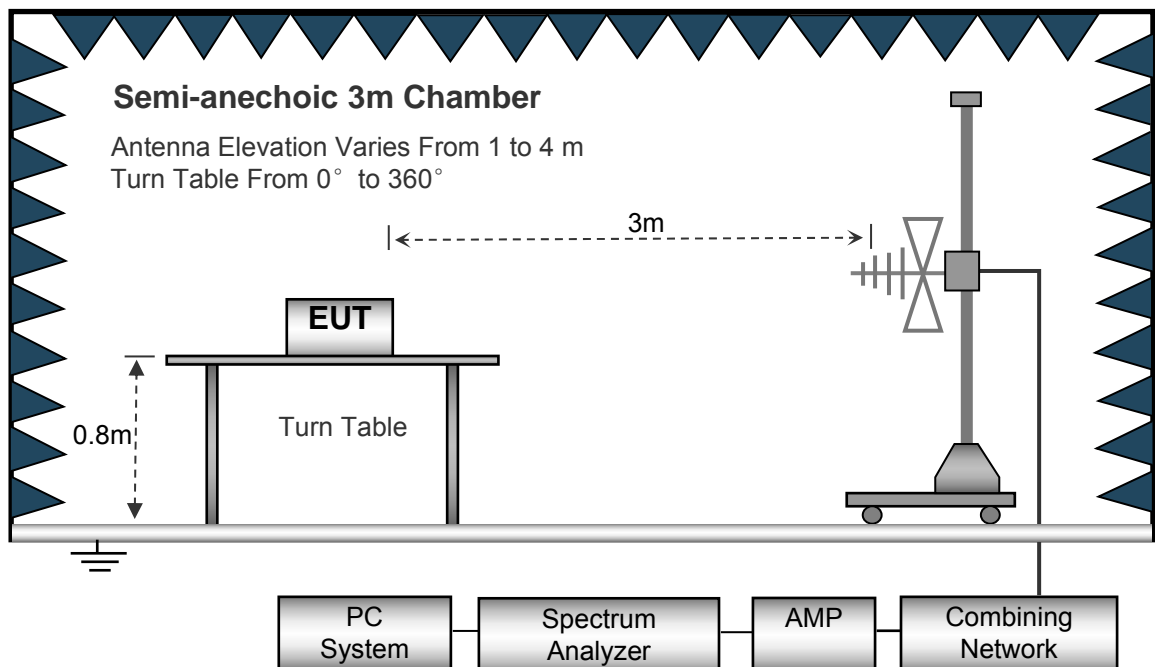
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.

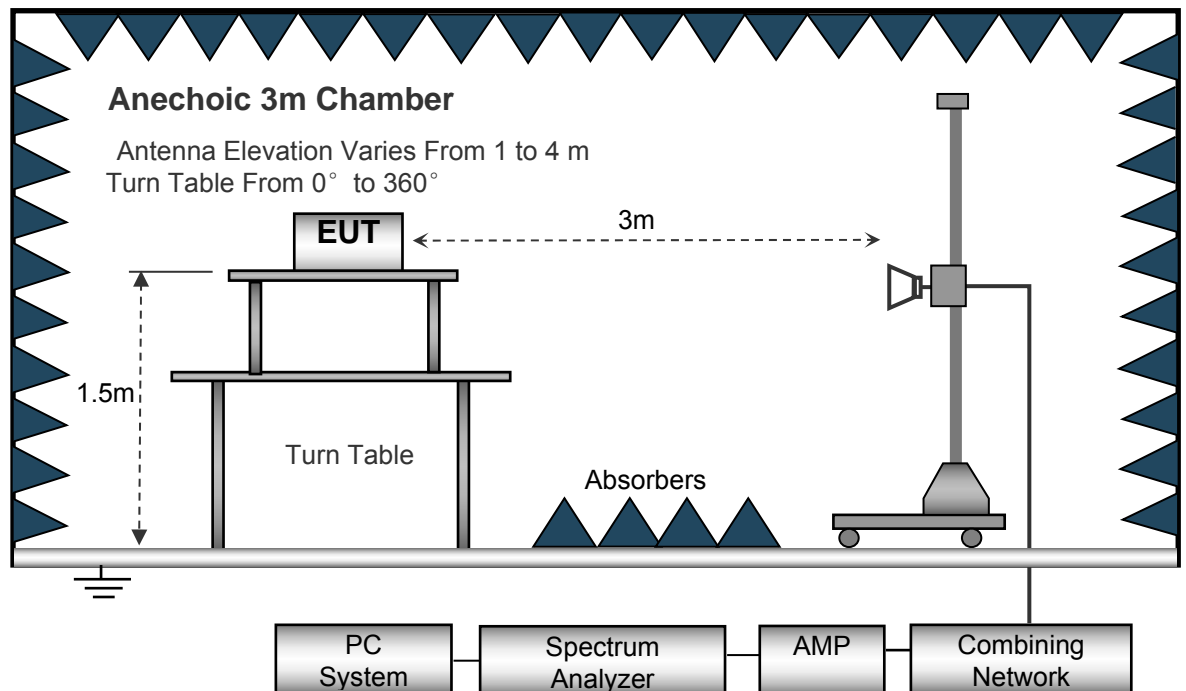
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 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
 DetectorPK
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 3MHz
 DetectorAve.
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above 1GHz, 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.

8.5 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 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
325.64	39.21	QP	68	1.1	V	-11.40	27.81	46.00	-18.19
2468.00	70.56	PK	279	1.7	H	4.28	74.84	114.00	-39.16
2468.00	80.31	PK	317	1.6	V	4.28	84.59	114.00	-29.41
4936.00	42.24	PK	8	1.3	H	0.09	42.33	94.00	-51.67
4936.00	53.63	PK	221	1.8	V	0.09	53.72	94.00	-40.28
2419.31	37.95	PK	134	1.2	H	3.01	40.96	74.00	-33.04
2419.31	38.20	PK	81	1.4	V	3.01	41.21	74.00	-32.79
2487.27	39.64	PK	36	1.6	H	5.39	45.03	74.00	-28.97
2487.27	35.27	PK	216	1.8	V	5.39	40.66	74.00	-33.34

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.249/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2468.00	74.84	279	1.7	H	-29.97	44.87	94.00	-49.13
2468.00	84.59	317	1.6	V	-29.97	54.62	94.00	-39.38
4936.00	42.33	8	1.3	H	-29.97	12.36	74.00	-61.64
4936.00	53.72	221	1.8	V	-29.97	23.75	74.00	-50.25
2419.31	40.96	134	1.2	H	-29.97	10.99	54.00	-43.01
2419.31	41.21	81	1.4	V	-29.97	11.24	54.00	-42.76
2487.27	45.03	36	1.6	H	-29.97	15.06	54.00	-38.94
2487.27	40.66	216	1.8	V	-29.97	10.69	54.00	-43.31

Test Frequency :From 18GHz to 25GHz

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

9 Periodic Operation

The duty cycle was determined by the following equation:

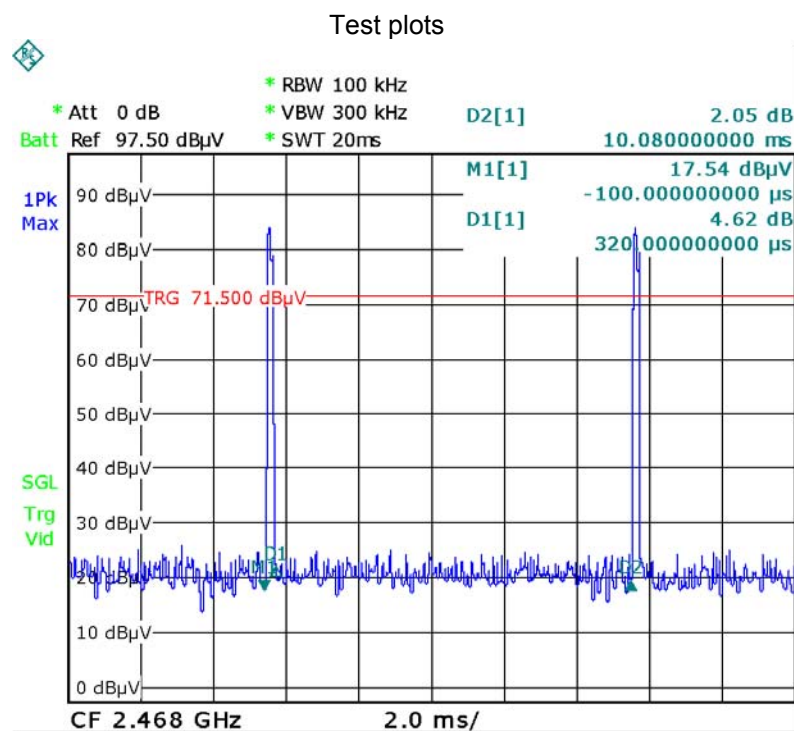
To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

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

Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle)

Total transmission time(us)	320
Length of a complete transmission period(us)	10080
Duty Cycle(%)	3.17
Duty Cycle Correction Factor(dB)	-29.97

Refer to the duty cycle plot (as below)



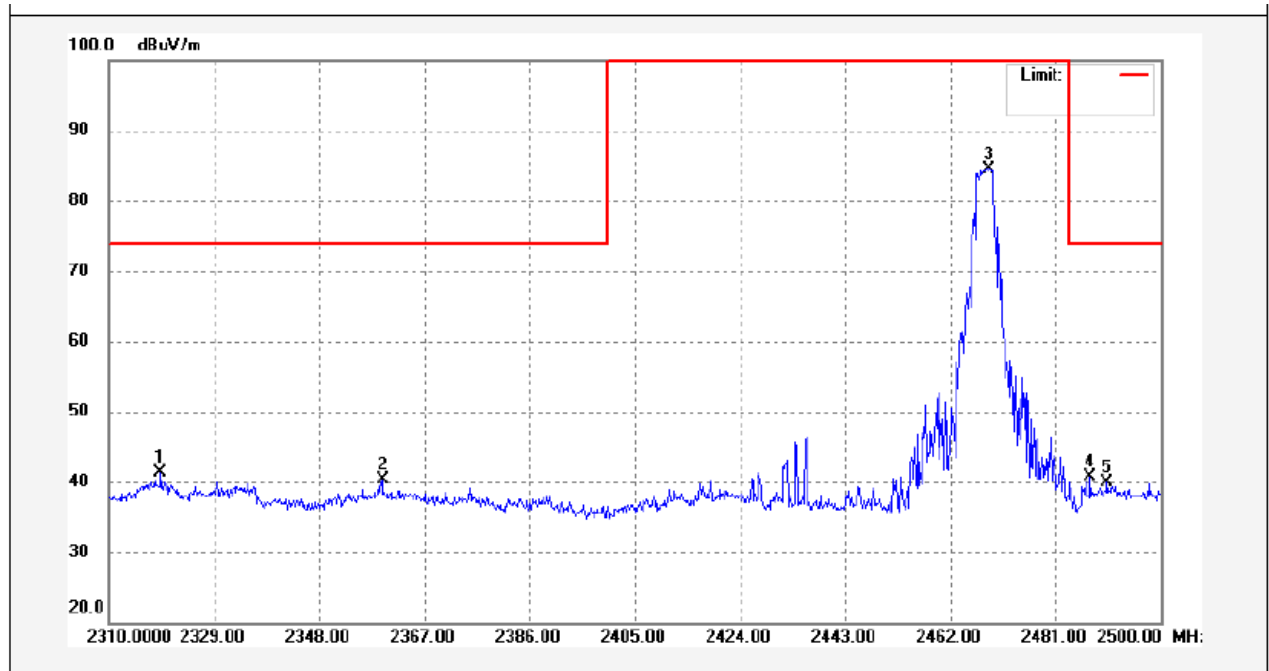
10 Outside of Band Emission

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 C63.10:2010
Test Mode:	Transmitting

10.1 Test Procedure

Refer to section 8.4 of this test report.

10.2 Test Result



Frequency (MHz)	Emission Level			Limit at 3m		Margin	
	PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
2319.31	41.21	-29.97	11.24	74.00	54.00	-32.79	-42.76
2359.40	40.37	-29.97	10.40	74.00	54.00	-33.63	-43.60
2468.00	84.59	-29.97	54.62	114.00	94.00	-29.41	-39.38
2487.27	40.66	-29.97	10.69	74.00	54.00	-33.34	-43.31
2490.31	39.91	-29.97	9.94	74.00	54.00	-34.09	-44.06

Remark: The worst case(Vertical) was recorded.

11 20 dB Bandwidth Measurement

Test Requirement:

FCC CFR47 Part 15 Section 15.215(c)

Test Method:

ANSI C63.10:2010

Test Mode:

Transmitting

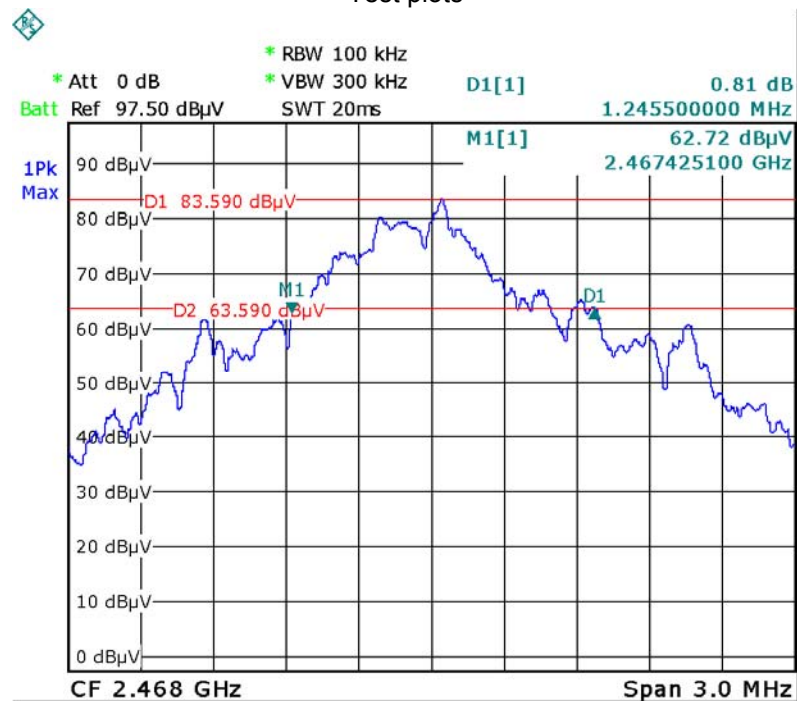
11.1 Test Procedure

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 = 100kHz, VBW = 300kHz

11.2 Test Result

Frequency (MHz)	Bandwidth Emission (MHz)	Result
2468	1.246	Pass

Test plots



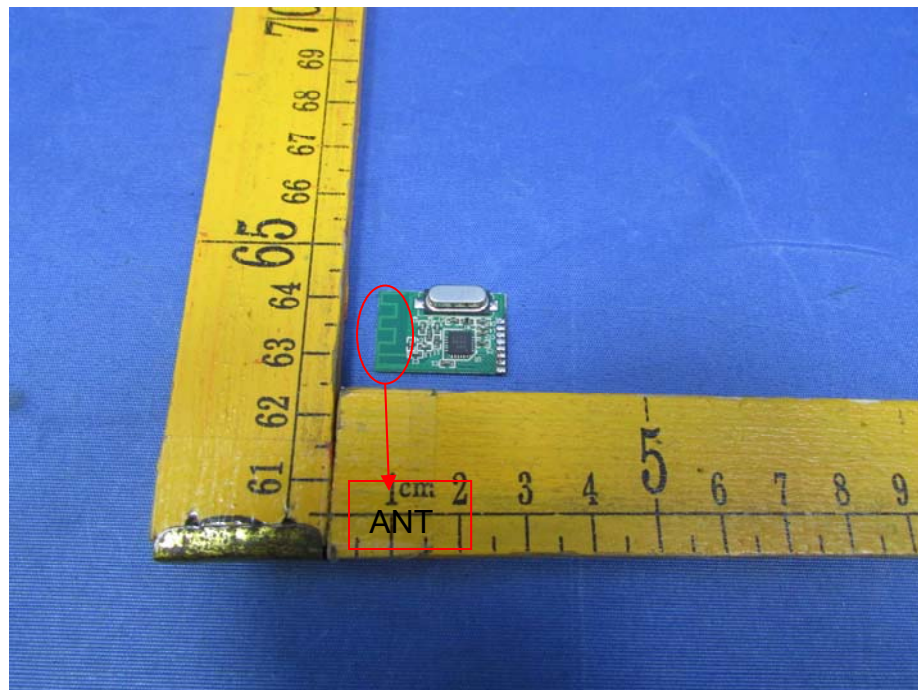
12 Antenna Requirement

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:

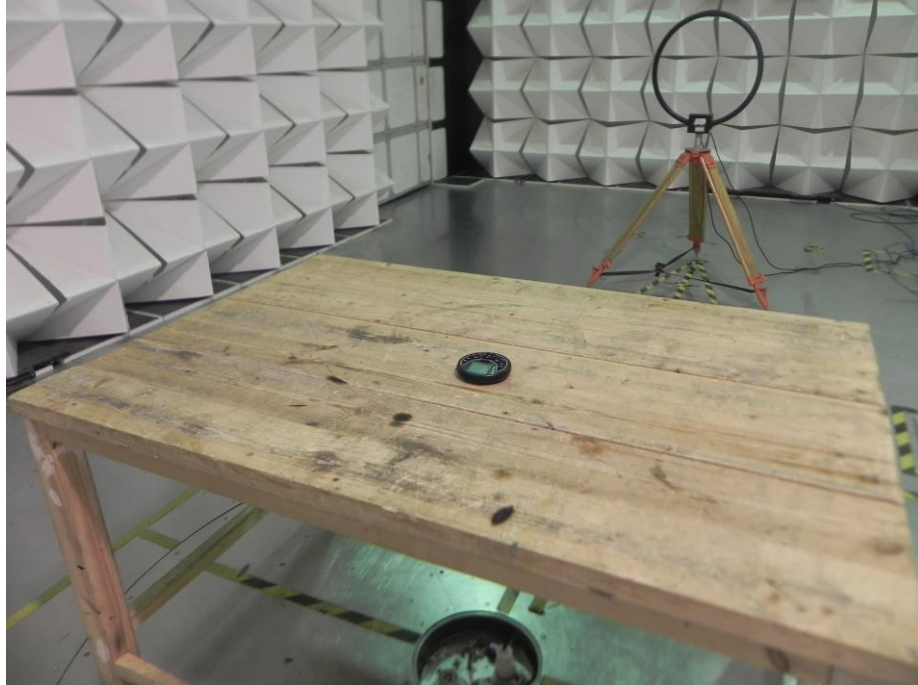
The EUT has one PCB Printed Antenna, the gain is 0dBi. meets the requirements of FCC 15.203.



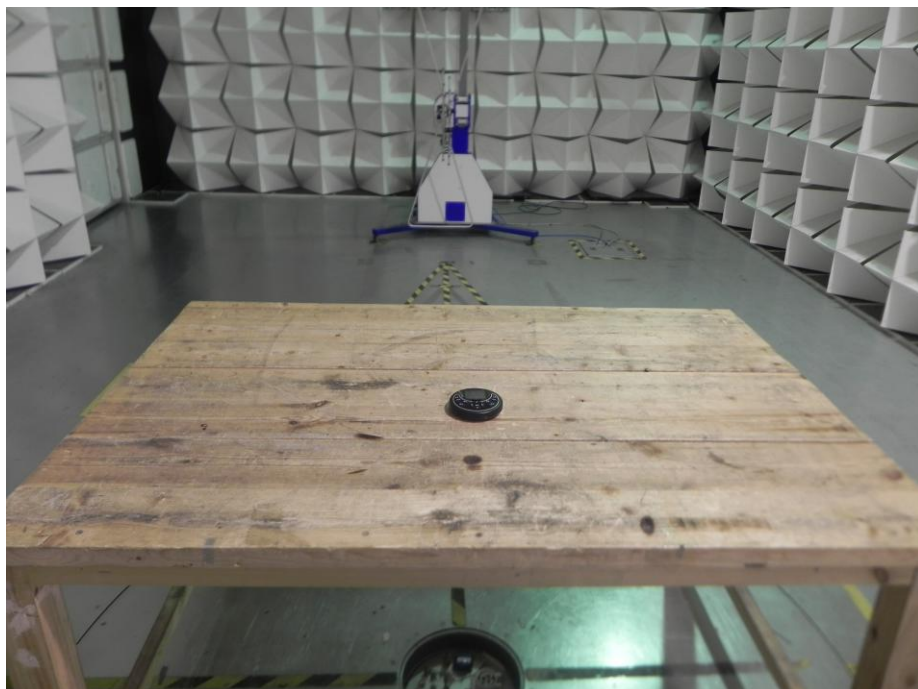
13 Photographs- Model TYD-ARF2498 with Host Test Setup Photos

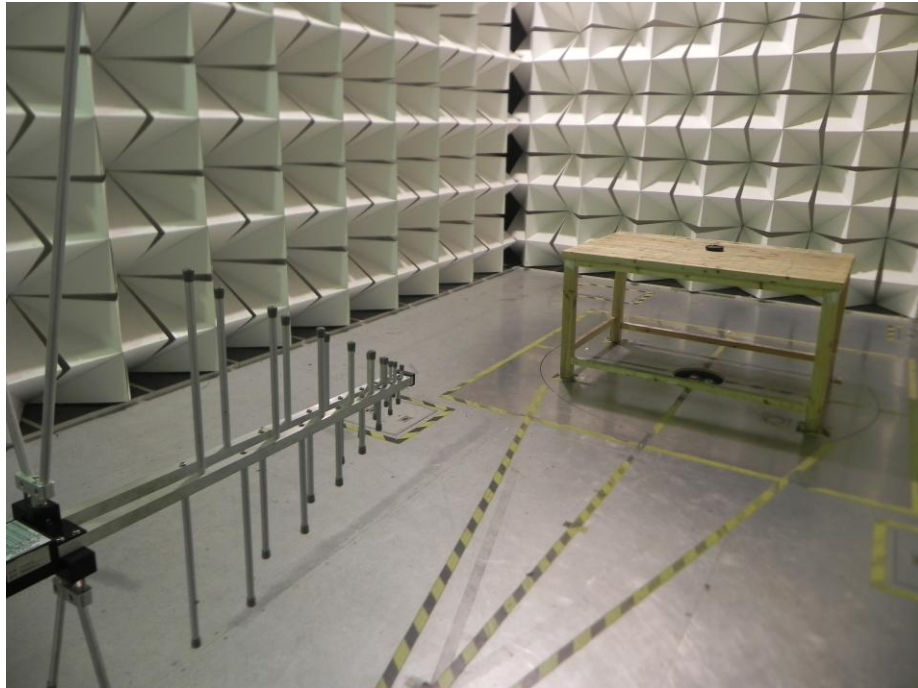
13.1 Radiation Emission

Test frequency From 16MHz to 30MHz at test site 2#



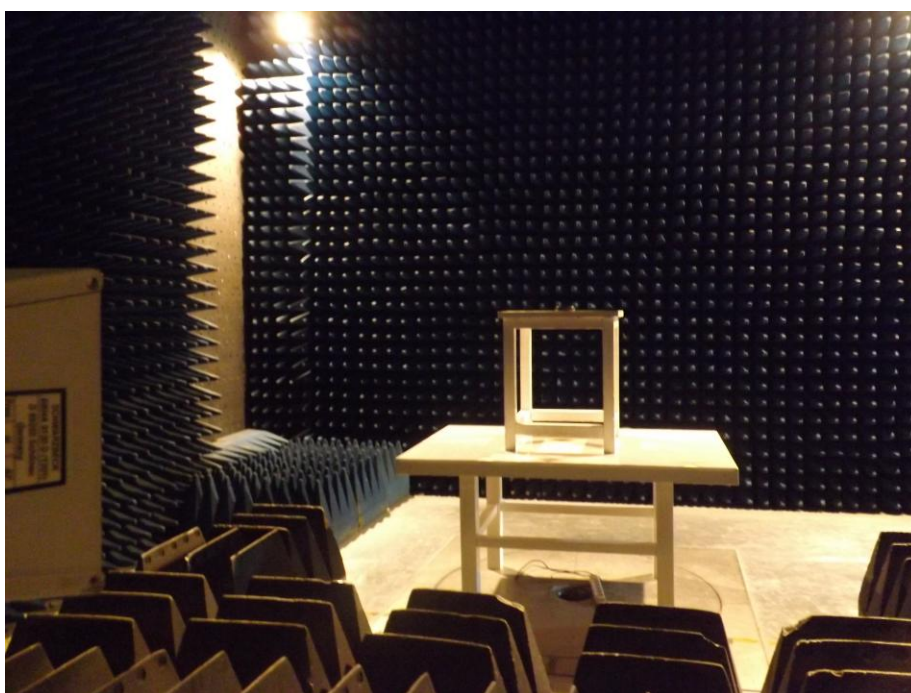
Test frequency from 30MHz to 1GHz at test site 2#





Test frequency above 1GHz at test site 1#



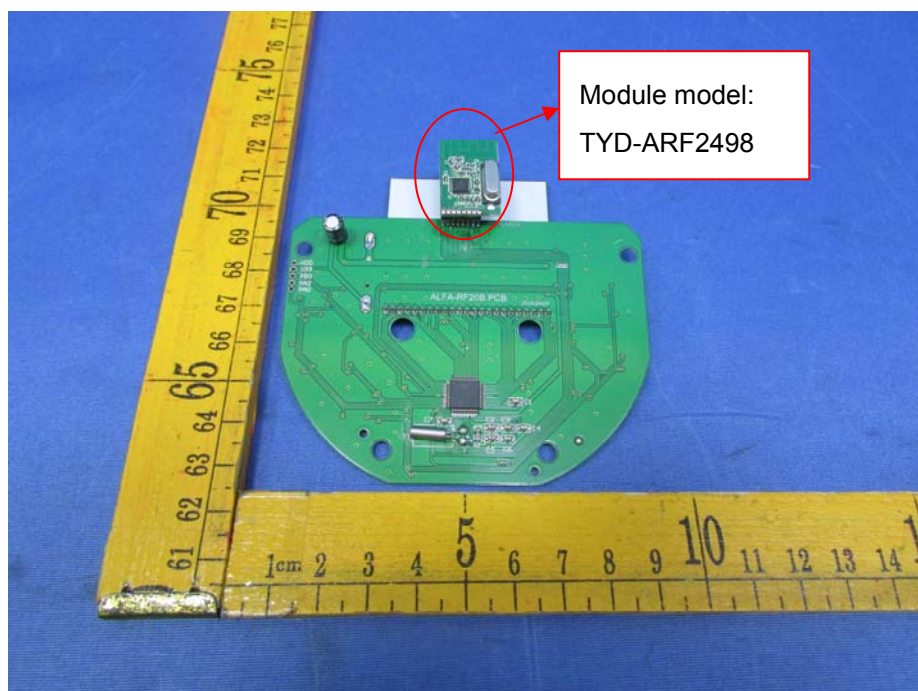
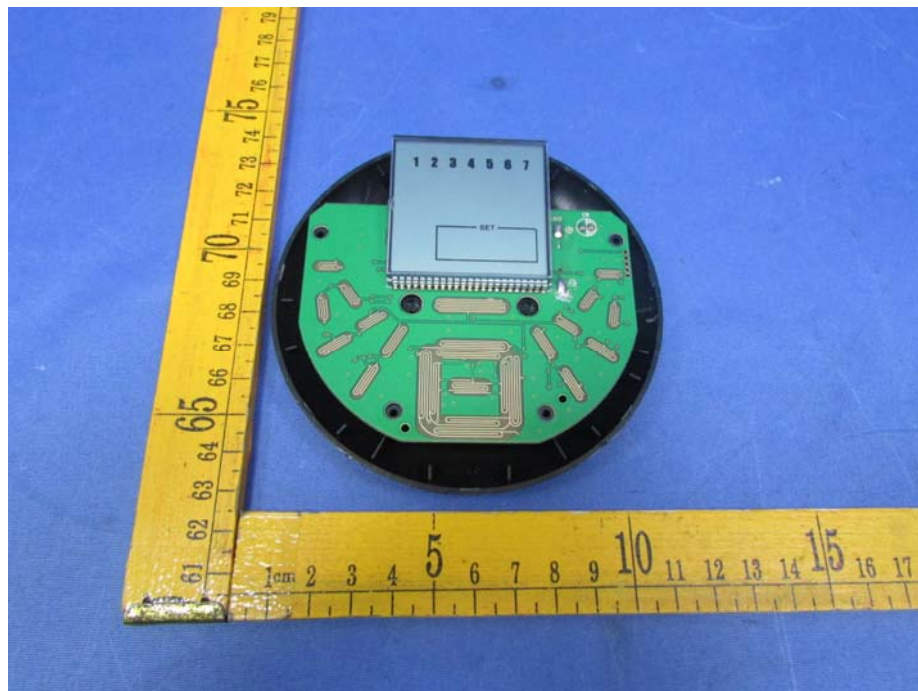


14 Photographs - Constructional Details

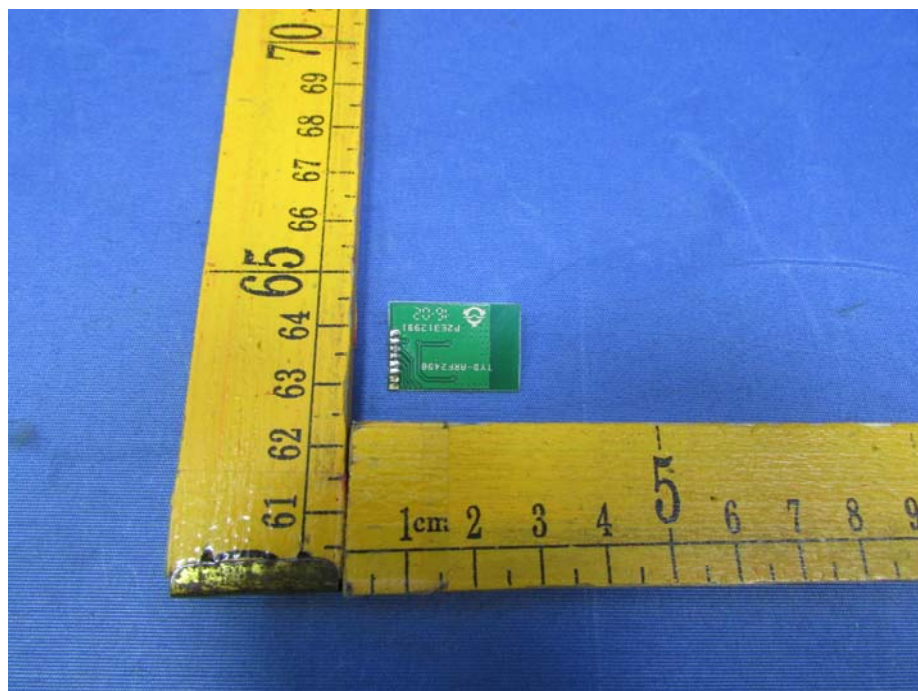
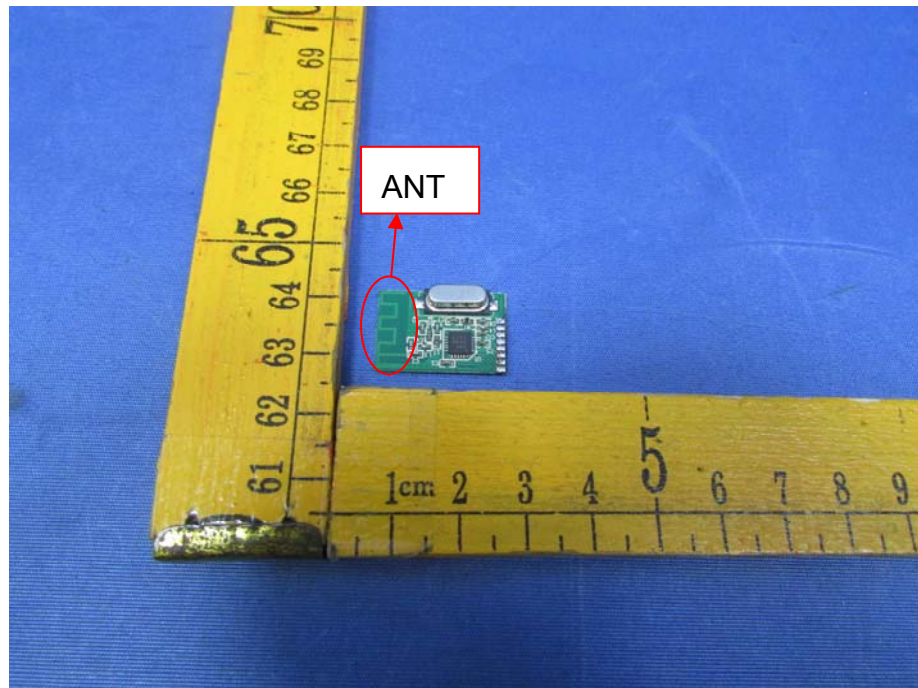
14.1 Photographs – Host External Photos



14.2 Photographs - Host Internal Photos



14.3 Photographs – Model TYD-ARF2498 Photos



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