TEST REPORT

Reference No.	:	WTS17S0990481E
FCC ID	:	2AGE6-TYX246105RX
Applicant	:	Shenzhen Silver Star Intelligent Technology Co., Ltd.
Address	:	Dafu Industrial Areas, Guanguang Road,Baoan District, Shenzhen, China
Manufacturer	:	The same as above
Address	:	The same as above
Product	:	Wireless module
Model(s)	:	TYX-2461-05RX
Standards	:	FCC CFR47 Part 15 Section 15.249: 2016
Date of Receipt sample	:	2017-09-18
Date of Test	:	2017-09-19 to 2017-10-10
Date of Issue	:	2017-10-11
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:
Waltek Services (Shenzhen) Co., Ltd.
Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China
Tel :+86-755-83551033
Fax:+86-755-83552400

Compiled by:

Jack Wen / Test Engineer

Approved by:

Philo Zhong / Manager

2 Laboratories Introduction

Waltek Services (Shenzhen) Co., Ltd is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.

2.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	**A2LA (Certificate No.: 4243.01)**	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India	**International Services**	WPC	-
Thailand		NTC	-
Singapore		IDA	-

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

B.TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of …	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS17S0990481E	2017-09-18	2017-09-19 to 2017-10-10	2017-10-11	original	-	Valid

4 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	C
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
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

5 Contents

6 General Information

6.1 General Description of E.U.T.

Product	:Wireless module
Model(s)	:TYX-2461-05RX
Model Differences	: N/A
Type of Modulation	: GFSK
Frequency Range	: 2404-2480MHz
The Lowest Oscillator	: 16MHz
Antenna installation	: PCB Printed Antenna

6.2 Details of E.U.T

Ratings	: Input: DC 3.0V

6.3 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	Lower channel	Middle channel	Upper channel
Transmitting	2404MHz	2442MHz	2480MHz

7 Equipment Used during Test

7.1 Equipment List

Conducted Emissions Test Site 1#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMI Test Receiver	R&S	ESCI	100947	2017-09-12	2018-09-11
2.	LISN	R&S	ENV216	100115	2017-09-12	2018-09-11
3.	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11

Conducted Emissions Test Site 2#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMI Test Receiver	R&S	ESCI	101155	2017-09-12	2018-09-11
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	2017-09-12	2018-09-11
3.	Limiter	York	MTS-IMP-136	261115-001-0024	2017-09-12	2018-09-11
4.	Cable	LARGE	RF300	-	2017-09-12	2018-09-11

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	2016-10-17	2017-10-16
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2016-10-17	2017-10-16
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2017-04-09	2018-04-08
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2017-09-12	2018-09-11
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2017-04-09	2018-04-08
6	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2017-04-13	2018-04-12
7	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	2017-04-13	2018-04-12

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	2017-04-13	2018-04-12
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2017-04-09	2018-04-08
3	Amplifier	ANRITSU	MH648A	M43381	2017-04-13	2018-04-12
4	Cable	HUBER+SUHNER	CBL2	525178	2017-04-13	2018-04-12

7.2 Description of Support Units

Equipment	Manufacturer	Model No.
/	/	/

7.3 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 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)

7.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO. , LTD. address is No.163, Pingyun Rd. West of Huangpu Ave,Tianhe District, Guangzhou, Guangdong, China.

8 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 (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 $\log_{10}$ RF Voltage(uV)

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

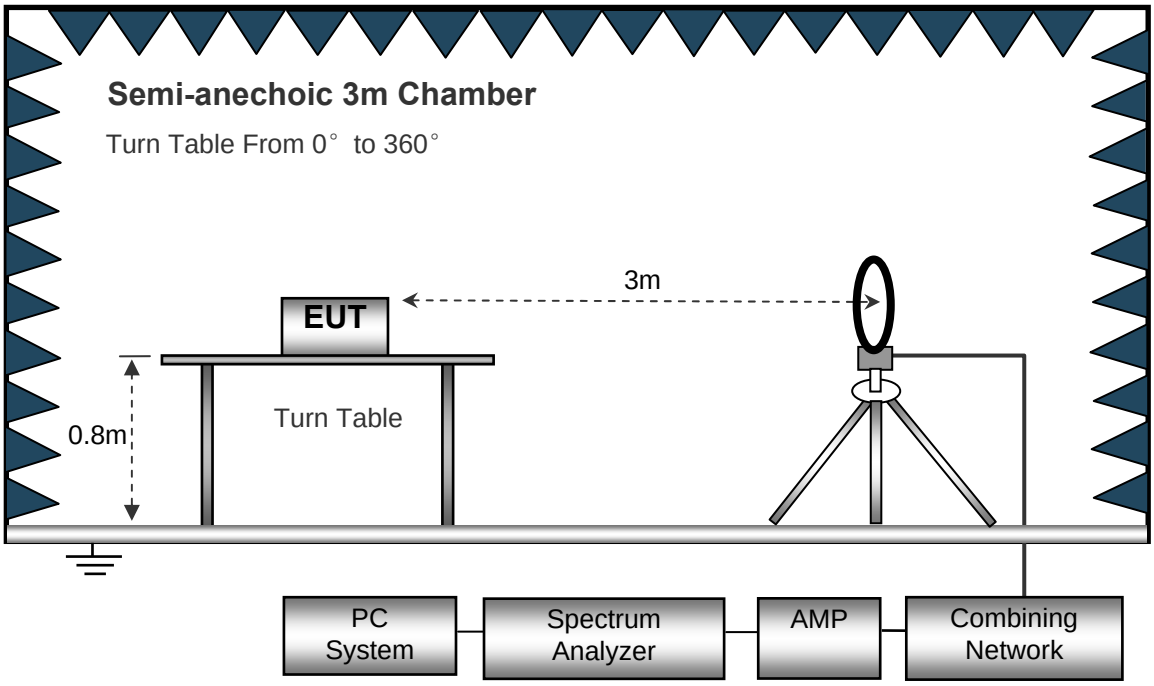
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

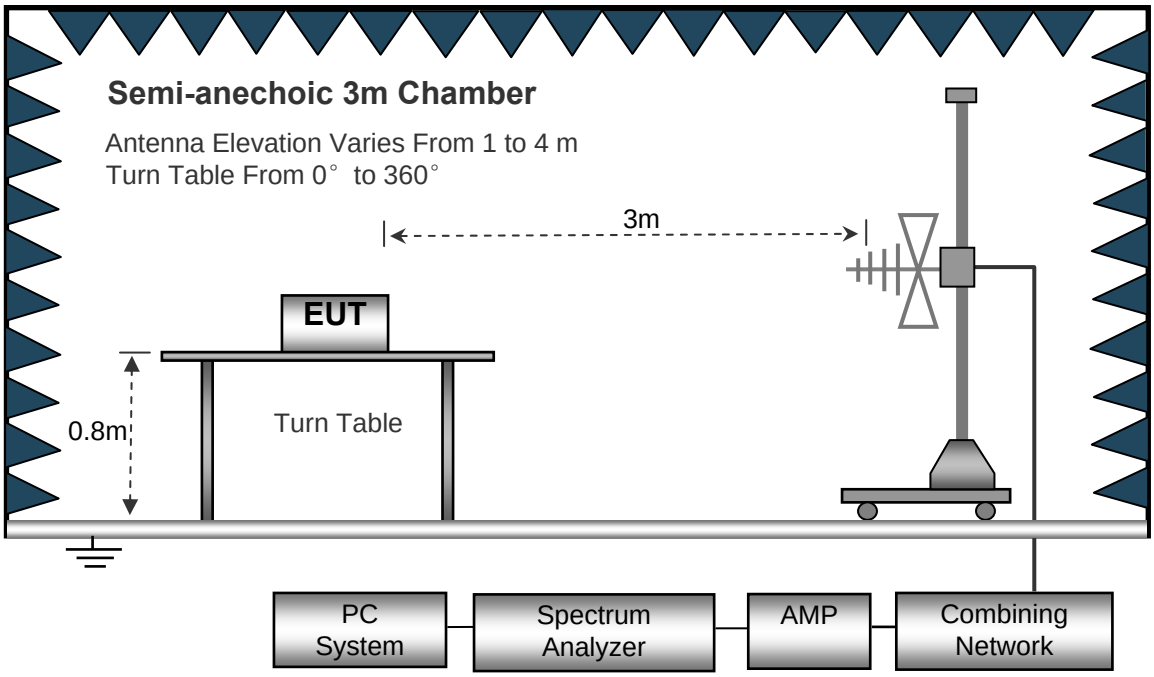
The test was performed in transmitting mode, the test data were shown in the report.

8.2 Test Setup

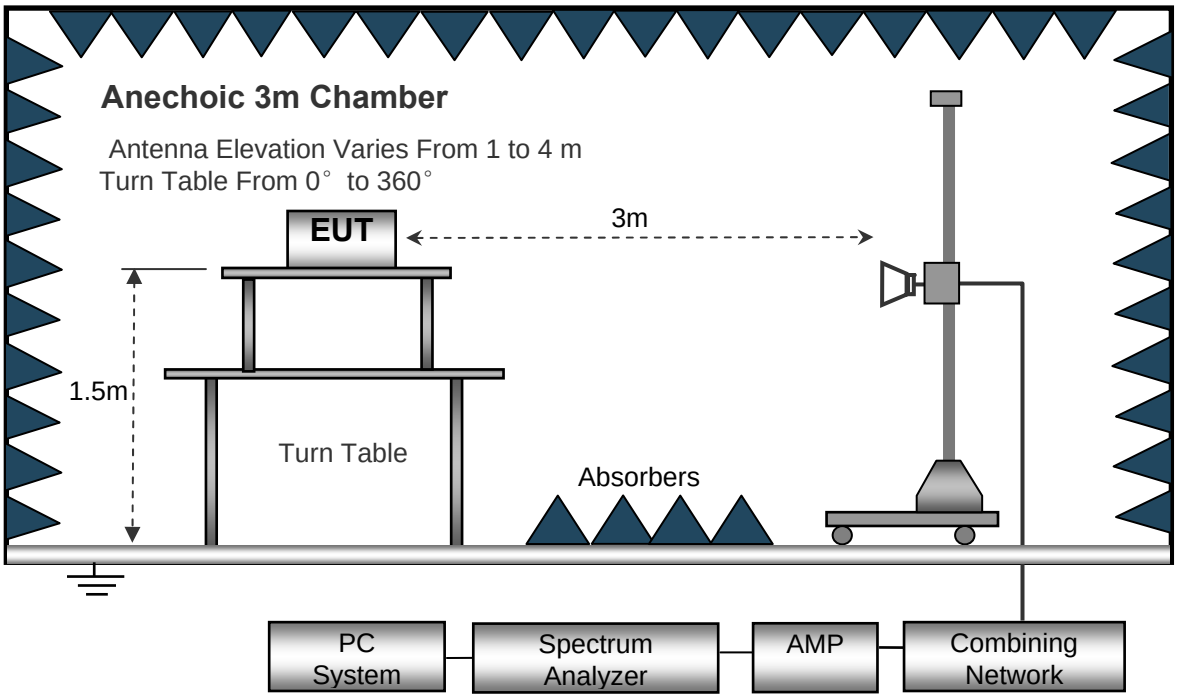
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.
The test setup for emission measurement below 30MHz.



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
Detector	PK
Resolution Bandwidth	1MHz
Video Bandwidth	3MHz
Detector	Ave.
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 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.
8. New battery is used during test.

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

Test Mode: Low channel Transmitting

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)
302.56	40.41	QP	189	1.9	V	-11.4	29.01	40.00	-10.99
2404.00	100.36	PK	211	2.0	H	-13.07	87.29	114.00	-26.71
2404.00	87.42	PK	299	1.5	V	-13.07	74.35	114.00	-39.65
4808.00	48.69	PK	207	1.6	H	-1.09	47.60	74.00	-26.40
4808.00	43.86	PK	264	1.6	V	-1.09	42.77	74.00	-31.23
7212.00	35.13	PK	286	2.0	H	1.26	36.39	74.00	-37.61
7212.00	36.39	PK	30	1.1	V	1.26	37.65	74.00	-36.35
9616.00	40.23	PK	223	1.7	H	3.29	43.52	74.00	-30.48
9616.00	36.46	PK	234	1.8	V	3.29	39.75	74.00	-34.25

AV = Peak +20Log10 (duty cycle) =Peak+ (0)[refer to section 10 for more detail]

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.231/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2404.00	87.29	211	2.0	H	0.00	87.29	94.00	-6.71
2404.00	74.35	299	1.5	V	0.00	74.35	94.00	-19.65
4808.00	47.60	207	1.6	H	0.00	47.60	54.00	-6.40
4808.00	42.77	264	1.6	V	0.00	42.77	54.00	-11.23
7212.00	36.39	286	2.0	H	0.00	36.39	54.00	-17.61
7212.00	37.65	30	1.1	V	0.00	37.65	54.00	-16.35
9616.00	43.52	223	1.7	H	0.00	43.52	54.00	-10.48
9616.00	39.75	234	1.8	V	0.00	39.75	54.00	-14.25

Test Mode: Middle channel Transmitting

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)
302.88	40.57	QP	230	1.4	V	-11.4	29.17	40.00	-10.83
2442.00	97.50	PK	112	1.0	H	-13.07	84.43	114.00	-29.57
2442.00	87.92	PK	26	1.8	V	-13.07	74.85	114.00	-39.15
4884.00	48.53	PK	22	1.6	H	-1.09	47.44	74.00	-26.56
4884.00	43.67	PK	203	1.7	V	-1.09	42.58	74.00	-31.42
7326.00	35.28	PK	158	1.5	H	1.26	36.54	74.00	-37.46
7326.00	36.19	PK	21	1.7	V	1.26	37.45	74.00	-36.55
9768.00	39.79	PK	154	2.0	H	3.29	43.08	74.00	-30.92
9768.00	35.89	PK	341	1.1	V	3.29	39.18	74.00	-34.82

AV = Peak +20Log10 (duty cycle) =Peak+ (0)[refer to section 10 for more detail]

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.231/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2442.00	84.43	112	1.0	H	0.00	84.43	94.00	-9.57
2442.00	74.85	26	1.8	V	0.00	74.85	94.00	-19.15
4884.00	47.44	22	1.6	H	0.00	47.44	54.00	-6.56
4884.00	42.58	203	1.7	V	0.00	42.58	54.00	-11.42
7326.00	36.54	158	1.5	H	0.00	36.54	54.00	-17.46
7326.00	37.45	21	1.7	V	0.00	37.45	54.00	-16.55
9768.00	43.08	154	2.0	H	0.00	43.08	54.00	-10.92
9768.00	39.18	341	1.1	V	0.00	39.18	54.00	-14.82

Test Mode: High channel Transmitting

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)
302.78	39.71	QP	9	1.5	V	-11.4	28.31	40.00	-11.69
2480.00	99.86	PK	98	1.2	H	-13.07	86.79	114.00	-27.21
2480.00	88.25	PK	241	1.9	V	-13.07	75.18	114.00	-38.82
4960.00	48.59	PK	168	1.6	H	-1.09	47.50	74.00	-26.50
4960.00	43.39	PK	275	1.6	V	-1.09	42.30	74.00	-31.70
7440.00	34.98	PK	238	1.1	H	1.26	36.24	74.00	-37.76
7440.00	36.62	PK	135	1.5	V	1.26	37.88	74.00	-36.12
9920.00	40.16	PK	317	2.0	H	3.29	43.45	74.00	-30.55
9920.00	35.68	PK	202	1.4	V	3.29	38.97	74.00	-35.03

AV = Peak +20Log10(duty cycle)=Peak+(0) [refer to section 10 for more detail]

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.231/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2480.00	86.79	98	1.2	H	0.00	86.79	94.00	-7.21
2480.00	75.18	241	1.9	V	0.00	75.18	94.00	-18.82
4960.00	47.50	168	1.6	H	0.00	47.50	54.00	-6.50
4960.00	42.30	275	1.6	V	0.00	42.30	54.00	-11.70
7440.00	36.24	238	1.1	H	0.00	36.24	54.00	-17.76
7440.00	37.88	135	1.5	V	0.00	37.88	54.00	-16.12
9920.00	43.45	317	2.0	H	0.00	43.45	54.00	-10.55
9920.00	38.97	202	1.4	V	0.00	38.97	54.00	-15.03

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 * %

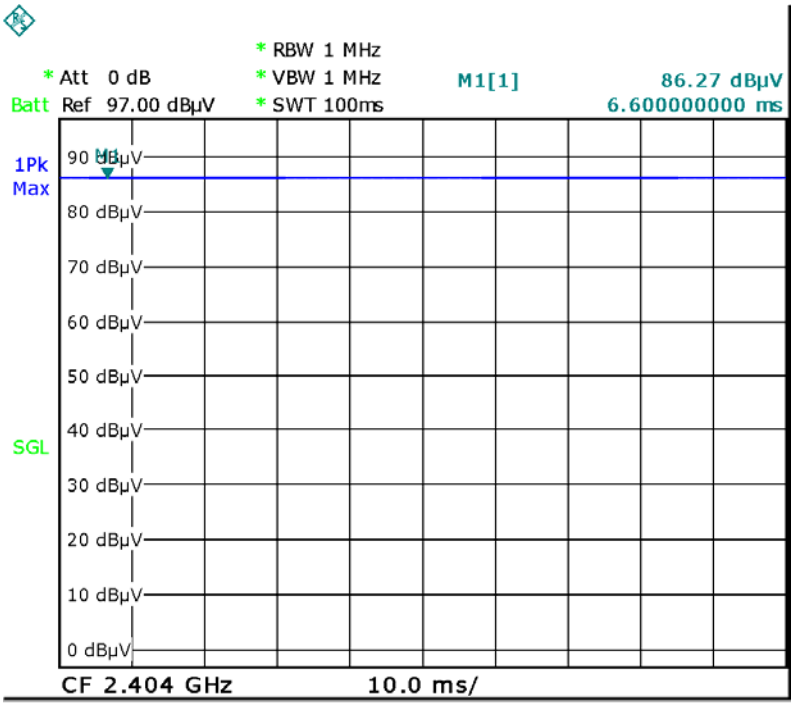
Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle)

Test Channel	Low Channel	Middle Channel	High Channel
Total transmission time(ms)	100	100	100
Length of a complete transmission period(ms)	100	100	100
Duty Cycle(%)	1	1	1
Duty Cycle Correction Factor(dB)	0	0	0

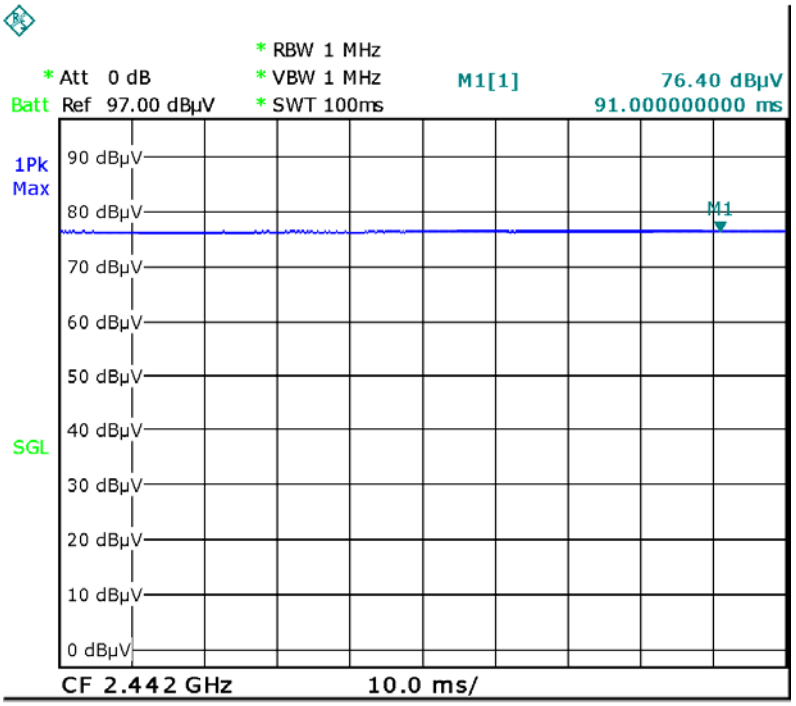
Refer to the duty cycle plot (as below)

Test plots

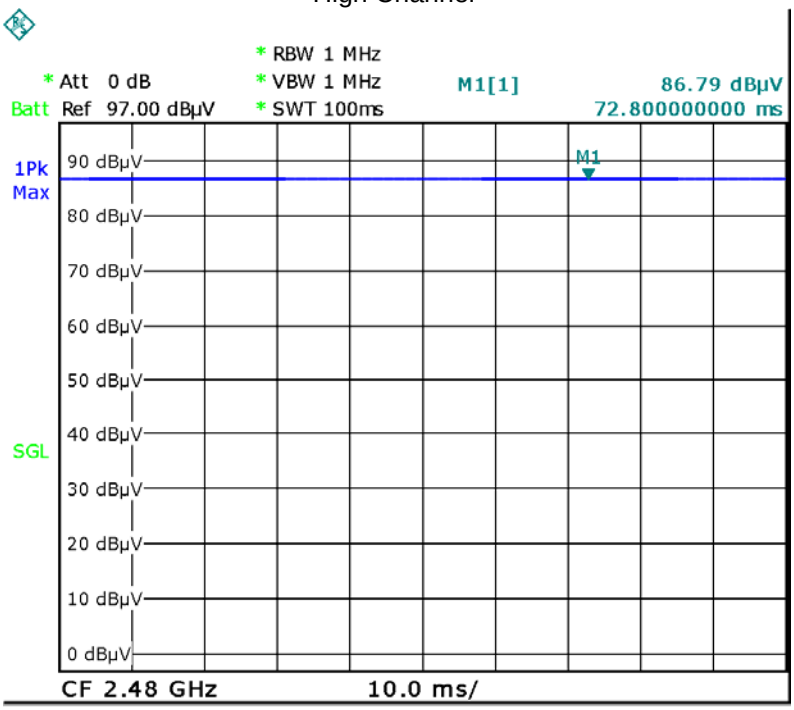
Low Channel



Middle Channel



High Channel



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 C63.10:2013
Test Mode:	Transmitting

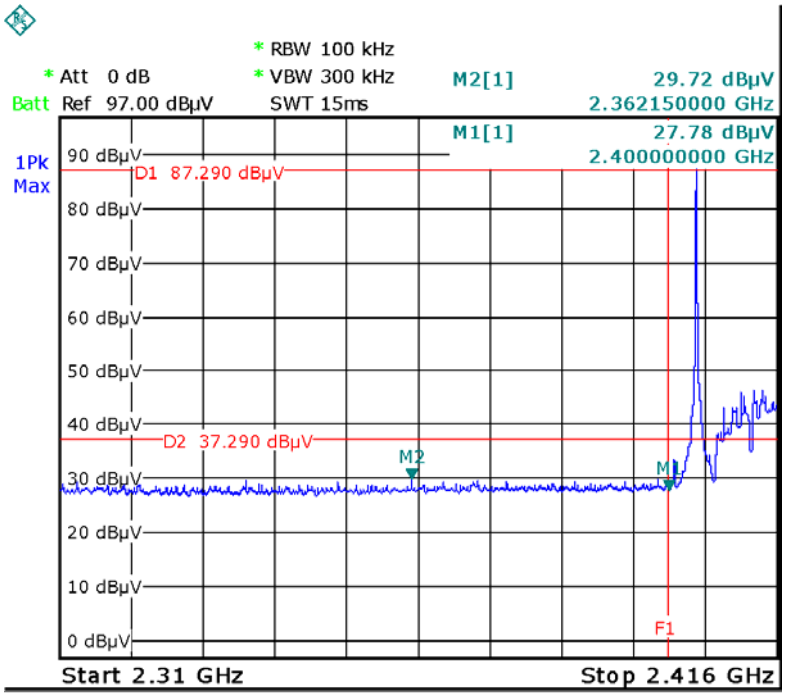
10.1 Test Procedure

Refer to section 7.4 of this test report.

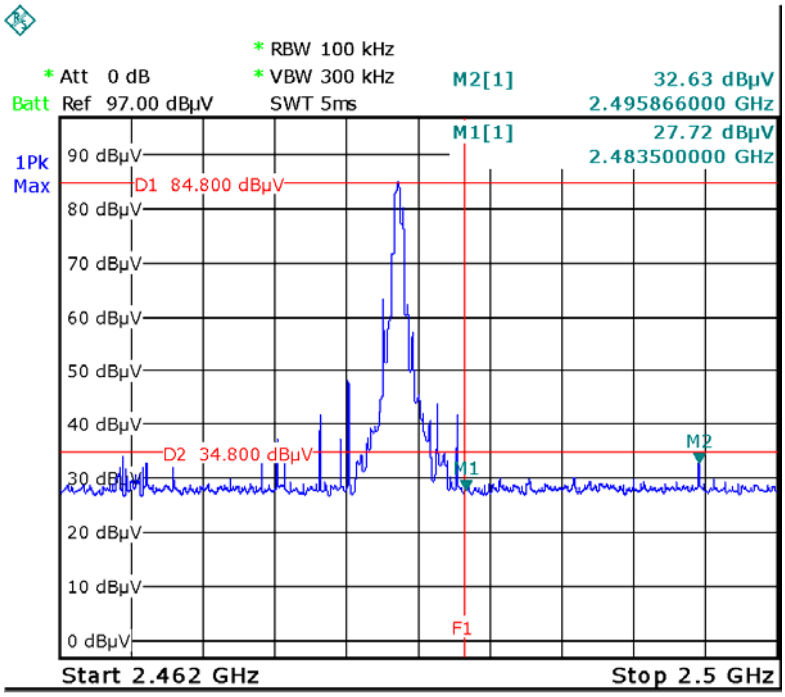
10.2 Test Result

Test plots

Left band



Right band


* RBW 100 kHz
* Att 0 dB
* VBW 300 kHz
M2[1]
32.63 dBµV
Batt
Ref 97.00 dBµV
SWT 5ms
2.495866000 GHz
M1[1]
27.72 dBµV
2.483500000 GHz
1Pk
Max
90 dBµV
D1 84.800 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
D2 34.800 dBµV
M2
M1
30 dBµV
20 dBµV
10 dBµV
F1
0 dBµV
Start 2.462 GHz
Stop 2.5 GHz

11 20 dB Bandwidth Measurement

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

Test Method: ANSI C63.10:2013

Test Mode: Transmitting

11.1 Test Procedure

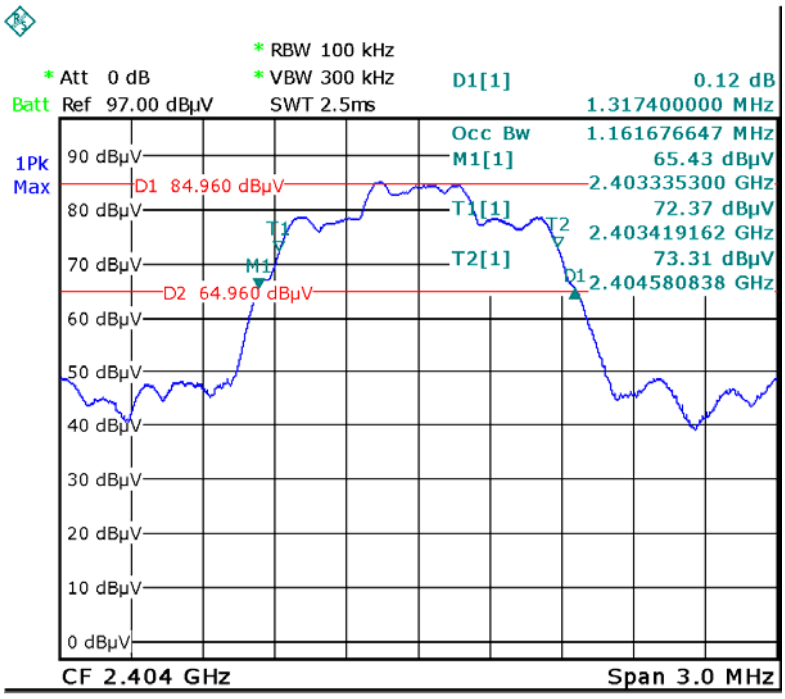
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

11.2 Test Result

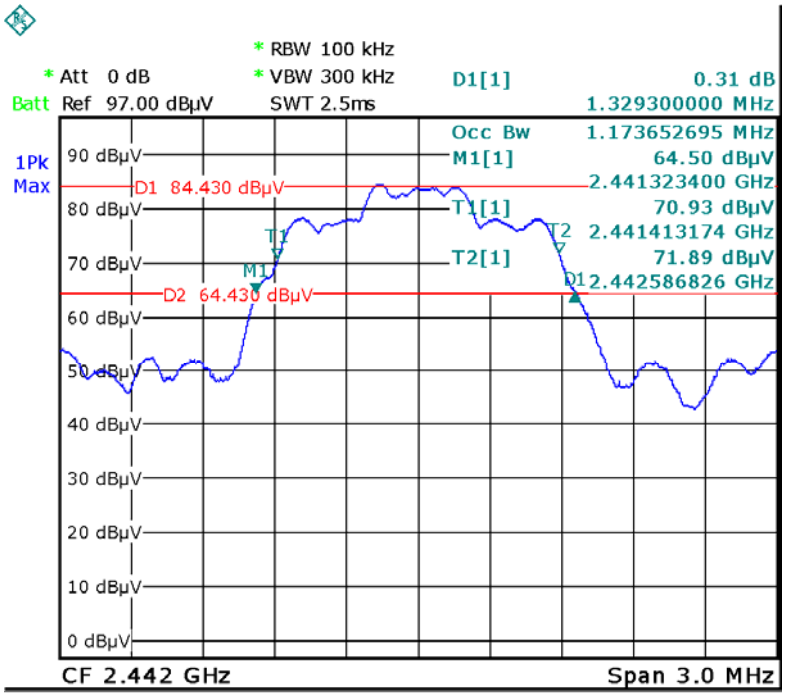
Test Channel	20dB Bandwidth	99% Bandwidth
low	1.317MHz	1.162MHz
Middle	1.329MHz	1.174MHz
high	1.329MHz	1.174MHz

Test plots

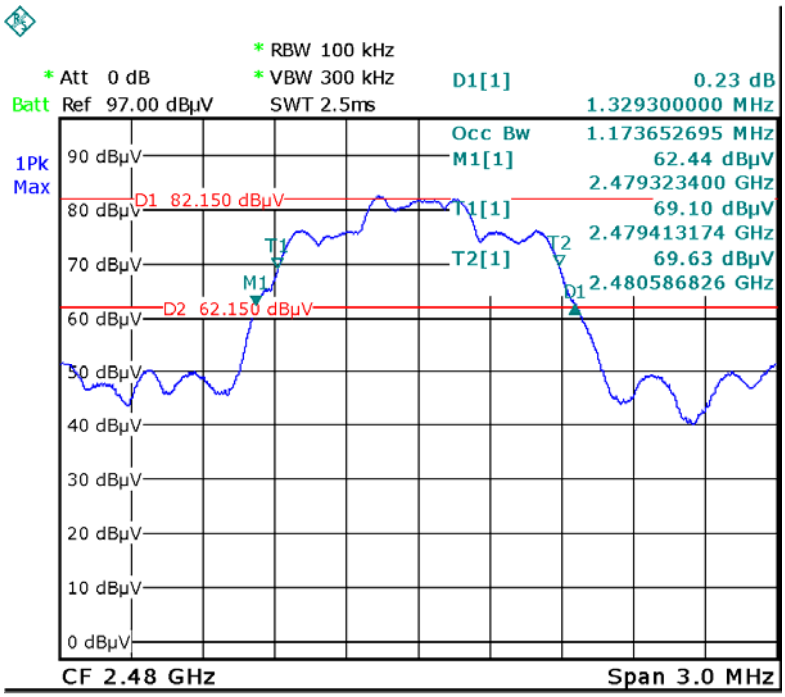
Low Channel



Middle Channel

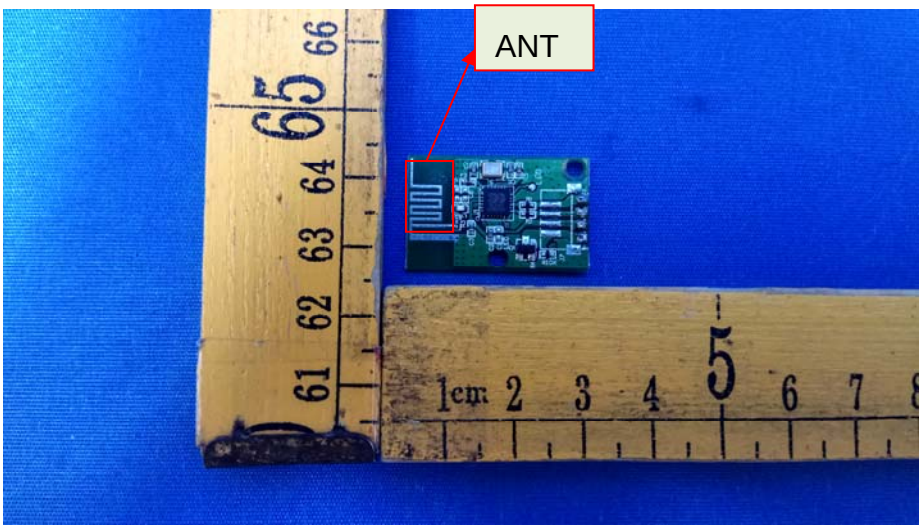


High Channel



12 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.



13 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091 & KDB 447498 D01 General RF Exposure Guidance v06

13.1 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.

13.2 Test result

Conducted Peak power(dBm)	Conducted Peak power(mW)	Source-based time-averaged maximum conducted output power(mW)	Minimum test separation distance required for the exposure conditions (mm)	SAR Test Exclusion Thresholds Calculation Value	SAR Test Exclusion Thresholds Limit	Result
-7.97	0.16	0.16	5	0.05	3.0	Compliance
Note: No SAR measurement is required.						

Remark: Max. duty factor is 100%, peak output power=87.29-95.26=-7.97dBm

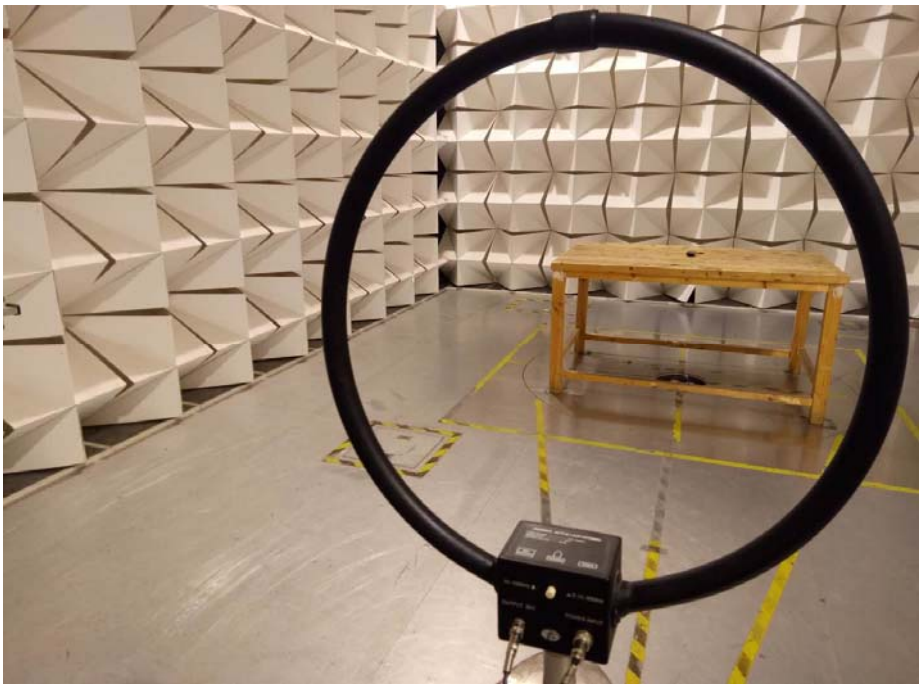
Result: Compliance

No SAR measurement is required.

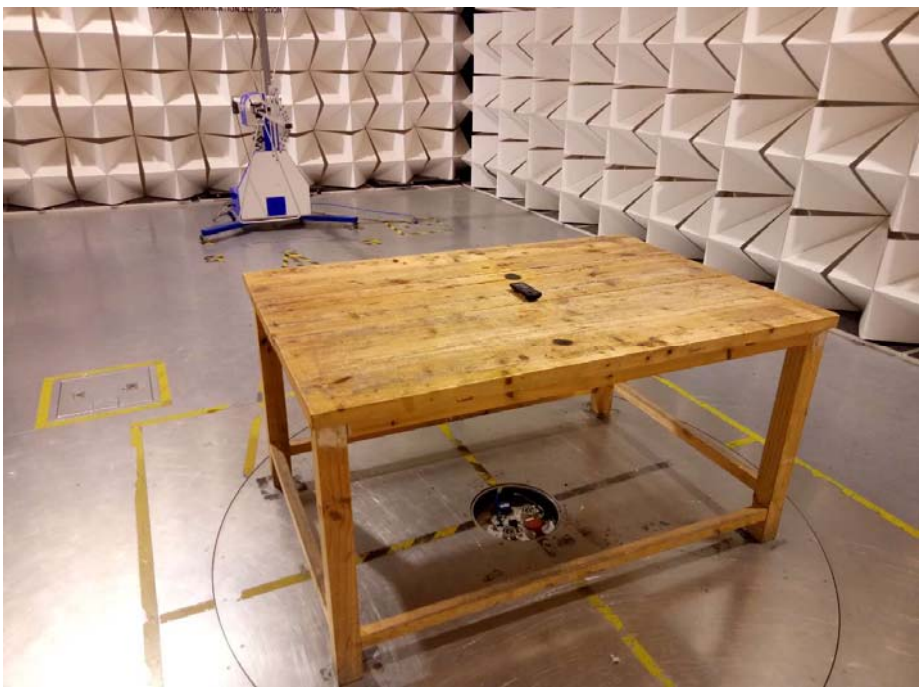
14 Photographs Test Setup

14.1 Radiation Emission

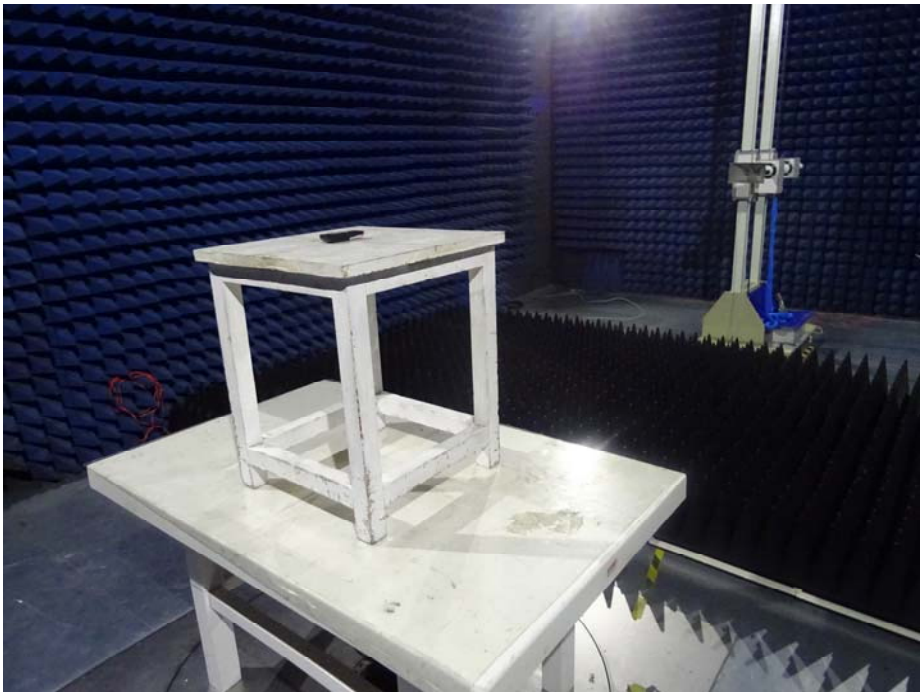
Test frequency Below 30MHz



Test frequency from 30MHz to 1GHz

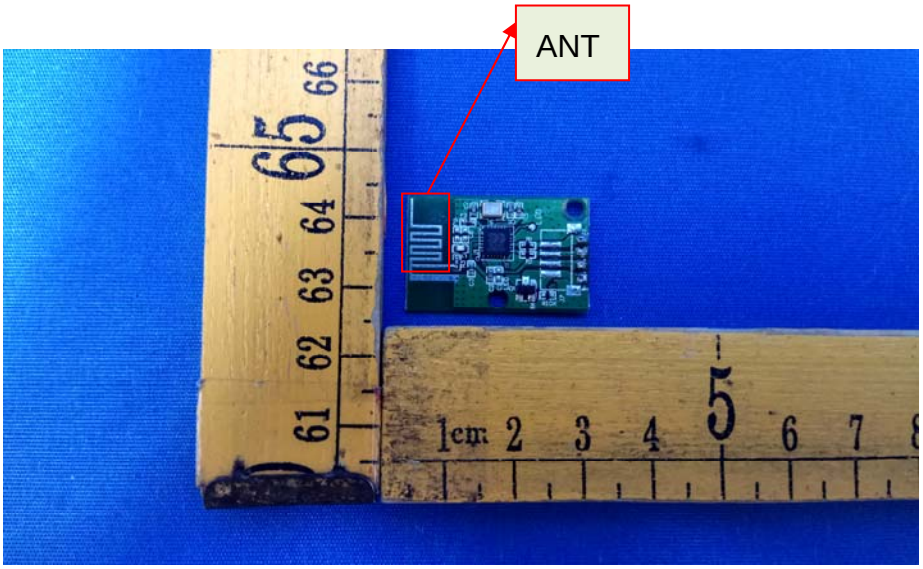


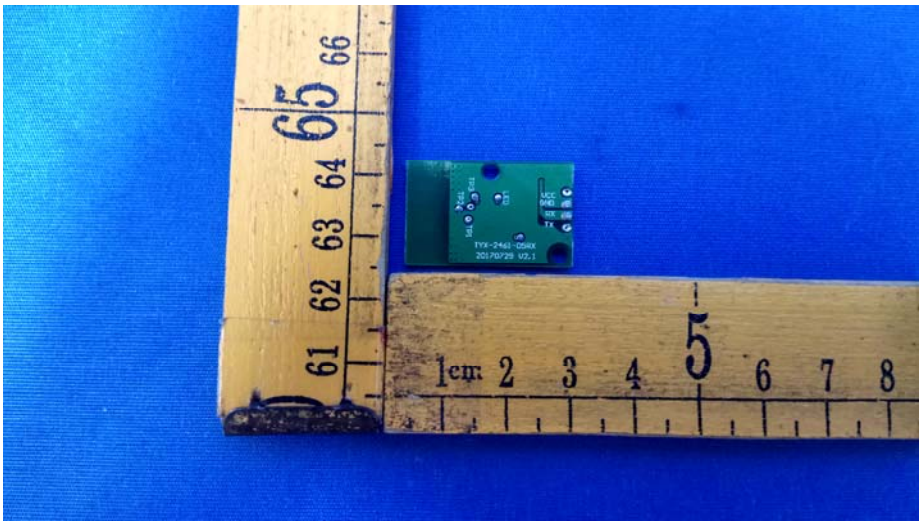
Test frequency above 1GHz



15 Photographs - Constructional Details

15.1 Photos





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