

TEST REPORT

Reference No. : WTS16S0344759-1E
FCC ID..... : O46RY12M03
Applicant..... : Zhejiang Rexense Technology Co., Ltd.
Address : Room 105, Hangzhou E-Commerce Industry Park, No.7 Cuibai Road,
Hangzhou 310012 P. R. China
Manufacturer : Zhejiang Rexense Technology Co., Ltd.
Address : Room 105, Hangzhou E-Commerce Industry Park, No.7 Cuibai Road,
Hangzhou 310012 P. R. China
Product Name : 802.15.4/ ZigBee Module
Model No. : REX3L
Brand : REXENSE
Standards..... : FCC CFR47 Part 15 C Section 15.247:2015
Date of Receipt sample..... : Mar. 14, 2016
Date of Test..... : Mar. 15 - 24, 2016
Date of Issue : Mar. 25, 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:

Waltek Services (Shenzhen) Co., Ltd.

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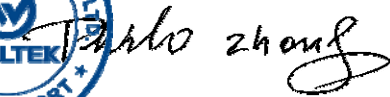
Fax:+86-755-83552400

Compiled by:



Zero Zhou / Test Engineer

Approved by:



Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207(a)	N/A
Radiated Emissions	15.247 15.205(a) 15.209(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(3),(4)	PASS
Power Spectral Density	15.247(e)	PASS
Band Edge	15.247(d)	PASS
Antenna Requirement	15.203	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	2.1091	PASS

Remark:

N/A: Not Applicable

PASS: Applicable

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4 General Information

4.1 General Description of E.U.T.

Product Name: 802.15.4/ ZigBee Module
Model No.: REX3L
Model Difference: N/A
Operation Frequency: 2405MHz ~ 2480MHz
The Lowest Oscillator: 24MHz
Antenna Gain: 0 dBi for ZigBee
Type of modulation: O-QPSK

4.2 Details of E.U.T.

Technical Data: DC 3.3V

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2405	2	2410	3	2415	4	2420
5	2425	6	2430	7	2435	8	2440
9	2445	10	2450	11	2455	12	2460
13	2465	14	2470	15	2475	16	2480

4.4 Test Mode

Table 1 Tests Carried Out Under FCC part 15.247

Test Items	Mode	Data Rate	Channel	TX/RX
Maximum Peak Output Power	Transmitting	250Kbps	1/8/16	TX
Power Spectral Density	Transmitting	250Kbps	1/8/16	TX
Band Edge	Transmitting	250Kbps	1/8/16	TX
Bandwidth	Transmitting	250Kbps	1/8/16	TX
Transmitter Spurious Emissions	Transmitting	250Kbps	1/8/16	TX

Note :Parameters set by test software during channel & power tests, the software provided by the customer was used to set the operating channels as well as the output power level. The RF output power set is the power expected by the manufacturer and is going to be fixed on the firmware of the final product .

4.5 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 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.

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.18,2015	Apr.17,2016
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.18,2015	Apr.17,2016
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.18,2015	Apr.17,2016
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr.18,2015	Apr.17,2016
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.09,2015	Apr.08,2016
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

5.2 Description of Support Units

Equipment	Manufacturer	Model No.
host	Zhejiang Rexense Technology Co., Ltd.	01

5.3 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 (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.4 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 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
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	$20\log^{(500)}$

6.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

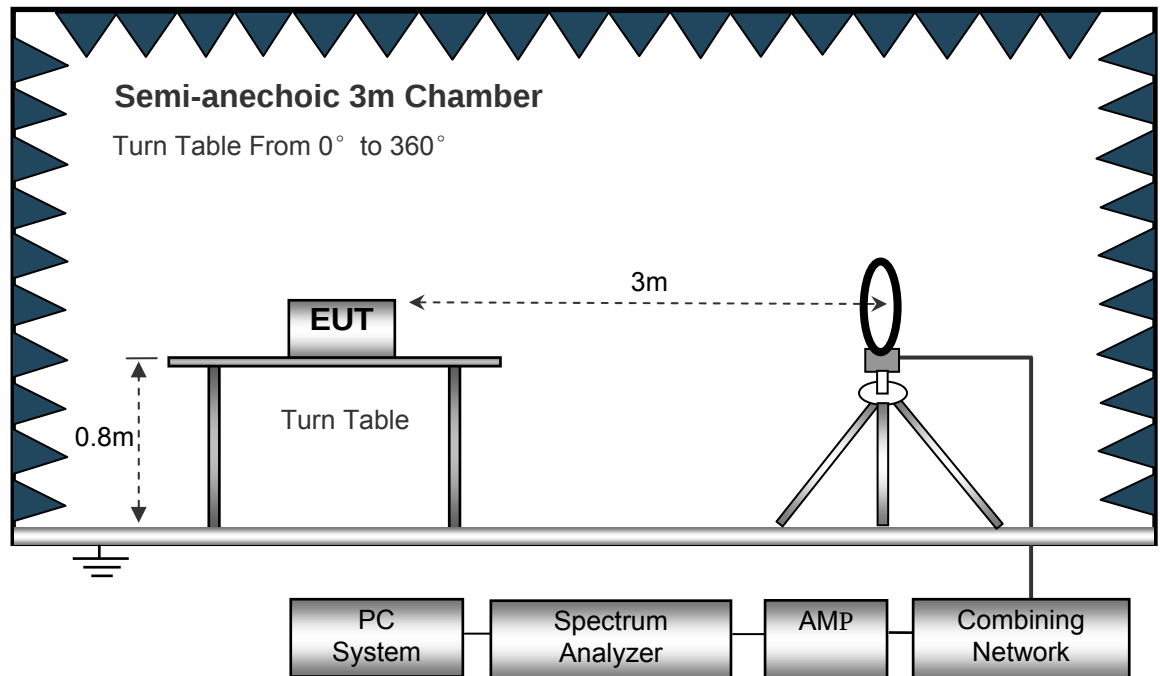
EUT Operation :

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

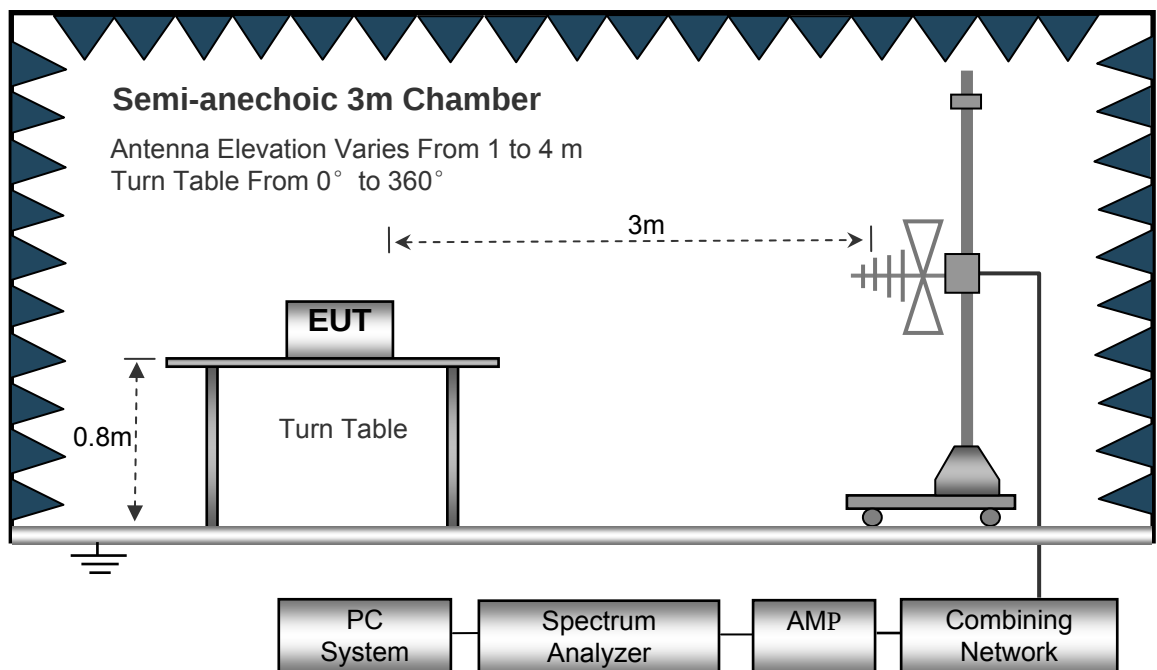
6.2 Test Setup

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

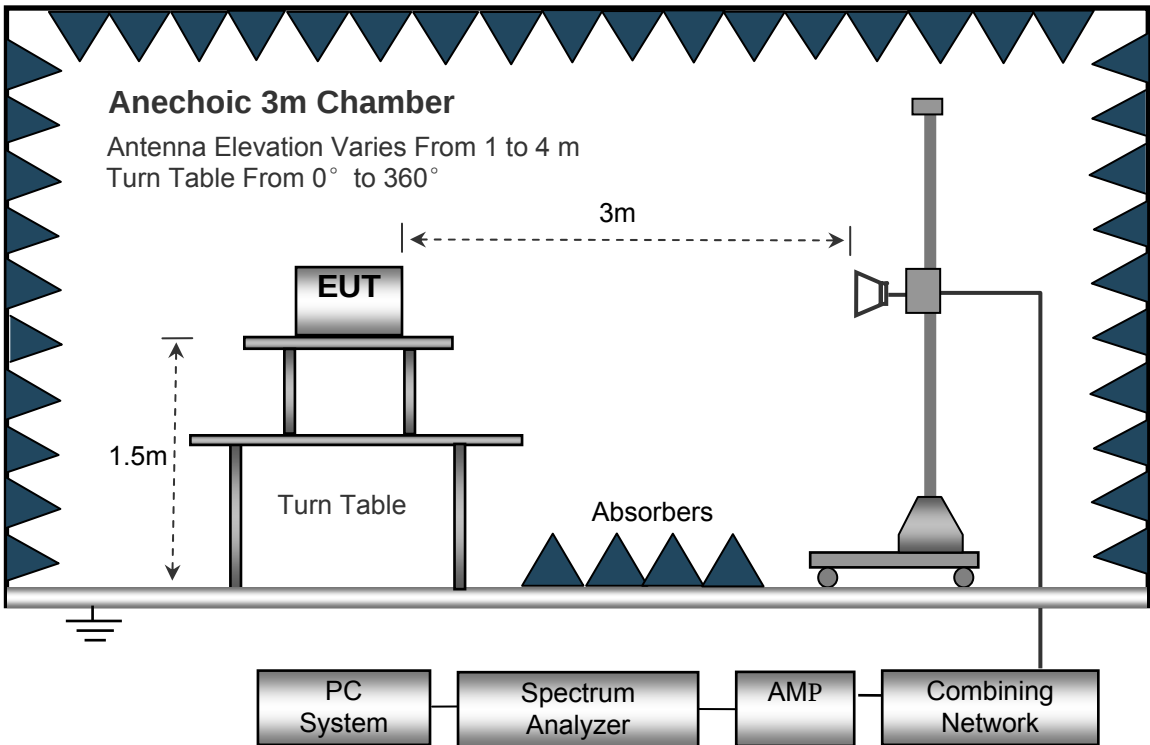
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



6.3 Spectrum Analyzer Setup

Below 30MHz

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

30MHz ~ 1GHz

Sweep Speed Auto
DetectorPK
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

6.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane 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.
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 performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in X axis,so the worst data were shown as follow.
8. A 2.4GHz high -pass filter is used during radiated emissions above 1GHz measurement.

6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

6.6 Summary of Test Results

Test Frequency : 24MHz~ 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 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
O-QPSK Low Channel									
268.32	37.75	QP	170	1.5	H	-13.35	24.40	46.00	-21.60
268.32	40.75	QP	284	1.1	V	-13.35	27.40	46.00	-18.60
4804.00	45.57	PK	68	1.1	V	-1.06	44.51	74.00	-29.49
4804.00	42.54	Ave	68	1.1	V	-1.06	41.48	54.00	-12.52
7206.00	40.28	PK	302	2.0	H	1.33	41.61	74.00	-32.39
7206.00	35.38	Ave	302	2.0	H	1.33	36.71	54.00	-17.29
2314.11	45.08	PK	168	1.8	V	-13.19	31.89	74.00	-42.11
2314.11	39.38	Ave	168	1.8	V	-13.19	26.19	54.00	-27.81
2357.22	44.44	PK	117	1.0	H	-13.14	31.30	74.00	-42.70
2357.22	36.75	Ave	117	1.0	H	-13.14	23.61	54.00	-30.39
2494.00	42.10	PK	268	1.3	V	-13.08	29.02	74.00	-44.98
2494.00	37.08	Ave	268	1.3	V	-13.08	24.00	54.00	-30.00

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
O-QPSK Middle Channel									
268.32	37.58	QP	329	1.1	H	-13.35	24.23	46.00	-21.77
268.32	39.98	QP	174	1.6	V	-13.35	26.63	46.00	-19.37
4880.00	44.41	PK	308	2.0	V	-0.62	43.79	74.00	-30.21
4880.00	42.25	Ave	308	2.0	V	-0.62	41.63	54.00	-12.37
7320.00	40.93	PK	345	1.2	H	2.21	43.14	74.00	-30.86
7320.00	35.55	Ave	345	1.2	H	2.21	37.76	54.00	-16.24
2316.33	45.31	PK	327	1.6	V	-13.19	32.12	74.00	-41.88
2316.33	37.30	Ave	327	1.6	V	-13.19	24.11	54.00	-29.89
2362.77	43.58	PK	255	1.7	H	-13.14	30.44	74.00	-43.56
2362.77	38.56	Ave	255	1.7	H	-13.14	25.42	54.00	-28.58
2488.21	44.15	PK	5	1.8	V	-13.08	31.07	74.00	-42.93
2488.21	37.96	Ave	5	1.8	V	-13.08	24.88	54.00	-29.12

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
O-QPSK High Channel									
268.32	37.89	QP	28	1.9	H	-13.35	24.54	46.00	-21.46
268.32	40.68	QP	351	1.2	V	-13.35	27.33	46.00	-18.67
4960.00	43.57	PK	34	1.4	V	-0.24	43.33	74.00	-30.67
4960.00	41.57	Ave	34	1.4	V	-0.24	41.33	54.00	-12.67
7440.00	39.76	PK	2	1.3	H	2.84	42.60	74.00	-31.40
7440.00	34.55	Ave	2	1.3	H	2.84	37.39	54.00	-16.61
2315.72	45.20	PK	180	1.0	V	-13.19	32.01	74.00	-41.99
2315.72	37.57	Ave	180	1.0	V	-13.19	24.38	54.00	-29.62
2365.91	43.50	PK	31	1.8	H	-13.14	30.36	74.00	-43.64
2365.91	37.00	Ave	31	1.8	H	-13.14	23.86	54.00	-30.14
2491.47	44.99	PK	166	1.9	V	-13.08	31.91	74.00	-42.09
2491.47	38.63	Ave	166	1.9	V	-13.08	25.55	54.00	-28.45

Test Frequency: 18GHz~25GHz

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

7 Band Edge Measurement

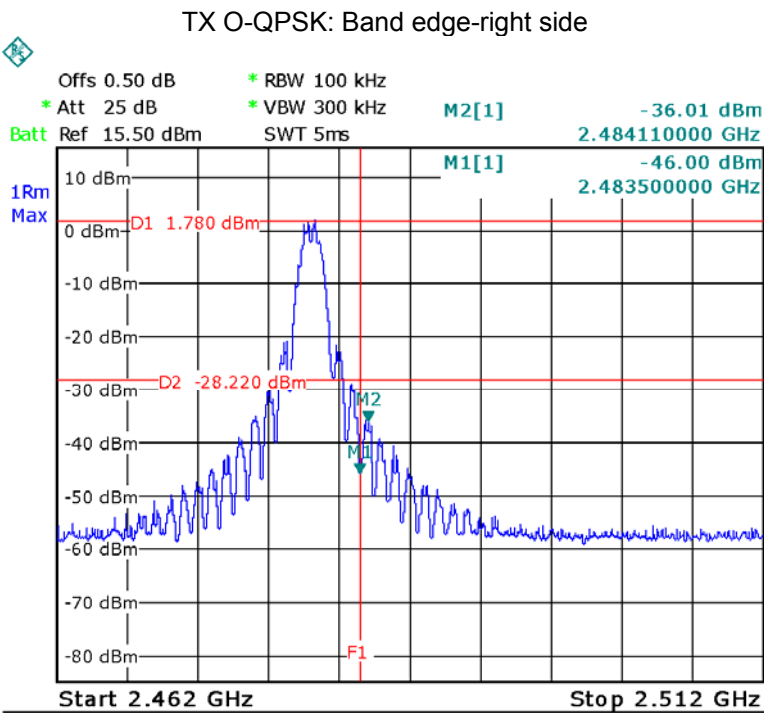
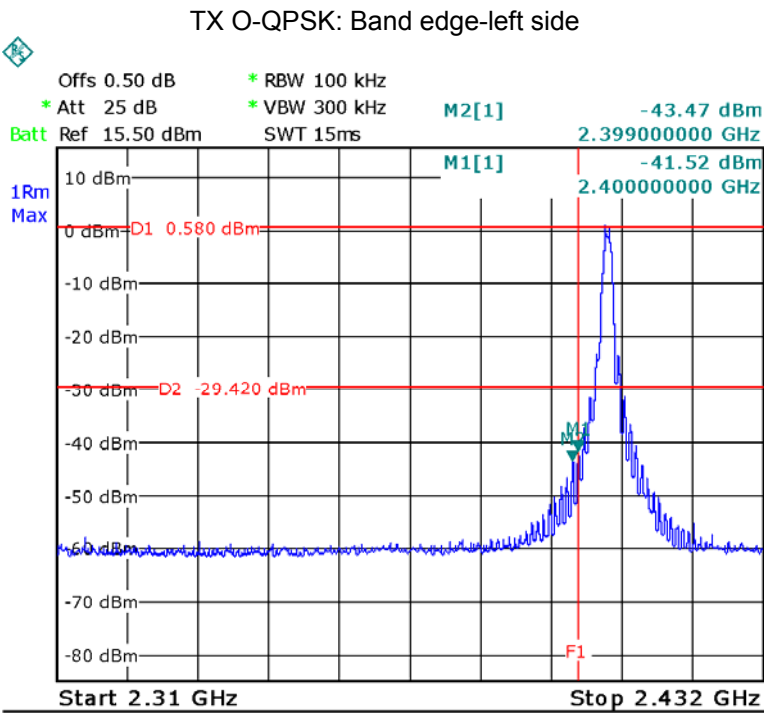
Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	558074 D01 DTS Meas Guidance v03r04 January 7, 2016
Test Limit:	Regulation 15.247 (d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
Test Mode:	Transmitting

7.1 Test Produce

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

7.2 Test Result

Test result plots shown as follows:



8 6 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: 558074 D01 DTS Meas Guidance v03r04 January 7, 2016

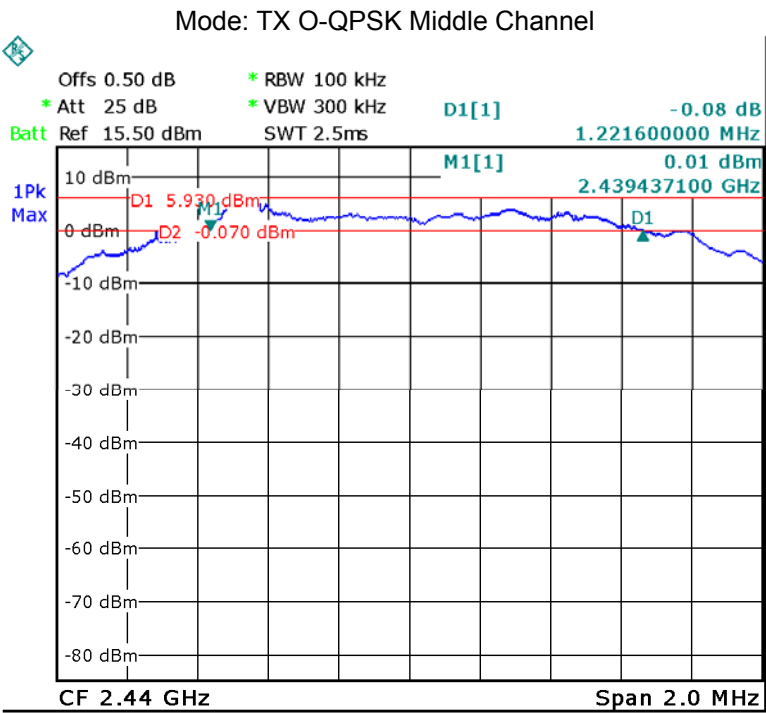
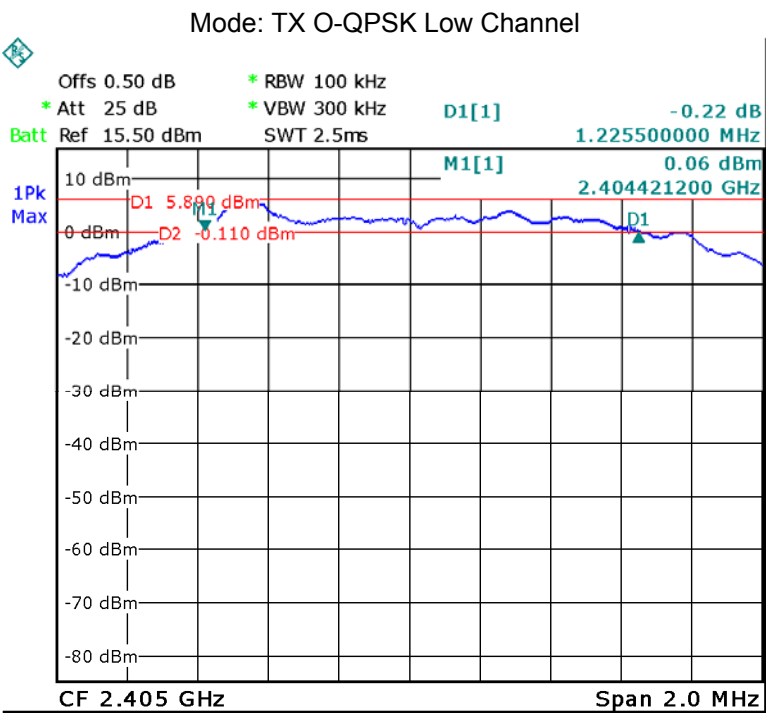
8.1 Test Procedure:

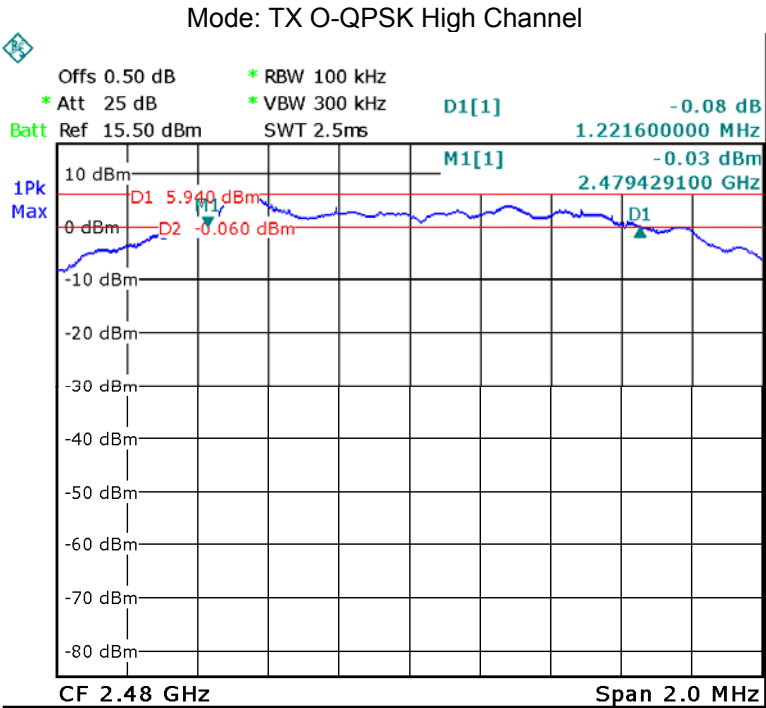
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

8.2 Test Result:

Operation mode	Bandwidth (MHz)		
	Low Channel	Middle Channel	High Channel
TX O-QPSK	1.223	1.222	1.222

Test result plot as follows:





9 Maximum Peak Output Power

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v03r04 January 7, 2016

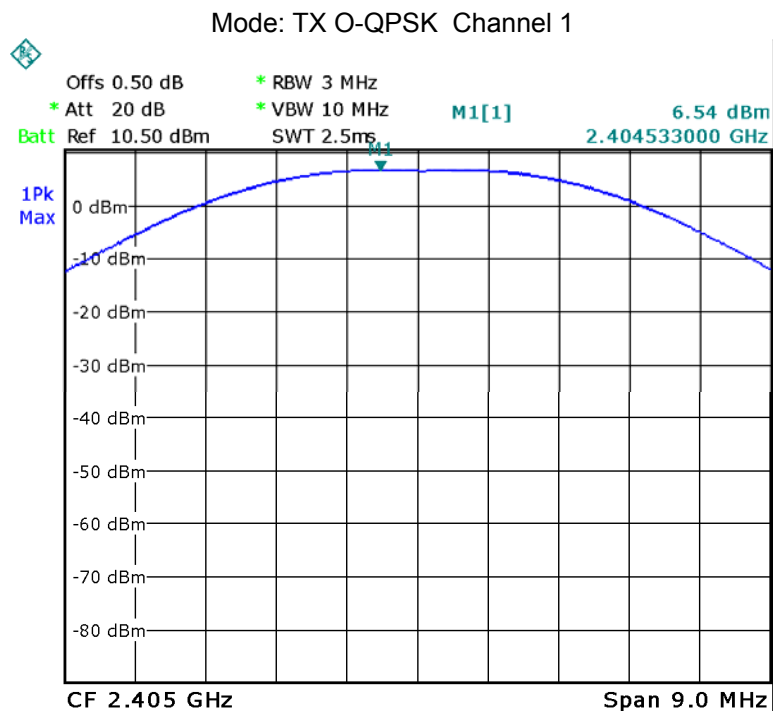
9.1 Test Procedure:

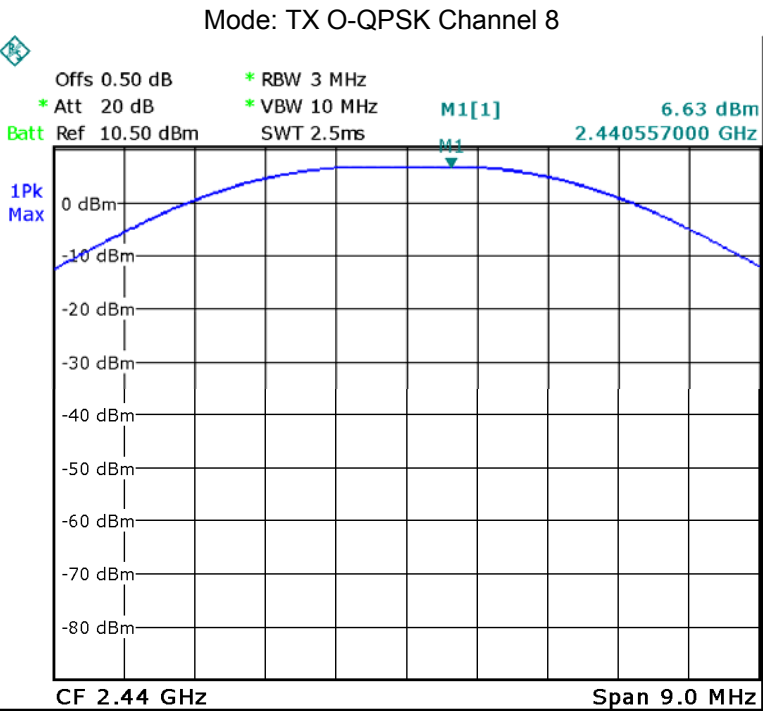
KDB 558074 D01 DTS Meas Guidance v03r04

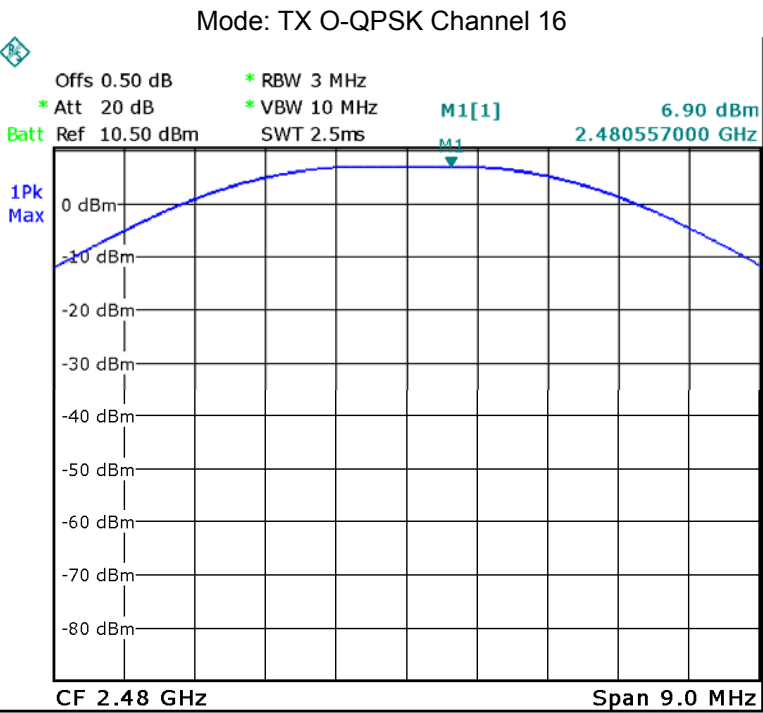
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 1MHz(WIFI)/3MHz(ZigBee),VBW =3MHz(WIFI)/10MHz(ZigBee).
Sweep = auto; Detector Function = Peak, Set the span to fully encompass the DTS bandwidth.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

9.2 Test Result:

Test mode :TX O-QPSK		
Maximum Peak Output Power (dBm)		
2405MHz	2440MHz	2480MHz
6.68	6.82	6.79
Limit: 1W/30dBm		







10 Power Spectral density

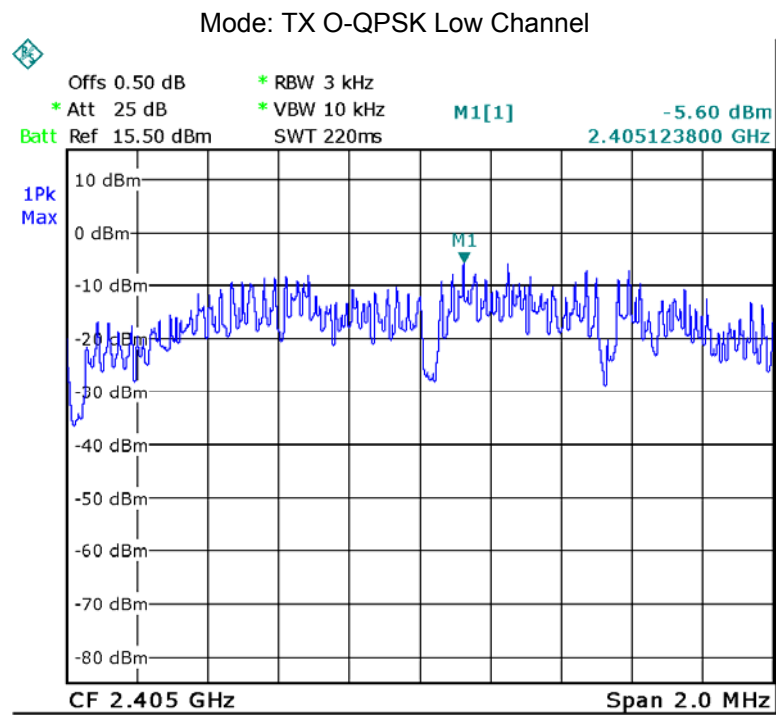
Test Requirement: FCC CFR47 Part 15 Section 15.247
Test Method: 558074 D01 DTS Meas Guidance v03r04 January 7, 2016

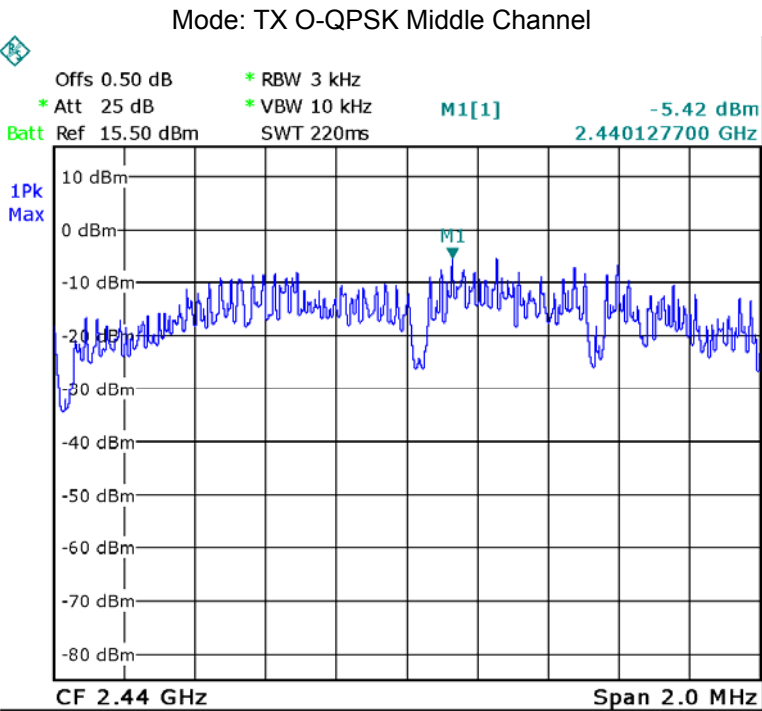
10.1 Test Procedure:

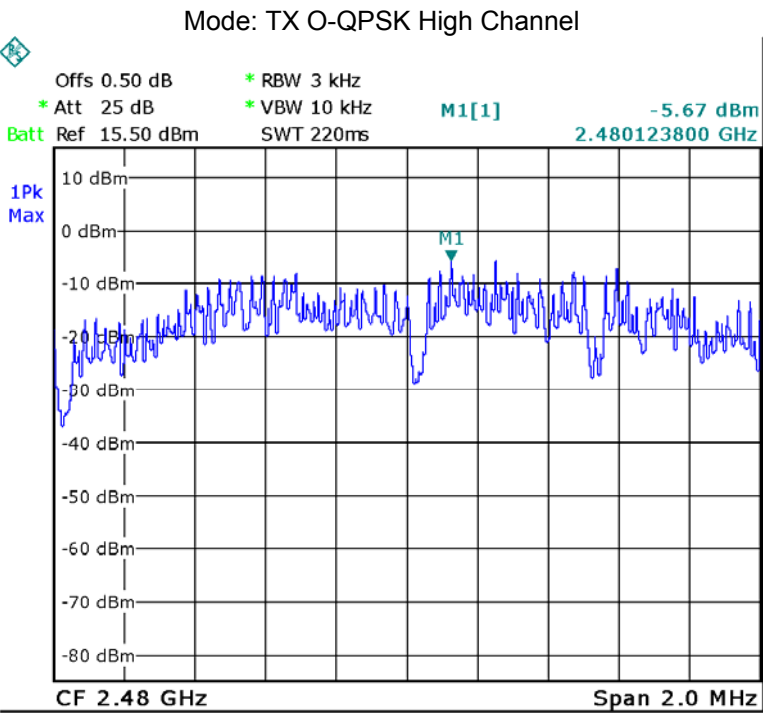
- KDB 558074 D01 DTS Meas Guidance v03r04 section 10.2
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
 2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
 3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section
Submit this plot.

10.2 Test Result:

Test mode : TX O-QPSK		
Power Spectral (dBm per 3kHz)		
Low Channel	Middle Channel	High Channel
-5.60	-5.42	-5.67
Limit: 8dBm per 3kHz		







11 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 Integrated Antenna for ZigBee ,fulfill the requirement of this section.

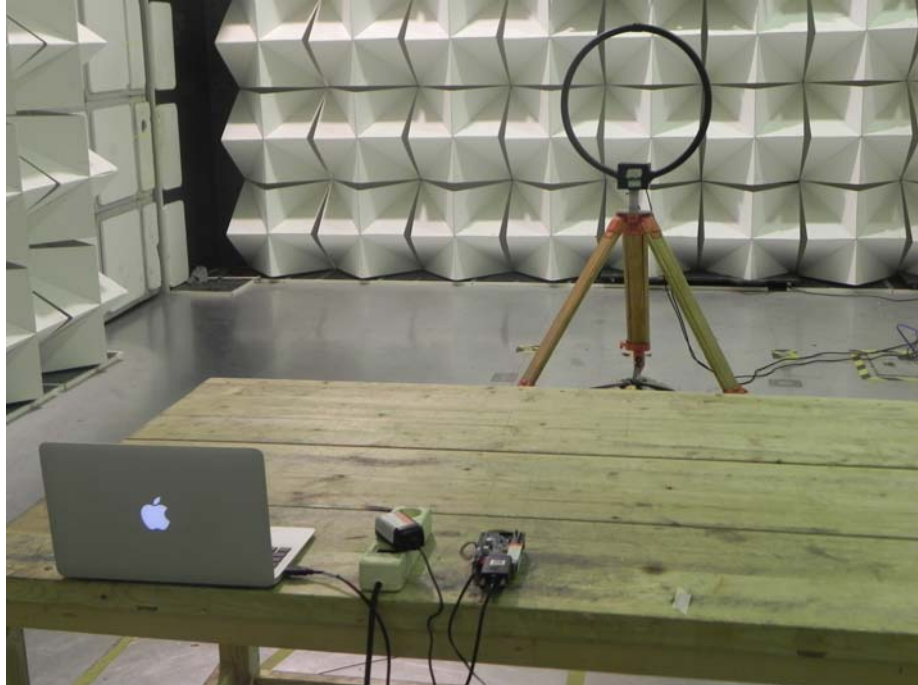
12 RF Exposure

Please refer to the WTS16S0344759-2E MPE Test Report

13 Photographs – Model WL-ZAVMDPW-C411121-06 Test Setup

13.1 Radiated Emission

Test frequency below 30MHz at Test Site 2#



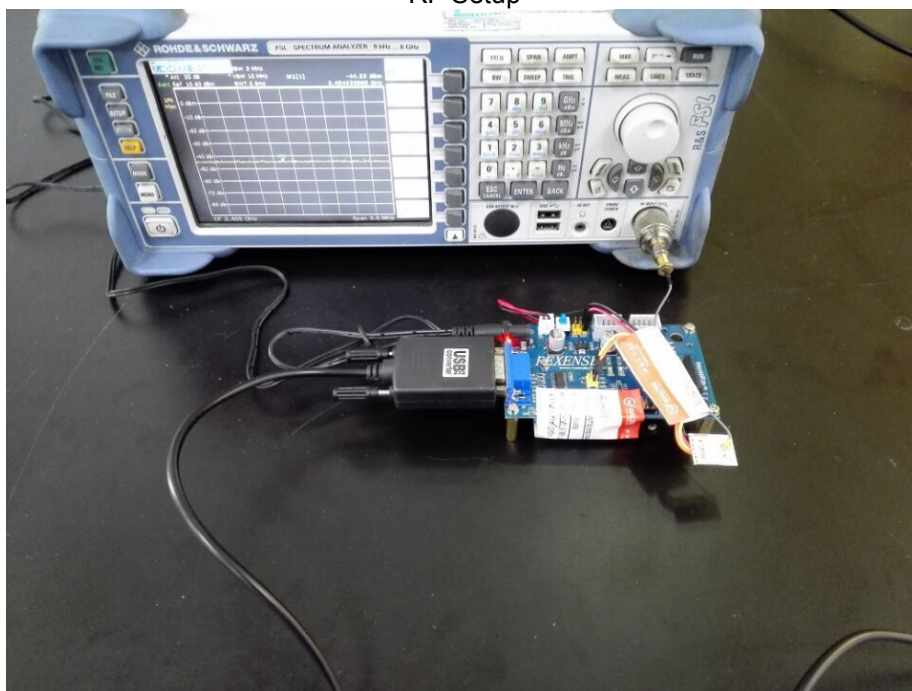
Test frequency from 30MHz to 1GHz at Test Site 2#



Test frequency above 1GHz at Test Site 1#

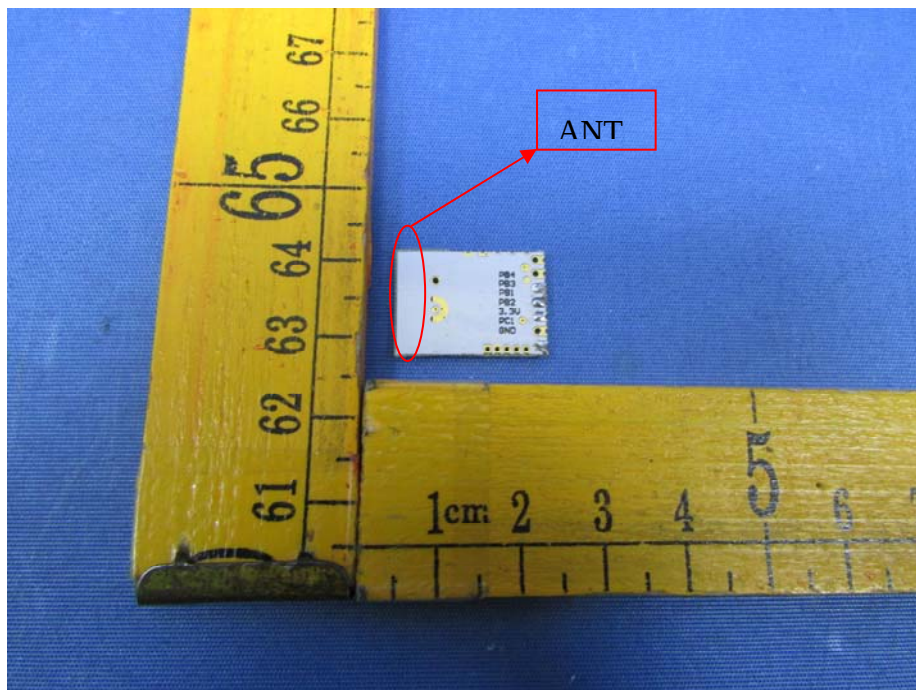
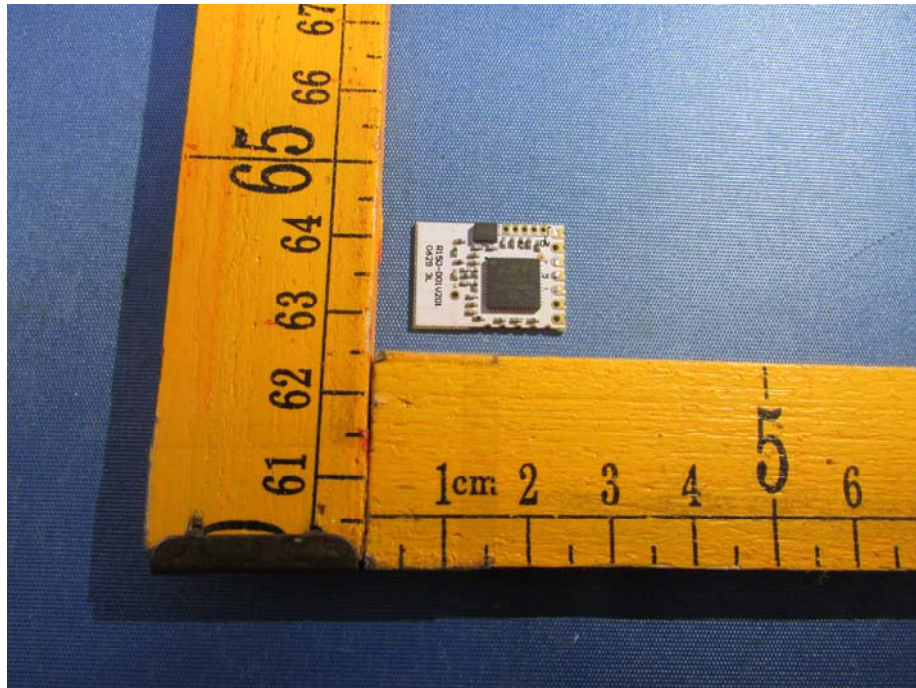


RF Setup



14 Photographs - Constructional Details

14.1 External Photos



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