

TEST REPORT

Reference No..... : WTS14S0413565E
FCC ID : XBAZW089
Applicant..... : Aeon Labs LLC.
Address..... : 1228 NORVELL ST.EL CERRITO, CA 94530 USA
Manufacturer : The same as above.
Address..... : The same as above.
Product Name..... : Recessed Door Sensor Gen5
Model No..... : ZW089-A
Trademark..... : AEON LABS/AEOTEC
Standards : FCC CFR47 Part 15 Section 15.249: 2012
Date of Receipt sample : Apr.30, 2014
Date of Test : May 04-05, 2014
Date of Issue..... : May 28, 2014
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

Testing location: The same as above

Tel :+86-755-83551033

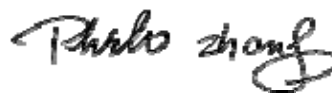
Fax:+86-755-83552400

Compiled by:

Approved by:



Zero Zhou / Project Engineer



Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	N/A
Radiated Emission	15.249(a) 15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside of Band Emission	15.249 15.205 15.209	PASS
20dB Bandwidth	15:215(c)	PASS
Antenna Requirement	15.203	PASS

3 Contents

	Page
1 COVER PAGE.....	1
2 TEST SUMMARY	2
3 CONTENTS	3
4 GENERAL INFORMATION.....	4
4.1 GENERAL DESCRIPTION OF E.U.T.....	4
4.2 DETAILS OF E.U.T.....	4
4.3 TEST FACILITY	4
4.4 TEST MODE	4
5 EQUIPMENT USED DURING TEST	5
5.1 EQUIPMENTS LIST	5
5.2 MEASUREMENT UNCERTAINTY.....	5
5.3 TEST EQUIPMENT CALIBRATION.....	5
6 CONDUCTED EMISSION	6
7 RADIATION EMISSION TEST	7
7.1 EUT OPERATION.....	7
7.2 TEST SETUP	8
7.3 SPECTRUM ANALYZER SETUP.....	9
7.4 TEST PROCEDURE.....	10
7.5 CORRECTED AMPLITUDE & MARGIN CALCULATION	10
7.6 TEST RESULT	11
8 PERIODIC OPERATION	13
9 OUTSIDE OF BAND EMISSION.....	14
9.1 TEST PROCEDURE.....	14
9.2 TEST RESULT	14
10 20 DB BANDWIDTH MEASUREMENT	16
10.1 TEST PROCEDURE.....	16
10.2 TEST RESULT	16
11 ANTENNA REQUIREMENT	17
12 PHOTOGRAPHS- MODEL ZW089-A TEST SETUP.....	18
12.1 RADIATION EMISSION FROM 30MHZ-1GHZ.....	18
12.2 RADIATION EMISSION ABOVE 1GHZ.....	18
13 PHOTOGRAPHS - CONSTRUCTIONAL DETAILS.....	19
13.1 MODEL ZW089-A - EXTERNAL VIEW	19
13.2 MODEL ZW089-A - INTERNAL VIEW.....	21
13.3 RF MODULE VIEW	24

4 General Information

4.1 General Description of E.U.T.

Product Name	: Recessed Door Sensor Gen5
Model No.	: ZW089-A
Model Differences	: N/A
Type of Modulation	: FSK
Frequency Range	: 908.40MHz, 908.42MHz
The Lowest Oscillator	: 32MHz
Antenna installation	: PCB Printed Antenna

4.2 Details of E.U.T.

Technical Data	: DC 3V by Battery(Capacity: 800mAh)
----------------	--------------------------------------

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, July 12, 2012.

- **FCC – 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.

4.4 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	908.40MHz	N/A	908.42MHz

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY4511494 3	Sep.18,2013	Sep.17,2014
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2014	Apr.18,2015
3	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.18,2013	Sep.17,2014
4	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2014	Apr.18,2015
5	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2014	Mar.16,2015
6	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2014	Apr.09,2015
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY4511494 3	Sep.18,2013	Sep.17,2014
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.18,2013	Sep.17,2014
3.	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	May 16,2014	May 15,2015

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 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	N/A
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)
Remark	This device powered by battery, this test is not applicable.

7 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249

Test Method: ANSI 63.4: 2003

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	$2400/F(\text{kHz})$	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	$20\log^{(500)}$

Note: RF Voltage(dBuV)= $20 \log_{10}$ RF Voltage(uV)

7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

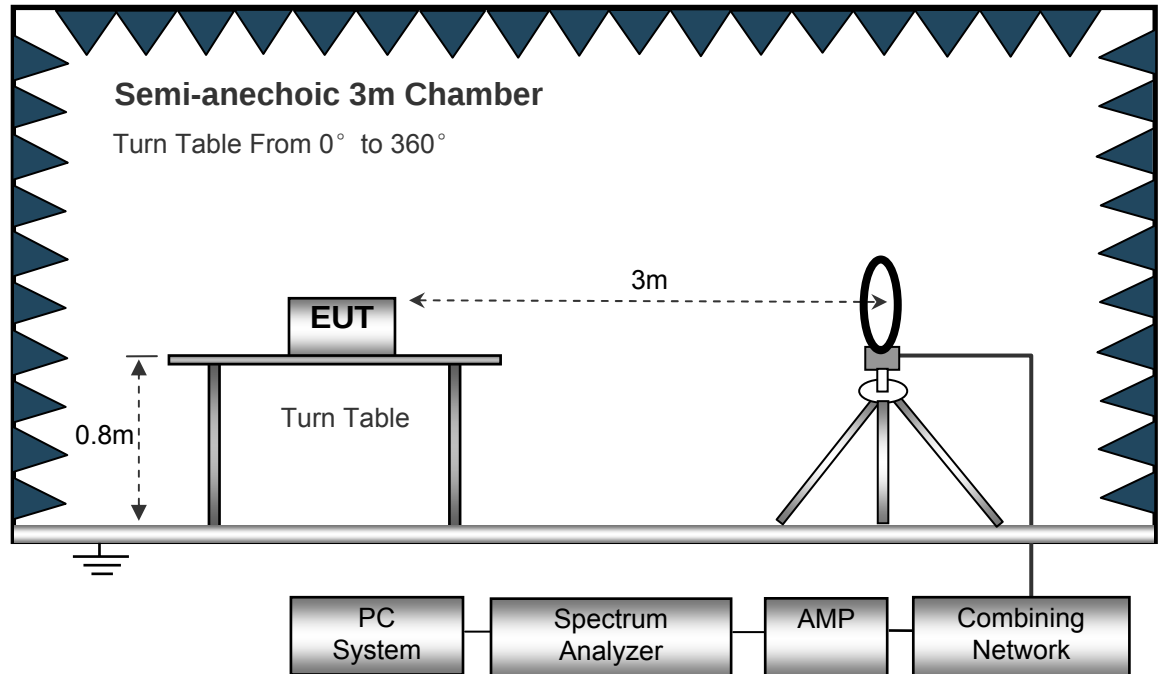
EUT Operation :

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

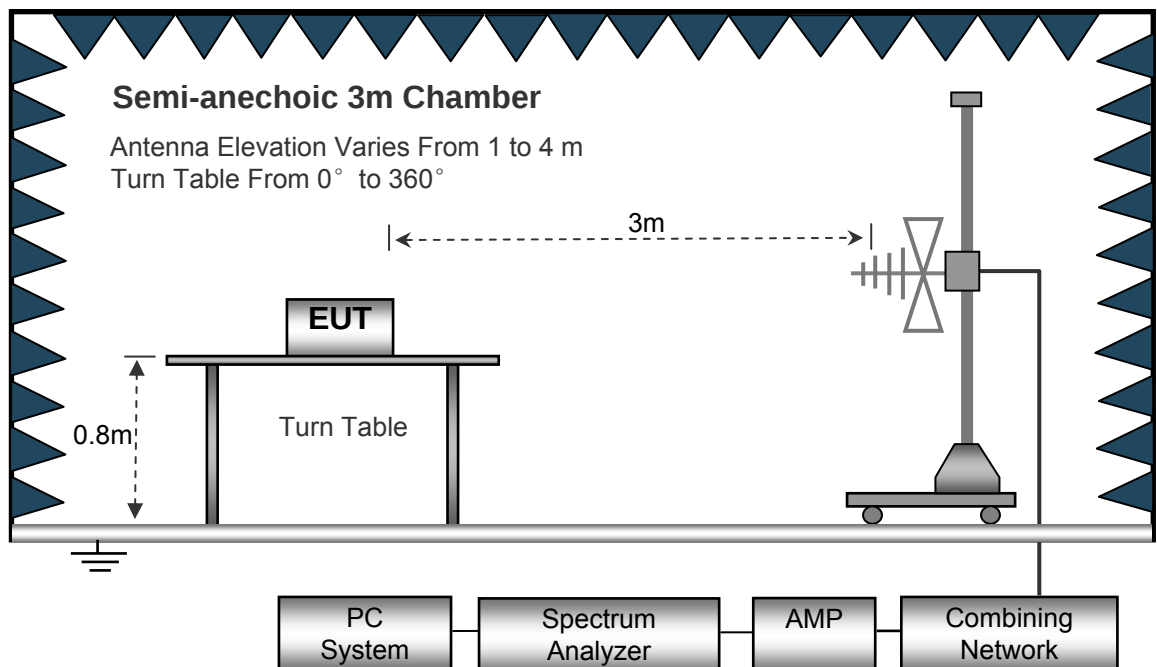
7.2 Test Setup

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

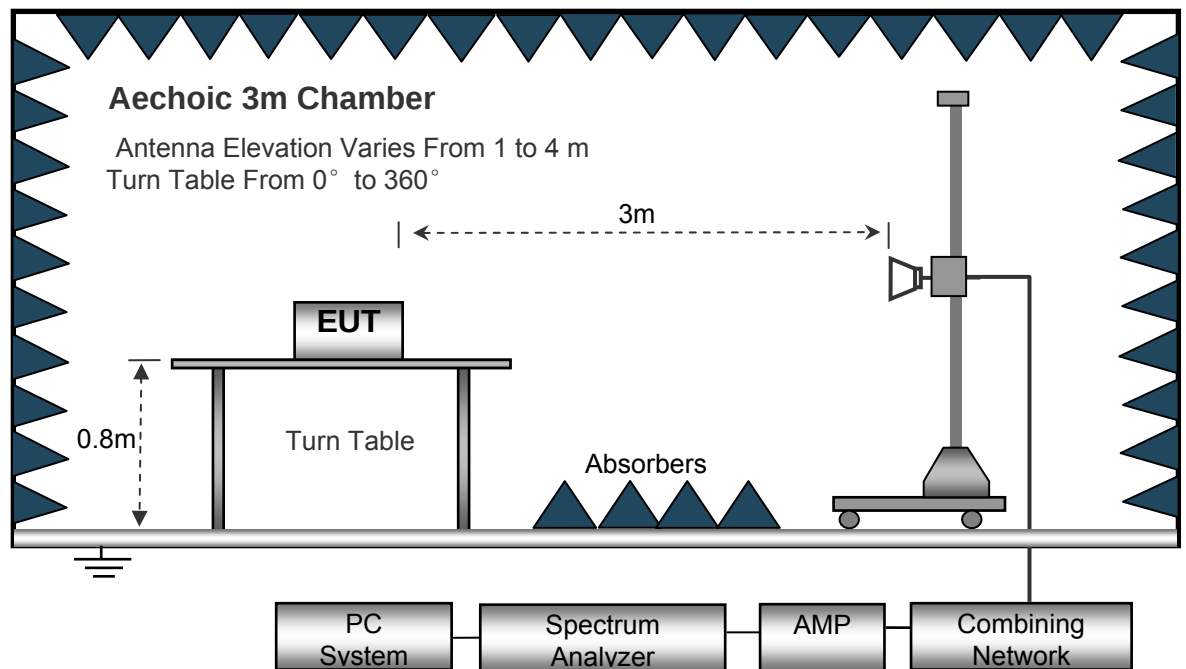
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep SpeedAuto
 IF Bandwidth.....10kHz
 Video Bandwidth10kHz
 Resolution Bandwidth10kHz

30MHz ~ 1GHz

Sweep Speed Auto
 IF Bandwidth.....120 KHz
 Video Bandwidth100KHz
 Quasi-Peak Adapter Bandwidth120 KHz
 Quasi-Peak Adapter ModeNormal
 Resolution Bandwidth.....100KHz

Above 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....1MHz
 Video Bandwidth3MHz
 DetectorAve.
 Resolution Bandwidth.....1MHz
 Video Bandwidth10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m 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 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 μ V means the emission is 7dB μ V below the maximum limit for Class B. The equation for margin calculation is as follows:

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

7.6 Test Result

$AV = \text{Peak} + 20\log_{10}(\text{duty cycle}) = PK + (-0.90)$ [refer to section 8 for more detail]

Test Frequency: 30MHz ~ 10GHz

Test Mode: Transmitting

Frequency	Receiver Reading (PK)	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude (PK)	FCC Part 15.249/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
33.51	10.24	291	2.0	V	20.43	30.67	40	-9.33
367.92	15.24	107	1.9	V	19.35	34.59	46	-11.41
908.42	59.24	187	1.0	H	30.98	90.22	114	-23.78
908.42	57.61	187	1.0	V	30.98	88.59	114	-25.41
1816.84	58.22	322	1.6	H	-16.38	41.84	74	-32.16
1816.84	54.21	322	1.6	V	-16.38	37.83	74	-36.17
2725.26	46.53	296	1.5	H	-14.87	31.66	74	-42.34
2725.26	45.17	296	1.5	V	-14.87	30.30	74	-43.70
1669.32	43.21	190	1.2	H	-11.77	31.44	74	-42.56
1669.32	39.57	190	1.2	V	-11.77	27.80	74	-46.20

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Calculated AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
908.42	90.22	H	-0.90	89.32	94	-4.68
908.42	88.59	V	-0.90	87.69	94	-6.31
1816.84	41.84	H	-0.90	40.94	54	-13.06
1816.84	37.83	V	-0.90	36.93	54	-17.07
2725.26	31.66	H	-0.90	30.76	54	-23.24
2725.26	30.30	V	-0.90	29.40	54	-24.60
1669.32	31.44	H	-0.90	30.54	54	-23.46
1669.32	27.80	V	-0.90	26.90	54	-27.10

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 * %

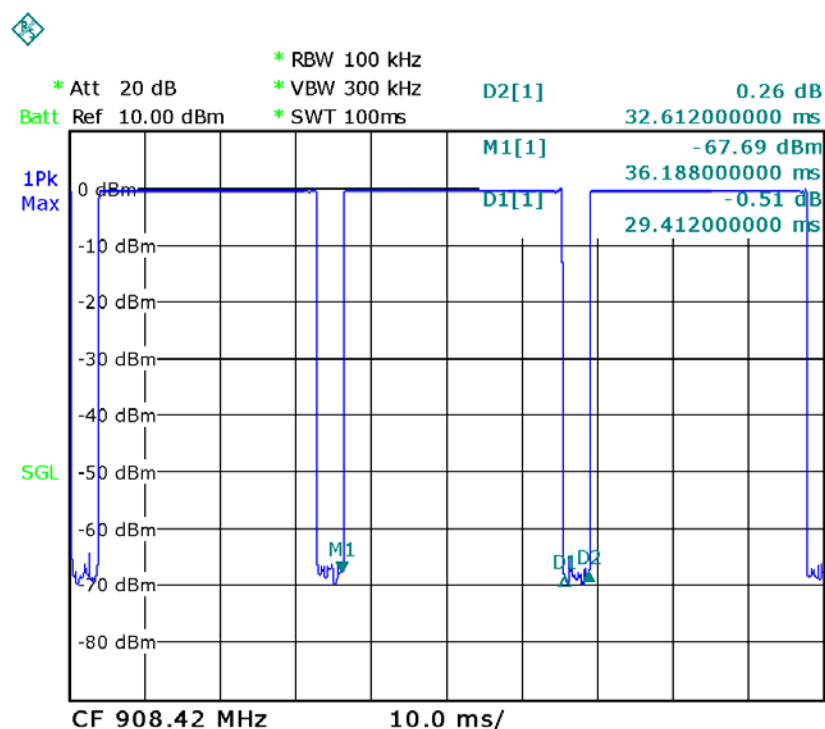
Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle(%))

Total transmission time(ms)	29.412
Length of a complete transmission period(ms)	32.612
Duty Cycle(%)	90.2
Duty Cycle Correction Factor(dB)	-0.90

Refer to the duty cycle plot (as below), This device meets the FCC requirement.

Length of a complete pulse train:

Remark: FCC part15.35(c) required that a complete pulse train is more 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.



9 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 C63.4:2003
Test Mode:	Transmitting

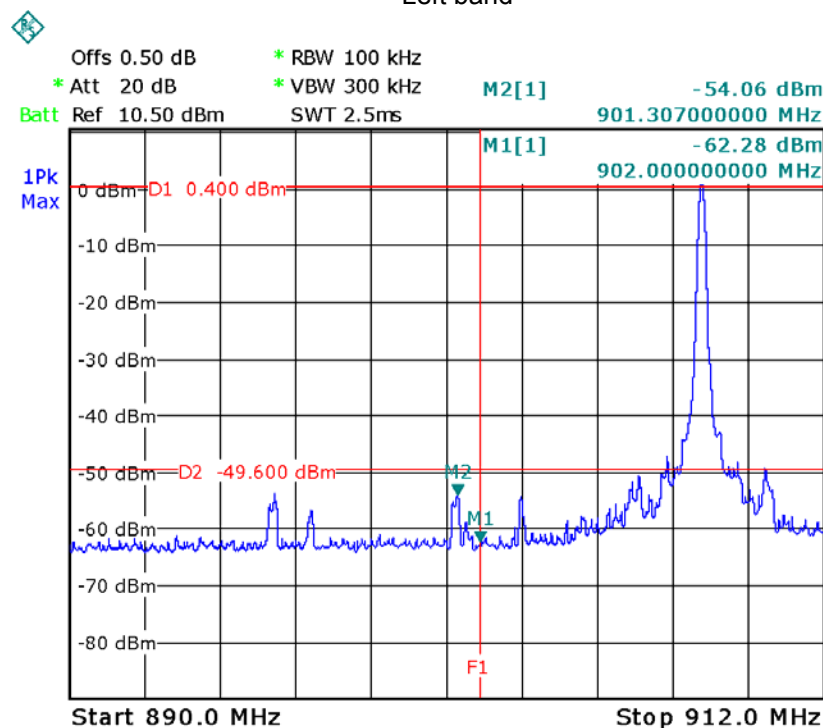
9.1 Test Procedure

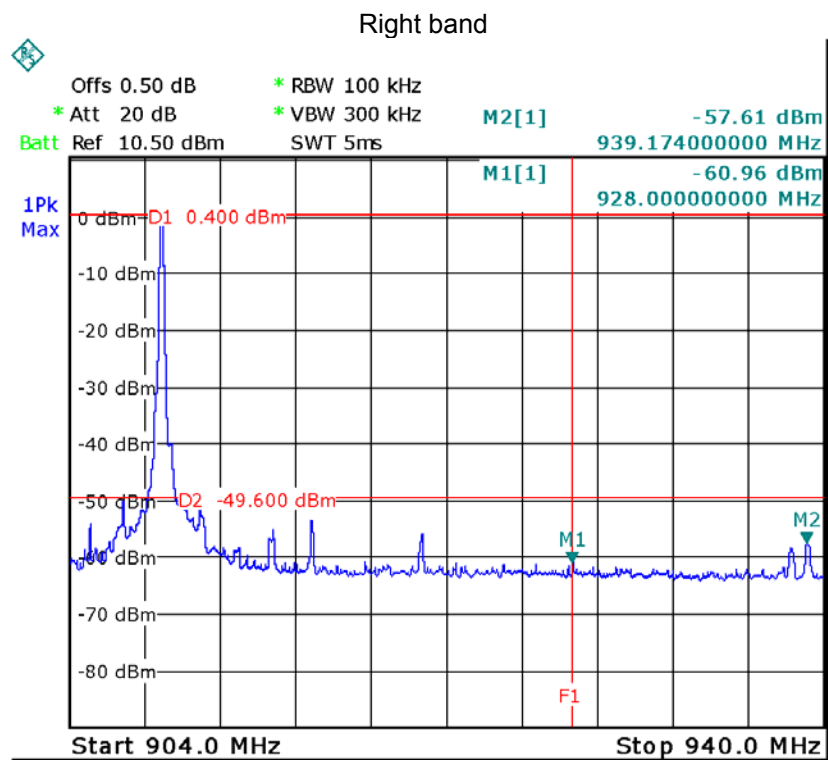
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

9.2 Test Result

Test plots

Left band





10 20 dB Bandwidth Measurement

Test Requirement:

FCC CFR47 Part 15 Section 15.215(c)

Test Method:

ANSI C63.4:2003

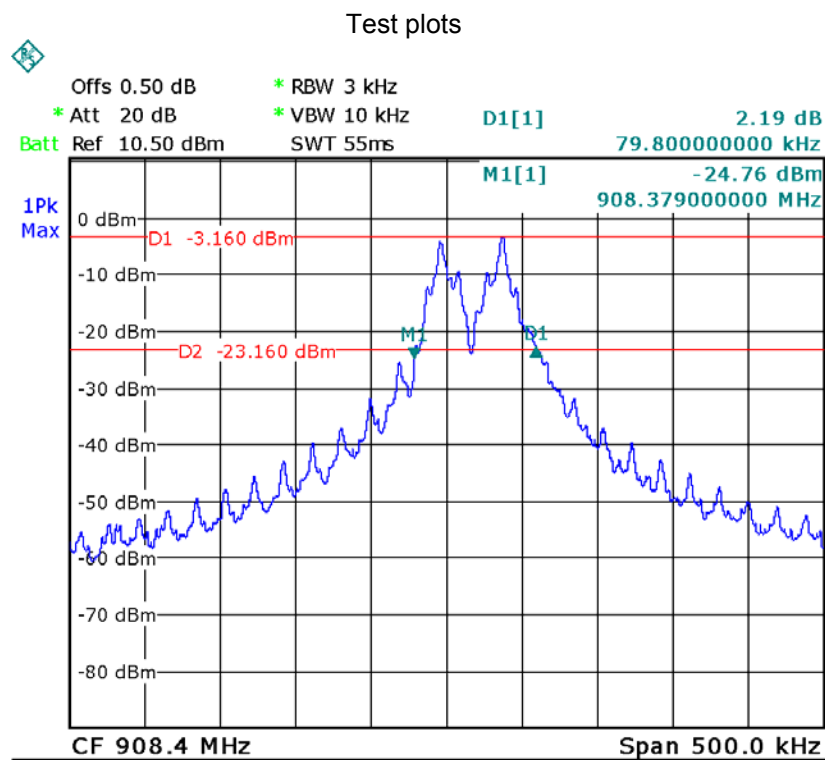
Test Mode:

Transmitting

10.1 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 = 3kHz, VBW = 10kHz

10.2 Test Result

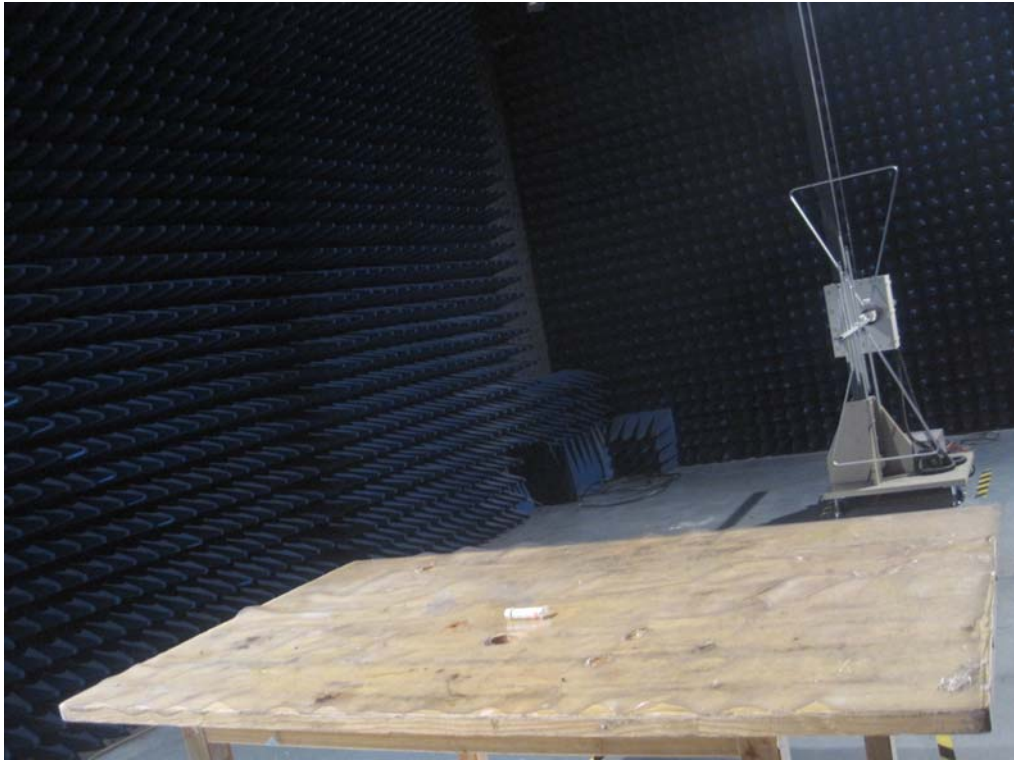


11 Antenna Requirement

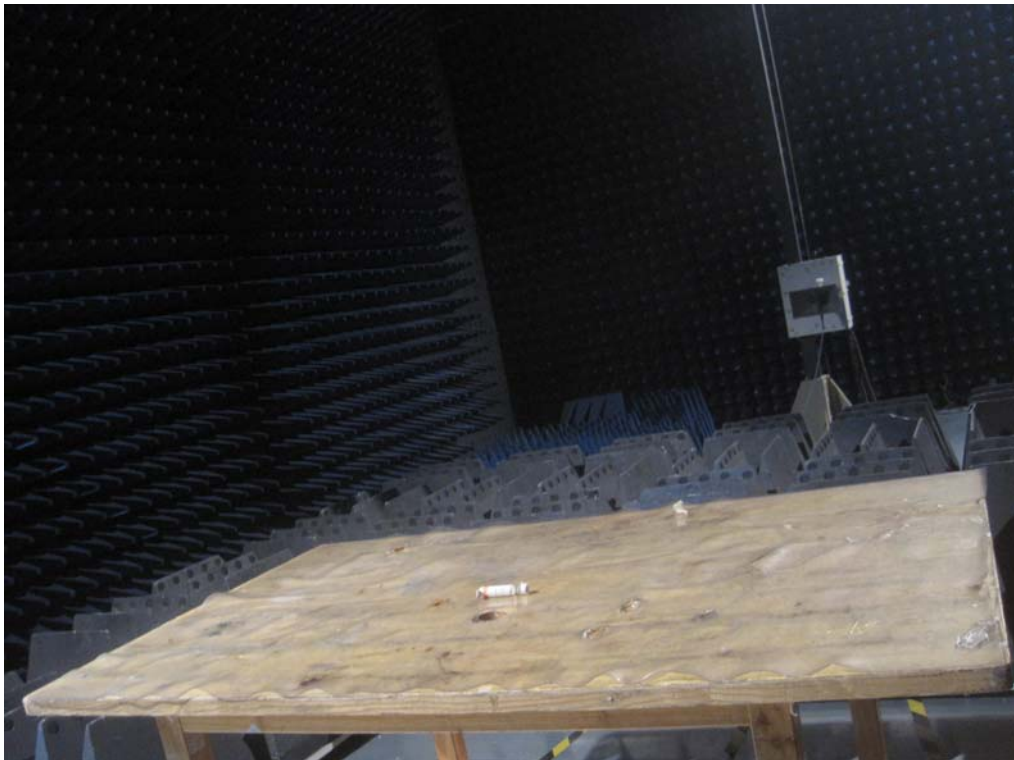
According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has a PCB printed Antenna, fulfil the requirement of this section.

12 Photographs- Model ZW089-A Test Setup

12.1 Radiation Emission From 30MHz-1GHz



12.2 Radiation Emission Above 1GHz



13 Photographs - Constructional Details

13.1 Model ZW089-A - External View

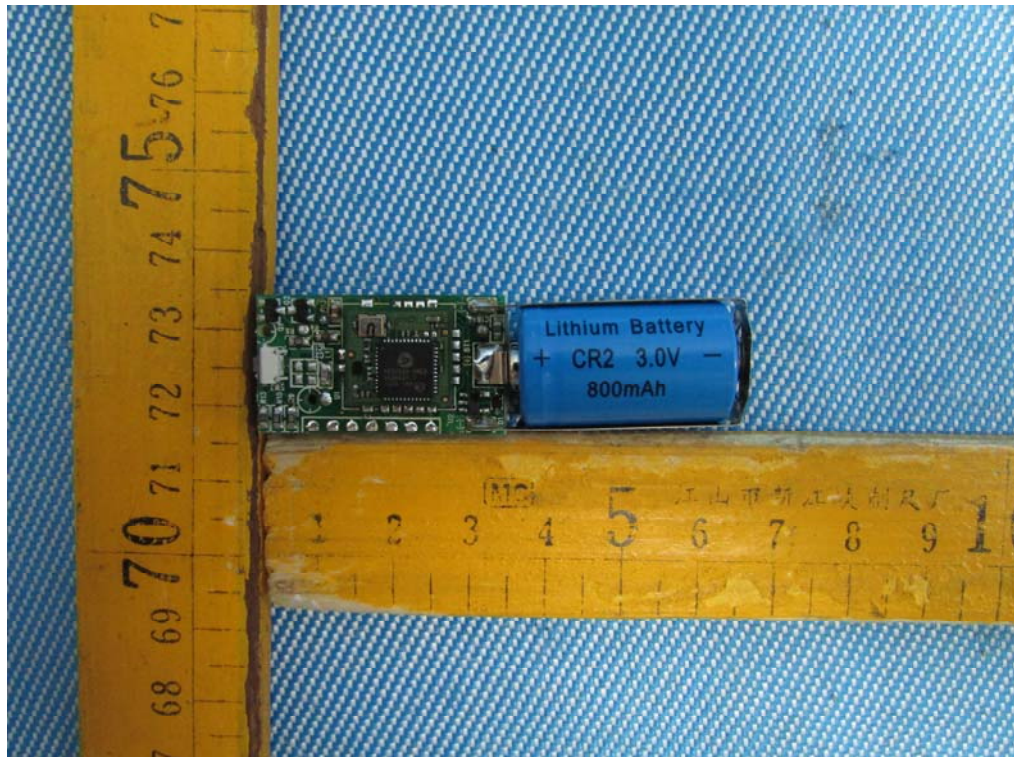


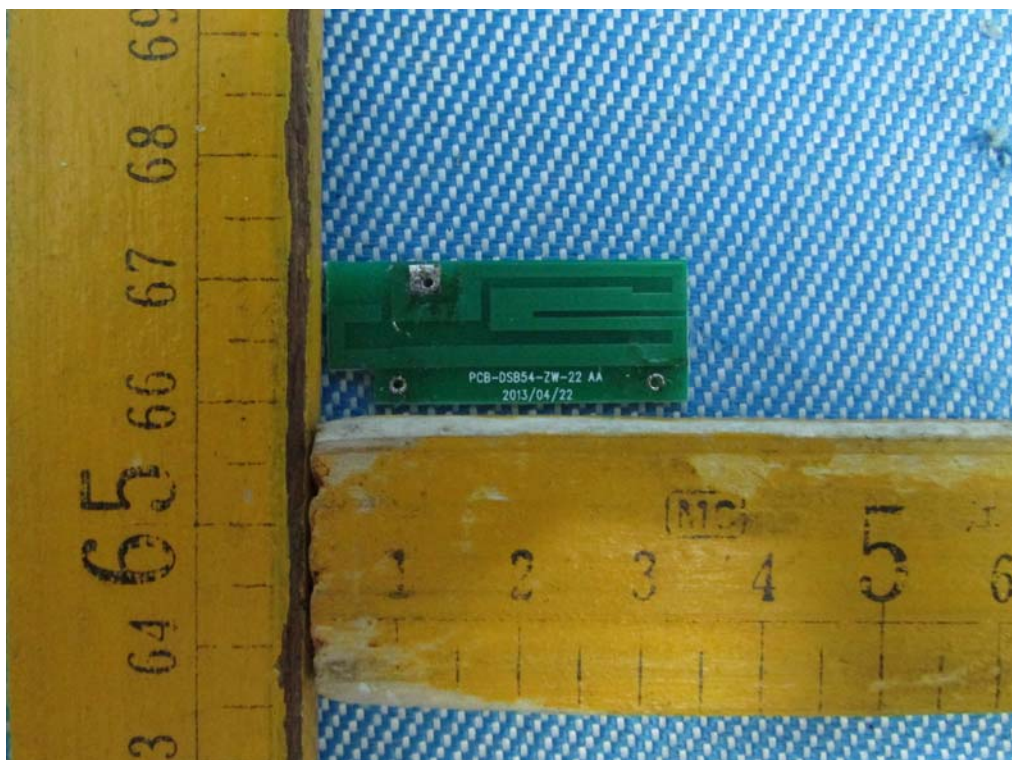
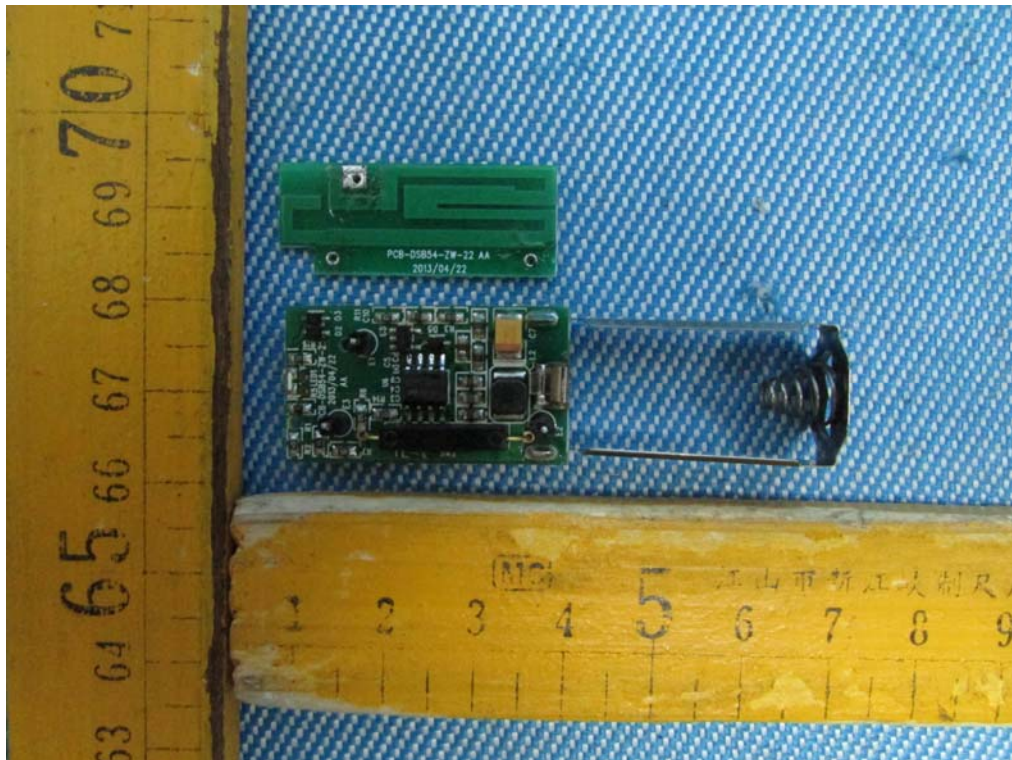




13.2 Model ZW089-A - Internal View



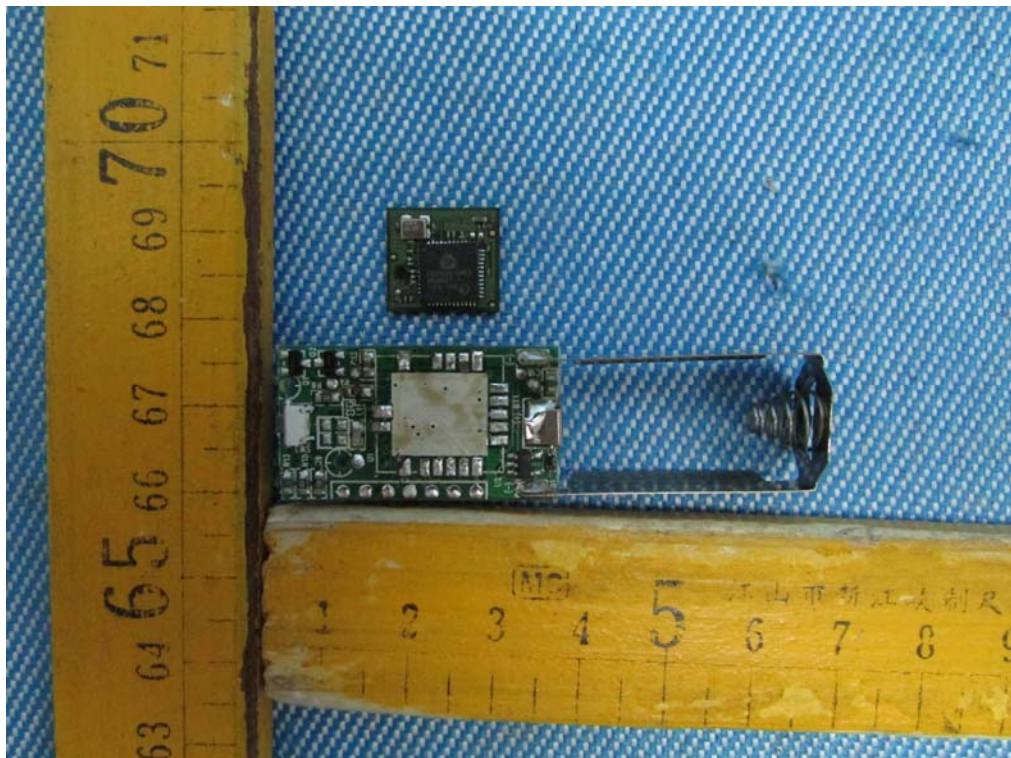


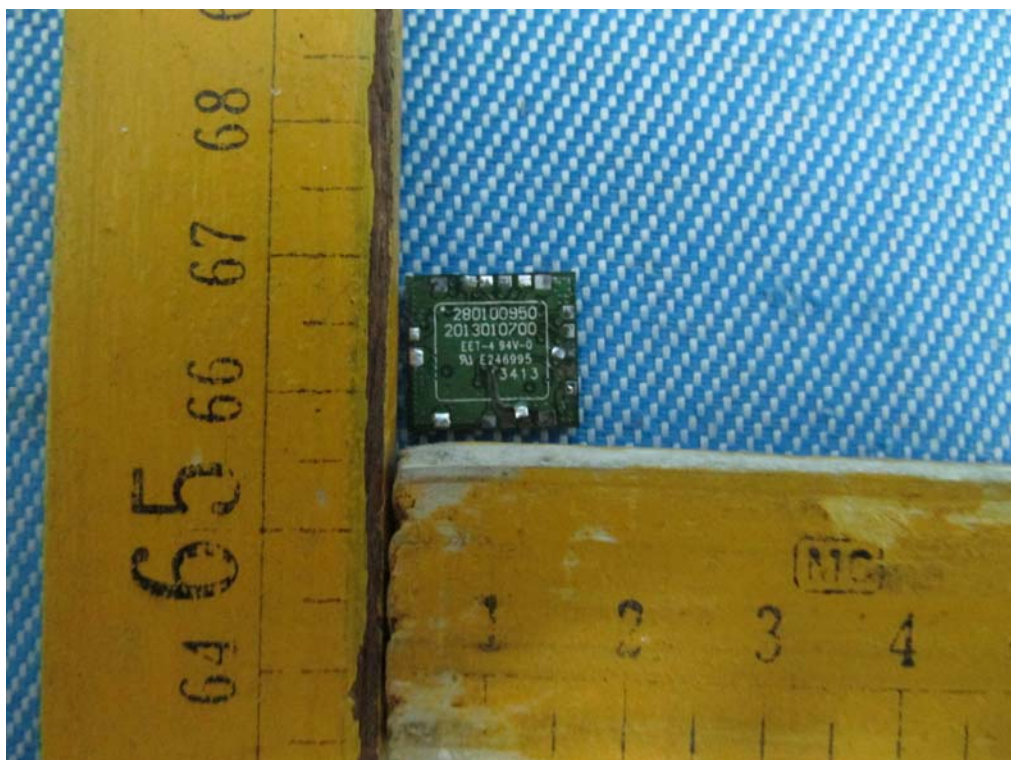
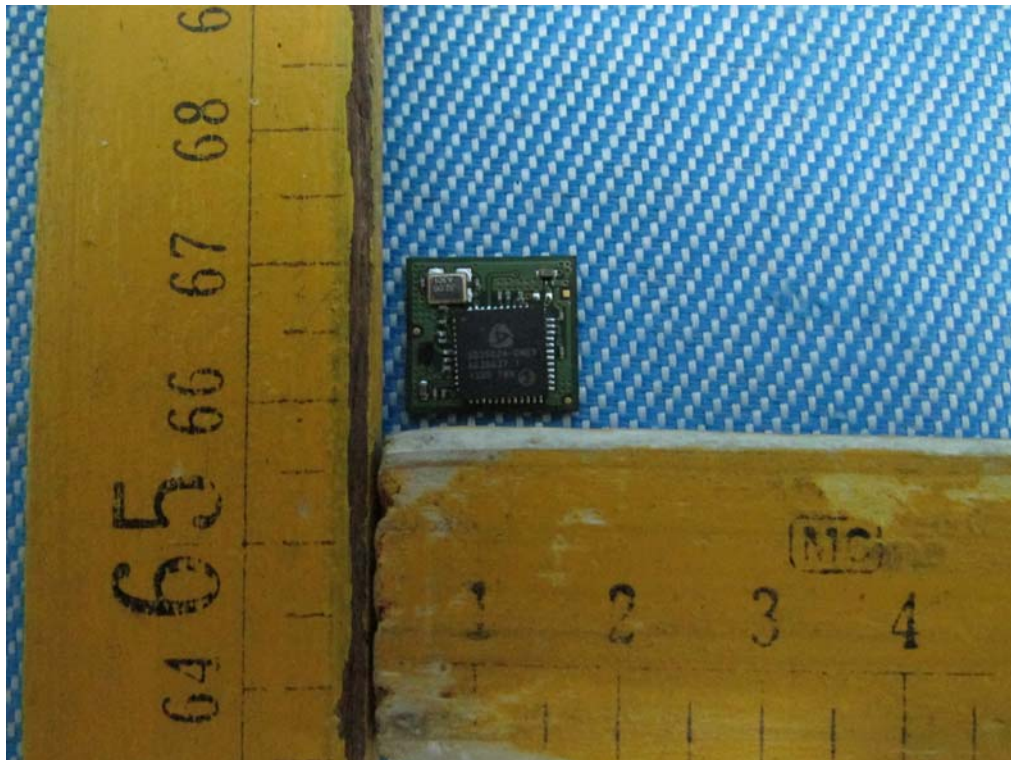


PCB printed ANT



13.3 RF Module View





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