

TEST REPORT

Reference No...... : WTS15S0324174E
FCC ID : XBAZW056SENSOR
Applicant..... : Aeon Labs LLC.
Address..... : 1228 NORVELL ST.EL CERRITO, CA 94530 USA
Manufacturer : Fantem Technologies (Shenzhen) Co.,Ltd
Address..... : North,3/F, Yitao Technology Industrial Park, Baihua Yuan Rd., The
Second Industrial Area, Guangming Sub-district Office, Guangming
New District, Shenzhen, Guangdong, China
Product Name..... : Doorbell Gen5(Garage Sensor)
Model No : ZW056-Sensor
Standards..... : FCC CFR47 Part 15 Section 15.231: 2014
Date of Receipt sample : Mar. 23, 2015
Date of Test : Mar. 28 ~ May. 05, 2015
Date of Issue..... : May. 07, 2015
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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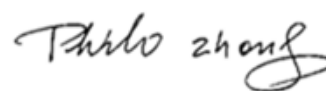
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Compiled by:



Zero Zhou / Project Engineer

Approved by:



Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	N/A
Radiated Spurious Emissions	15.205(a) 15.209 15.231(a)	PASS
Periodic Operation	15.231(a)	PASS
20dB Bandwidth	15.231(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
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 RADIATED SPURIOUS EMISSIONS.....	7
7.1 EUT OPERATION.....	7
7.2 TEST SETUP	8
7.3 SPECTRUM ANALYZER SETUP	9
7.4 TEST PROCEDURE.....	10
7.5 SUMMARY OF TEST RESULTS	11
8 PERIODIC OPERATION	12
9 20DB BANDWIDTH	15
9.1 TEST PROCEDURE.....	15
9.2 TEST RESULT	15
10 ANTENNA REQUIREMENT	16
11 PHOTOGRAPHS- MODEL ZW056-SENSOR TEST SETUP.....	17
11.1 RADIATION EMISSION TEST SETUP.....	17
12 PHOTOGRAPHS - CONSTRUCTIONAL DETAILS	19
12.1 MODEL ZW056-SENSOR - APPEARANCE VIEW	19
12.2 MODEL ZW056-SENSOR - INTERNAL VIEW.....	22

4 General Information

4.1 General Description of E.U.T.

Product Name	:Doorbell Gen5(Garage Sensor)
Model No.	:ZW056-Sensor
Model Difference	: N/A
Type of Modulation	: FSK
Frequency Range	: 433.92MHz
The Lowest Oscillator	: 13.56MHz
Antenna installation	: Integrated Antenna

4.2 Details of E.U.T.

Technical Data	: DC 3V by battery
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4.3 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 7760A-1, July 12, 2012.

- **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 Radiated Spurious Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.15,2014	Sep.14,2015
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2014	Sep.14,2015
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2015	Apr.18,2016
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2014	Sep.14,2015
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2015	Apr.18,2016
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2015	Apr.18,2016
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2015	Mar.16,2016
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2015	Apr.09,2016

5.2 Measurement Uncertainty

Test Item	Frequency Range	Uncertainty	Note
Conducted Emissions	150kHz~30MHz	±3.64dB	(1)
Radiated Spurious Emissions	30MHz~1000MHz	±5.03dB	(1)
	1000M~5000MHz	± 5.47 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

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
Remark	The device is powered by battery, it is not application for this test.

7 Radiated Spurious Emissions

Test Requirement: FCC Part15 Paragraph 15.231(a)

Test Method: ANSI C63.4:2003

Test Result: PASS

Measurement Distance: 3m

Limit:

Fundamental Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emission (uV/m)	Field Strength of Spurious Emission (dBuV/m)
44.66-40.70	2250	67	225	47
70-130	1250	62	125	42
130-174	1250 to 3750	62 to 71.48	125 to 375	42 to 51.48
174-260	3750	71.48	375	51.48
260-470	3750 to 12500	71.48 to 81.94	375 to 1250	51.48 to 61.94
Above 470	12500	81.94	1250	61.94
** linear interpolations				

7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

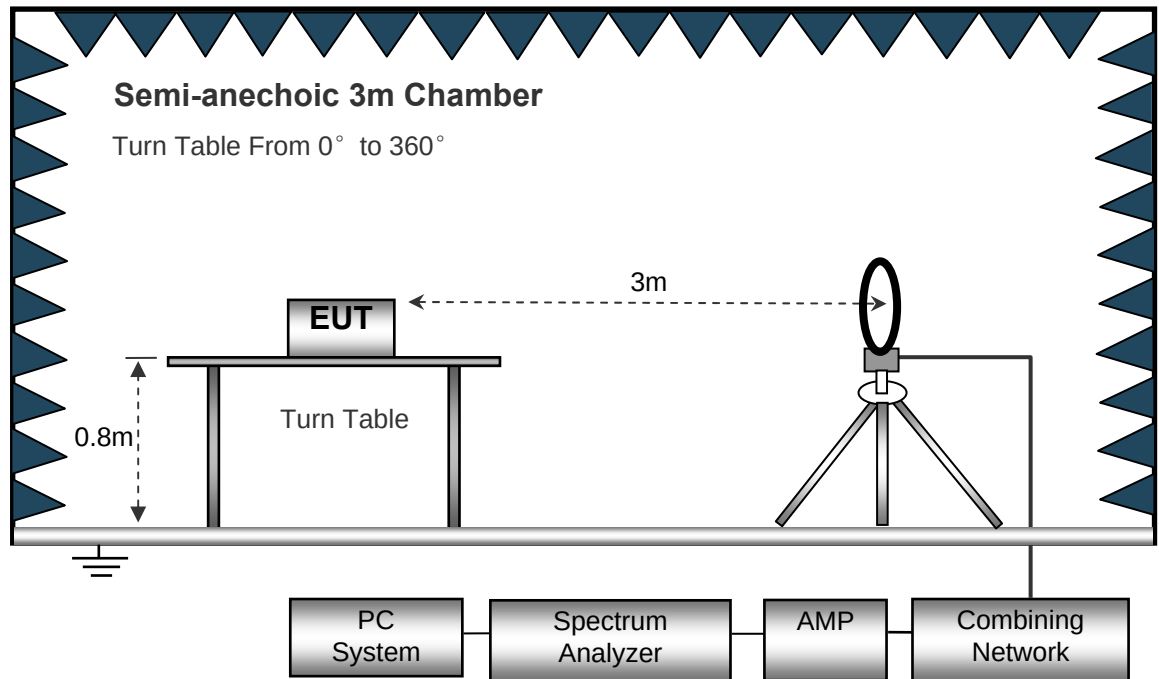
EUT Operation :

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

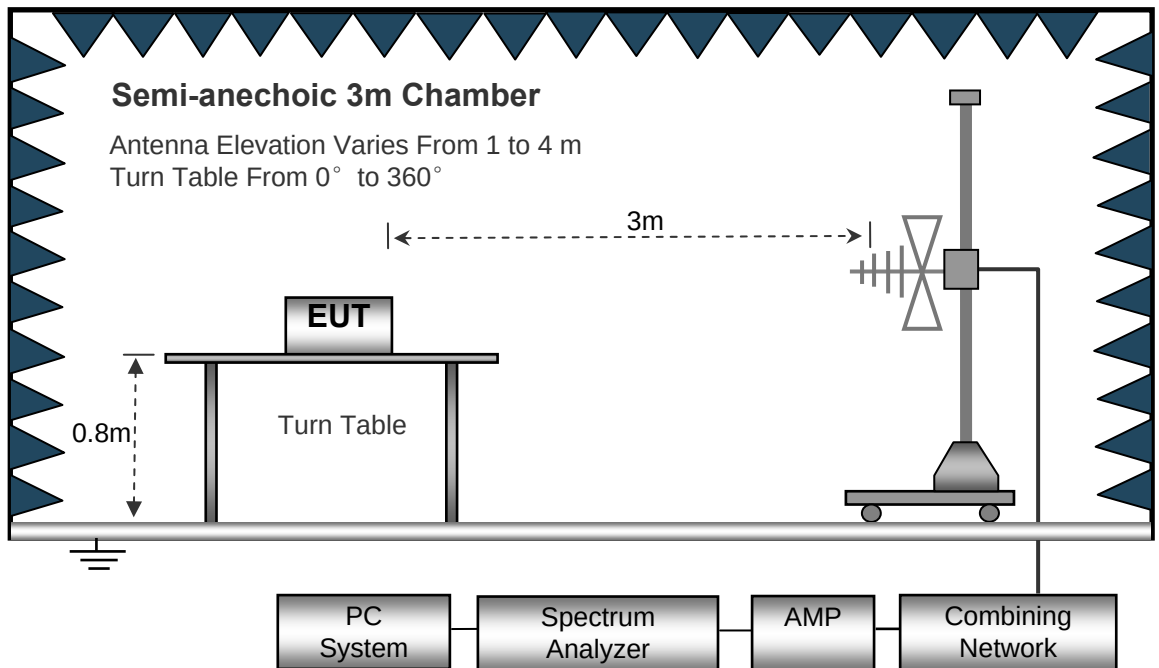
7.2 Test Setup

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

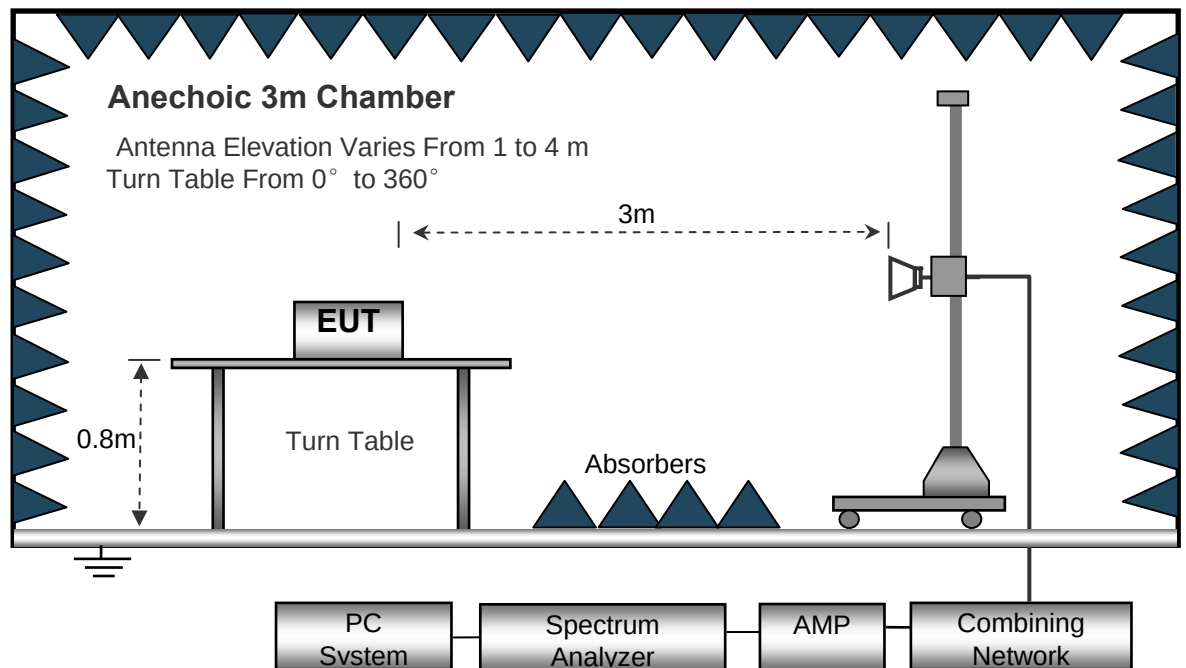
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

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

30MHz ~ 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....100kHz
 Video Bandwidth.....300kHz

Above 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....1MHz
 Video Bandwidth.....3MHz

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 Summary of Test Results

AV = Peak +20Log₁₀(duty cycle)

Test Frequency: Below 30MHz

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

Test Frequency: 30MHz ~ 5GHz

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)
433.92	59.34	PK	355	1.6	H	19.68	79.02	100.82	-21.80
433.92	67.01	PK	234	1.5	V	19.68	86.69	100.82	-14.13
867.84	15.64	PK	106	1.6	H	29.71	45.35	80.82	-35.47
867.84	18.36	PK	109	1.1	V	29.71	48.07	80.82	-32.75
1816.80	54.21	PK	149	1.4	H	-16.38	37.83	74.00	-36.17
1816.80	50.89	PK	137	1.5	V	-16.38	34.51	74.00	-39.49
2725.20	53.01	PK	116	1.5	H	-14.87	38.14	74.00	-35.86
2725.20	51.24	PK	348	1.7	V	-14.87	36.37	74.00	-37.63

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)
433.92	79.02	317	1.6	H	-10.47	68.55	80.82	-12.27
433.92	86.69	147	1.5	V	-10.47	76.22	80.82	-4.60
867.84	45.35	71	1.6	H	-10.47	34.88	60.82	-25.94
867.84	48.07	76	1.1	V	-10.47	37.60	60.82	-23.22
1816.80	37.83	79	1.4	H	-10.47	27.36	54.00	-26.64
1816.80	34.51	316	1.5	V	-10.47	24.04	54.00	-29.96
2725.20	38.14	325	1.5	H	-10.47	27.67	54.00	-26.33
2725.20	36.37	159	1.7	V	-10.47	25.90	54.00	-28.10

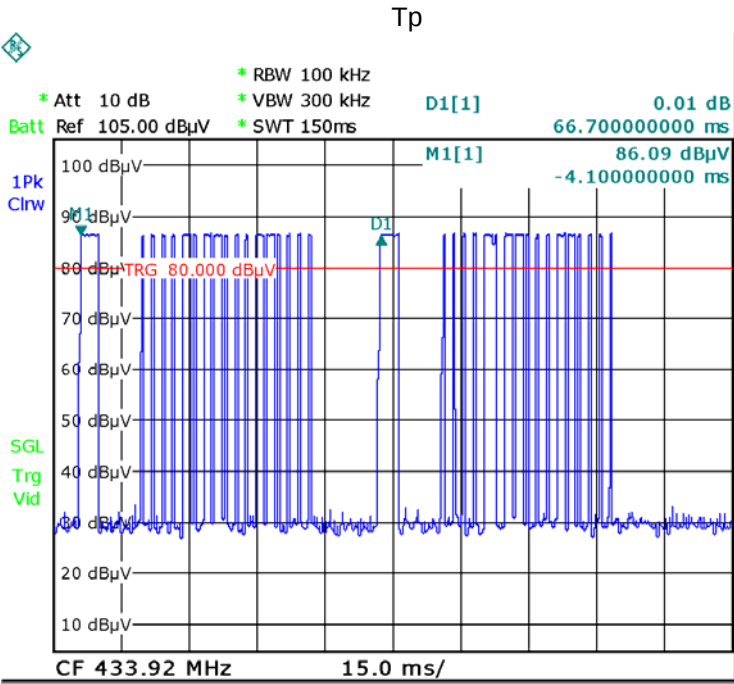
8 Periodic Operation

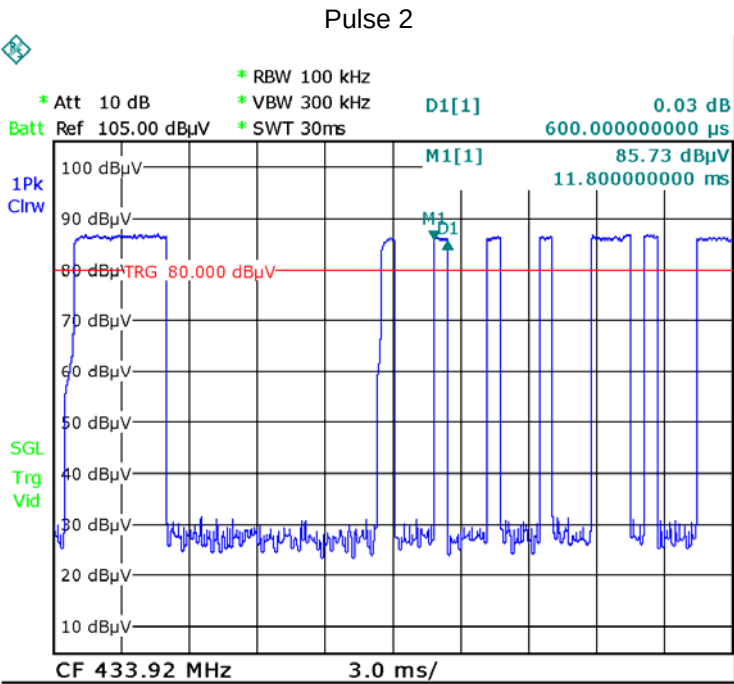
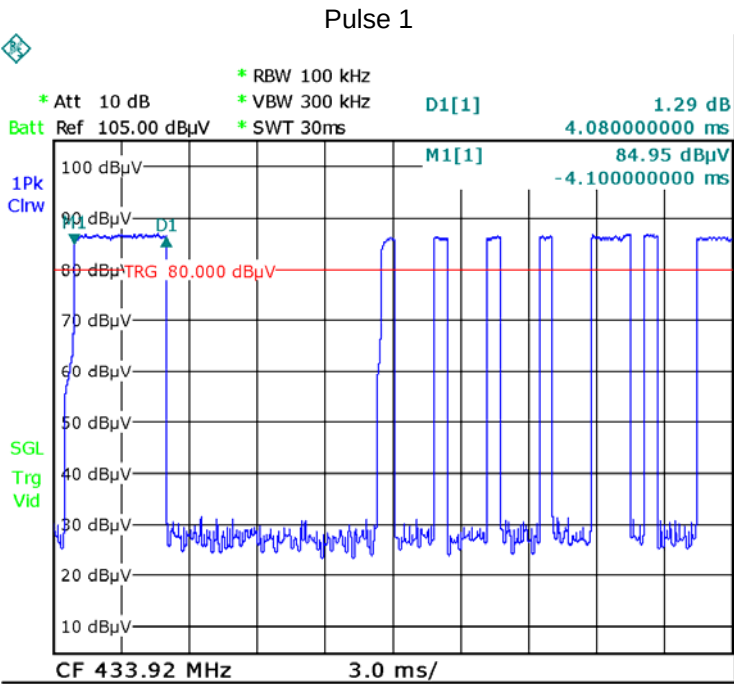
The duty cycle was determined by the following equation:
To calculate the actual field intensity, The duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

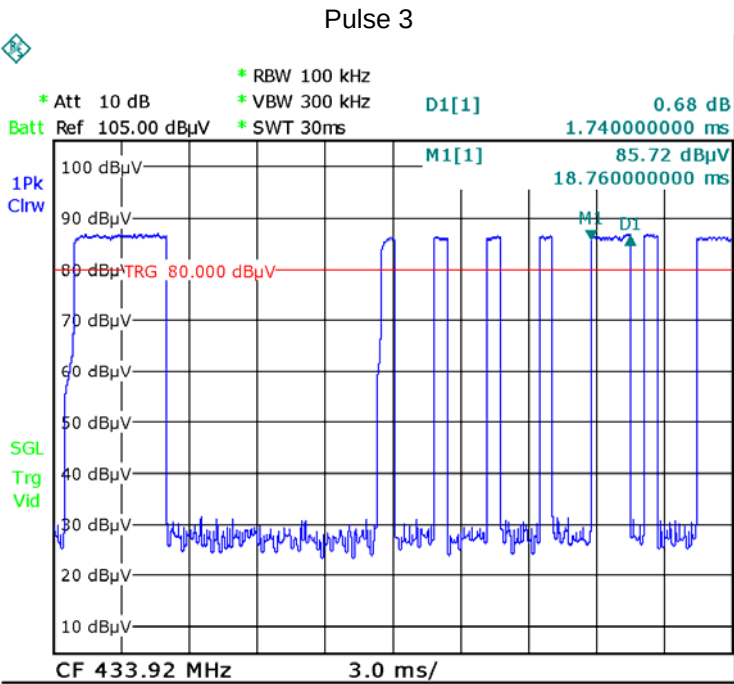
Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train *100 %
Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle(%))

Total transmission time(ms)	66.7
Length of a complete transmission period(ms)	4.08+12*0.6+5*1.74=19.98
Duty Cycle(%)	29.96
Duty Cycle Correction Factor(dB)	-10.47

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.

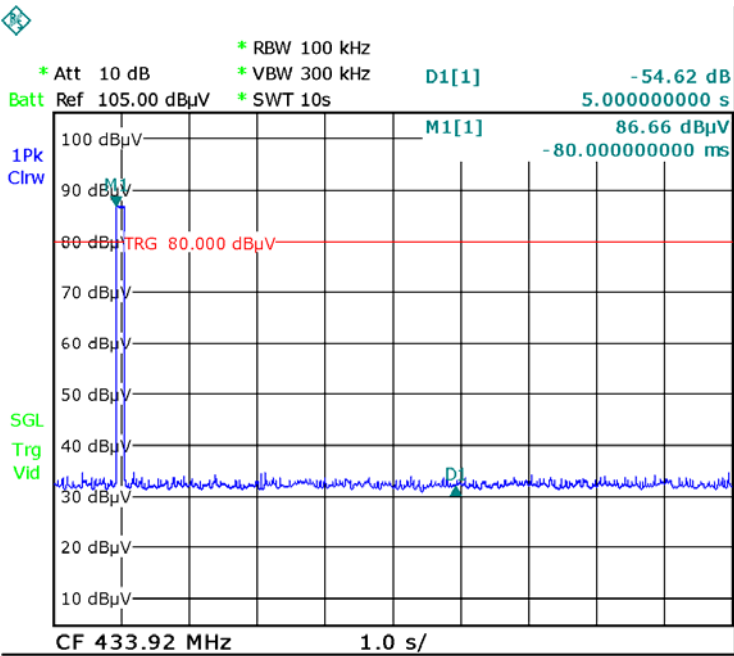






FCC Part15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.



9 20dB Bandwidth

Test Requirement: FCC Part15.231(c)

Test Method: FCC Part15.231(c)

Limit The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

9.1 Test Procedure

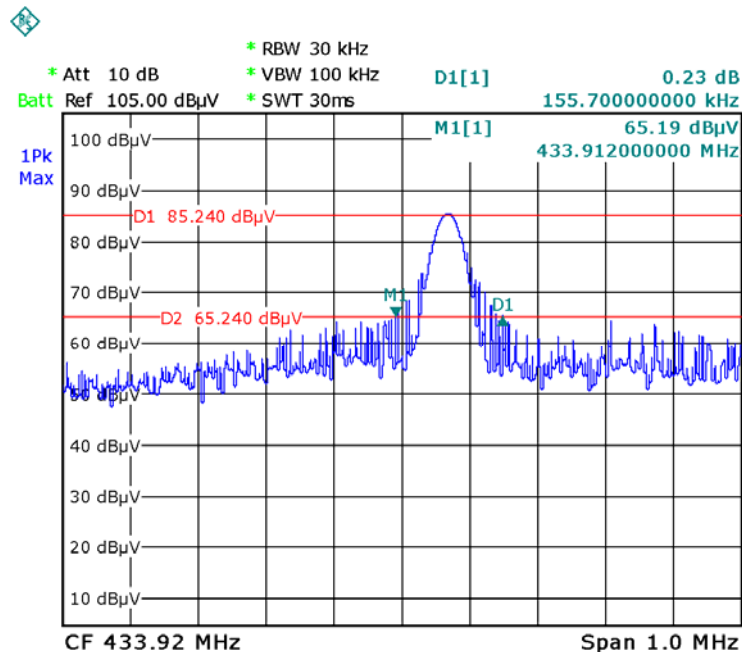
1. The transmitter output (antenna port) was connected to the spectrum analyzer. EUT and its simulators are placed on a table, let EUT working in test mode, then test it.
2. The bandwidth of the fundamental frequency was measure by spectrum analyser with 3kHz RBW and 10kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power 20dB.

9.2 Test Result

Frequency (MHz)	Bandwidth Emission (kHz)	Limit (kHz)	Result
433.92	155.70	1084.80	Pass

Limit=Center Frequency*0.25%

Test Plot



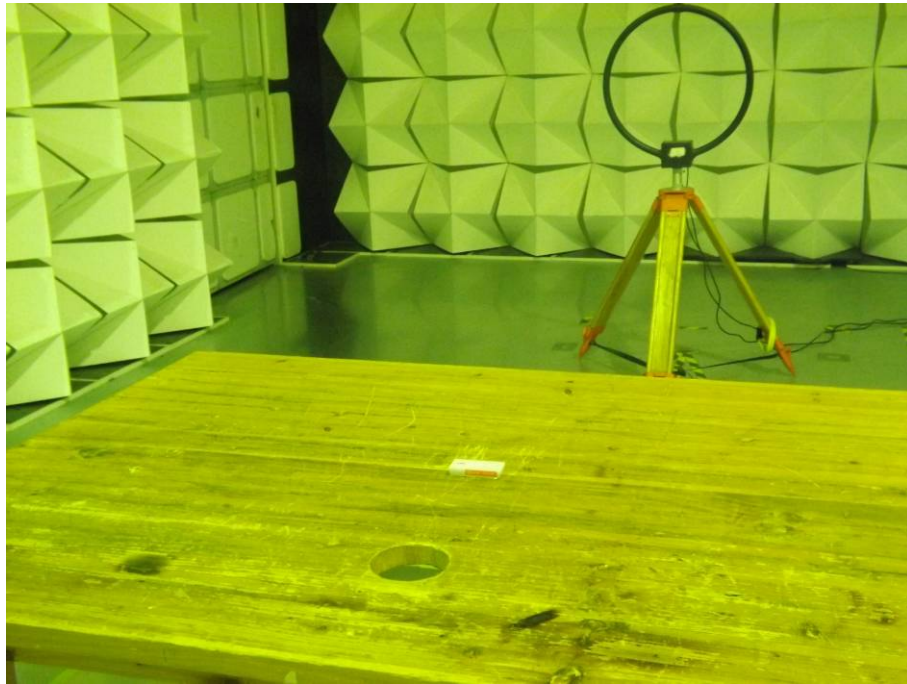
10 Antenna Requirement

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. The use of a permanently attached antenna to the intentional radiator shall be considered sufficient to comply with the provisions of this section. This product use a permanent integrated antenna, fulfill the requirement of this section

11 Photographs- Model ZW056-Sensor Test Setup

11.1 Radiation Emission Test Setup

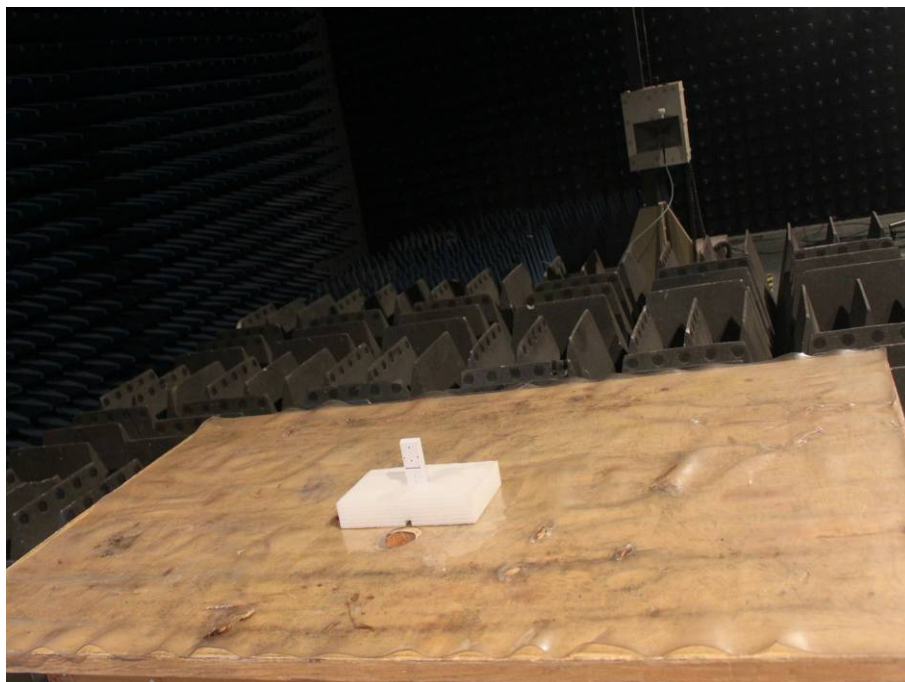
Below 30MHz Test site 2#



From 30MHz to 1GHz Test site 2#

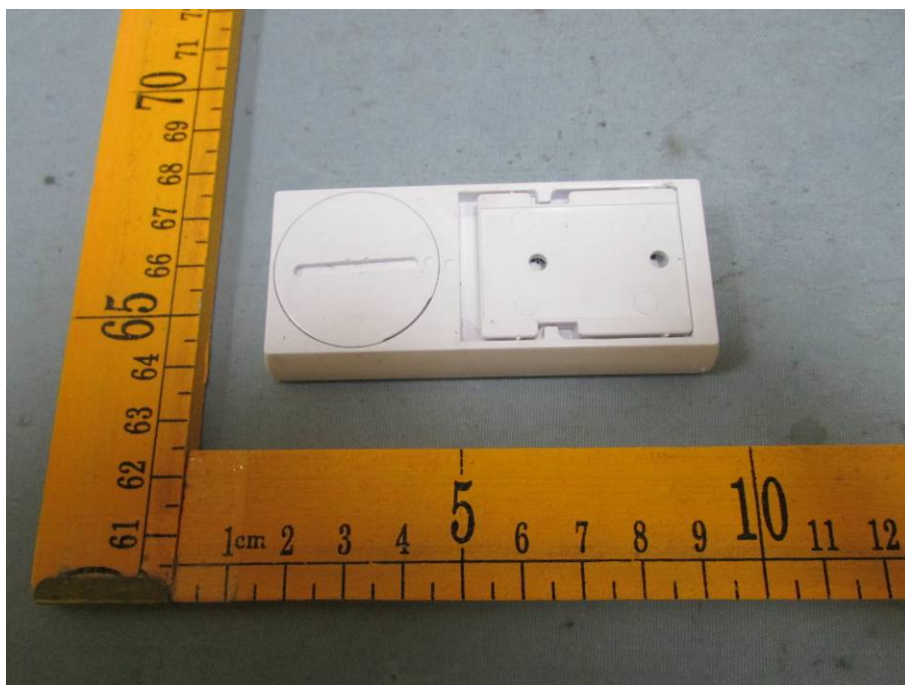
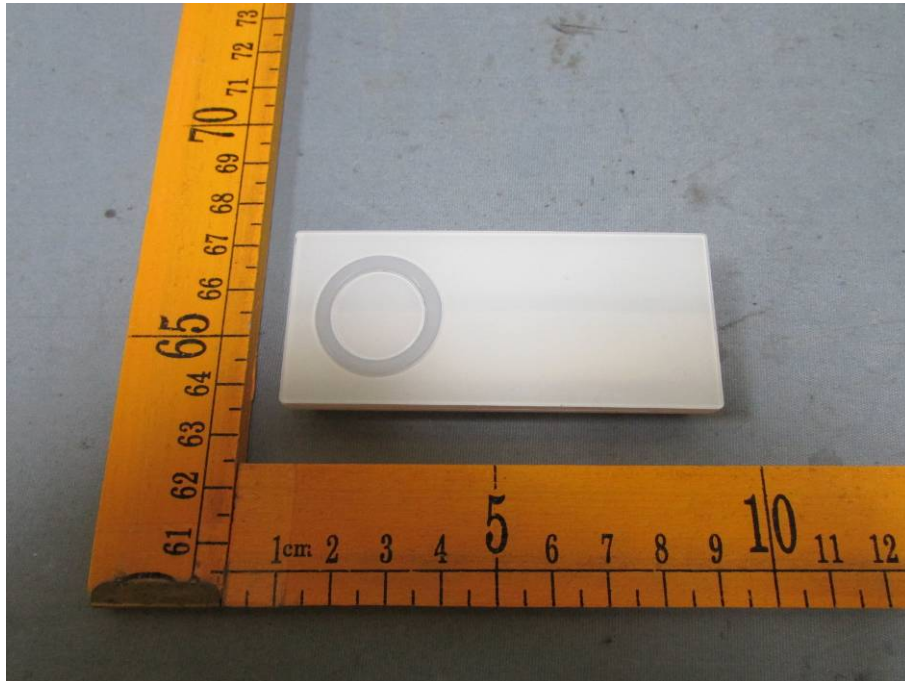


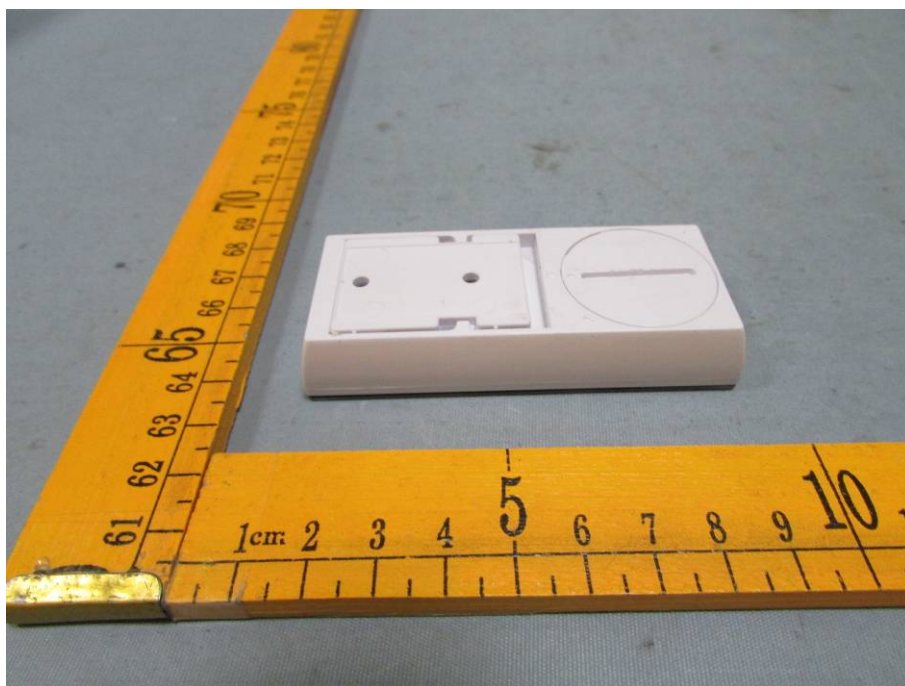
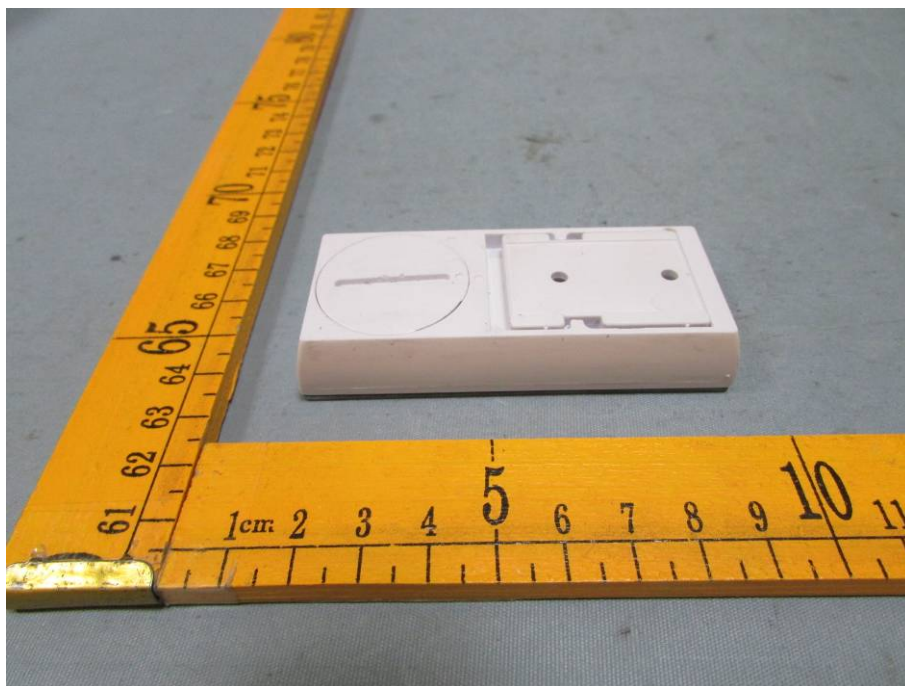
Above 1GHz Test site 1#

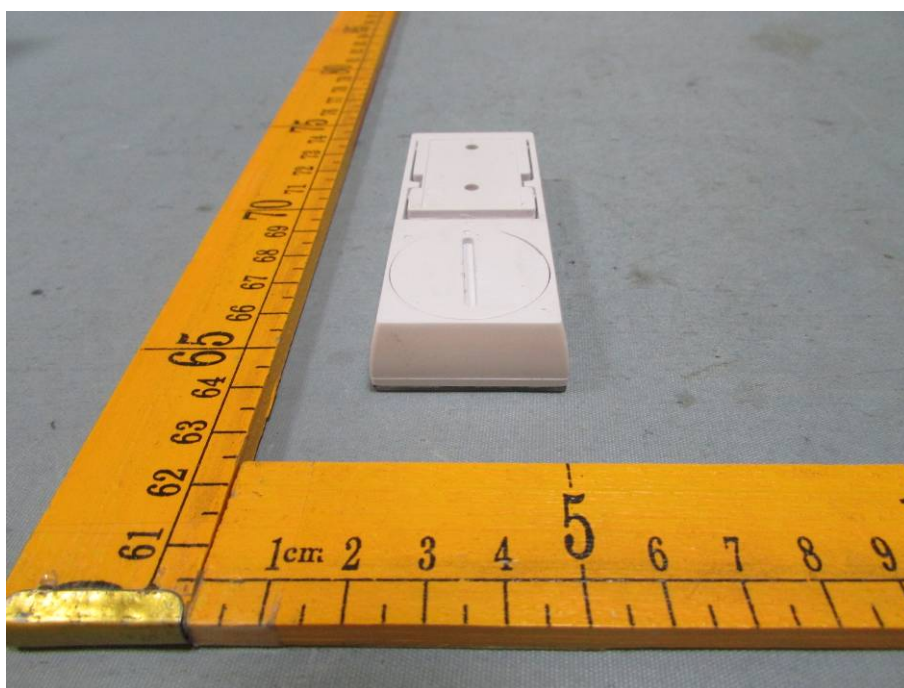
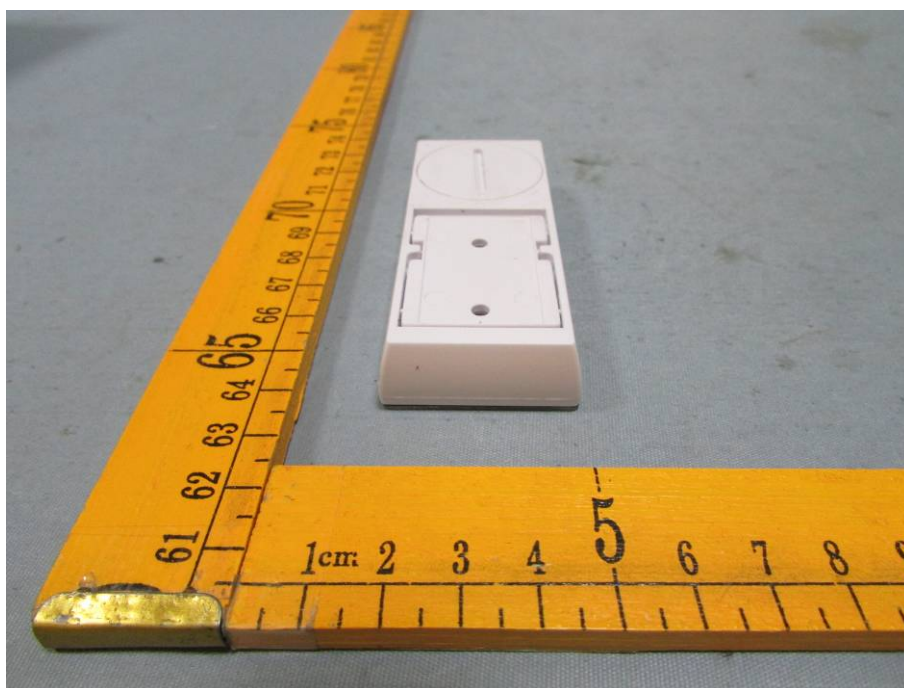


12 Photographs - Constructional Details

12.1 Model ZW056-Sensor - Appearance View

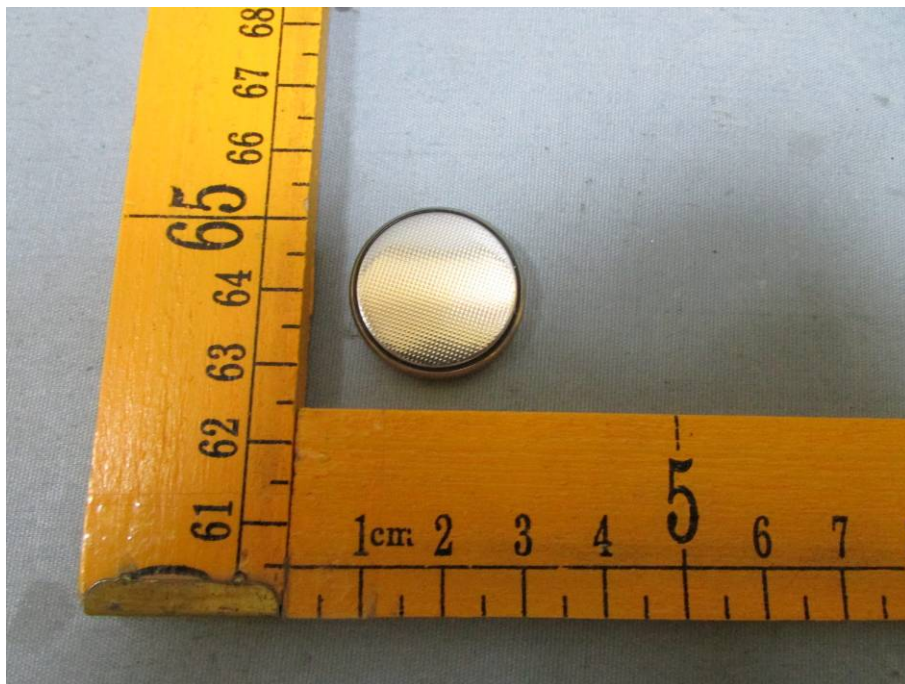






12.2 Model ZW056-Sensor - Internal View





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