TEST REPORT

Reference No.	:	WTS19S05032780W
FCC ID	:	2AOGIZWA008
Applicant	:	AEOTEC LIMITED
Address	:	OFFICE 4 10/F KWAN CHART TOWER NO. 6 TONNOCHY ROAD WANCHAI HK, China
Manufacturer	:	A&R Technologies
Address	:	34B Zheng Feng Nan Lu, Baoan Qu, Shenzhen Shi, Guangdong Sheng, China
Product	:	Door/Window Sensor 7
Model(s)	:	ZWA008-A
Brand	:	Aeotec
Standards	:	FCC CFR47 Part 15 Section 15.249: 2019
Date of Receipt sample	:	2019-05-23
Date of Test	:	2019-05-25 to 2019-07-25
Date of Issue	:	2019-07-26
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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Test site/Test location:
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Compiled by: Approved by:

Robin Zhou / Test Engineer

Philo Zhong / Manager

1 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, the certification number is 4243.01) of USA, CNAS (China National Accreditation Service for Conformity Assessment, the registration number is L3110) of China. 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), ISED Canada (Innovation, Science and Economic Development 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. Electro Magnetic 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.

1.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Scope Covered By	Scope	Note
USA	ISO/IEC 17025	FCC ID \ SDoC(VOC/DOC)	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India		WPC	-
Thailand		NTC	-
Singapore		IDA	-
Note: 1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476. 2. ISED CAB identifier: CN0013.			

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

2 Contents

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS19S05032780W	2019-05-23	2019-05-25 to 2019-07-25	2019-07-26	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	Door/Window Sensor 7
Model(s):	ZWA008-A
Model difference:	N/A
Operation Frequency:	908-916MHz
Antenna installation:	Integrated Loop Antenna
Antenna Gain:	2.2dBi
Type of Modulation:	FSK, GFSK
Data rate:	9.6kbps, 908.42MHz, FSK 40kbps, 908.40MHz, FSK 100kbps, 916.00MHz, GFSK
HW version:	V1.00
FW version:	V1.00

4.2 Details of E.U.T.

Ratings: DC 3.6V by 1/2AA SIZE ER14250 LITHIUM BATTERY

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	908.40	2	908.42	3	916.00	4	N/A

4.4 Standards Applicable for Testing

The tests were performed according to following standards:

FCC CFR47 Part 15 Section 15.249: 2019	Telecommunication-RADIO FREQUENCY DEVICES-Intentional Radiators-Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests.

And according to FCC 47 CFR Section 15.203(m):

Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle.
1 to 10 MHz	2	1 near top and 1 near bottom.
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

So frequency range over 908MHz to 916MHz is 1 to 10 MHz. Only the Lower channel and Upper channel were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	908.40MHz	N/A	916.00MHz

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP30	100091	2019-04-19	2020-04-18
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2019-04-19	2020-04-18
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2019-04-19	2020-04-18
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2019-04-19	2020-04-18
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	2019-04-20	2020-04-19
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2019-05-24	2020-05-23
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2019-04-28	2020-04-27
4	Amplifier	ANRITSU	MH648A	M43381	2019-04-19	2020-04-18
5	Cable	HUBER+SUHNER	CBL2	525178	2019-04-20	2020-04-19
6	Coaxial Cable (below 1GHz)	Top	TYPE16 (13M)	-	2018-10-15	2019-10-14
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	Spectrum Analyzer	R&S	FSL6	100959	2018-11-18	2019-11-17
2	Coaxial Cable	Top	10Hz-30GHz	_	2018-09-12	2019-09-11
3	Antenna Connector*	Realacc	45RSm	_	2018-09-12	2019-09-11
4	DC Block	Gwave	GDCB-3G-N-SMA	140307001	2018-09-12	2019-09-11

5.2 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)

5.3 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.

6 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
Band Edge	15.249 15.205 15.209	Pass
20dB Bandwidth	15:215(c)	Pass
Antenna Requirement	15.203	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable. *: This requirement does not apply for device powered by battery.		

7 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 ☐ Fail

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(29.54+40)
30 ~ 88	100	3	100	$20\log^{(100)}$ =(40)
88 ~ 216	150	3	150	$20\log^{(150)}$ =(43.5)
216 ~ 960	200	3	200	$20\log^{(200)}$ =(46)
Above 960	500	3	500	$20\log^{(500)}$ =(54)

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

7.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

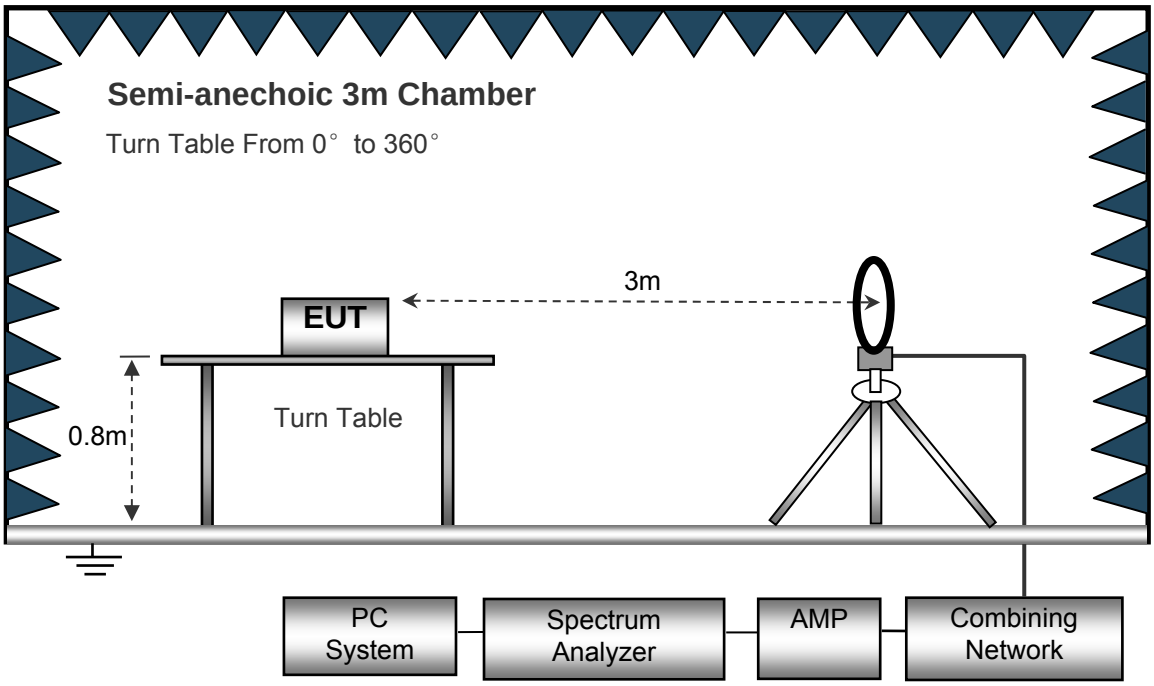
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

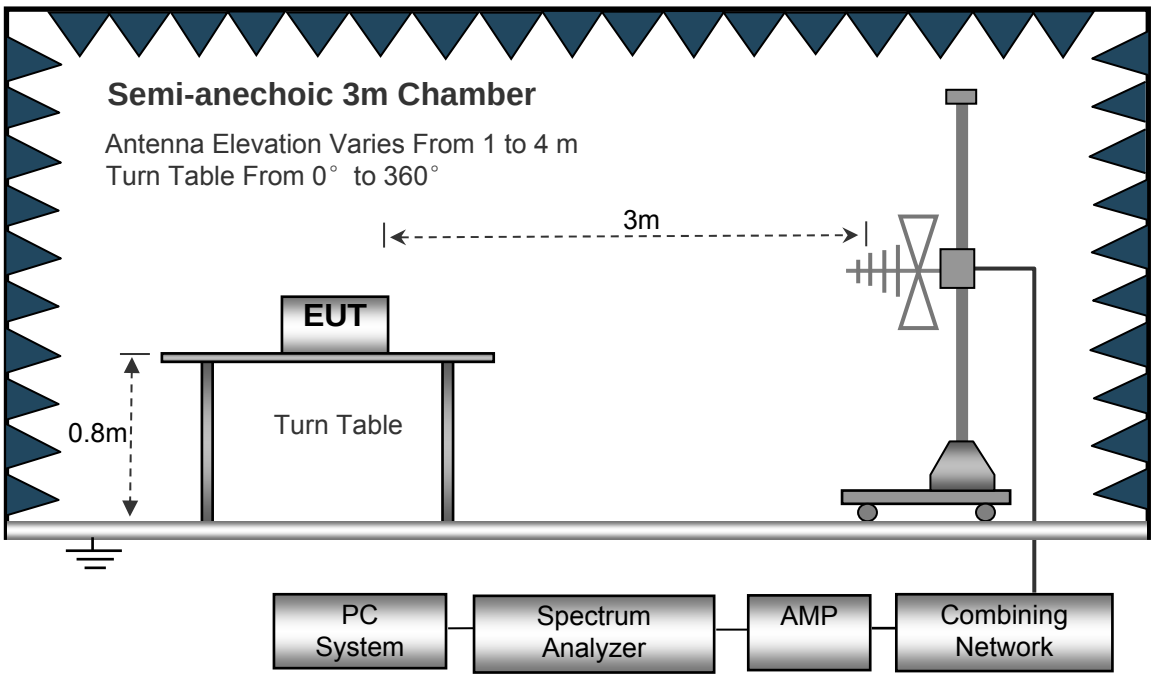
The test was performed in transmitting mode, the test data were shown in the report.

7.2 Test Setup

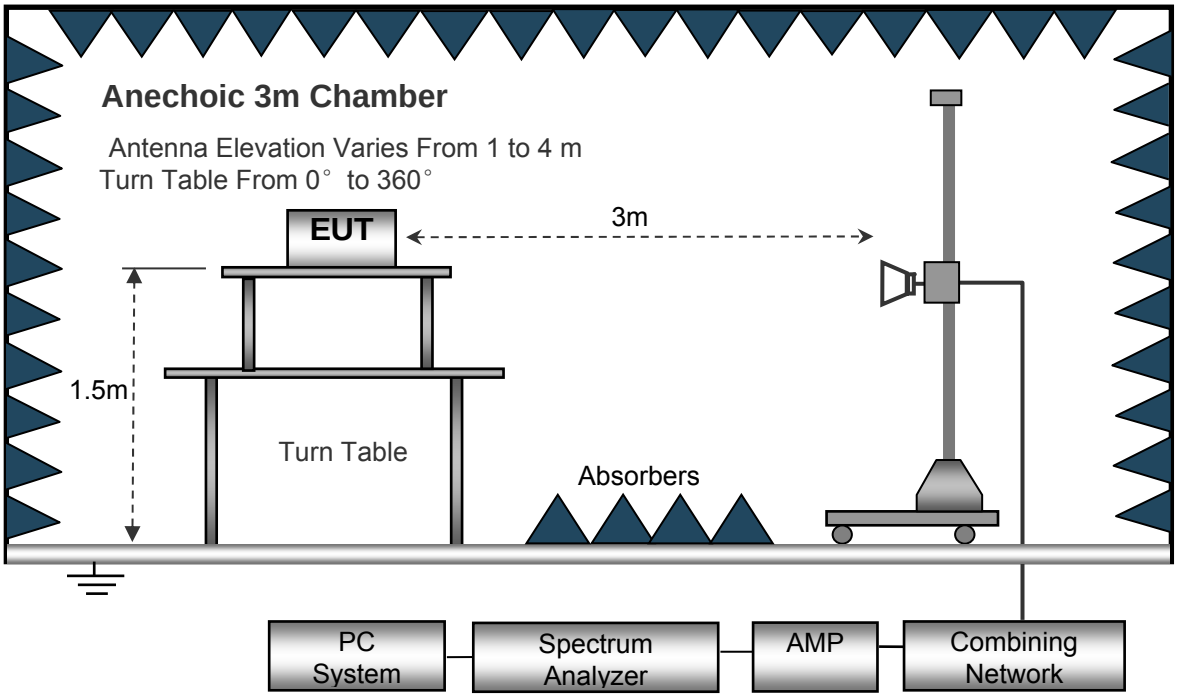
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 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

7.4 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.

7.5 Frequency range of radiated measurements.

According to FCC 47 CFR Section 15.33:

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

7.6 Test Result

Test Frequency: 9 kHz ~ 30 MHz

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

Test Frequency: 30MHz ~ 10GHz

Low Channel

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)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
67.83	32.70	QP	111	1.7	V	1.92	34.62	40.00	-5.38
908.40	77.16	PK	39	1.8	H	8.16	85.32	114.00	-28.68
908.40	73.46	PK	294	1.7	V	8.16	81.62	114.00	-32.38
1816.80	48.32	PK	259	1.3	H	-9.93	38.39	74.00	-35.61
1816.80	49.95	PK	27	1.6	V	-9.93	40.02	74.00	-33.98
3633.60	47.88	PK	296	1.5	H	-5.83	42.05	74.00	-31.95
3633.60	50.45	PK	307	1.9	V	-5.83	44.62	74.00	-29.38
5450.40	51.46	PK	254	1.8	H	-2.27	49.19	74.00	-24.81
5450.40	49.14	PK	119	1.2	V	-2.27	46.87	74.00	-27.13

AV = Peak +20Log10(duty cycle) =PK+(0) [refer to section 8 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
908.40	85.32	H	0	85.32	94.00	-8.68
908.40	81.62	V	0	81.62	94.00	-12.38
1816.80	38.39	H	0	38.39	54.00	-15.61
1816.80	40.02	V	0	40.02	54.00	-13.98
3633.60	42.05	H	0	42.05	54.00	-11.95
3633.60	44.62	V	0	44.62	54.00	-9.38
5450.40	49.19	H	0	49.19	54.00	-4.81
5450.40	46.87	V	0	46.87	54.00	-7.13

High Channel

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)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
127.97	36.19	QP	141	1.2	H	2.70	38.89	43.50	-4.61
916.00	73.16	PK	329	1.1	H	8.19	81.35	114.00	-32.65
916.00	77.42	PK	170	1.4	V	8.19	85.61	114.00	-28.39
1832.00	48.28	PK	354	1.8	H	-11.55	36.73	74.00	-37.27
1832.00	50.30	PK	18	1.9	V	-11.55	38.75	74.00	-35.25
3664.00	47.60	PK	295	1.1	H	-5.59	42.01	74.00	-31.99
3664.00	50.07	PK	99	1.1	V	-5.59	44.48	74.00	-29.52
4580.00	52.23	PK	317	1.8	H	-3.04	49.19	74.00	-24.81
4580.00	52.19	PK	358	2.0	V	-3.04	49.15	74.00	-24.85

AV = Peak +20Log10(duty cycle) =PK+(0) [refer to section 8 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
916.00	81.35	H	0	81.35	94.00	-12.65
916.00	85.61	V	0	85.61	94.00	-8.39
1832.00	36.73	H	0	36.73	54.00	-17.27
1832.00	38.75	V	0	38.75	54.00	-15.25
3664.00	42.01	H	0	42.01	54.00	-11.99
3664.00	44.48	V	0	44.48	54.00	-9.52
4580.00	49.19	H	0	49.19	54.00	-4.81
4580.00	49.15	V	0	49.15	54.00	-4.85

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 * Log_{10}(Duty Cycle)

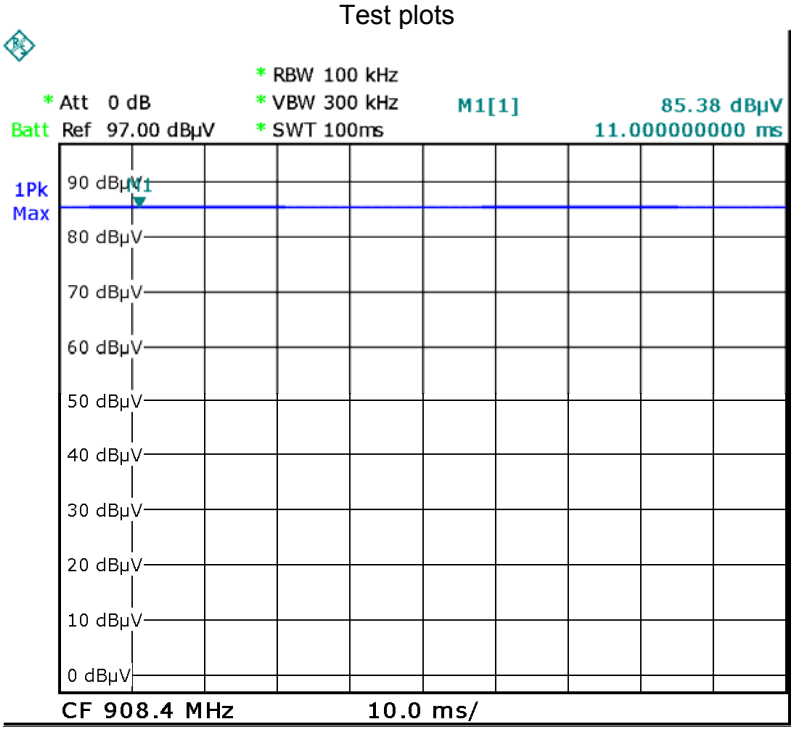
Test channel	Low Channel	High Channel
Total transmission time(ms)	100	100
Length of a complete transmission period(ms)	100*	100*
Duty Cycle(%)	100	100
Duty Cycle Correction Factor(dB)	0	0

(* Note: the transmitter operates for longer 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. So the Length of a complete transmission period=100ms)

Refer to the duty cycle plot (as below)

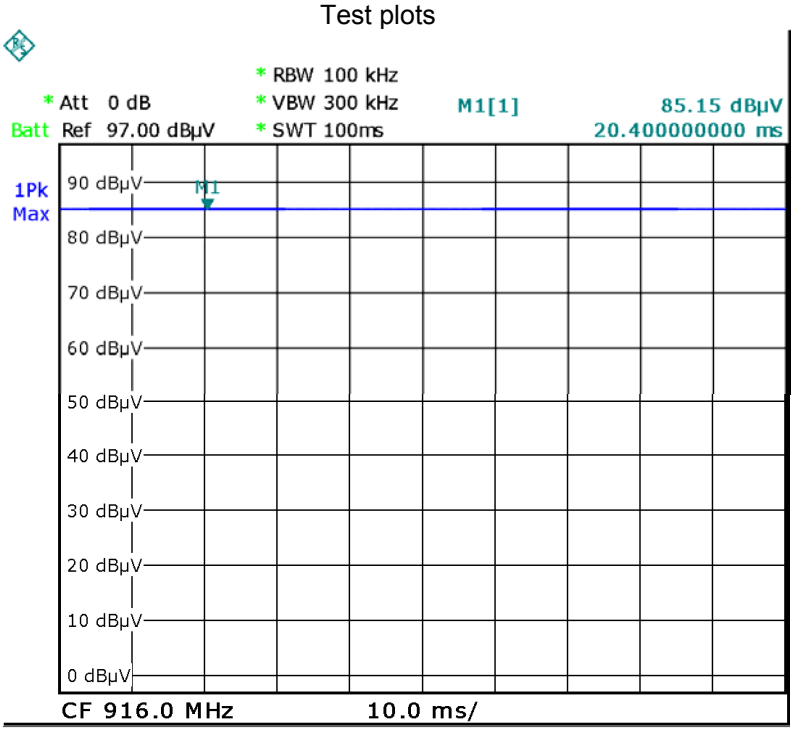
Lower Channel

Test plots



High Channel

Test plots



9 Band Edge

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

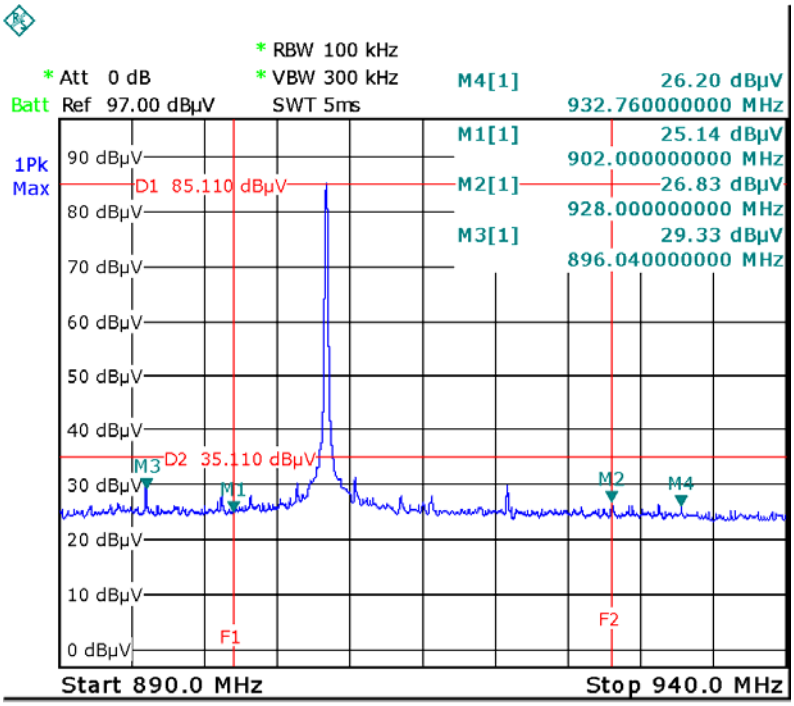
9.1 Test Procedure

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

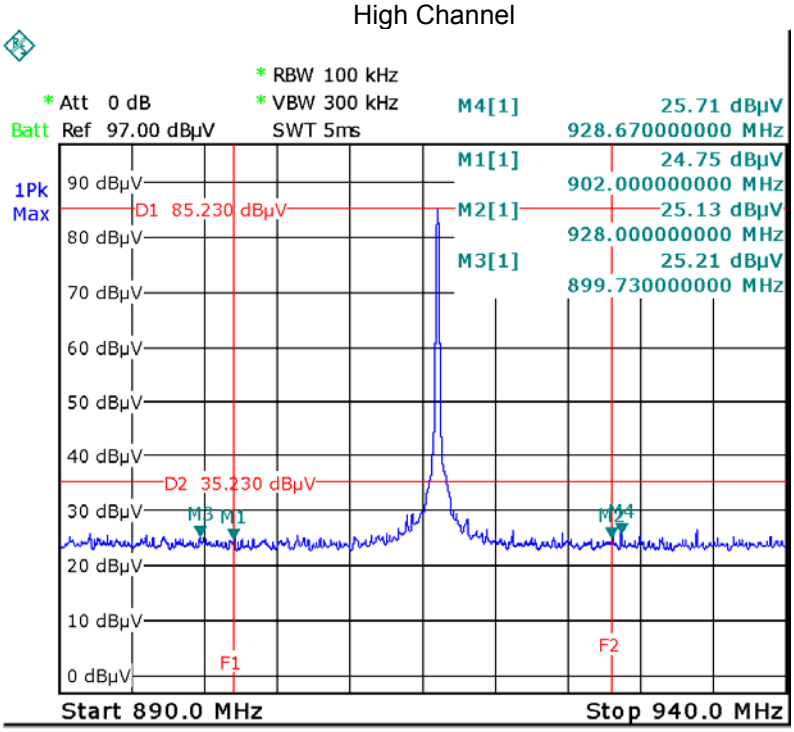
9.2 Test Result

Test plots

Low Channel



High Channel



10 20 dB Bandwidth Measurement

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

Test Method: ANSI C63.10:2013

Test Mode: Transmitting

10.1 Test Procedure

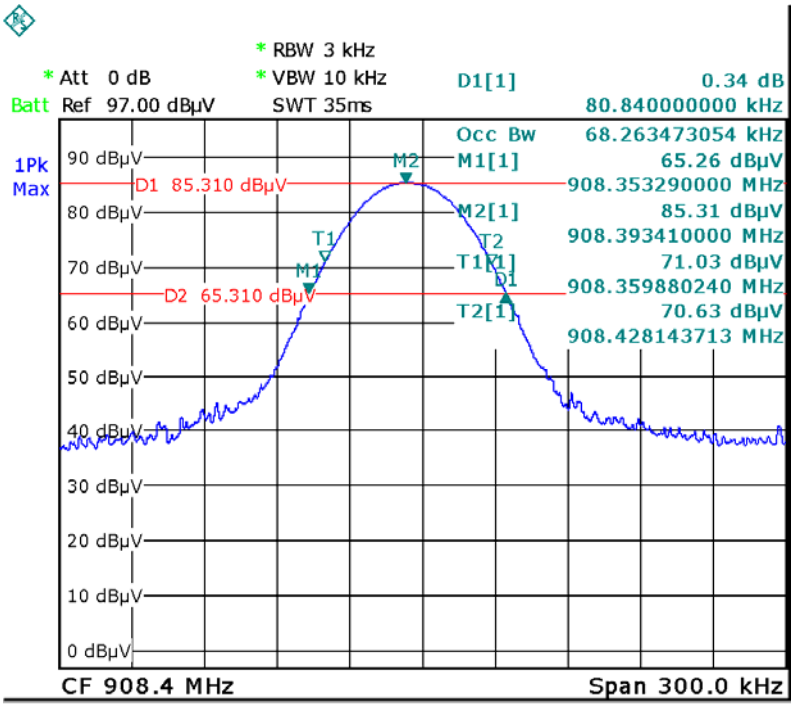
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 3kHz, VBW = 10kHz

10.2 Test Result

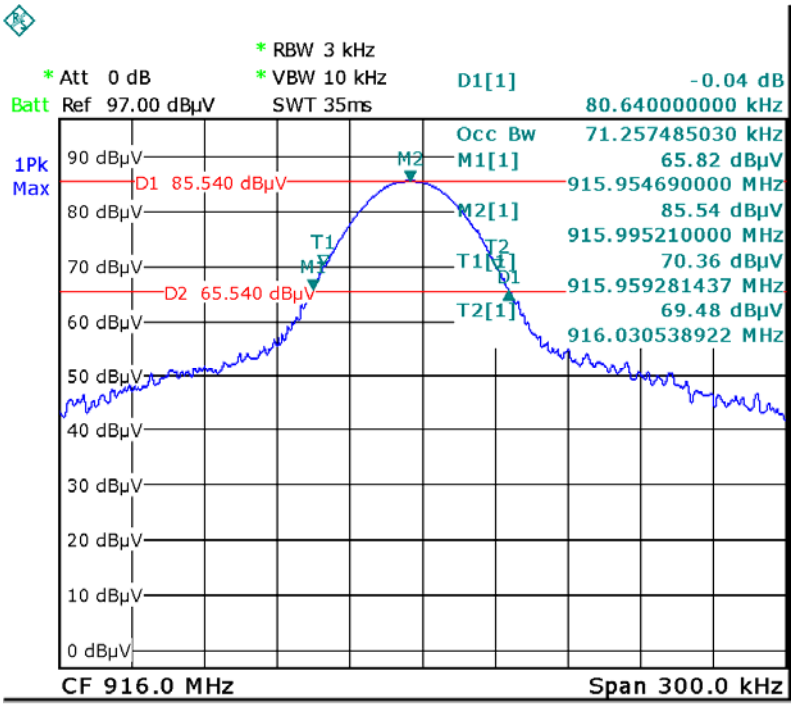
Test channel	Frequency (MHz)	20dB Bandwidth Emission(kHz)
Low Channel	908.40	80.84
High Channel	916.00	80.64

Test plots

Low Channel



High Channel



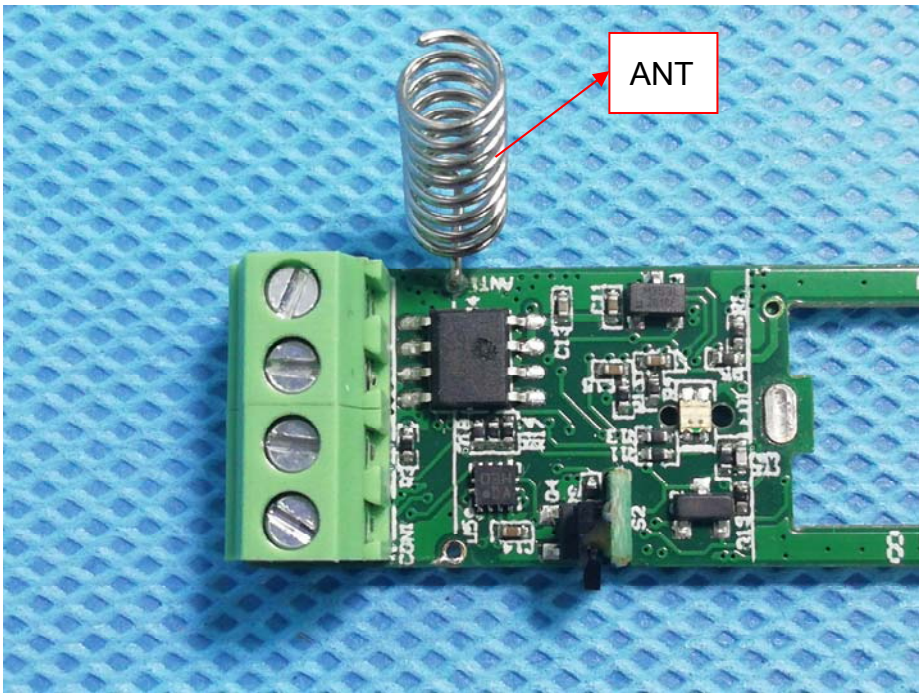
11 Antenna Requirement

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 Integrated Loop Antenna, the gain is 2.2dBi. meets the requirements of FCC 15.203.



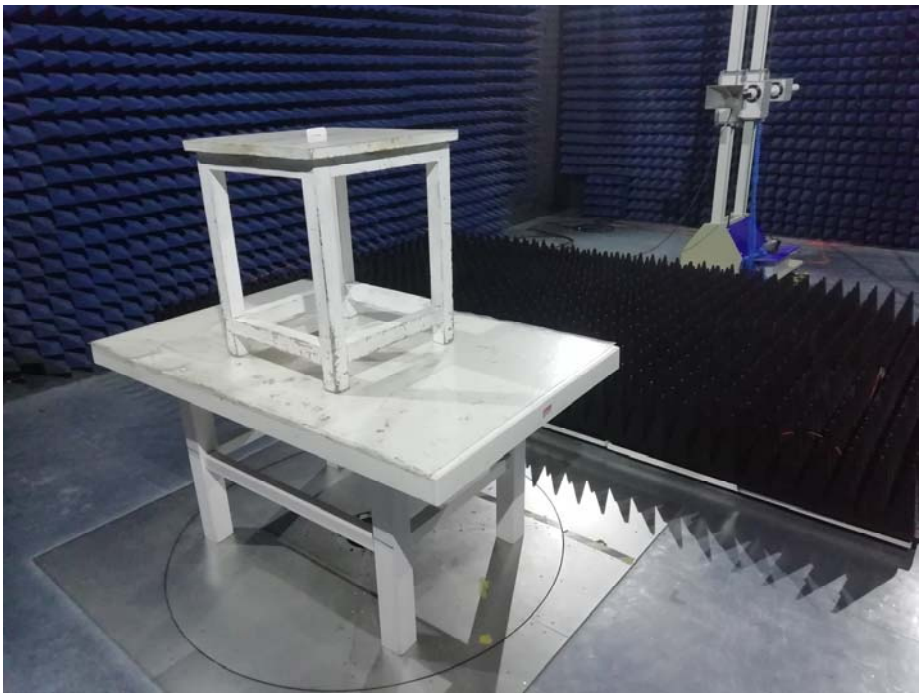
12 Photographs- Model ZWA008-A Test Setup Photos

12.1 Photograph – Radiation Emission

From 9kHz to 30MHz

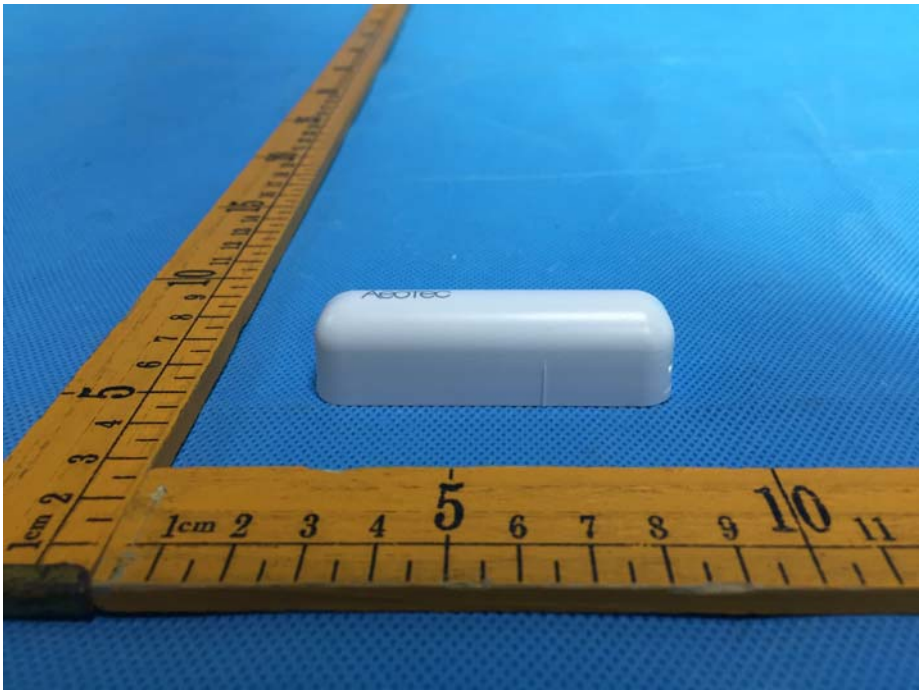
From 30MHz to 1GHz

From 1GHz to 10GHz

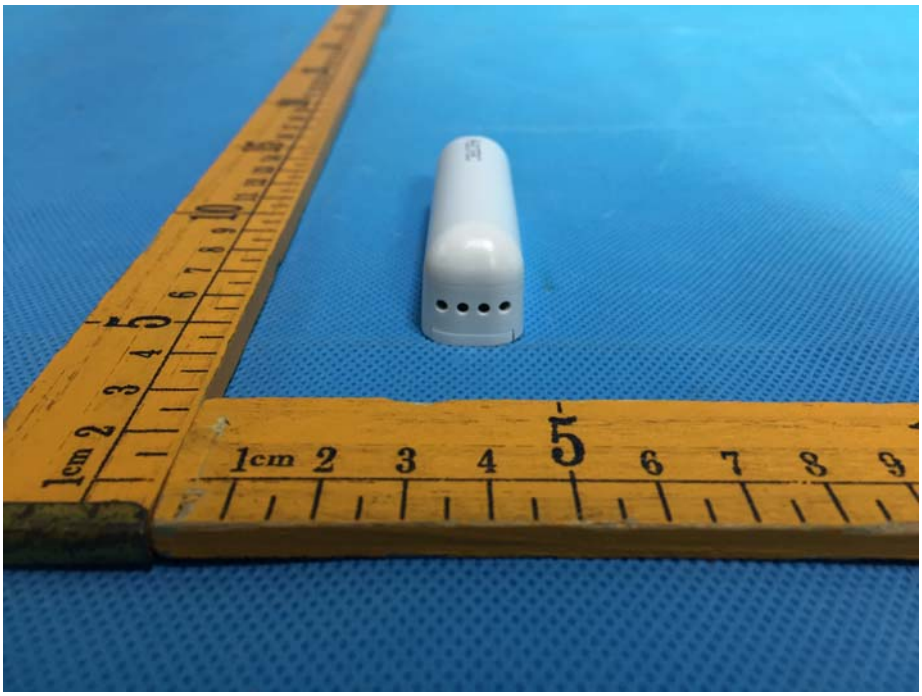


13 Photographs - Constructional Details

13.1 Model ZWA008-A - External Photos

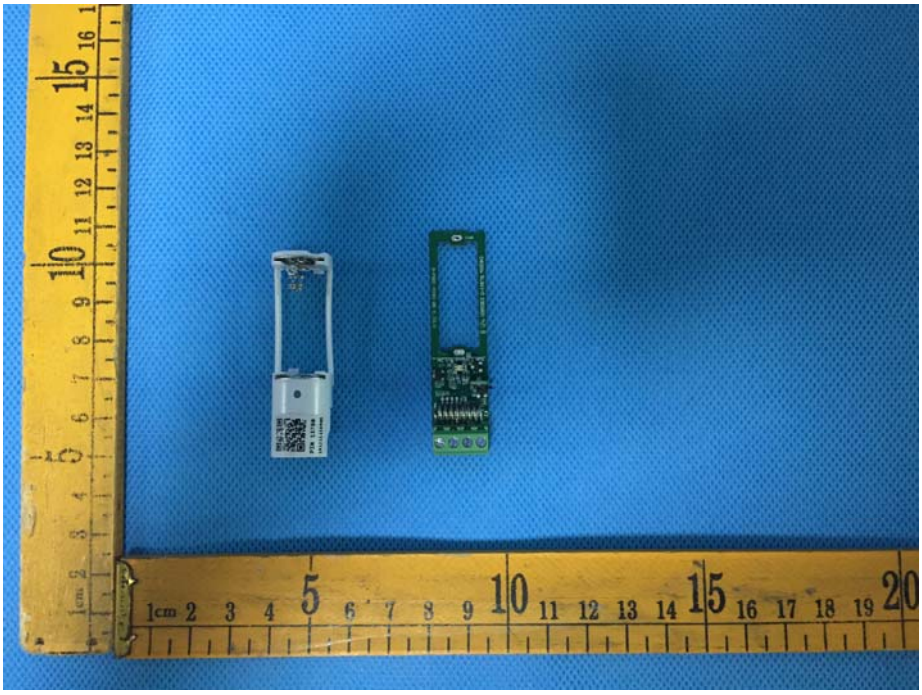


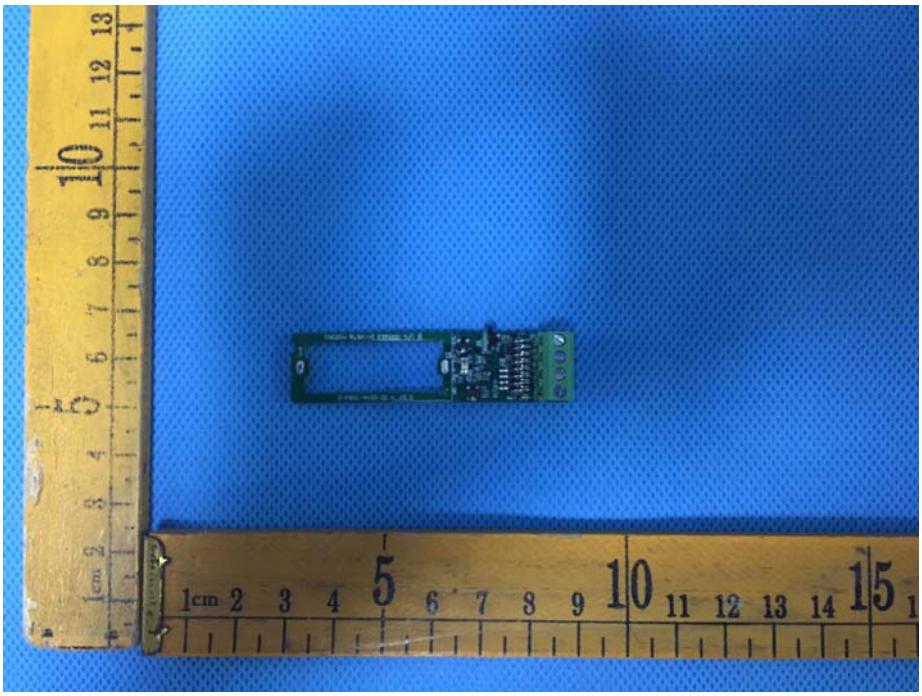

1cm 2 3 4 5 6 7 8 9

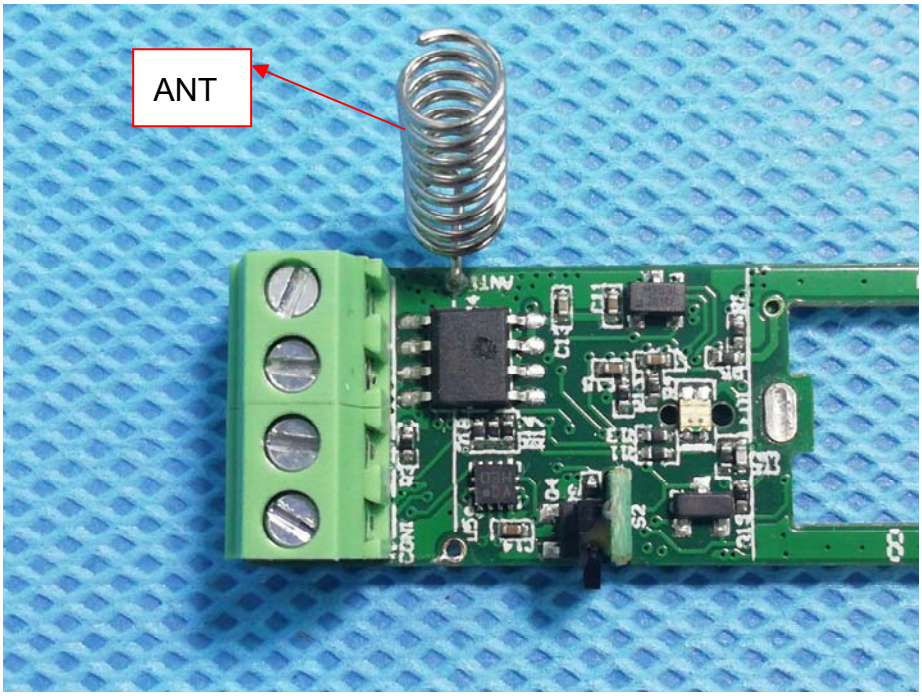

1cm 2 3 4 5 6 7 8 9


1cm 2 3 4 5 6 7 8 9 10 11 12 13 14

13.2 Model ZWA008-A - Internal Photos



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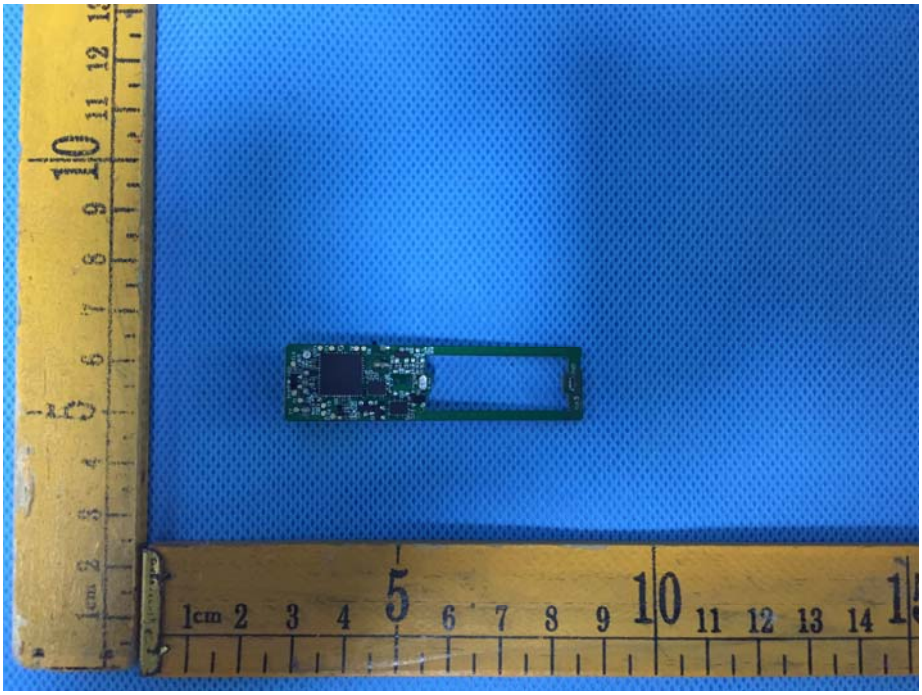

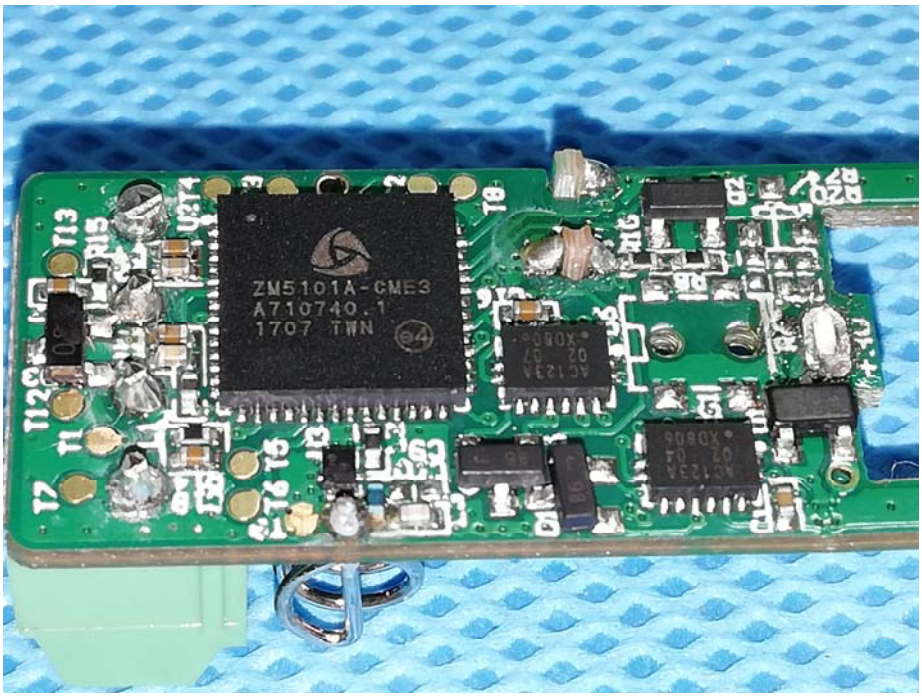

======End of Report======