TEST REPORT

Reference No.	:	WTS17S0271118-3E
FCC ID	:	XBAFT122
Applicant	:	Aeon Labs LLC.
Address	:	121 Buckingham Drive, Unit 36, Santa Claras, California, United States
Manufacturer	:	Fantem Technologies (Shenzhen) Co., Ltd.
Address	:	North,3/F, Yitoa Technology Industrial Park, Baihua Yuan Rd.,The Second Industrial Area,Guangming Sub-districtOffice,Guangming New District,Shenzhen, Guangdong, China.
Product Name	:	Water Sensor 6
Product Type	:	Water Sensor 6 with Water Sensor 6 Dock
Model No.	:	ZW122-A
Brand Name	:	AEOTEC
Standards	:	FCC CFR47 Part 15 Section 15.249: 2016
Date of Receipt sample	:	Feb. 20, 2017
Date of Test	:	Feb. 21 – Mar. 21, 2017
Date of Issue	:	Mar. 22, 2017
Test Result	:	Pass
Note	:	This report is for Z-wave Function.

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.

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS17S0271118-3E	Feb. 20, 2017	Feb. 21 – Mar. 21, 2017	Mar. 22, 2017	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name:	Water Sensor 6
Product Type:	Water Sensor 6 with Water Sensor 6 Dock
Model No.:	ZW122-A
Model Differences Description:	N/A
Accessory:	Product Name: Water Sensor 6 Dock Model No.: ZW160-Z
Note: Water Sensor 6 and Water Sensor 6 Dock is a combination, Water Sensor 6 can power supply from Water Sensor 6 Dock.	
Type of Modulation:	FSK for Z-wave
Z-wave Frequency Range:	908.40MHz,908.42MHz
NFC:	Not support
Antenna installation:	Integrated Antenna for Z-wave
Antenna Gain:	-3dBi for Z-wave
Hardware Version:	AA
Software Version:	V1.00

4.2 Details of E.U.T.

Technical Data: Battery: CR123A 1500mAh
DC 5V from Dock to USB port from PC

4.3 Channel List

Z-wave Test Mode			
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	908.40	1	908.42

4.4 Standards Applicable for Testing

The tests were performed according to following standards:

FCC CFR47 Part 15 Section 15.249: 2016	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 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, Octorber 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

4.6 Z-wave Test Mode

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

And according to Part 15.31(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

The frequency range of this product over 908.40MHz to 908.42MHz is less than 1MHz, so only one channel 908.42MHz was recorded and reported.

Test mode	Upper channel
Transmitting	908.42MHz

5 Equipment Used during Test

5.1 Equipments 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	Sep.12, 2016	Sep.11, 2017
2.	LISN	R&S	ENV216	101215	Sep.12, 2016	Sep.11, 2017
3.	Cable	Top	TYPE16(3.5M)	-	Sep.12, 2016	Sep.11, 2017
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	Sep.12, 2016	Sep.11, 2017
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	Sep.12, 2016	Sep.11, 2017
3.	Limiter	York	MTS-IMP-136	261115-001-0024	Sep.12, 2016	Sep.11, 2017
4.	Cable	LARGE	RF300	-	Sep.12, 2016	Sep.11, 2017
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP	100091	Apr.29, 2016	Apr.28, 2017
2	Amplifier	Agilent	8447D	2944A10178	Sep.12, 2016	Sep.11, 2017
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	Oct.17, 2016	Oct.16, 2017
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	33 6	Apr.09, 2016	Apr.08, 2017
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.12, 2016	Sep.11, 2017
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.09, 2016	Apr.08, 2017
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr.13, 2016	Apr.12, 2017
8	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	Apr.13, 2016	Apr.12, 2017
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	Apr.13, 2016	Apr.12, 2017
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Apr.09, 2016	Apr.08, 2017
3	Amplifier	ANRITSU	MH648A	M43381	Apr.13, 2016	Apr.12, 2017
4	Cable	HUBER+SUHNER	CBL2	525178	Apr.13, 2016	Apr.12, 2017

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.12, 2016	Sep.11, 2017
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.12, 2016	Sep.11, 2017
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.12, 2016	Sep.11, 2017

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 CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

6 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
Band Edge	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(b)(1)	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013;ANSI C63.4:2014

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Conducted Limit (dBμV)	
	Qsi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5.0	56	46
5.0 to 30	60	50
*Decreases with the logarithm of the frequency.		

Test Result: PASS

7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 25.5 °C

Humidity: 51 % RH

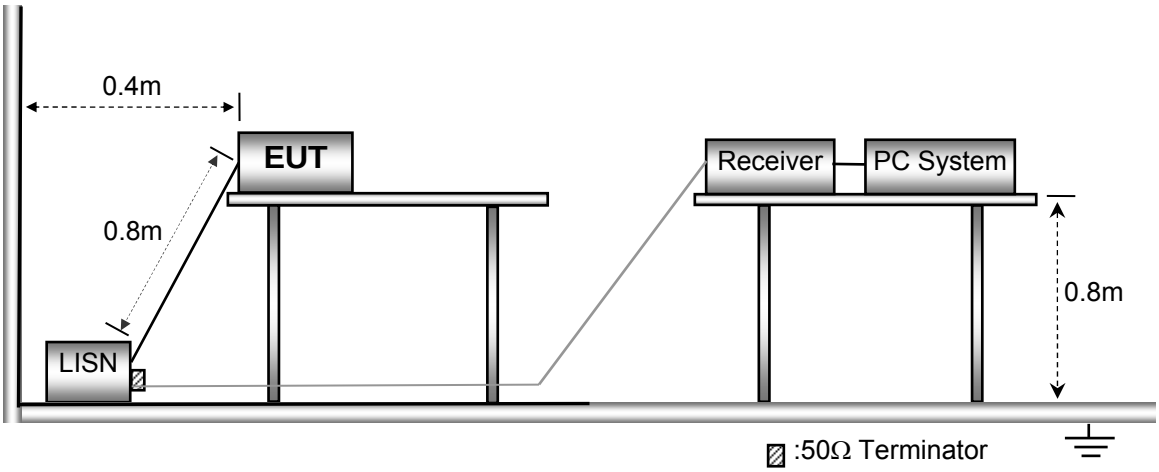
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

The test was performed in Z-wave transmitting mode (DC 5V by Dock), the test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013

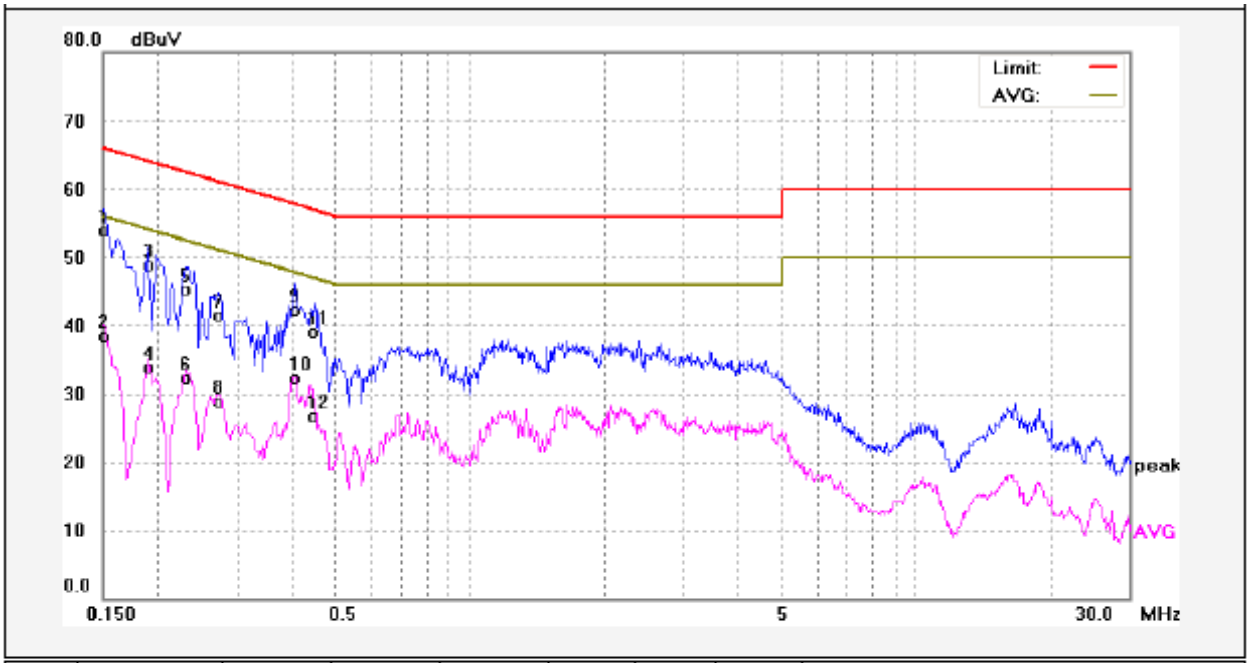


7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

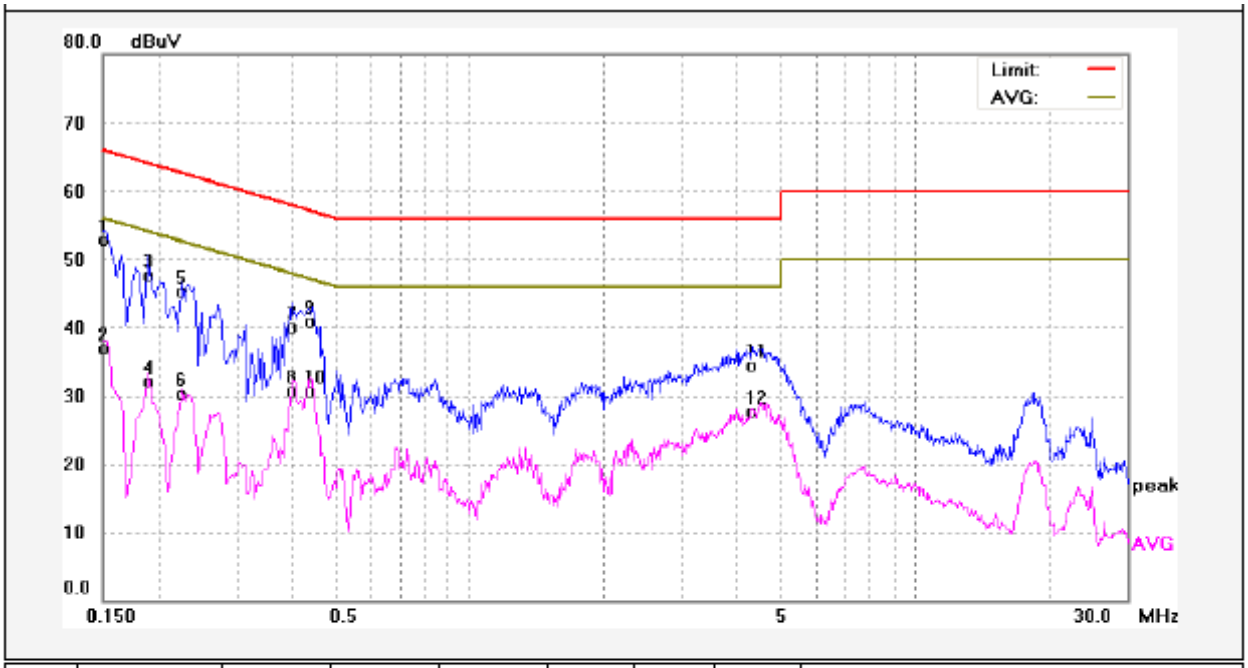
7.4 Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	44.27	9.64	53.91	65.99	-12.08	QP	
2	0.1500	28.87	9.64	38.51	55.99	-17.48	AVG	
3	0.1900	39.18	9.63	48.81	64.03	-15.22	QP	
4	0.1900	24.35	9.63	33.98	54.03	-20.05	AVG	
5	0.2300	35.67	9.63	45.30	62.45	-17.15	QP	
6	0.2300	22.64	9.63	32.27	52.45	-20.18	AVG	
7	0.2740	31.90	9.64	41.54	60.99	-19.45	QP	
8	0.2740	19.18	9.64	28.82	50.99	-22.17	AVG	
9	0.4060	32.69	9.64	42.33	57.73	-15.40	QP	
10	0.4060	22.65	9.64	32.29	47.73	-15.44	AVG	
11	0.4500	29.38	9.64	39.02	56.87	-17.85	QP	
12	0.4500	17.11	9.64	26.75	46.87	-20.12	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	43.18	9.64	52.82	65.99	-13.17	QP	
2	0.1500	27.34	9.64	36.98	55.99	-19.01	AVG	
3	0.1900	38.09	9.63	47.72	64.03	-16.31	QP	
4	0.1900	22.57	9.63	32.20	54.03	-21.83	AVG	
5	0.2260	35.74	9.63	45.37	62.59	-17.22	QP	
6	0.2260	20.68	9.63	30.31	52.59	-22.28	AVG	
7	0.3980	30.44	9.64	40.08	57.89	-17.81	QP	
8	0.3980	21.13	9.64	30.77	47.89	-17.12	AVG	
9	0.4460	31.17	9.64	40.81	56.95	-16.14	QP	
10	0.4460	21.02	9.64	30.66	46.95	-16.29	AVG	
11	4.3340	24.56	9.98	34.54	56.00	-21.46	QP	
12	4.3340	17.81	9.98	27.79	46.00	-18.21	AVG	

8 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013;ANSI C63.4:2014

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	$20\log^{(30)} + 40=(29.54+40)$
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)

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

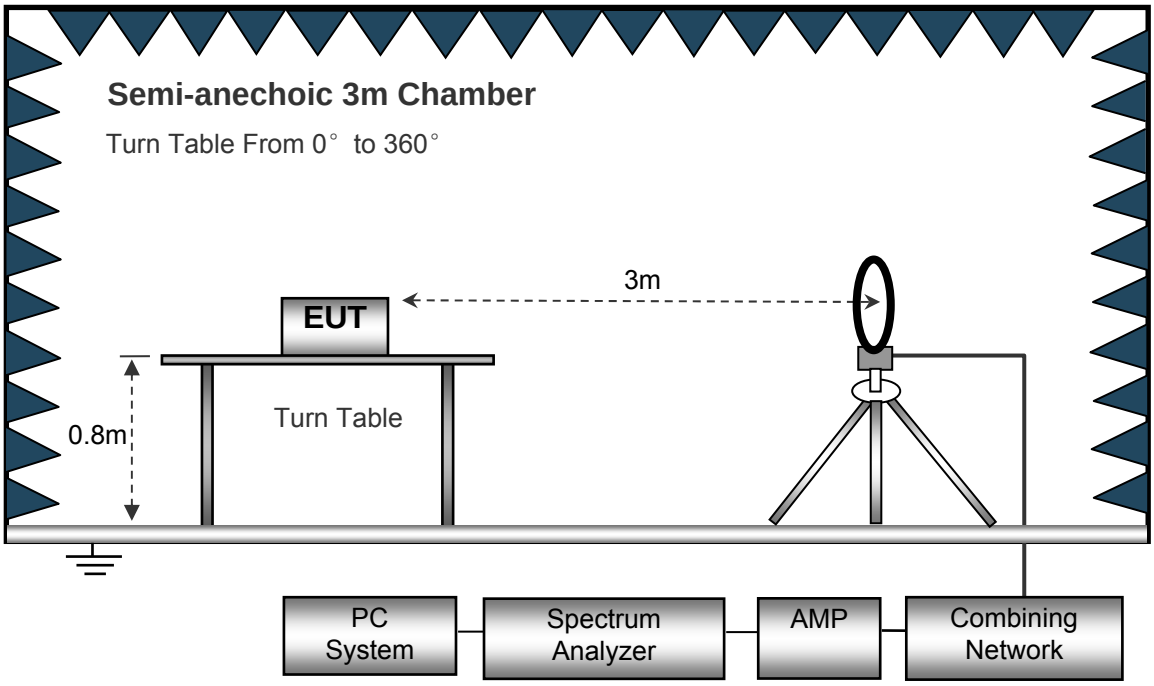
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

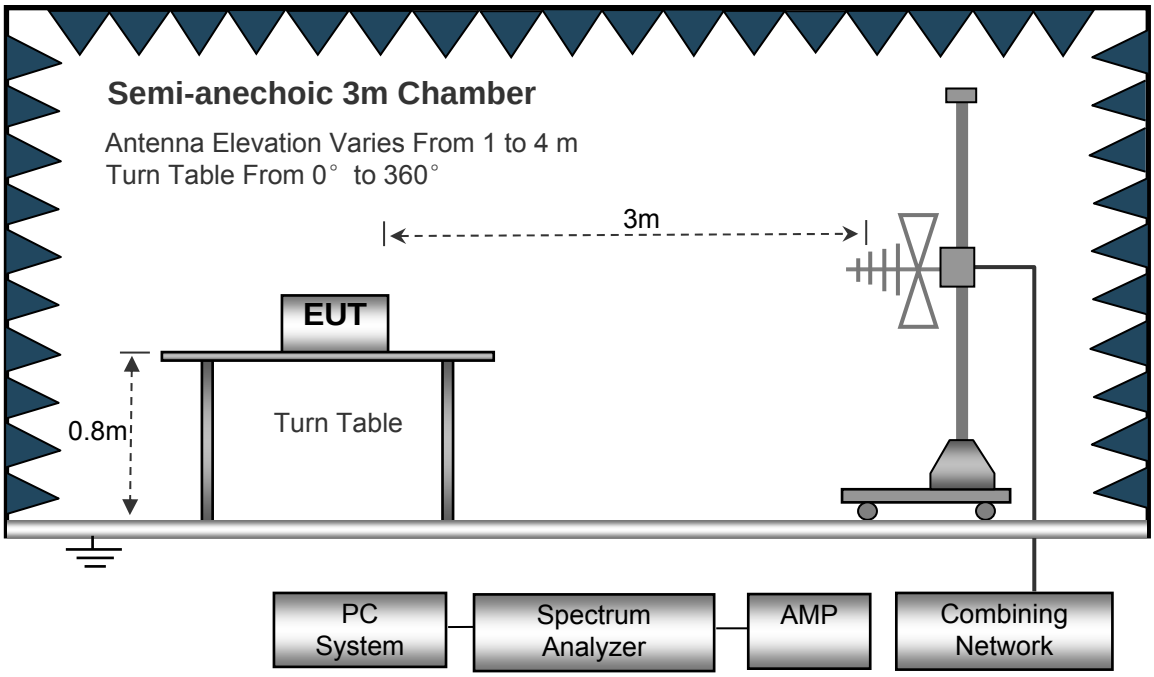
The test was performed in Z-wave transmitting mode (DC 5V by Dock) and Z-wave transmitting mode (DC 3V by battery), all test mode were tested and passed, only shown the worst case mode Z-wave transmitting mode (DC 5V by Dock) in the report.

8.2 Test Setup

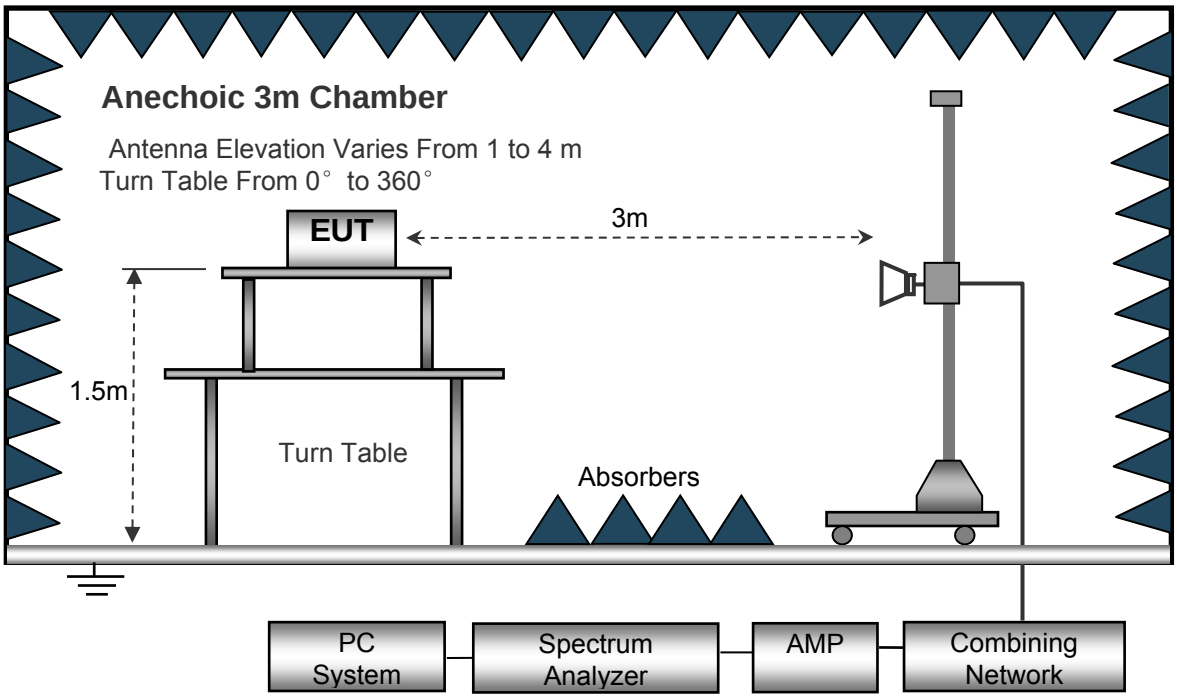
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.
The test setup for emission measurement below 30MHz.



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
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.

8.5 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.

Result: So the Frequency range of radiated form: 9KHz to 10GHz.

8.6 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

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)
153.19	56.72	QP	279	1.1	H	-18.97	37.75	43.50	-5.75
908.42	74.88	PK	33	1.2	H	0.50	75.38	114.00	-38.62
908.42	72.42	PK	24	1.5	V	0.50	72.92	114.00	-41.08
1816.84	73.43	PK	155	1.8	H	-15.00	58.43	74.00	-15.57
1816.84	63.28	PK	134	1.5	V	-15.00	48.28	74.00	-25.72
3760.00	53.57	PK	45	1.1	H	-8.59	44.98	74.00	-29.02
3760.00	49.34	PK	12	1.4	V	-8.59	40.75	74.00	-33.25
5030.00	49.13	PK	46	1.6	H	-0.95	48.18	74.00	-25.82
5030.00	48.72	PK	190	1.2	V	-0.95	47.77	74.00	-26.23

AV = Peak +20Log10(duty cycle) =PK+(-18.86) [refer to section 9 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)
908.42	75.38	H	-18.86	56.52	94.00	-37.48
908.42	72.92	V	-18.86	54.06	94.00	-39.94
1816.84	58.43	H	-18.86	39.57	54.00	-14.43
1816.84	48.28	V	-18.86	29.42	54.00	-24.58
3760.00	44.98	H	-18.86	26.12	54.00	-27.88
3760.00	40.75	V	-18.86	21.89	54.00	-32.11
5030.00	48.18	H	-18.86	29.32	54.00	-24.68
5030.00	47.77	V	-18.86	28.91	54.00	-25.09

9 Periodic Operation

The duty cycle was determined by the following equation:

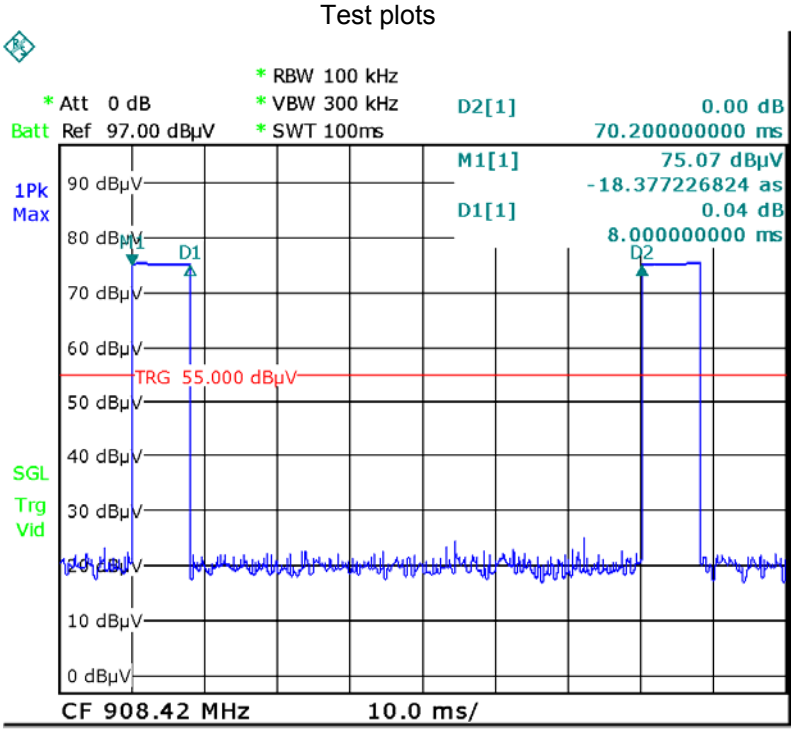
To calculate the actual field intensity,the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

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)

Total transmission time(ms)	8.0
Length of a complete transmission period(ms)	70.20
Duty Cycle(%)	11.40
Duty Cycle Correction Factor(dB)	-18.86

Test plots



10 Band Edge

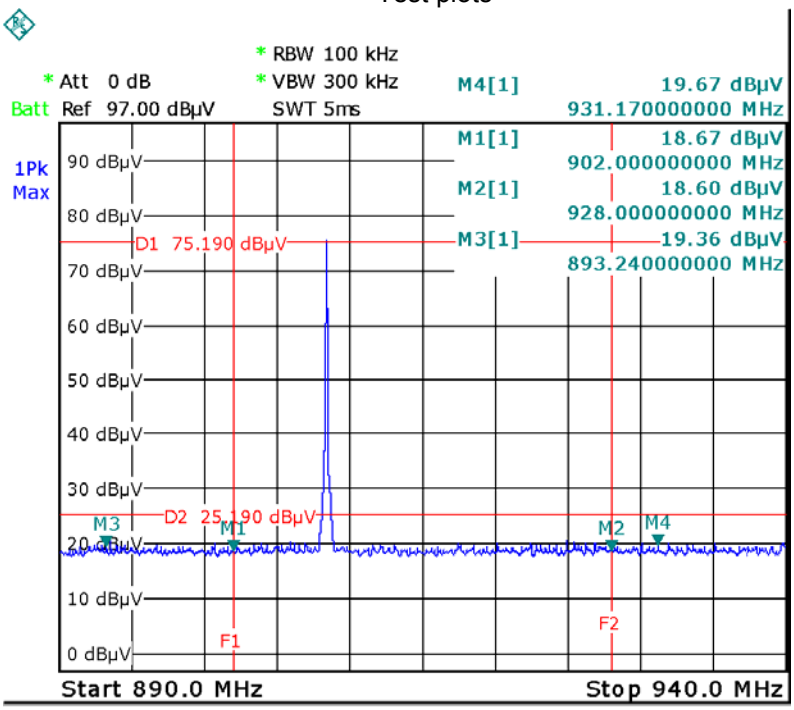
Test Requirement:	15.249(d):Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.10:2013
Test Mode:	Transmitting

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 = 100kHz, VBW = 300kHz, Sweep = auto
   Detector function = peak, Trace = max hold

10.2 Test Result

Test plots



11 20 dB Bandwidth Measurement

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

Test Method: ANSI C63.10:2013

Test Mode: Transmitting

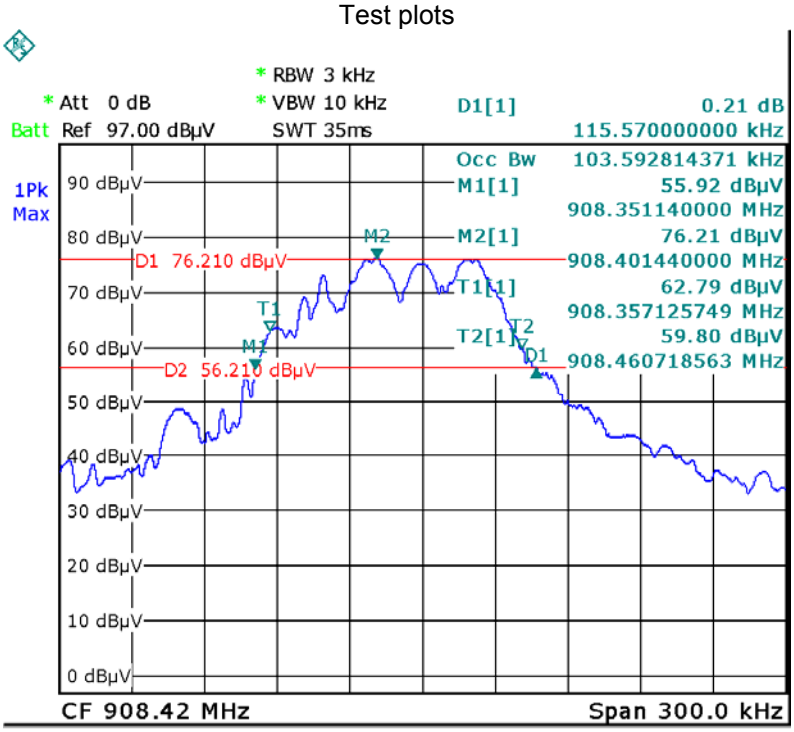
11.1 Test Procedure

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 analyser: RBW = 3 kHz, VBW = 10 kHz

11.2 Test Result

Frequency (MHz)	20dB Bandwidth Emission (kHz)
908.42	115.57

Test plots



12 RF Exposure

Note: Please refer to RF Exposure test report: WTS17S0271118-4E.

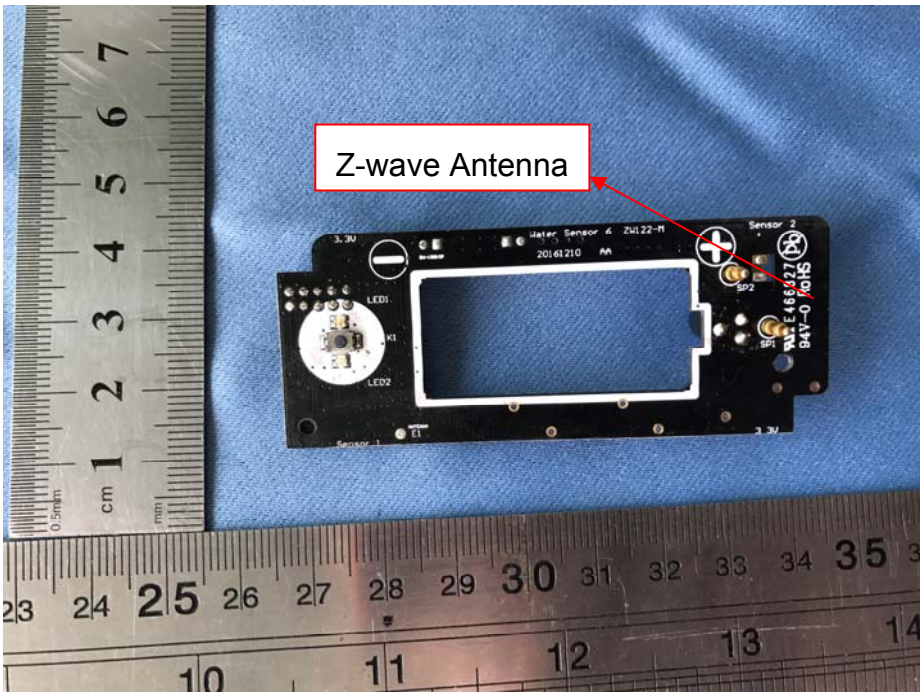
13 Antenna Requirement

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 Antenna for Z-wave, the gain is -3dBi. meets the requirements of FCC 15.203.

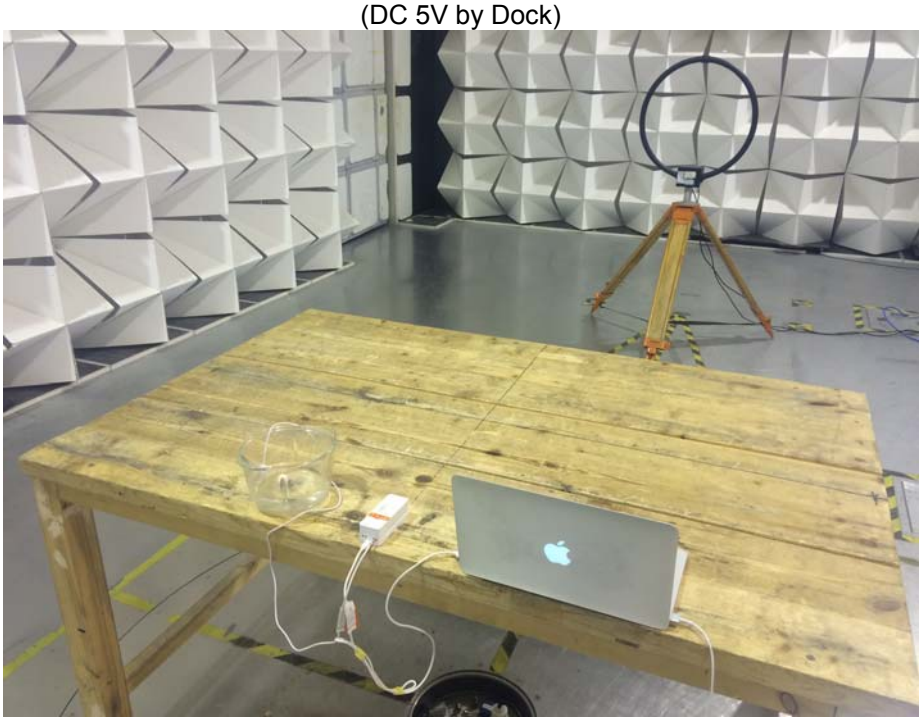


14 Photographs- Model ZW122-A Test Setup Photos

14.1 Photograph – Radiation Emission

Test frequency from 9 KHz to 30 MHz at test site 2#

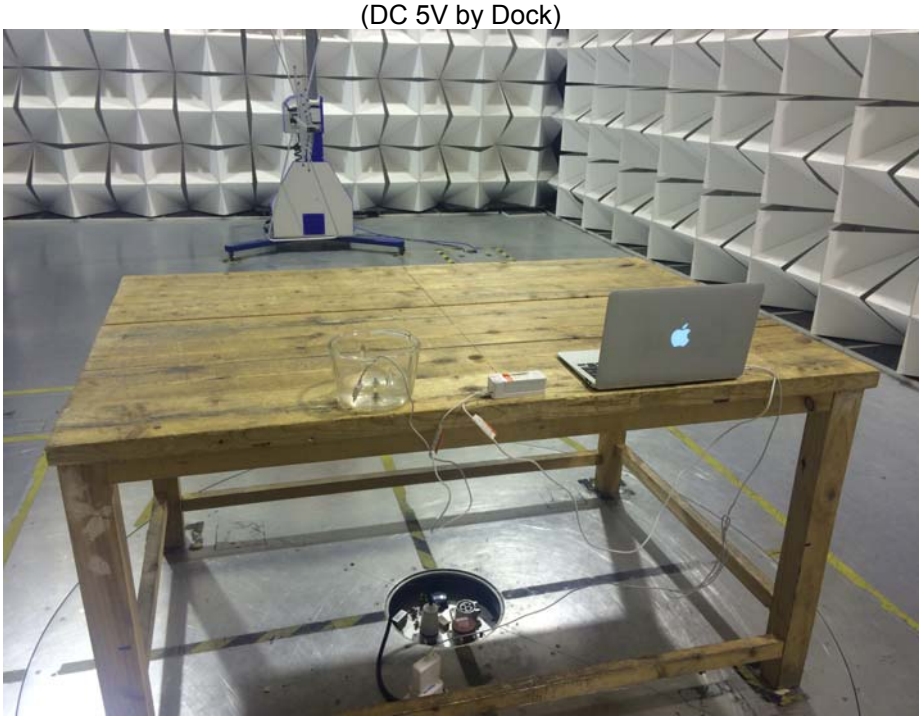
(DC 5V by Dock)



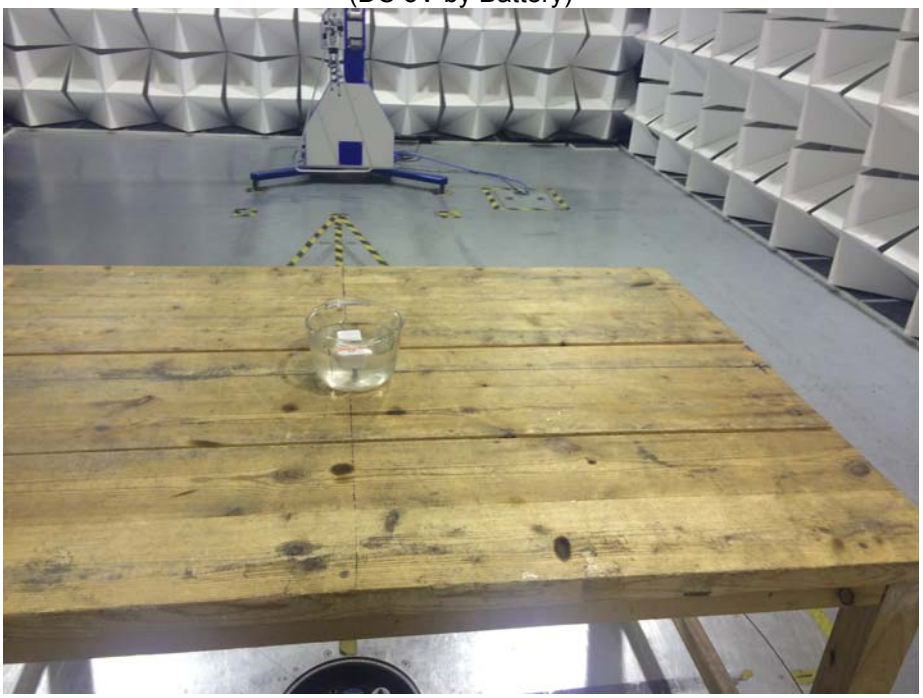
(DC 3V by Battery)

Test frequency from 30 MHz to 1 GHz at test site 2#

(DC 5V by Dock)



(DC 3V by Battery)



Test frequency from 1GHz to 10 GHz at test site 1#

(DC 5V by Dock)

(DC 3V by Battery)

14.2 Photograph – Conducted Emission Test Setup at Test Site 1#

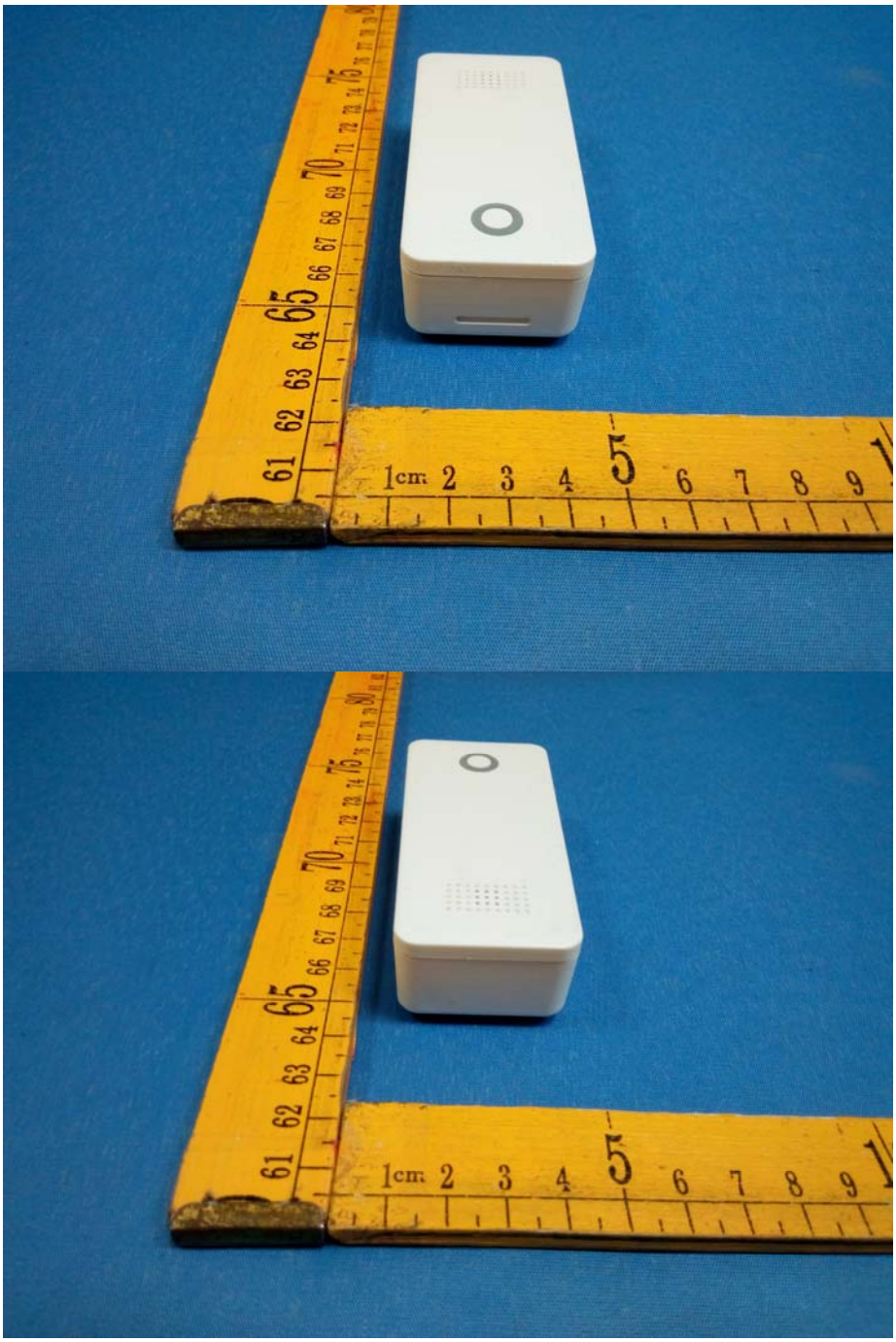
(DC 5V by Dock)

15 Photographs - Constructional Details

15.1 Model ZW122-A - External Photos

combination

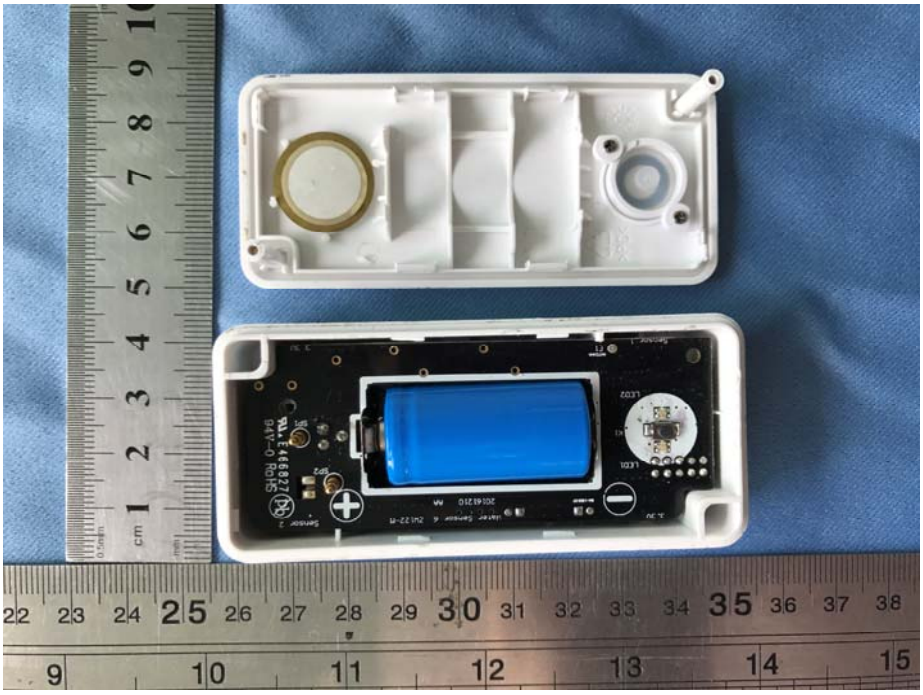
For model ZW122-A

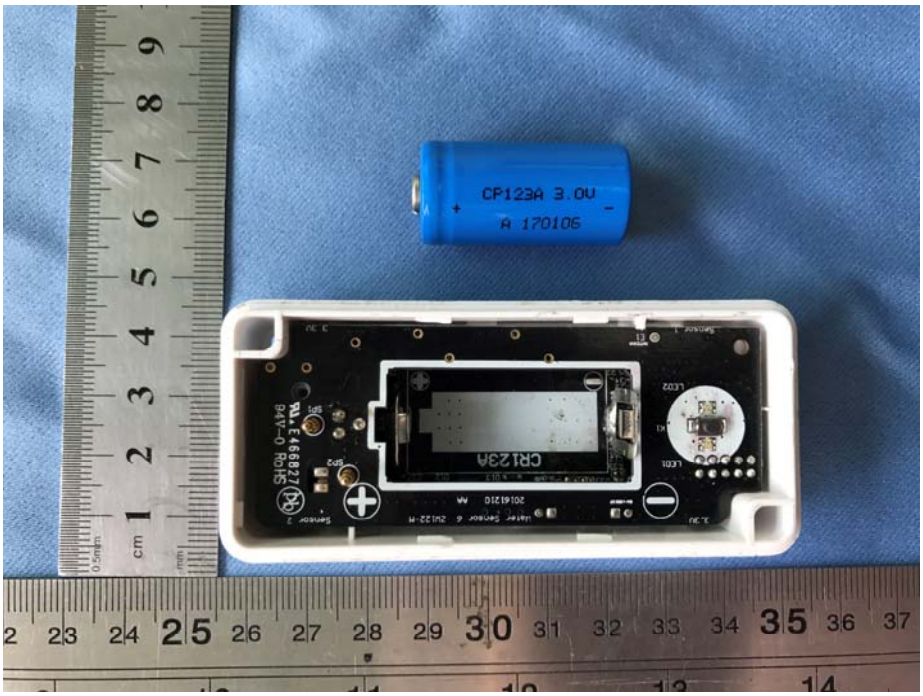


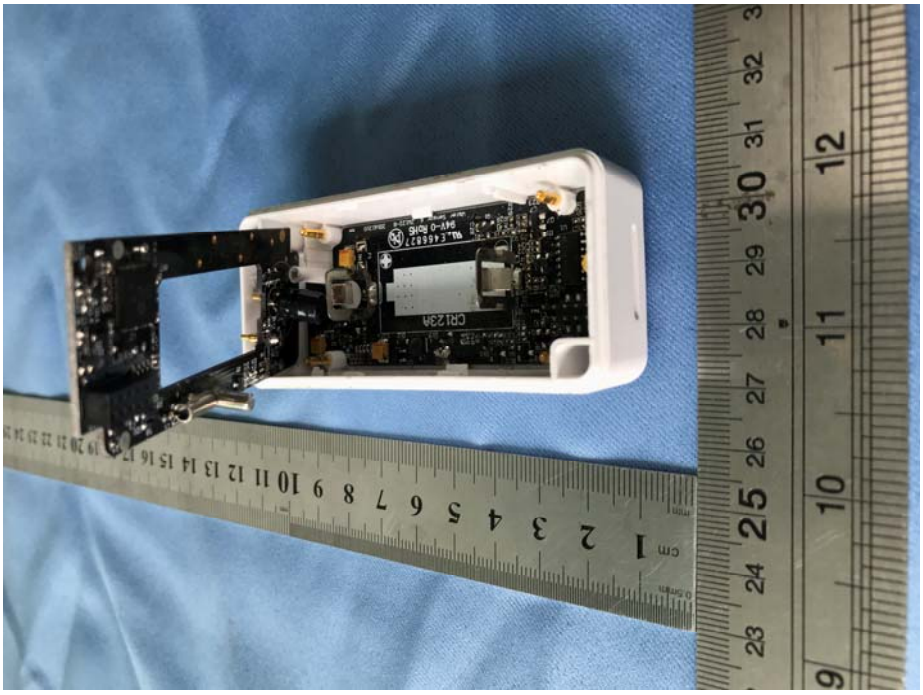

1cm 2 3 4 5 6 7 8 9 10
61 62 63 64 65 66 67 68 69 70 71 72 73

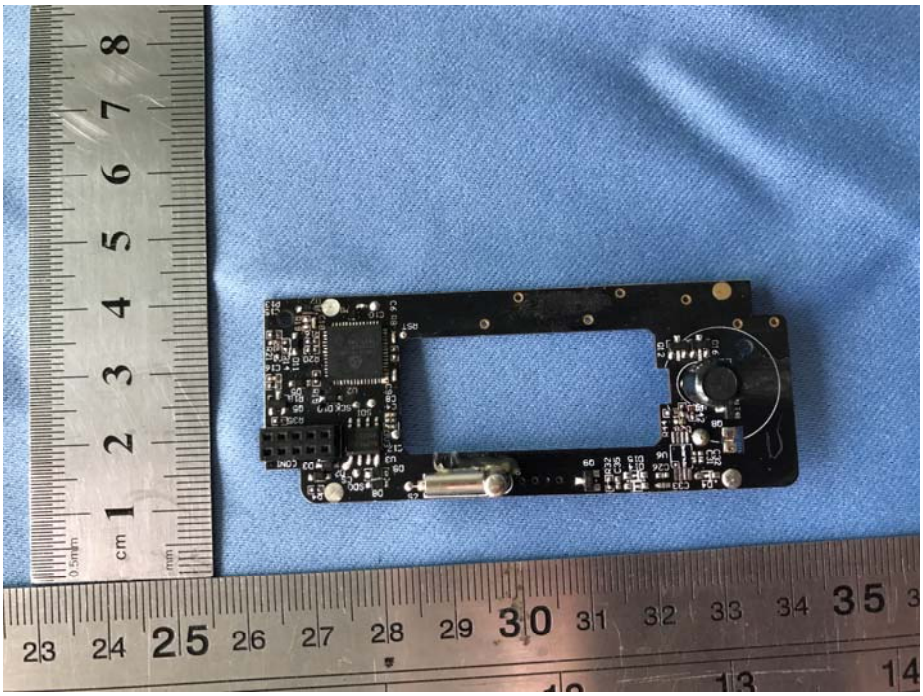
15.2 Model ZW122-A - Internal Photos

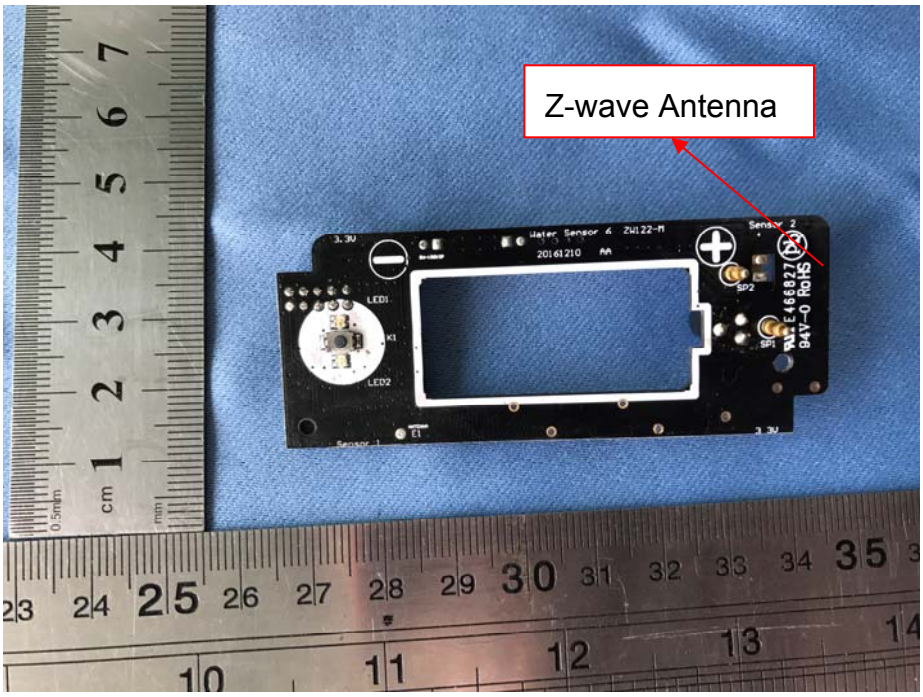
For model ZW122-A

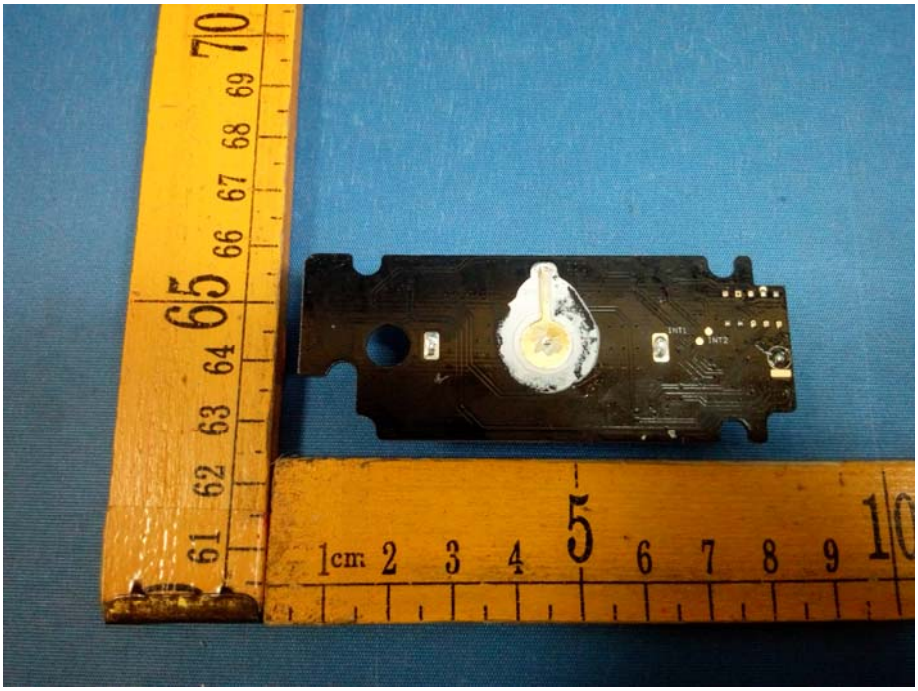


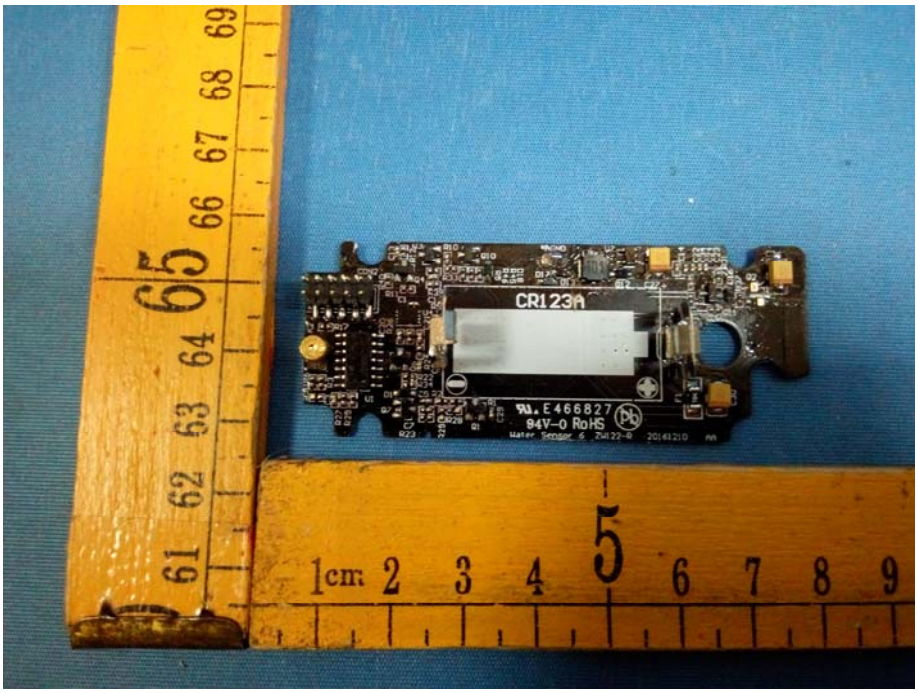


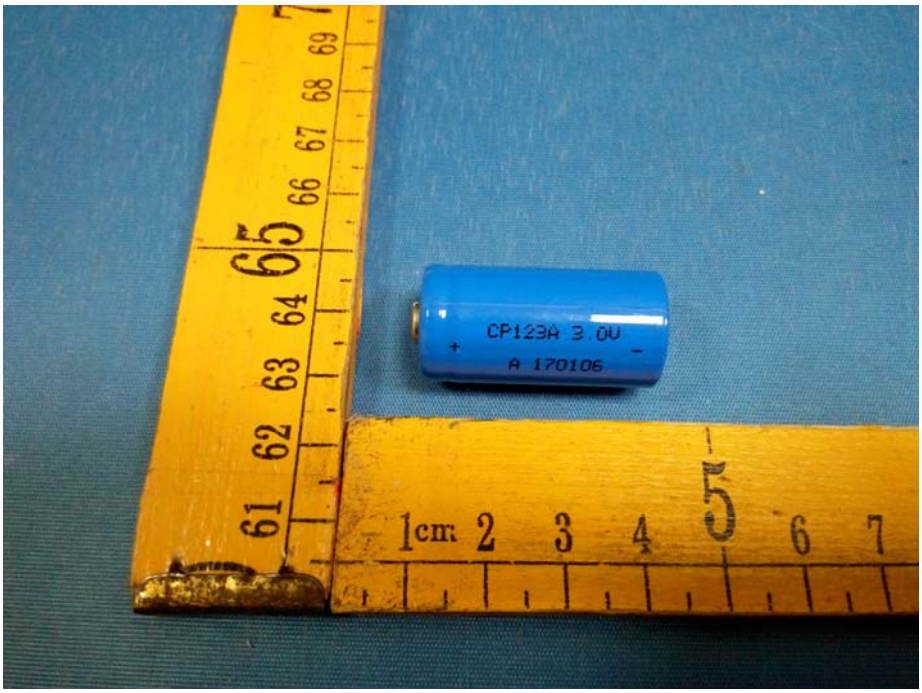





Z-wave Antenna




CR123A
E466827
94V-0 RoHS



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