

FCC Test Report

Report No.: AGC03767200303FE03

FCC ID : Z52NAS-WS02Z1U
APPLICATION PURPOSE : Original Equipment
PRODUCT DESIGNATION : Z-Wave water sensor
BRAND NAME : NEO
MODEL NAME : NAS-WS02Z1U
APPLICANT : SHENZHEN NEO ELECTRONICS CO., LTD
DATE OF ISSUE : Apr. 10, 2020
STANDARD(S) : FCC Part 15 Rules
TEST PROCEDURE(S)
REPORT VERSION : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

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Attestation of Global Compliance

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REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Apr. 10, 2020	Valid	Initial Release



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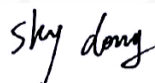
1. VERIFICATION OF CONFORMITY

Applicant	SHENZHEN NEO ELECTRONICS CO., LTD
Address	East 6/F, Building 2LaoBing Industry, No.44 TieZai Road, Baoan District, Shenzhen.
Manufacturer	SHENZHEN NEO ELECTRONICS CO., LTD
Address	East 6/F, Building 2LaoBing Industry, No.44 TieZai Road, Baoan District, Shenzhen.
Factory	SHENZHEN NEO ELECTRONICS CO., LTD
Address	East 6/F, Building 2LaoBing Industry, No.44 TieZai Road, Baoan District, Shenzhen.
Product Designation	Z-Wave water sensor
Brand Name	NEO
Test Model	NAS-WS02Z1U
Date of test	Mar. 27, 2020 to Apr. 10, 2020
Deviation	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.249.

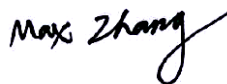
Prepared By



Sky Dong
Project Engineer

Apr. 10, 2020

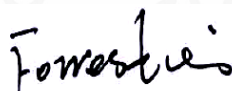
Reviewed By



Max Zhang
Reviewer

Apr. 10, 2020

Approved By



Forrest Lei
Authorized Officer

Apr. 10, 2020

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

A major technical description of EUT is described as following

Operation Frequency	908.4MHz, 916MHz
Maximum field strength	73.90dBuV/m(Peak)@3m
Modulation	FSK, GFSK
Number of channels	2
Antenna Gain	2.0dBi
Antenna Designation	PCB Antenna (Met 15.203 Antenna requirement)
Hardware Version	NAS-WS02Z1UEH V3 20200115
Software Version	01 2A
Power Supply	DC 3V by battery



3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

- Uncertainty of Conducted Emission, $U_c = \pm 3.1$ dB
- Uncertainty of Radiated Emission below 1GHz, $U_c = \pm 4.0$ dB
- Uncertainty of Radiated Emission above 1GHz, $U_c = \pm 4.8$ dB
- Uncertainty of Occupied Channel Bandwidth: $U_c = \pm 2$ %



4. DESCRIPTION OF TEST MODES

NO.	TEST MODE DESCRIPTION
1	TX: 908.4MHz
2	TX: 916MHz



5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM



5.2. EQUIPMENT USED IN TESTED SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	Z-Wave water sensor	NAS-WS02Z1U	Z52NAS-WS02Z1U	EUT

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.249&15.209	Radiated Emission	Compliant
§15.215	20dB bandwidth	Compliant
§15.207	Conducted Emission	N/A

Note: The EUT is only powered by battery.

6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	Jun. 12, 2019	Jun. 11, 2020
EXA Signal Analyzer	Aglient	N9010A	MY53470504	Dec. 12, 2019	Dec. 11, 2020
Attenuator	ZHINAN	E-002	N/A	Sep. 09, 2019	Sep. 08, 2020
Active loop antenna (9K-30MHz)	ZHINAN	ZN30900C	18051	Jun. 14, 2018	Jun. 13, 2020
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May. 26, 2018	May. 25, 2020
Broadband Preamplifier	ETS LINDGREN	3117PA	00225134	Oct. 15, 2019	Oct. 16, 2020
ANTENNA	SCHWARZBECK	VULB9168	494	Jan. 09, 2019	Jan. 08, 2021
Test software	FARA	EZ-EMC (Ver RA-03A)	N/A	N/A	N/A



7. RADIATED EMISSION

7.1. TEST LIMIT

Standard FCC15.249

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
900-928MHz	50	500
2400-2483.5MHz	50	500
5725-5875MHz	50	500
24.0-24.25GHz	250	2500

Standard FCC 15.209

Frequency (MHz)	Distance Meters	Field Strengths Limit	
		μ V/m	dB(μ V)/m
0.009 ~ 0.490	300	2400/F(kHz)	---
0.490 ~ 1.705	30	24000/F(kHz)	---
1.705 ~ 30	30	30	---
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	Other:74.0 dB(μ V)/m (Peak) 54.0 dB(μ V)/m (Average)	

Remark: (1) Emission level dB μ V = 20 log Emission level μ V/m
(2) The smaller limit shall apply at the cross point between two frequency bands.
(3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.

7.2. MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use minimum resolution bandwidth of 1 MHz. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 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 values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

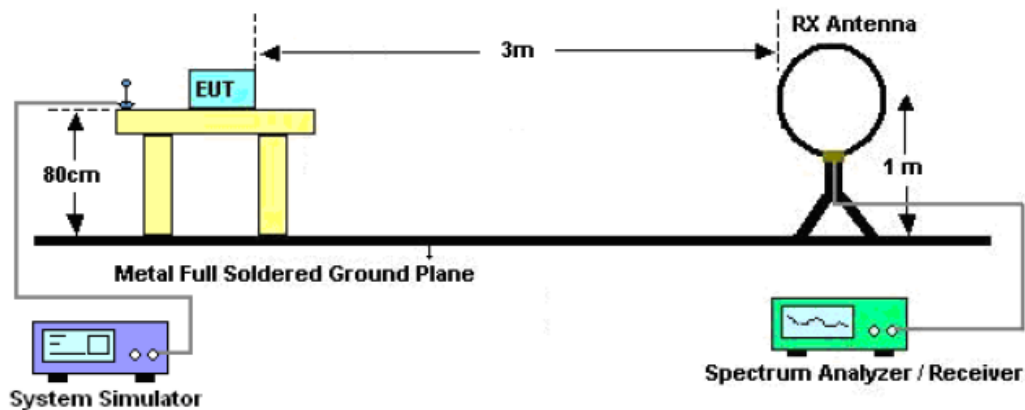
Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~10GHz 1.5MHz/ VBW 8MHz for Peak, 1.5MHz/10Hz for Average

Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

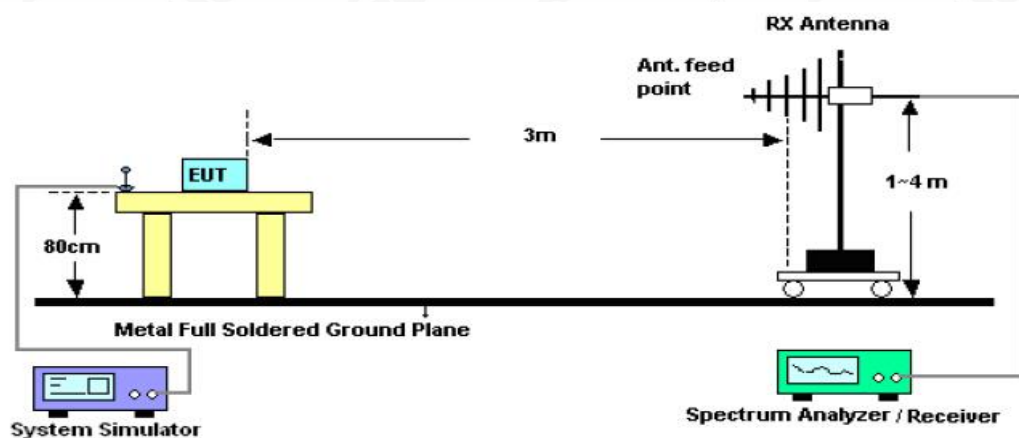


7.3. TEST SETUP

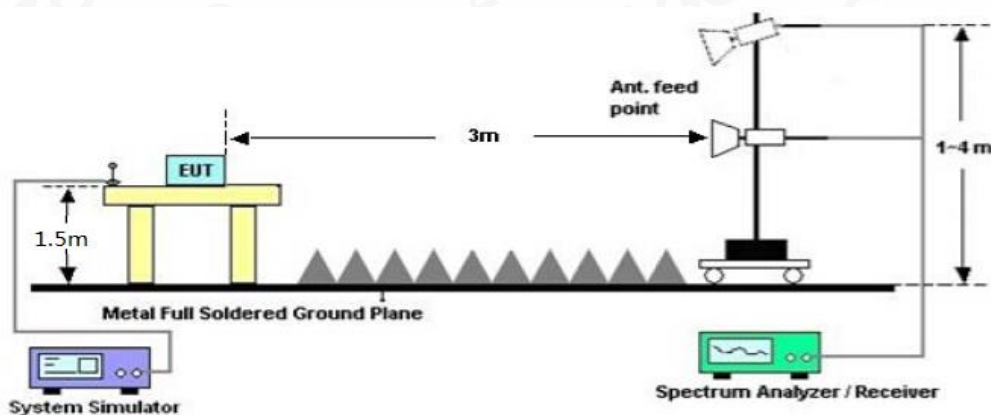
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



7.4. TEST RESULT

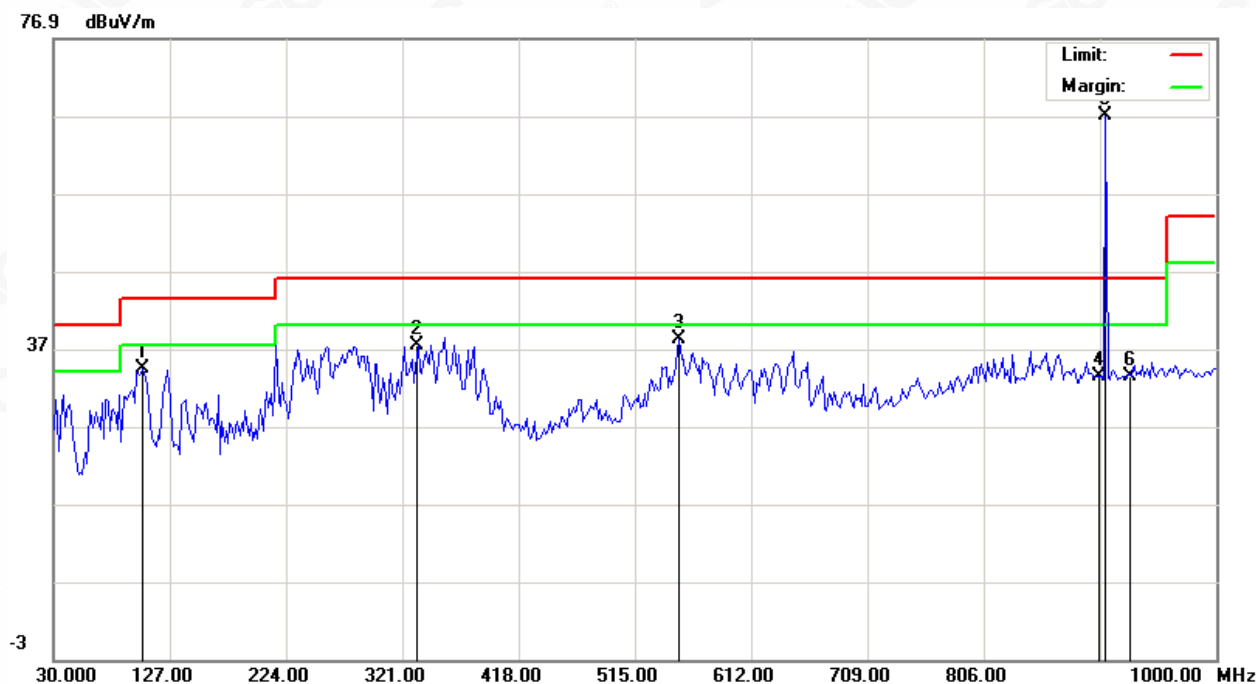
908.4MHz

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

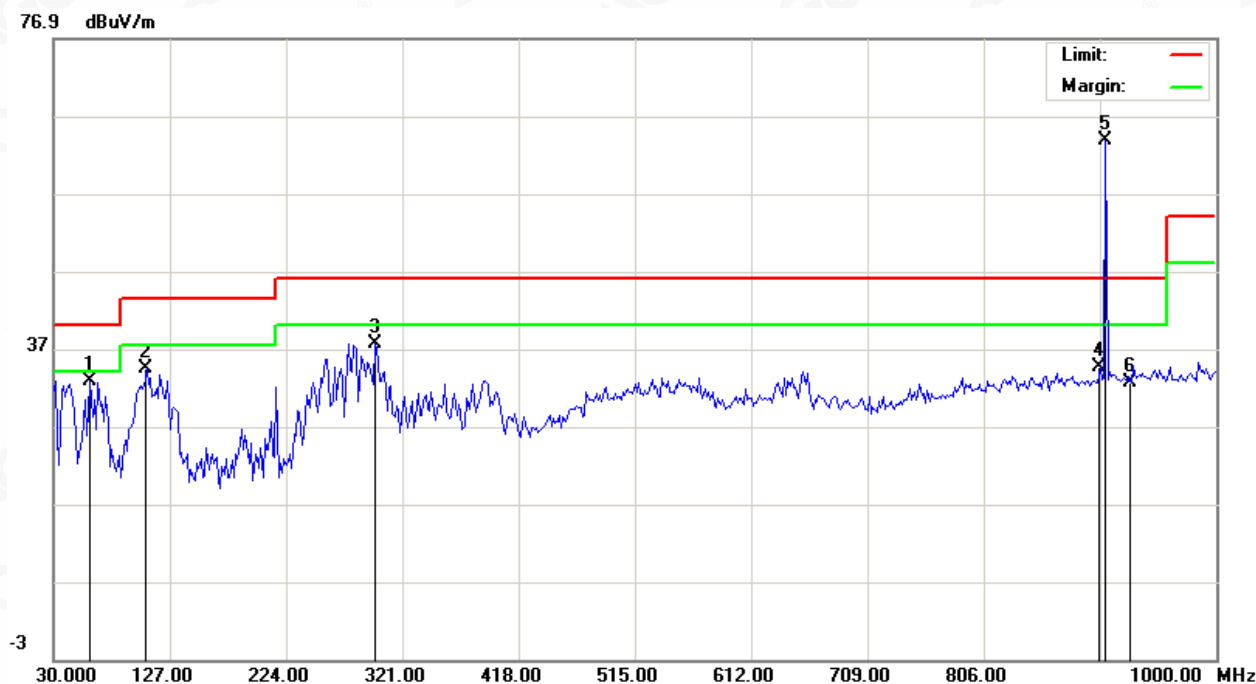
RADIATED EMISSION 30MHz- 1GHZ

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3V
Test Mode	Mode 1	Polarization	Horizontal



No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		104.3666	17.88	16.44	34.32	43.50	-9.18	peak			
2		333.9332	16.80	20.66	37.46	46.00	-8.54	peak			
3		552.1833	12.26	26.01	38.27	46.00	-7.73	peak			
4		902.0000	1.64	31.72	33.36	46.00	-12.64	peak			
5	*	908.4000	35.20	31.77	66.97	46.00	20.97	peak			
6		928.0000	1.39	31.94	33.33	46.00	-12.67	peak			

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3V
Test Mode	Mode 1	Polarization	Vertical



No.	Mk	Freq. MHz	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		60.7167	14.15	18.74	32.89	40.00	-7.11	peak			
2		107.5999	17.65	16.75	34.40	43.50	-9.10	peak			
3		298.3666	18.15	19.51	37.66	46.00	-8.34	peak			
4		902.0000	2.80	31.72	34.52	46.00	-11.48	peak			
5	*	908.4000	31.99	31.77	63.76	46.00	17.76	peak			
6		928.0000	0.74	31.94	32.68	46.00	-13.32	peak			

RESULT: PASS

Note: Factor=Antenna Factor + Cable loss, Margin=Result-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

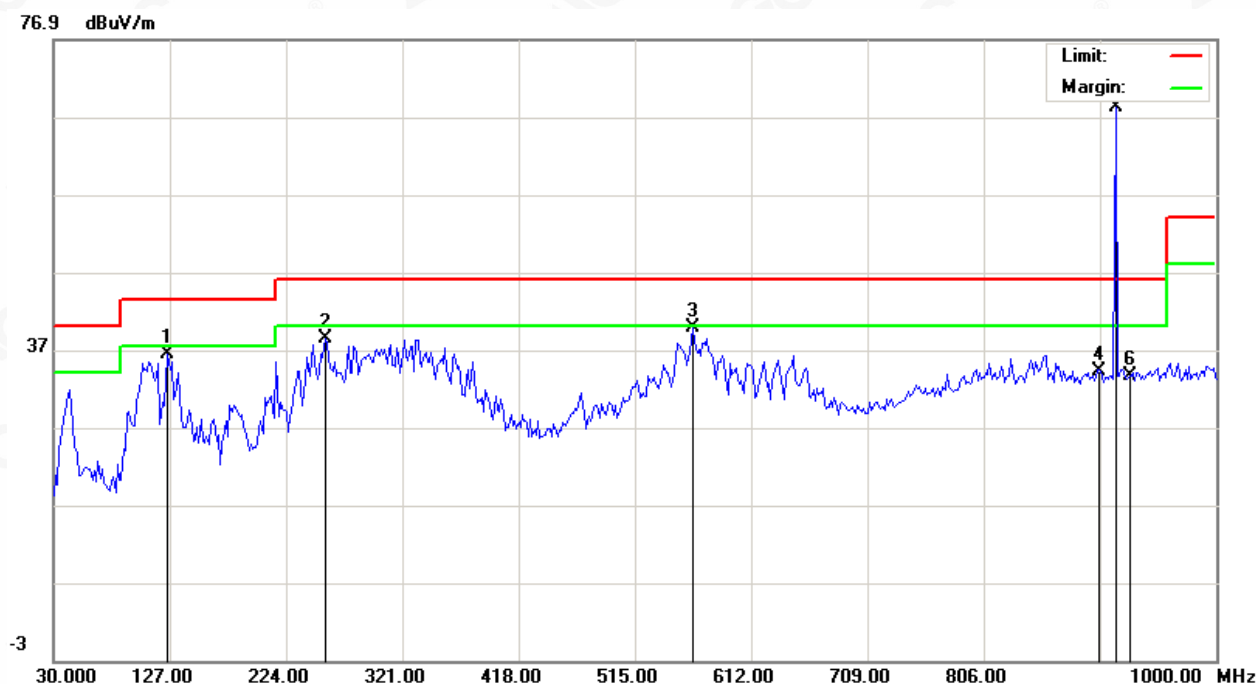
916MHz

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION 30MHZ- 1GHZ

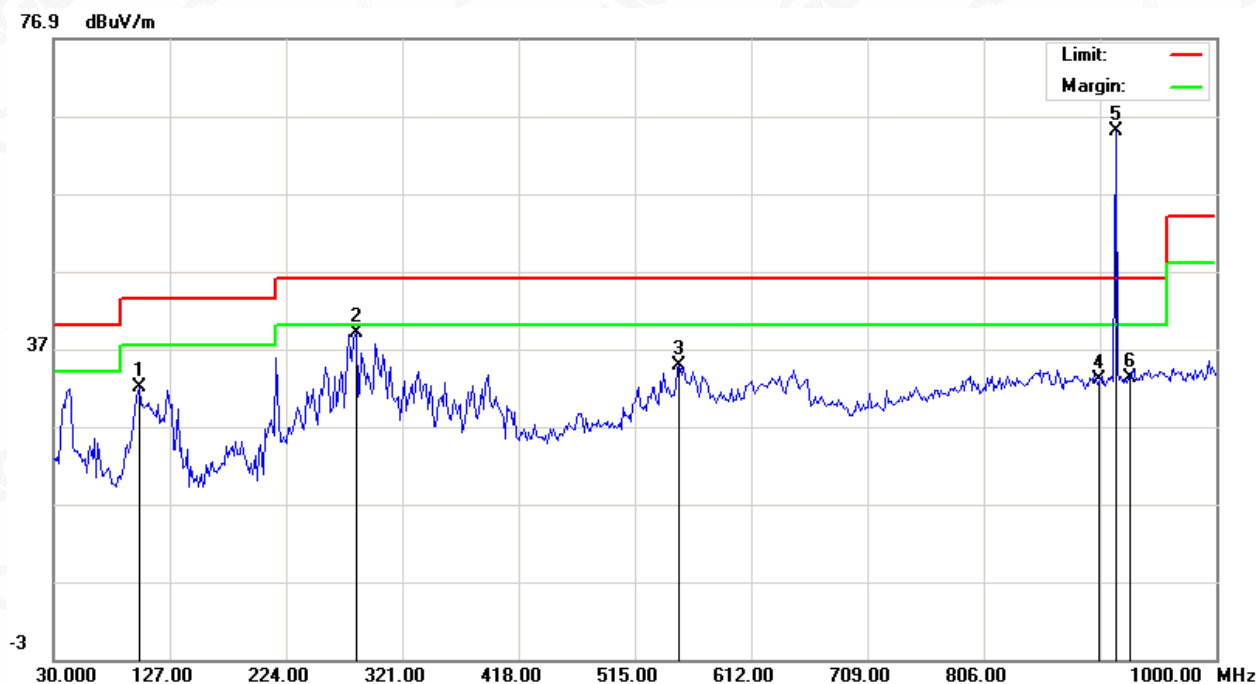
EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3V
Test Mode	Mode 2	Polarization	Horizontal



No.	Mk	Freq. MHz	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		125.3833	18.18	18.31	36.49	43.50	-7.01	peak			
2		256.3333	19.96	18.37	38.33	46.00	-7.67	peak			
3		563.5000	13.57	26.23	39.80	46.00	-6.20	peak			
4		902.0000	2.41	31.72	34.13	46.00	-11.87	peak			
5	*	916.0000	36.29	31.84	68.13	46.00	22.13	peak			
6		928.0000	1.74	31.94	33.68	46.00	-12.32	peak			



EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3V
Test Mode	Mode 2	Polarization	Vertical



No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		101.1333	15.96	16.12	32.08	43.50	-11.42	peak			
2		282.2000	19.06	19.89	38.95	46.00	-7.05	peak			
3		552.1833	8.78	26.01	34.79	46.00	-11.21	peak			
4		902.0000	1.30	31.72	33.02	46.00	-12.98	peak			
5	*	916.0000	33.18	31.84	65.02	46.00	19.02	peak			
6		928.0000	1.18	31.94	33.12	46.00	-12.88	peak			

RESULT: PASS

Note: Factor=Antenna Factor + Cable loss, Margin=Result-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

908.4MHz

RADIATED EMISSION ABOVE 1GHZ

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3.7V
Test Modulation	Mode 1	Polarization	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
1816.8	73.90	-13.62	60.28	74.00	-13.72	peak
1816.8	52.99	-13.62	39.37	54.00	-14.63	AVG
2725.2	56.36	-9.53	46.83	74.00	-27.17	peak
2725.2	36.86	-9.53	27.33	54.00	-26.67	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3.7V
Test Modulation	Mode 1	Polarization	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
1816.8	68.88	-13.62	55.26	74.00	-18.74	peak
1816.8	49.29	-13.62	35.67	54.00	-18.33	AVG
2725.2	50.61	-9.53	41.08	74.00	-32.92	peak
2725.2	29.65	-9.53	20.12	54.00	-33.88	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note: Factor=Antenna Factor + Cable loss - Amplifier gain, Margin=Measurement-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

Other emissions from 1G to 9.2 GHz are considered as ambient noise. No re

916MHz

RADIATED EMISSION ABOVE 1GHZ

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3.7V
Test Modulation	Mode 2	Polarization	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
1832.00	68.50	-13.62	54.88	74.00	-19.12	peak
1832.00	47.67	-13.62	34.05	54.00	-19.95	AVG
2748.00	50.52	-9.53	40.99	74.00	-33.01	peak
2748.00	31.60	-9.53	22.07	54.00	-31.93	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT	Z-Wave water sensor	Model Name	NAS-WS02Z1U
Temperature	20 °C	Relative Humidity	48%
Pressure	1010 hPa	Test Voltage	DC 3.7V
Test Modulation	Mode 2	Polarization	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
1832.00	68.74	-13.62	55.12	74.00	-18.88	peak
1832.00	49.36	-13.62	35.74	54.00	-18.26	AVG
2748.00	50.75	-9.53	41.22	74.00	-32.78	peak
2748.00	30.51	-9.53	20.98	54.00	-33.02	AVG

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note: Factor=Antenna Factor + Cable loss - Amplifier gain, Margin=Measurement-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

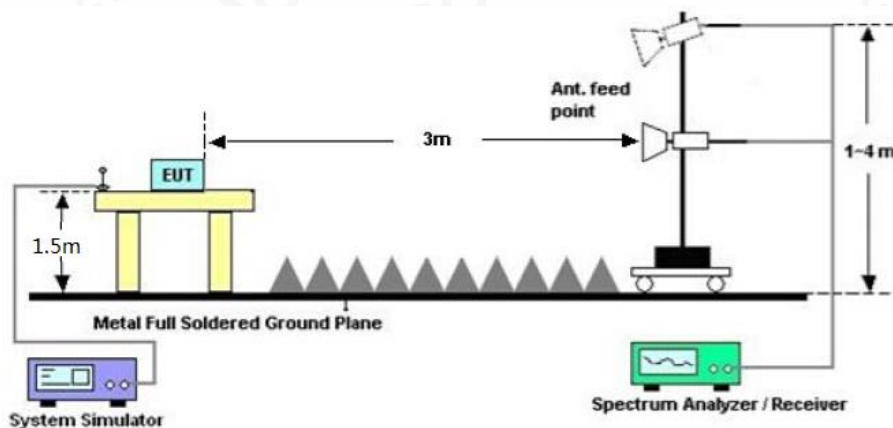
Other emissions from 1G to 9.2 GHz are considered as ambient noise. No recording in the test report.

8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
2. Set SPA Centre Frequency = Operation Frequency, RBW= 1~5% OBW, VBW $\geq 3 \times$ RBW.
3. Set SPA Trace 1 Max hold, then View.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

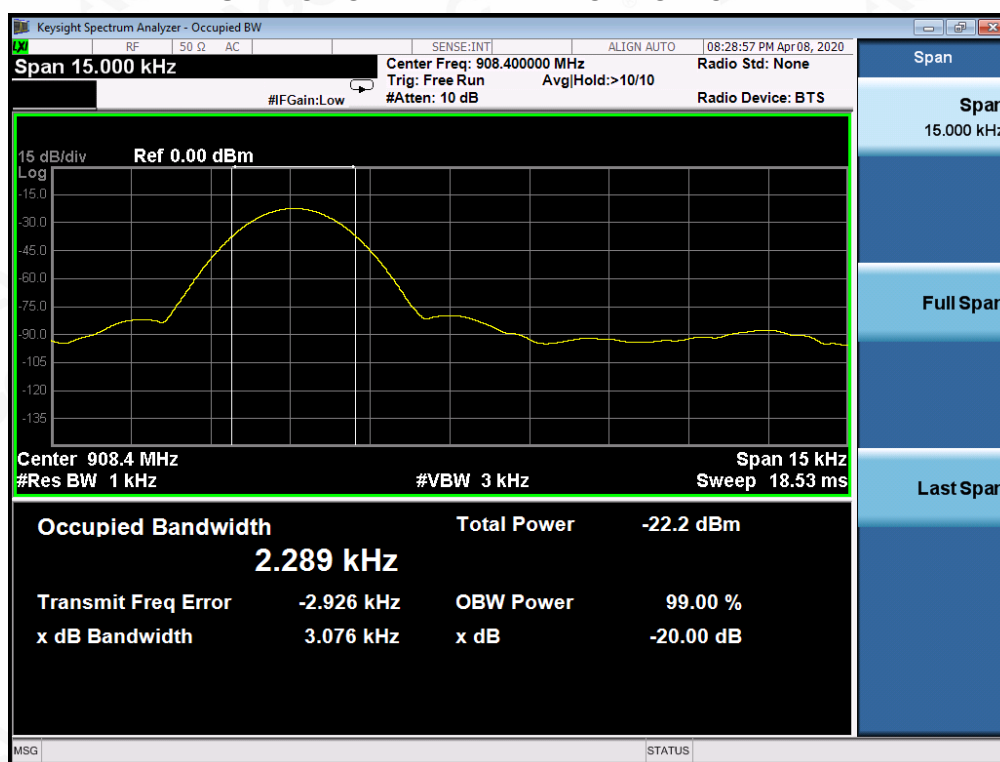


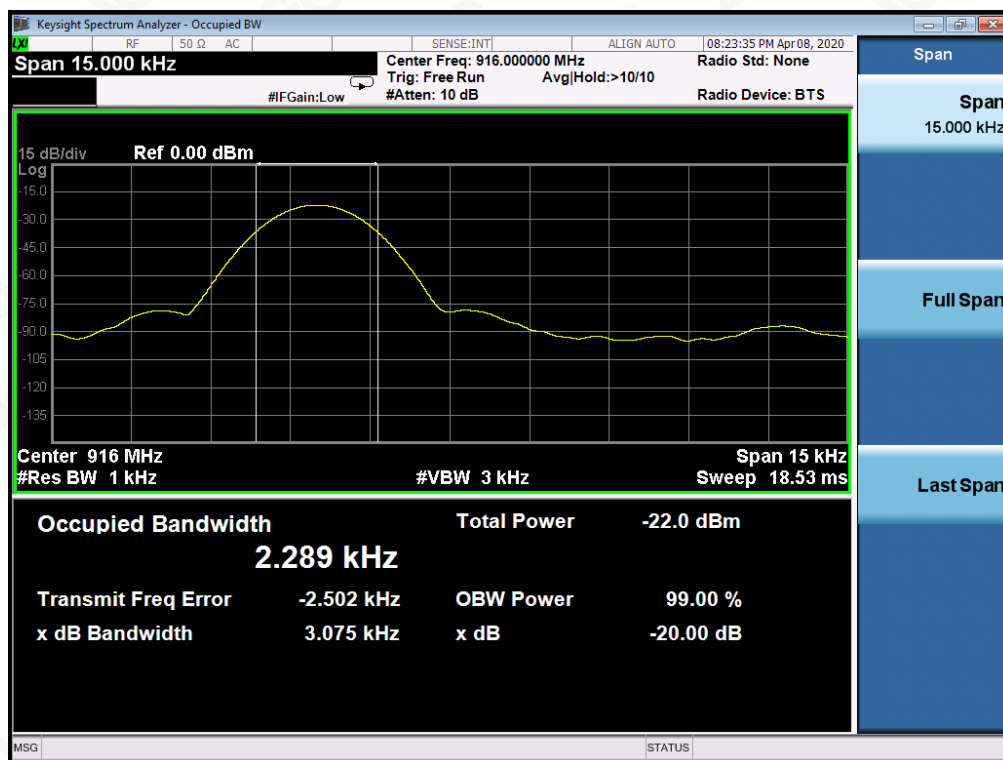
8.3. MEASUREMENT RESULTS

TEST ITEM	20DB BANDWIDTH
TEST MODULATION	GFSK

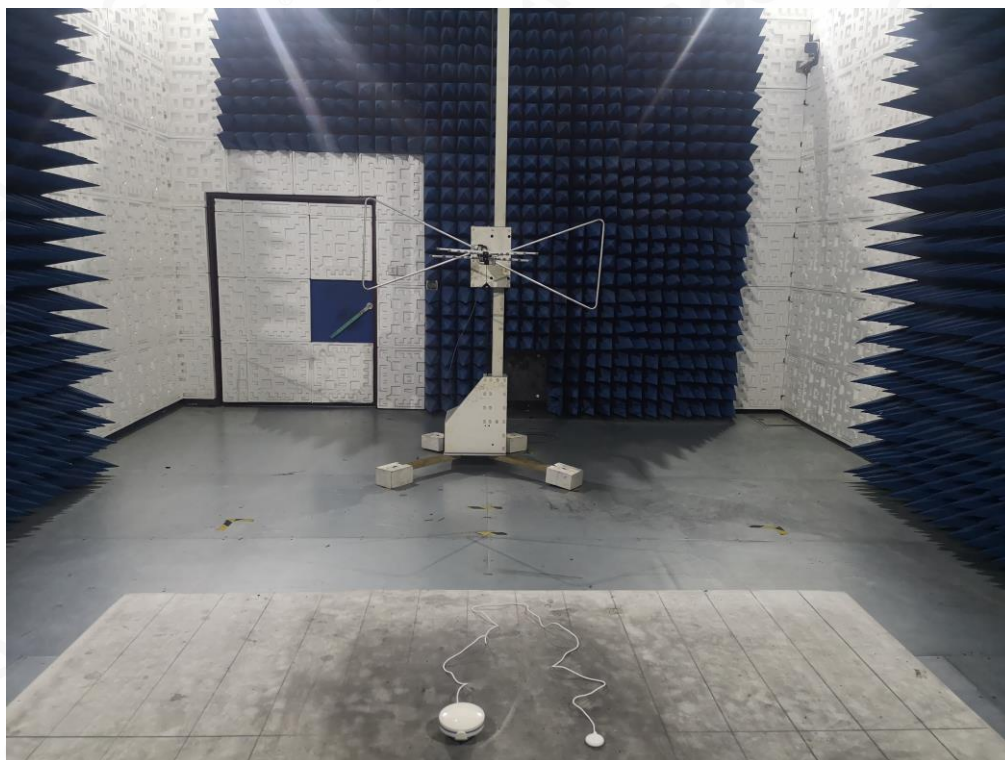
Test Data		Criteria
908.4MHz	3.076KHz	PASS
916MHz	3.075KHz	PASS

TEST PLOT OF BANDWIDTH FOR LOW CHANNEL





APPENDIX A: PHOTOGRAPHS OF TEST SETUP
FCC RADIATED EMISSION TEST SETUP BELOW 1GHZ



FCC RADIATED EMISSION TEST SETUP ABOVE 1GHZ

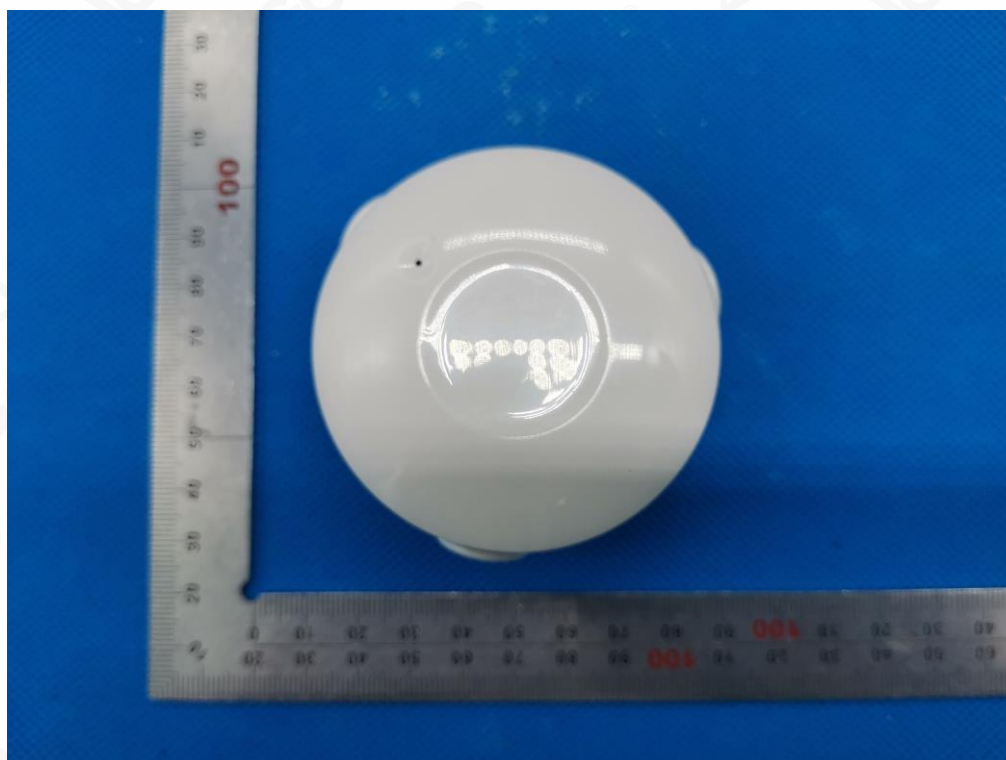


APPENDIX B: PHOTOGRAPHS OF EUT

TOTAL VIEW OF EUT



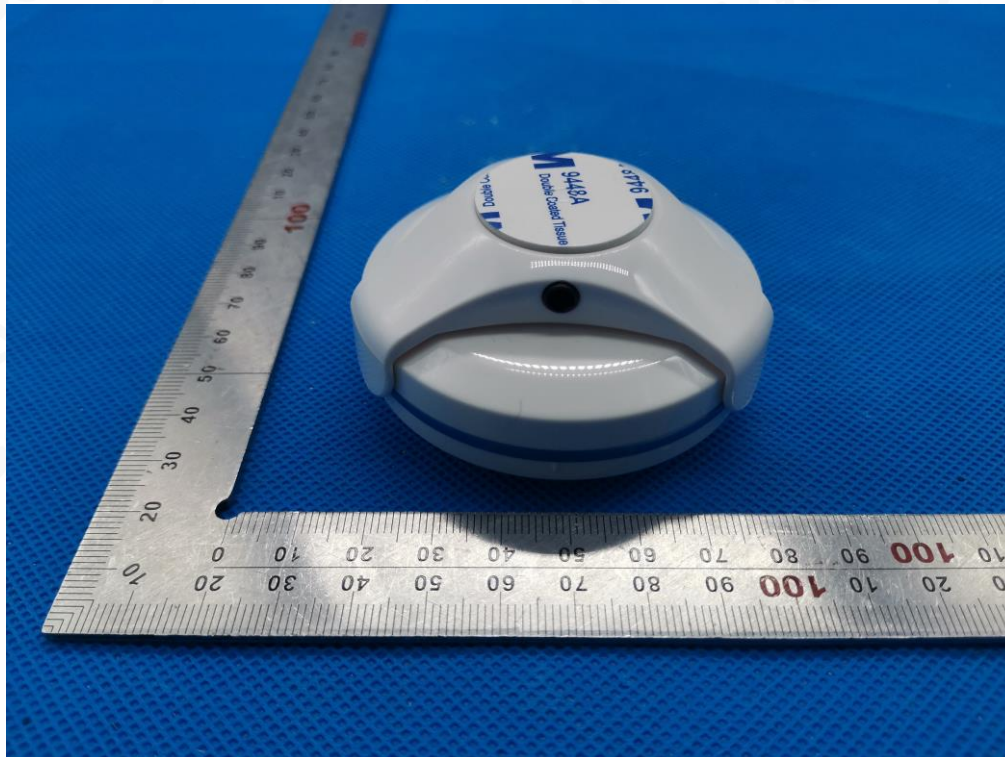
TOP VIEW OF EUT



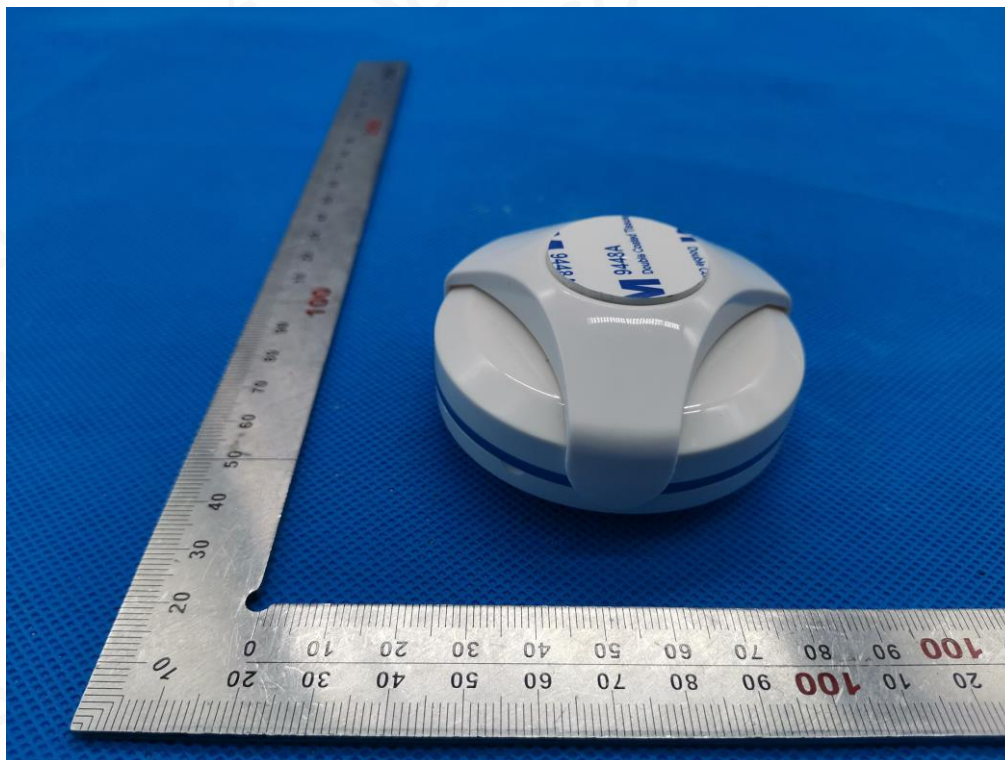
BOTTOM VIEW OF EUT



FRONT VIEW OF EUT



BACK VIEW OF EUT



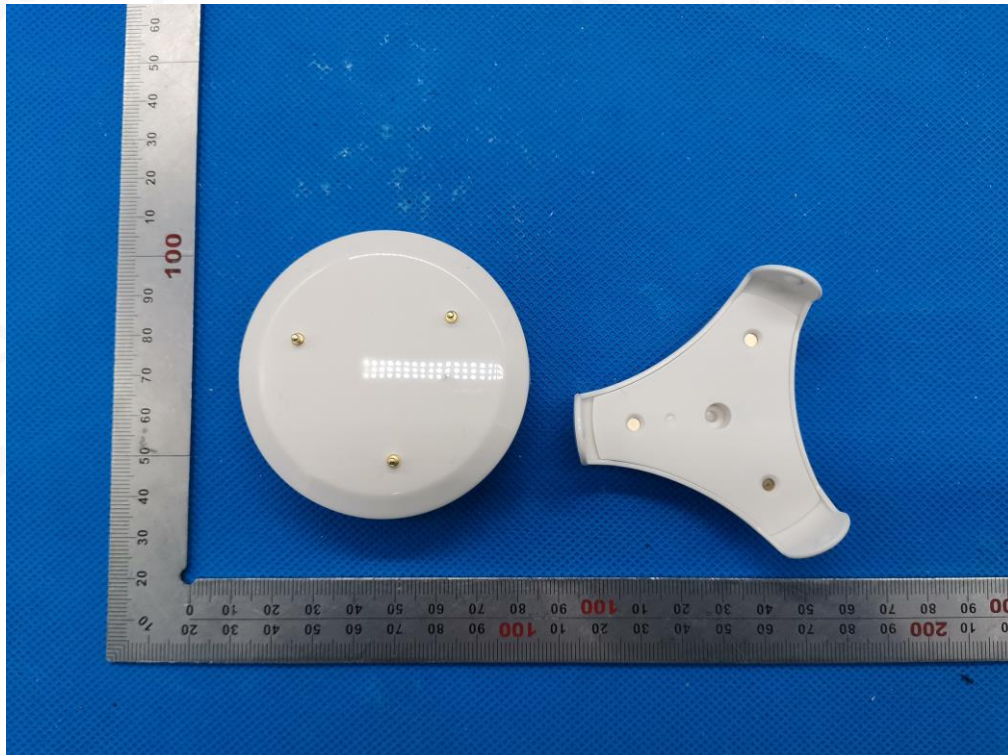
LEFT VIEW OF EUT



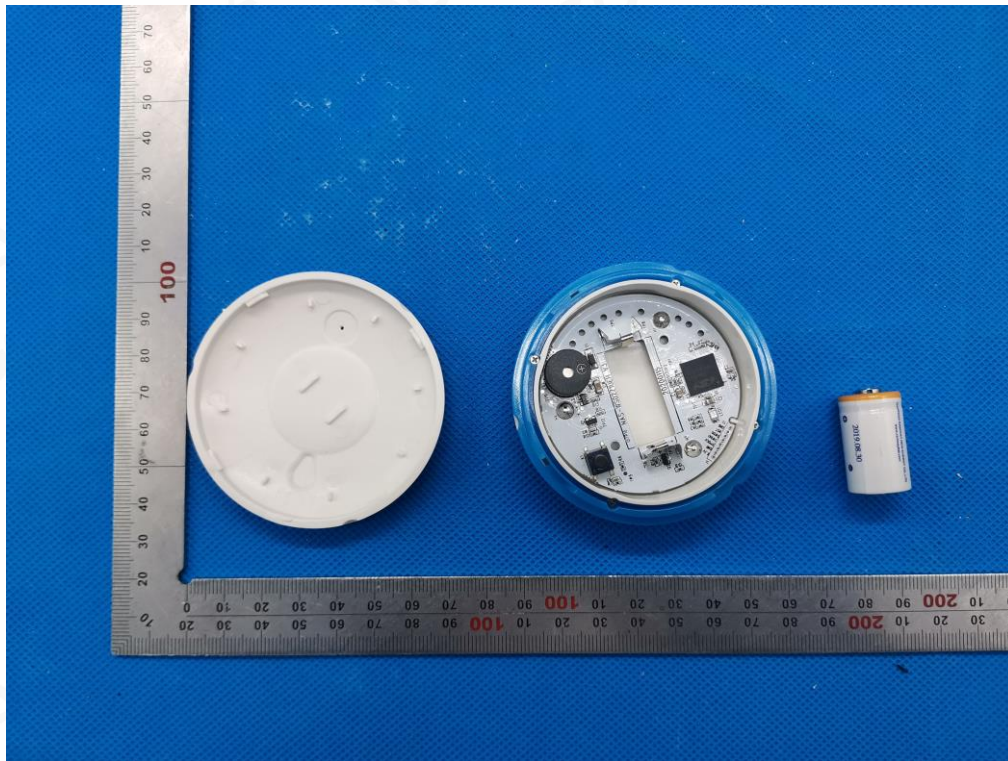
RIGHT VIEW OF EUT



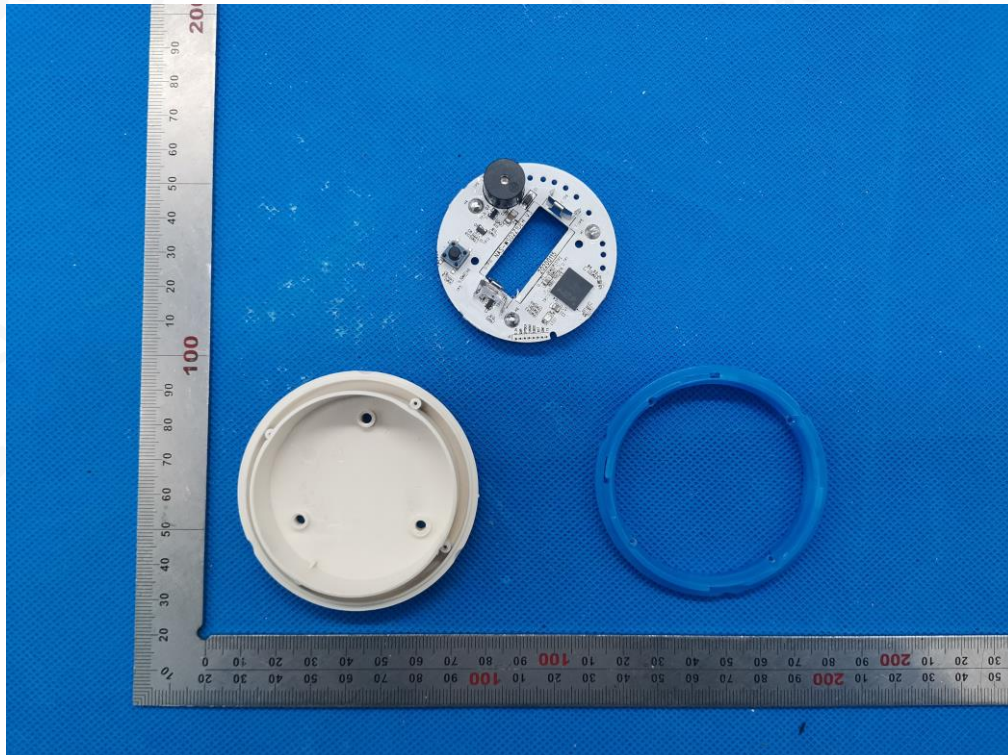
OPEN VIEW OF EUT-1



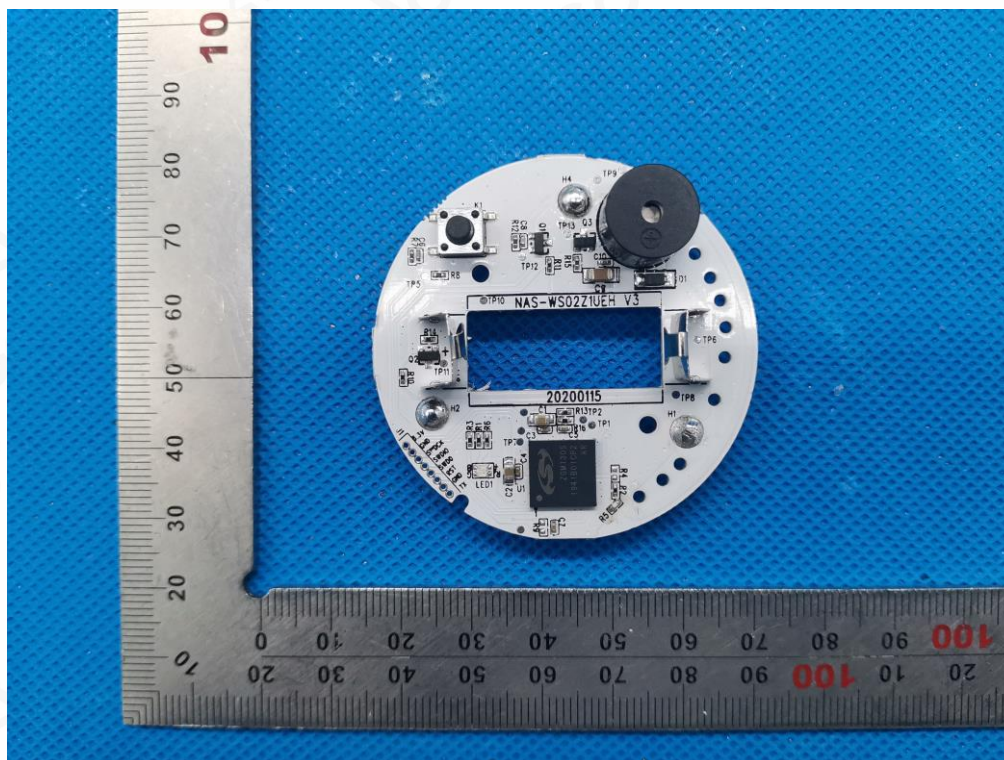
OPEN VIEW OF EUT-2



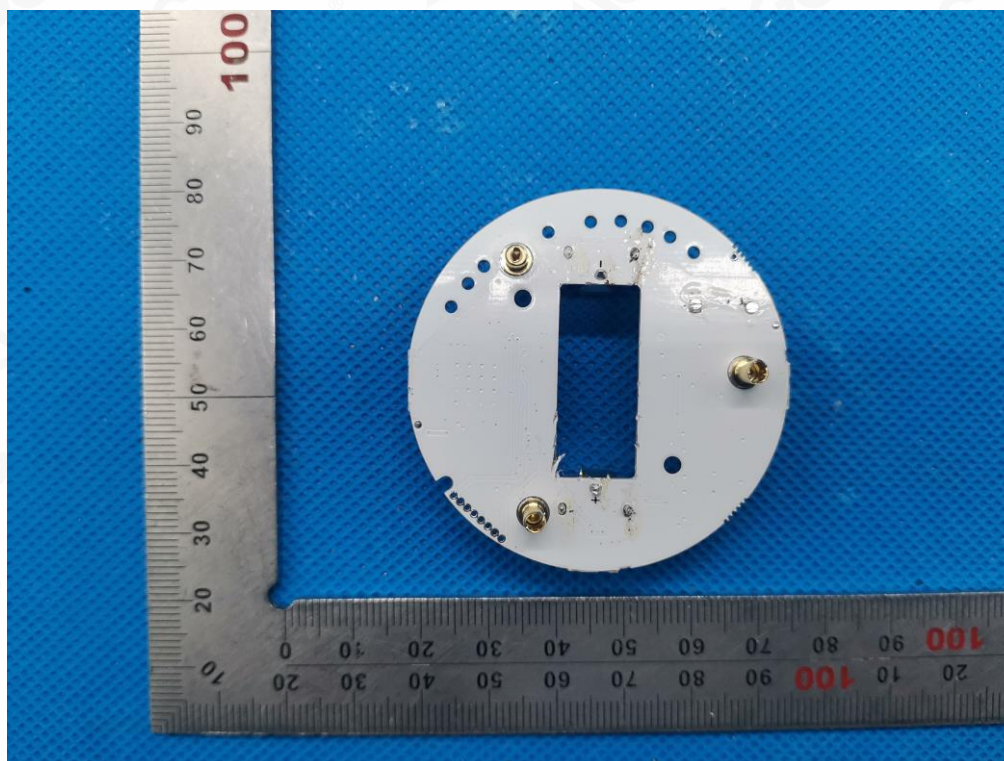
OPEN VIEW OF EUT-3



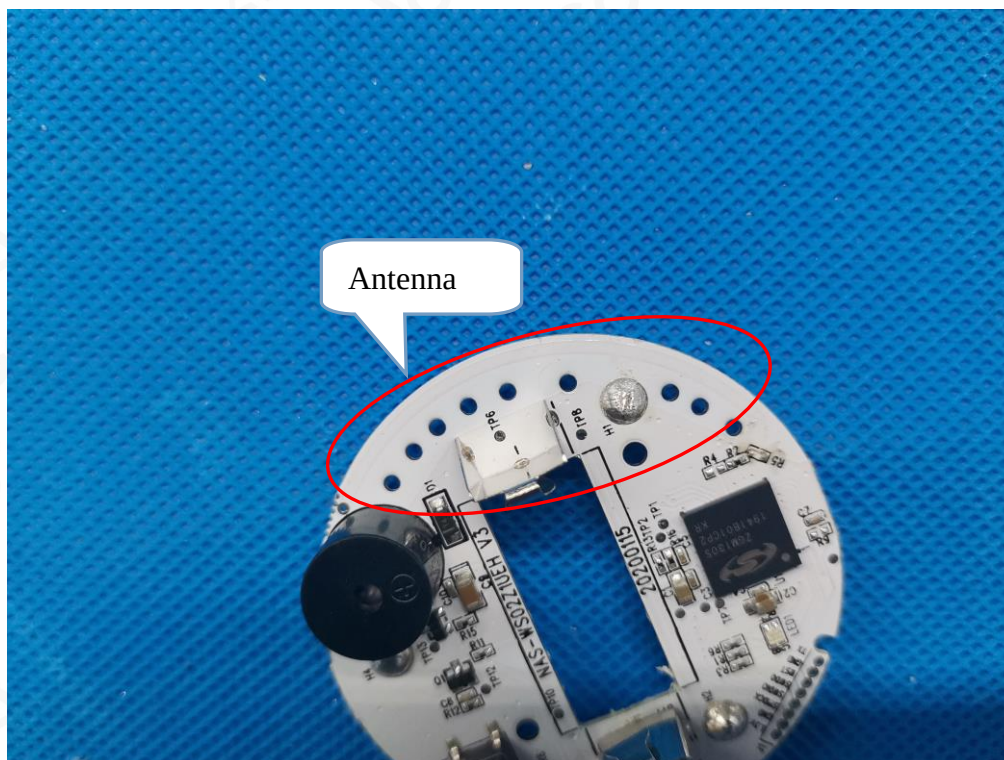
INTERNAL VIEW OF EUT-1



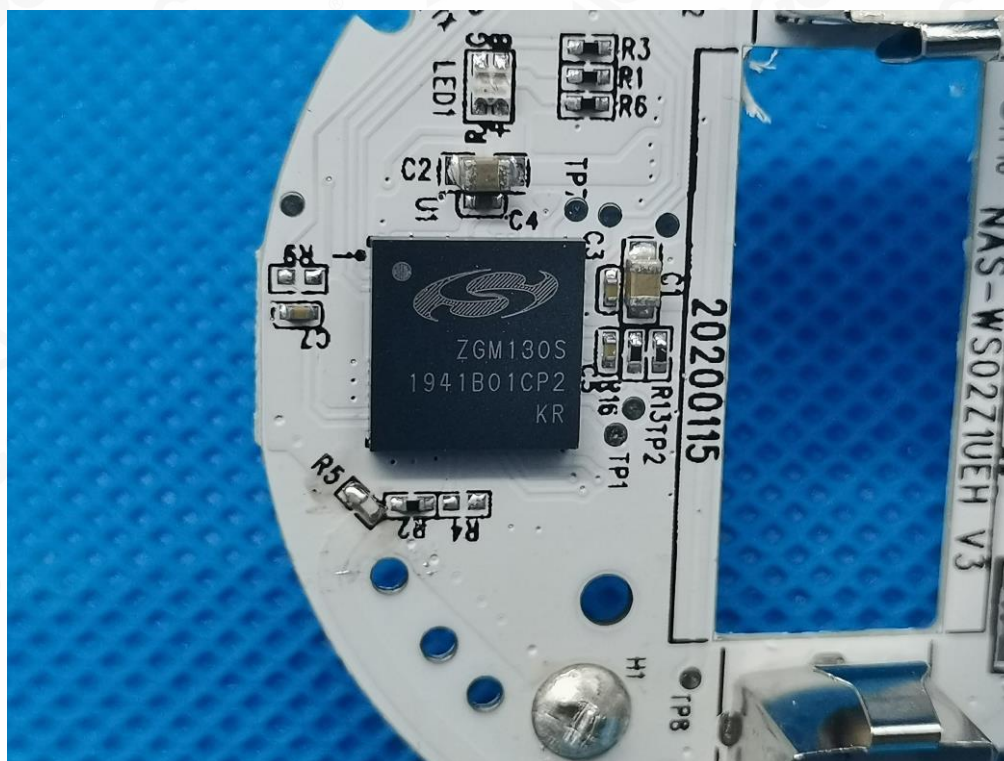
INTERNAL VIEW OF EUT-2



INTERNAL VIEW OF EUT-3



INTERNAL VIEW OF EUT-4



VIEW OF BATTERY



----END OF REPORT----



Attestation of Global Compliance

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