

TEST REPORT

FCC ID: 2ANQU-WT0224

Product: Wireless Swimming Pool Thermometer

Model No.: WT0224

Additional Model: WT0222

Trade Mark: N/A

Report No.: TCT170913E013

Issued Date: Sep. 21, 2017

Issued for:

**Shenzhen TianKan Electronic Technology Co., Ltd
Room 602, Block B, Songgang, Songyu Road, Songgang district, Bao'an,
Shenzhen, China**

Issued By:

**Shenzhen Tongce Testing Lab.
1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District,
Shenzhen, Guangdong, China
TEL: +86-755-27673339
FAX: +86-755-27673332**

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the revision section of the document. The test results in the report only apply to the tested sample.**

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1. Test Certification

Product:	Wireless Swimming Pool Thermometer
Model No.:	WT0224
Additional Model No.:	WT0222
Trade Mark:	N/A
Applicant:	Shenzhen TianKan Electronic Technology Co., Ltd
Address:	Room 602, Block B, Songgang, Songyu Road, Songgang district, Bao'an, Shenzhen, China
Manufacturer:	Shenzhen TianKan Electronic Technology Co., Ltd
Address:	Room 602, Block B, Songgang, Songyu Road, Songgang district, Bao'an, Shenzhen, China
Date of Test:	Sep. 14, 2017 - Sep. 20, 2017
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.231

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By:



Date: Sep. 20, 2017

Garen

Reviewed By:



Date: Sep. 21, 2017

Joe Zhou

Approved By:



Date: Sep. 21, 2017

Tomsin

2. Test Result Summary

Requirement	CFR 47 Section	Result
Conduction Emission, 0.15MHz to 30MHz	§15.207	N/A
Transmission time and silent time	15.23(e)	PASS
Radiation Emission	§15.231(e), §15.205, §15.209, §15.35	PASS
Occupied Bandwidth	§15.231(c)	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

Product:	Wireless Swimming Pool Thermometer
Model No.:	WT0224
Additional Model No.:	WT0222
Trade Mark:	N/A
Operation Frequency:	433.92MHz
Modulation Technology:	FSK
Antenna Type:	Internal Antenna
Antenna Gain:	0dBi
Power Supply:	DC 3V (2AA battery*2)
Remark:	All models above are identical in interior structure, electrical circuits and components, and just model names are different for the marketing requirement.

4. General Information

4.1. Test Environment and Mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Operation mode:	Keep the EUT in continuous transmitting with modulation
<p>The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p>	

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
/	/	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098

Shenzhen Tongce Testing Lab

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

TEL: +86-755-27673339

5.3. Measurement Uncertainty

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

No.	Item	MU
1	Conducted Emission	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^\circ\text{C}$
7	Humidity	$\pm 1.0\%$

6. Test Results and Measurement Data

6.1. Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
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15.203 requirement:

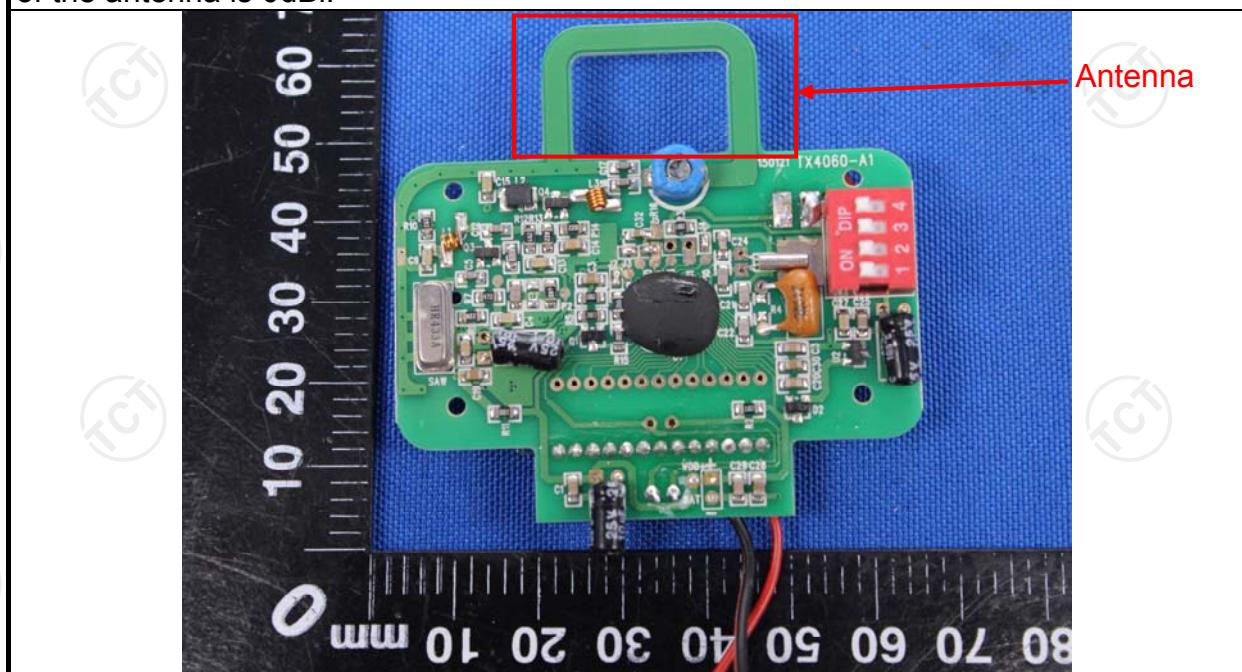
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

E.U.T Antenna:

The antenna is internal antenna which permanently attached, and the best case gain of the antenna is 0dBi.



6.2. Conducted Emission

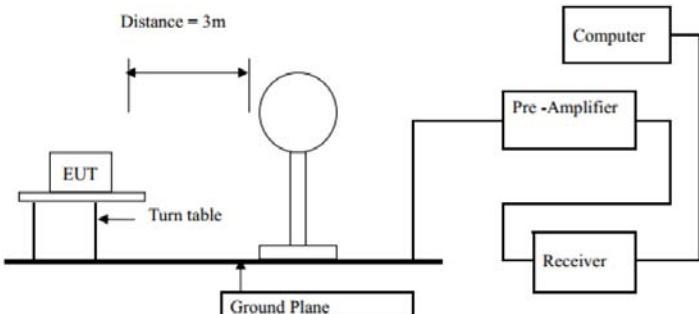
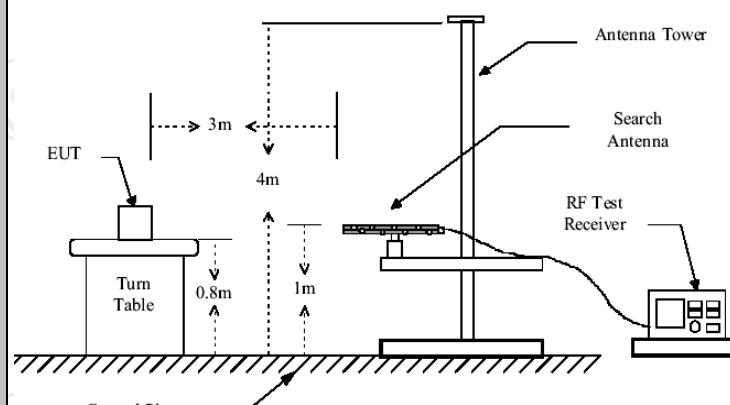
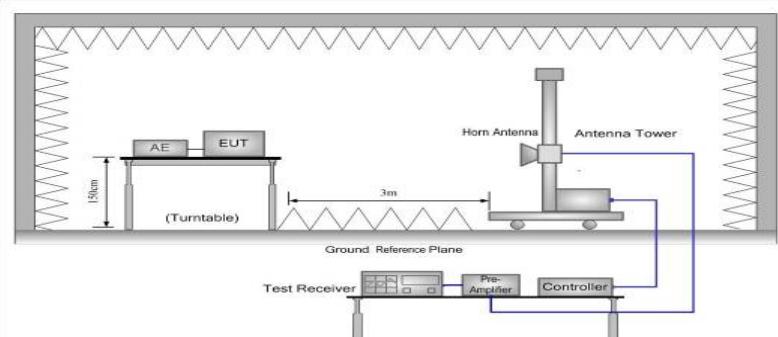
6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207														
Test Method:	ANSI C63.10:2013														
Frequency Range:	150 kHz to 30 MHz														
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>0.15-0.5</td> <td>66 to 56*</td> <td>56 to 46*</td> </tr> <tr> <td>0.5-5</td> <td>56</td> <td>46</td> </tr> <tr> <td>5-30</td> <td>60</td> <td>50</td> </tr> </tbody> </table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	<p>Reference Plane</p> <p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Mode:	Transmitting Mode														
Test Procedure:	<ol style="list-style-type: none"> 1. The E.U.T is connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement. 														
Test Result:	N/A; The EUT powered by battery, so this test item is not applicable														

6.3. Radiated Emission Measurement

6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.231(e) and 15.209				
Test Method:	ANSI C63.10:2013				
Frequency Range:	9 kHz to 5 GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
	<ol style="list-style-type: none"> 1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber in below 1GHz, 1.5m above the ground in above 1GHz. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 				

Test setup:	For radiated emissions below 30MHz	
		
	30MHz to 1GHz	
		
Above 1GHz		
Test Mode:	Transmitting Mode	
Test results:	PASS	

6.3.2. Limit

Fundamental Frequency (MHz)	Filed Strength of Fundamental (microvolts/meter)	Filed Strength of Spurious Emission (microvolts/meter)
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500*	50 to 150*
174-260	1500	150
260-470	1500 to 5000*	150 to 500*
Above 470	5000	500

*Linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

For the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $22.7273(F) - 2454.5455$;
for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $16.6667(F) - 2833.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

For EUT

Fundamental Frequency (MHz)	Filed Strength of Fundamental (microvolts/meter)	Filed Strength of Spurious Emission(dB $\mu\text{V/m}$)
433.92	72.87	52.87

Note:

1. Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions.
2. According to 15.35, on any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test.
3. According to 15.231(b), The limits on the field strength of the spurious emissions in the above table is based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits one higher field strength.

Frequencies in restricted band are complied to limit on Paragraph 15.209

Frequency Range (MHz)	Distance (m)	Field strength (dB μ V/m)
0.009-0.490	3	$20\log 2400/F$ (kHz) + 80
0.490-1.705	3	$20\log 24000/F$ (kHz) + 40
1.705-30	3	$20\log 30 + 40$
30-88	3	40.0
88-216	3	43.5
216-960	3	46.0
Above 960	3	54.0

Note:

1. RF Voltage (dB μ V) = $20 \log$ RF Voltage (μ V)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT
4. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand). After pre-test. It was found that the worse radiated emission was get at the lying position.
5. If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula $Ld1 = Ld2 * (d2/d1)$

6.3.3. Test Instruments

Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Test Receiver	ROHDE&SCHW ARZ	ESVD	100008	Oct. 13, 2017
Spectrum Analyzer	ROHDE&SCHW ARZ	FSQ	200061	Oct. 13, 2017
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Oct. 13, 2017
Pre-amplifier	HP	8447D	2727A05017	Oct. 13, 2017
Loop antenna	ZHINAN	ZN30900A	12024	Oct. 13, 2017
Broadband Antenna	Schwarzbeck	VULB9163	340	Oct. 13, 2017
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Oct. 13, 2017
Horn Antenna	Schwarzbeck	BBH 9170	582	Jun. 07, 2018
Antenna Mast	Keleto	CC-A-4M	N/A	N/A
Coax cable (9KHz-1GHz)	TCT	RE-low-01	N/A	Oct. 13, 2017
Coax cable (9KHz-40GHz)	TCT	RE-high-02	N/A	Oct. 13, 2017
Coax cable (9KHz-1GHz)	TCT	RE-low-03	N/A	Oct. 13, 2017
Coax cable (9KHz-40GHz)	TCT	RE-high-04	N/A	Oct. 13, 2017
EMI Test Software	Shurples Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.3.4. Test Data

Duty Cycle Test Data:

Total time (ms)	100 (ms)	Duty Cycle	AV Factor(dB)
68.596	100	0.68596	-3.27

Note: Duty Cycle= Duty cycle = $T_{on}/100 \text{ milliseconds}$ or period, whichever is less

$T_{on} = 0.321 + 0.641 * 3 + 9.936 + 2.083 * 16 + 0.962 * 24 = 68.596(\text{ms})$, T period = 100ms

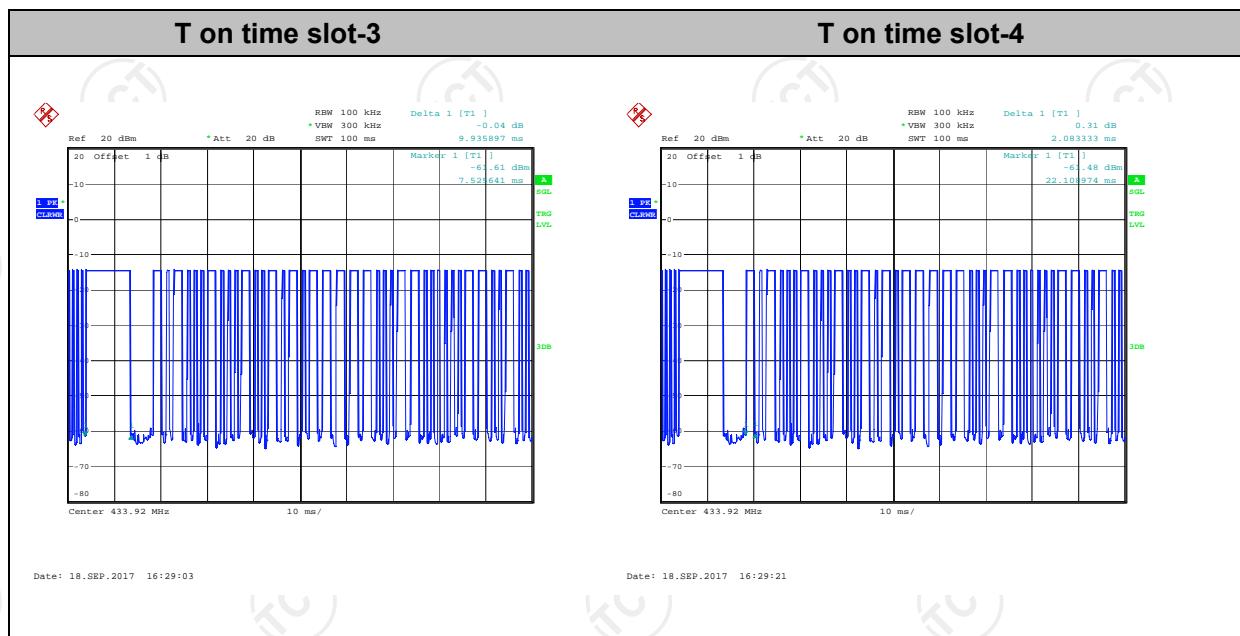
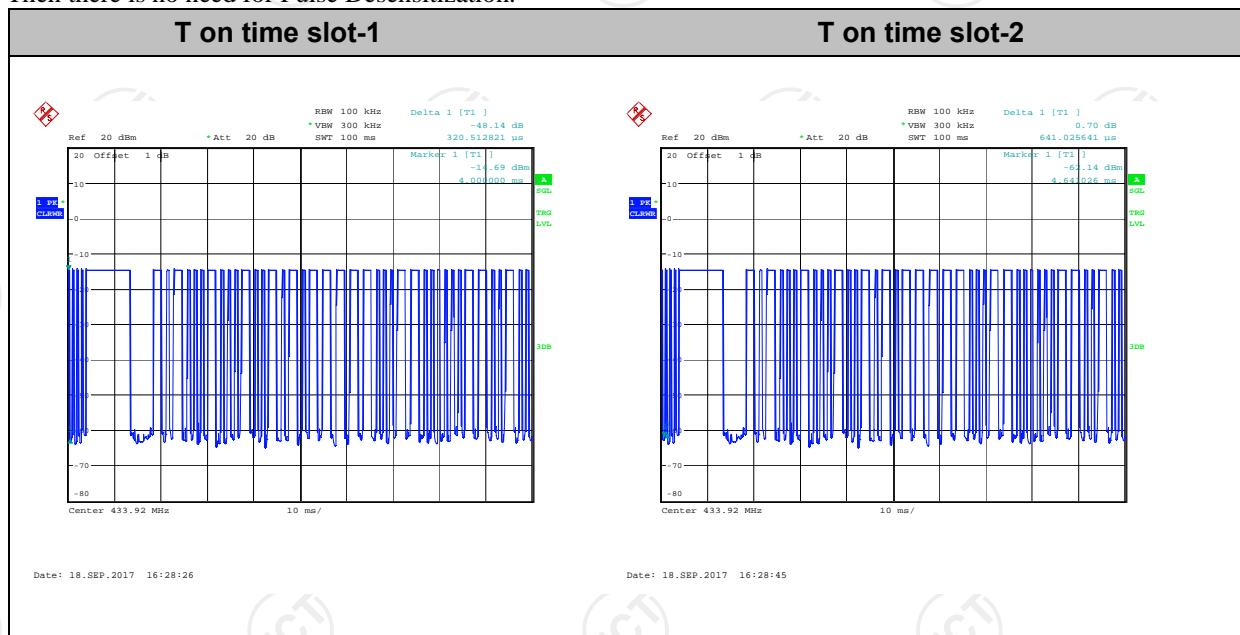
So, Duty cycle = 68.596%

AV Factor = $20 \log(\text{Duty Cycle}) = -3.27$

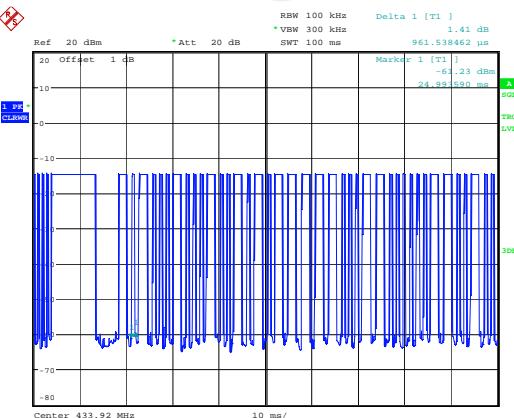
Pulse Desensitization Correction Factor (PDCF):

$\text{PW} = 0.1256\text{s}$, $\text{RBW} = 100\text{KHz}$, $\text{RBW} > 2/\text{PW}$

Then there is no need for Pulse Desensitization.

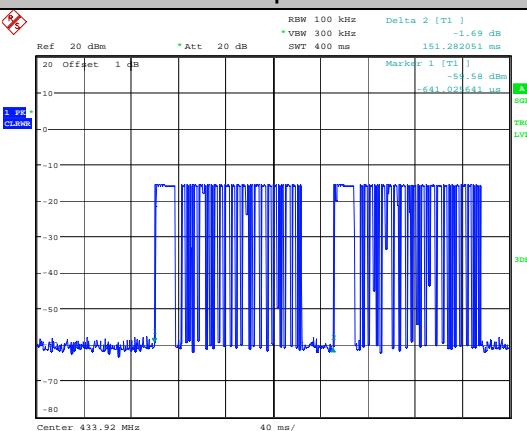


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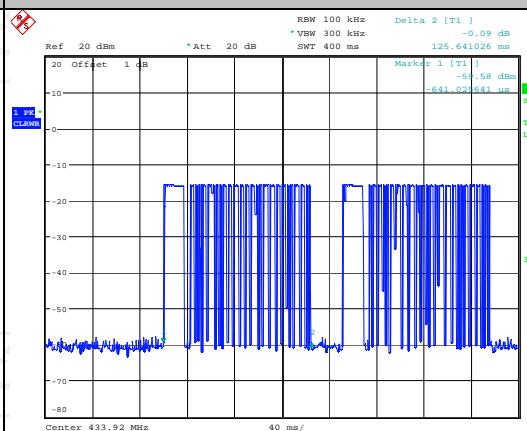
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T period



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PW



Date: 18.SEP.2017 17:02:13

Field Strength of Fundamental

Frequency (MHz)	Emission PK (dBuV/m)	Horizontal /Vertical	Limits PK (dBuV/m)	Margin (dB)
433.92	70.80	H	92.87	-22.07
433.92	72.56	V	92.87	-20.31

Frequency (MHz)	Emission PK (dBuV/m)	AV Factor(dB)	Horizontal /Vertical	Emission AVG (dBuV/m)	Limits AV (dBuV/m)	Margin (dB)
433.92	70.80	-3.27	H	67.53	72.87	-5.34
433.92	72.56	-3.27	V	69.29	72.87	-3.58

Harmonics and Spurious Emissions

Frequency Range (9 kHz-30MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Limit@3m (dB μ V/m)
Remark: The margin for All level in this frequency band is > 20dB from Limit, so not listed in report. It is deemed to comply with the requirement		

Note: 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor

Frequency Range (30MHz–5GHz)

Frequency (MHz)	Emission Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)	Remark	Result
42.18	29.10	H	40.0	QP	PASS
867.84	42.85	H	52.87	QP	PASS
1301.76	51.65	H	74.0	Peak	PASS
1735.68	50.49	H	74.0	Peak	PASS
42.18	28.08	V	40.0	QP	PASS
867.84	40.87	V	52.87	QP	PASS
1301.76	52.51	V	74.0	Peak	PASS
1735.68	51.66	V	74.0	Peak	PASS

Frequency (MHz)	Peak Emission Level@3m (dB μ V/m)	AV Factor (dB)	Antenna Polarity	AV Emission Level@3m (dB μ V/m)	Limit@3m (dB μ V/m)	Result
1301.76	52.78	-3.27	H	49.51	54.0	PASS
1735.68	50.42	-3.27	H	47.15	54.0	PASS
1301.76	53.65	-3.27	V	50.38	54.0	PASS
1735.68	51.86	-3.27	V	48.59	54.0	PASS

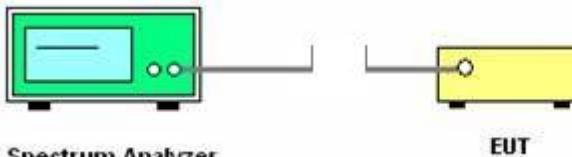
Note: Emission Level=Reading+ Cable loss+ Antenna factor-Amp factor

AV=Average

AV Emission level = Peak Emissions level +AV Factor

6.4. Occupied Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.215(c)
Test Method:	ANSI C63.10: 2013
Limit:	According to 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the centre 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 centre frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
	<ol style="list-style-type: none"> 1. According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW\geq 1% of the 20 dB bandwidth; VBW\geq RBW; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test setup:	 <p>The diagram illustrates the test setup. A green 'Spectrum Analyzer' is connected to a yellow 'EUT' (Equipment Under Test) via a grey cable. The analyzer has a display screen and two control knobs. The EUT is a simple rectangular box with a single output port.</p>
Test Mode:	Transmitting Mode
Test results:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Oct. 13, 2017

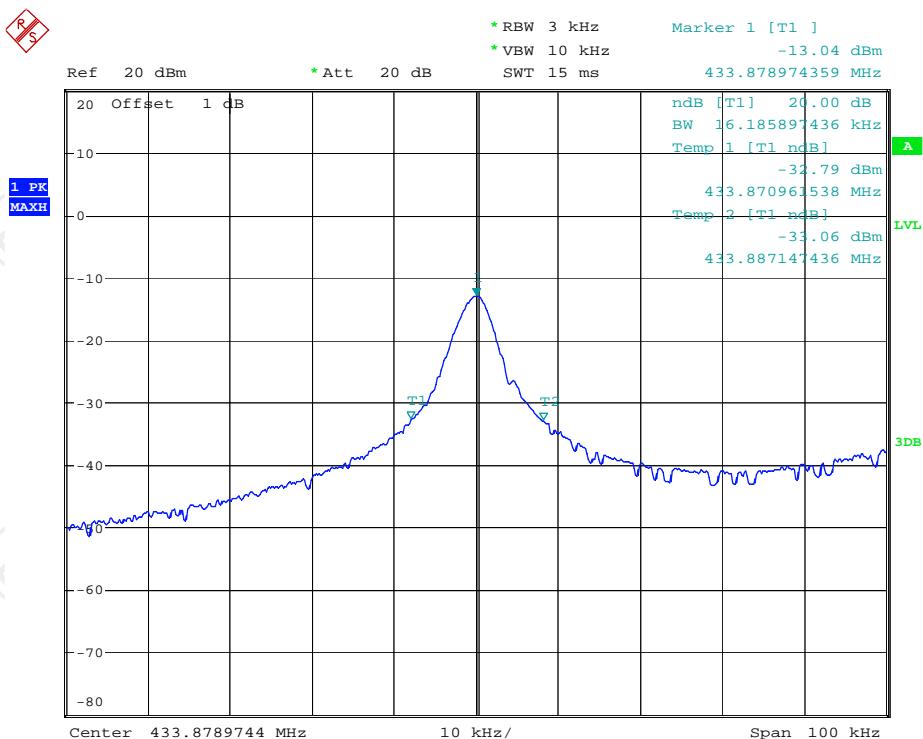
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test data

Test Channel	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Conclusion
Lowest	16.19	1084.8	PASS

Note: Limit = 433.92MHz *0.25% = 1084.8 kHz

Test plots as follows:



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6.5. Transmission time and silent time

6.5.1. Test Specification

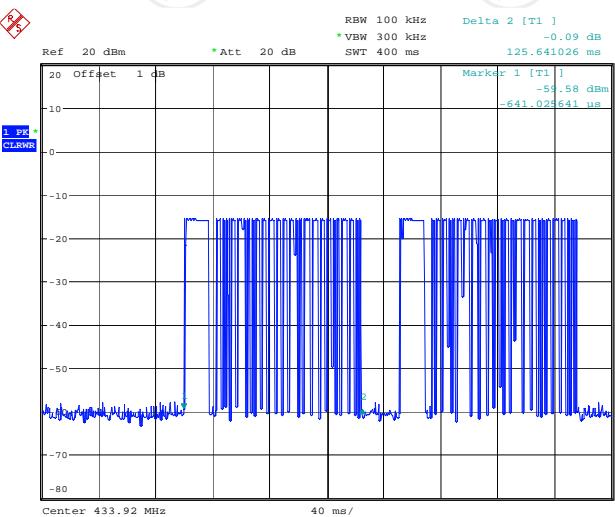
6.5.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Oct. 13, 2017

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

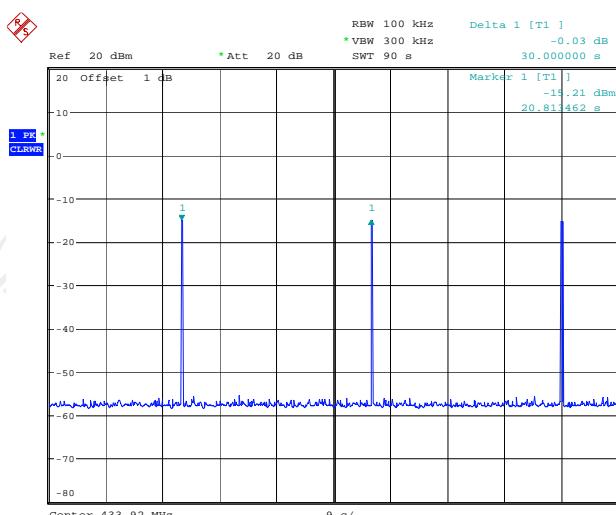
6.5.3. Test data

Channel Frequency (MHz)	Transmission Time (s)	Limit (s)	Test conclusion
433.92	0.1256*2=0.2512	<1s	PASS



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Channel Frequency (MHz)	Silent Period (s)	Limit 30 Times Of The Transmission Time (s)	Limit (s)	Test conclusion
433.92	30	7.54	>10s	PASS



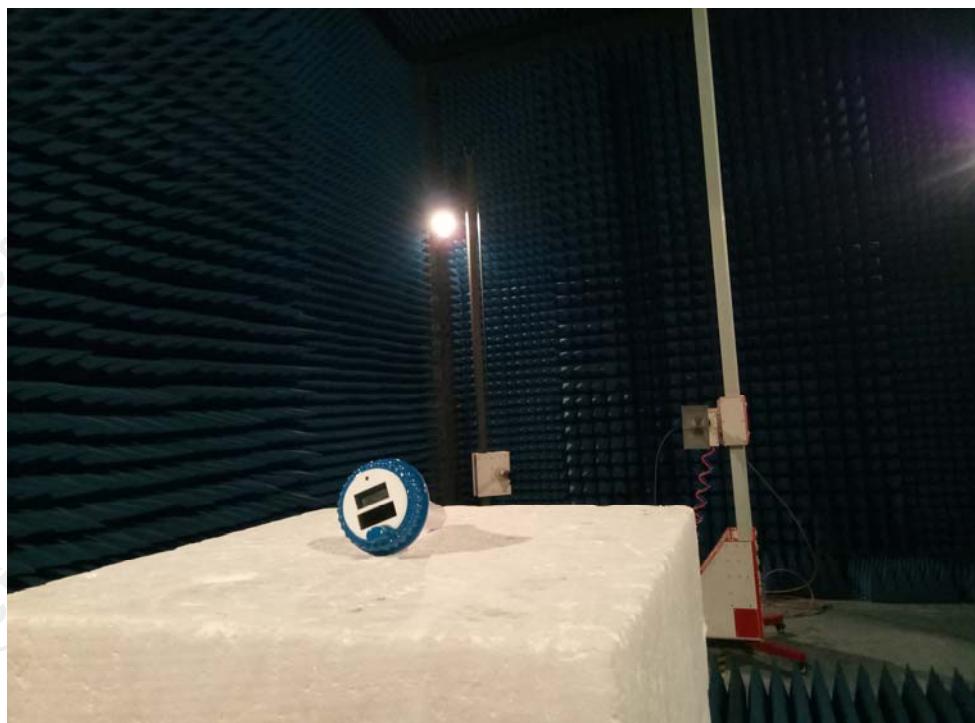
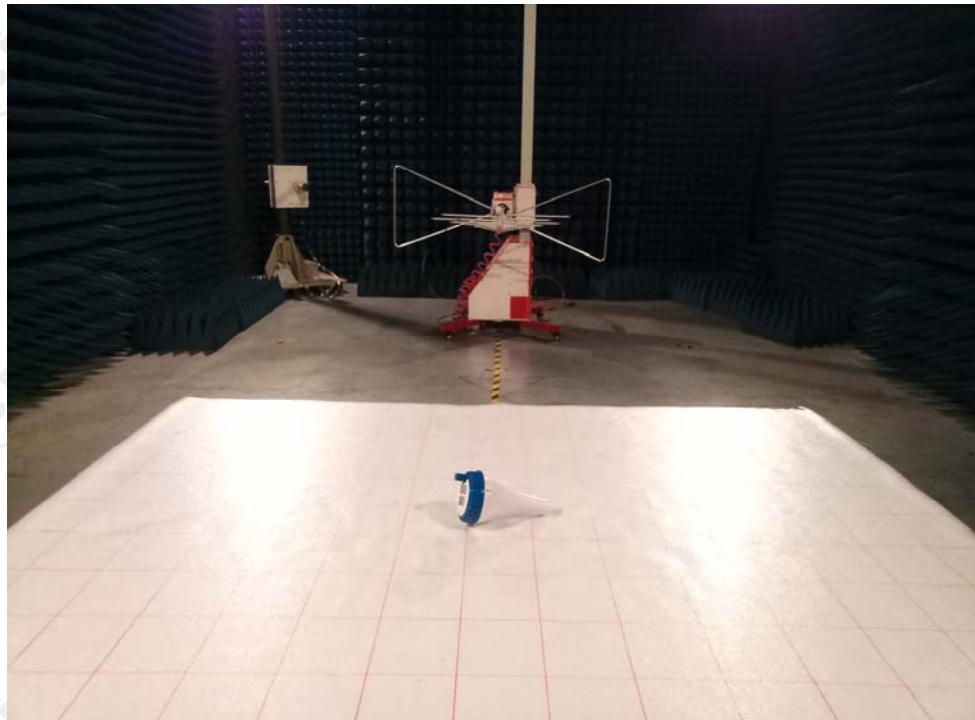
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Appendix A: Photographs of Test Setup

Product: Wireless Swimming Pool Thermometer

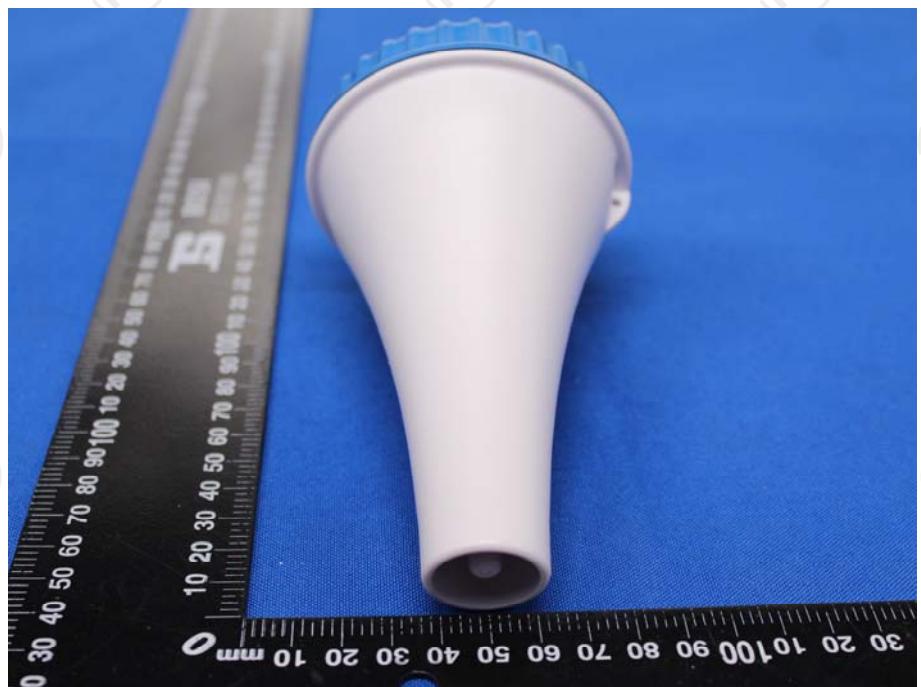
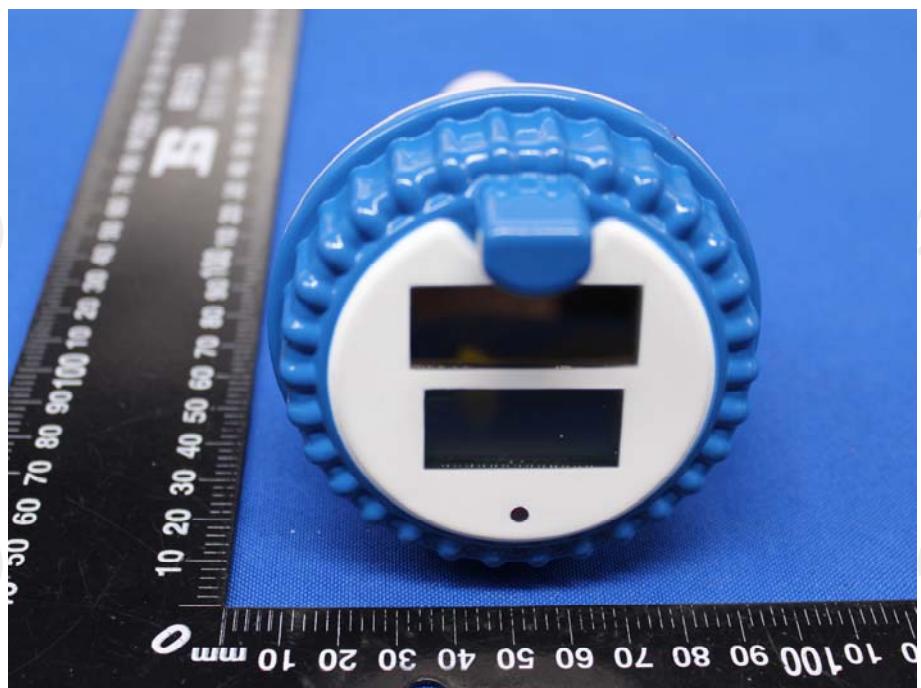
Model: WT0224

Radiated Emission



Appendix B: Photographs of EUT
Product: Wireless Swimming Pool Thermometer
Model: WT0224
External Photos

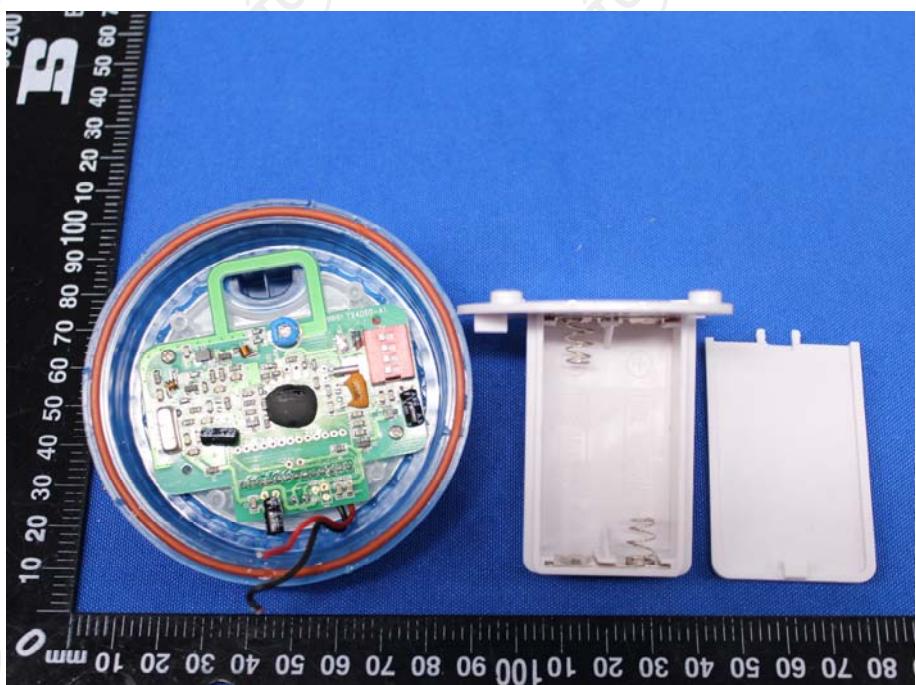
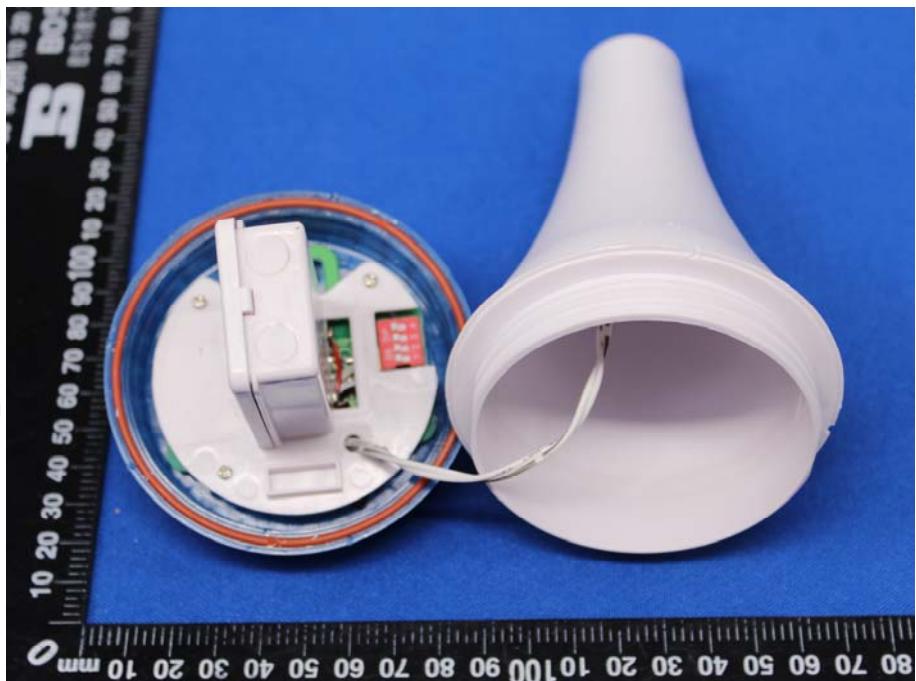


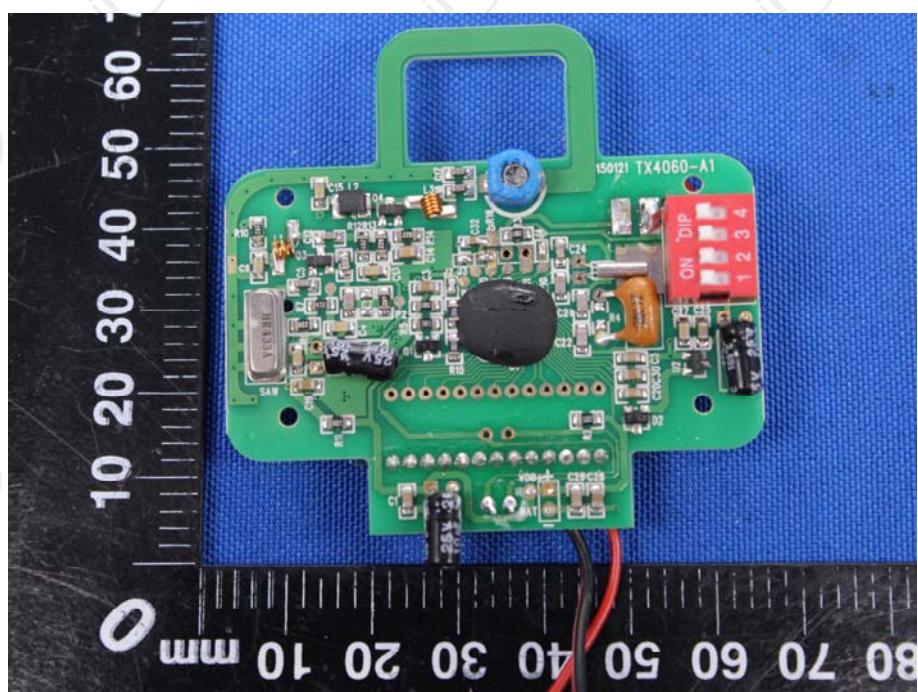
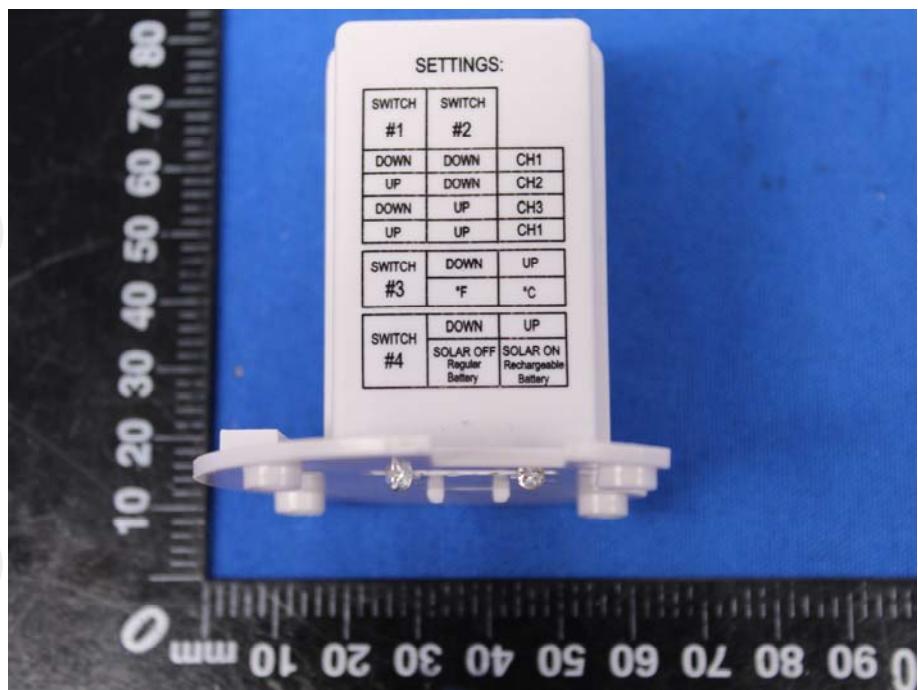


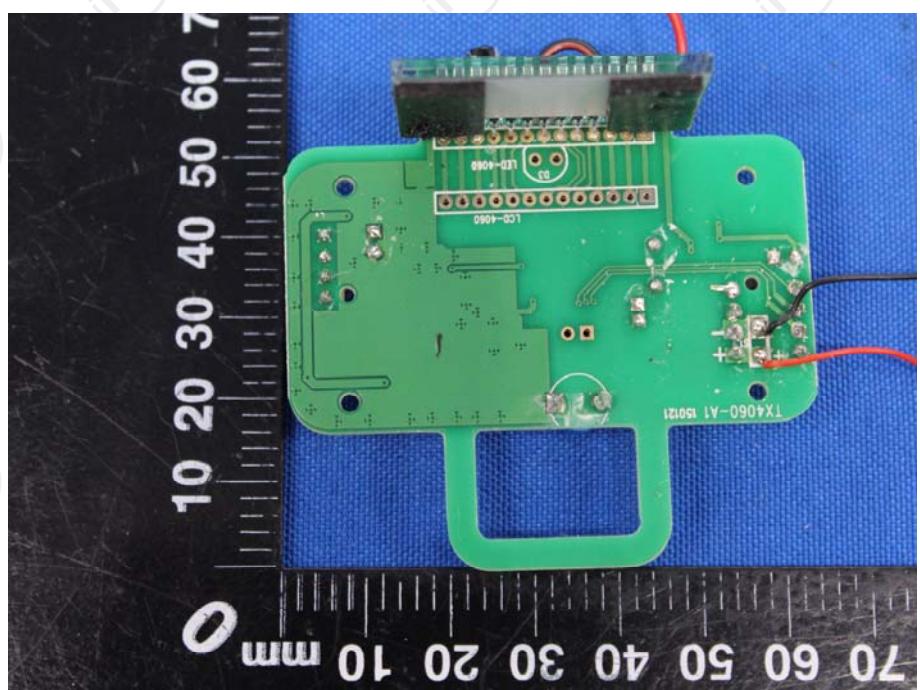
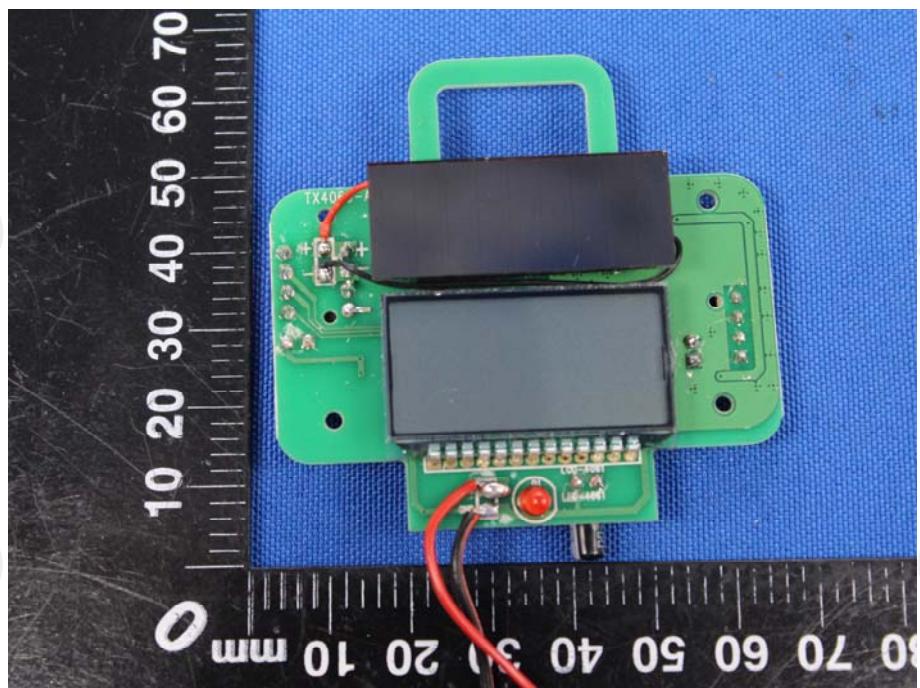
Product: Wireless Swimming Pool Thermometer

Model: WT0224

Internal Photos







*******END OF REPORT*******