

TEST REPORT

FCC ID: ZK8-H2405

Product: Smart Sprinkler Controller

Model No.: SD-H2405

Additional Model: SD-HXXXX(The X is variables, X=0 TO 9)

Trade Mark:  zmodo™

Report No.: TCT171025E008

Issued Date: Nov. 10, 2017

Issued for:

ZMODO Technology Shenzhen Corp. Ltd.
25/F, Office Tower A, Financial Technology Building, 11 Keyuan Road,
Nanshan District, 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

Note: This report shall not be reproduced except in full, without the written approval of Shenzhen Tongce Testing Lab.

This document may be altered or revised by Shenzhen Tongce Testing Lab. personnel only, and shall be noted in the revision section of the document. The test results in the report only apply to the tested sample.

TABLE OF CONTENTS

1. Test Certification.....	3
2. Test Result Summary	4
3. EUT Description	5
4. Genera Information.....	6
4.1. Test Environment and Mode	6
4.2. Description of Support Units	6
5. Facilities and Accreditations	7
5.1. Facilities	7
5.2. Location	7
5.3. Measurement Uncertainty	7
6. Test Results and Measurement Data	8
6.1. Antenna Requirement.....	8
6.2. Conducted Emission.....	9
6.3. Radiated Emission Measurement.....	10
6.4. 20dB Occupied Bandwidth.....	17

Appendix A: Photographs of Test Setup

Appendix B: Photographs of EUT

1. Test Certification

Product:	Smart Sprinkler Controller
Model No.:	SD-H2405
Additional Model:	SD-HXXXX(The X is variables, X=0 TO 9)
Trade Mark:	
Applicant:	ZMODO Technology Shenzhen Corp. Ltd.
Address:	25/F, Office Tower A, Financial Technology Building, 11 Keyuan Road, Nanshan District, Shenzhen, China
Manufacturer:	ZMODO Technology Shenzhen Corp. Ltd.
Address:	25/F, Office Tower A, Financial Technology Building, 11 Keyuan Road, Nanshan District, Shenzhen, China
Date of Test:	Oct. 26, 2017 – Nov. 09, 2017
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.249

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:

Nov. 09, 2017



Reviewed By:



Date:

Nov. 10, 2017



Approved By:



Date:

Nov. 10, 2017



2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203	PASS
AC Power Line Conducted Emission	§15.207	N/A
Field Strength of Fundamental	§15.249 (a)	PASS
Spurious Emissions	§15.249 (a) (d)/ §15.209	PASS
Band Edge	§15.249 (d)/ §15.205	PASS
20dB Occupied Bandwidth	§15.215 (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 Name:	Smart Sprinkler Controller
Model :	SD-H2405
Additional Model:	SD-HXXXX(The X is variables, X=0 TO 9)
Trade Mark:	
Operation Frequency:	915MHz
Number of Channel:	1
Modulation Technology:	FSK
Antenna Type:	Internal Antenna
Antenna Gain:	1.0dBi

4. General Information

4.1. Test Environment and Mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel
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.	

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(<1GHz)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1GHz)	$\pm 4.28\text{dB}$
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)
-----------------------	-------------------------------------

15.203 requirement:

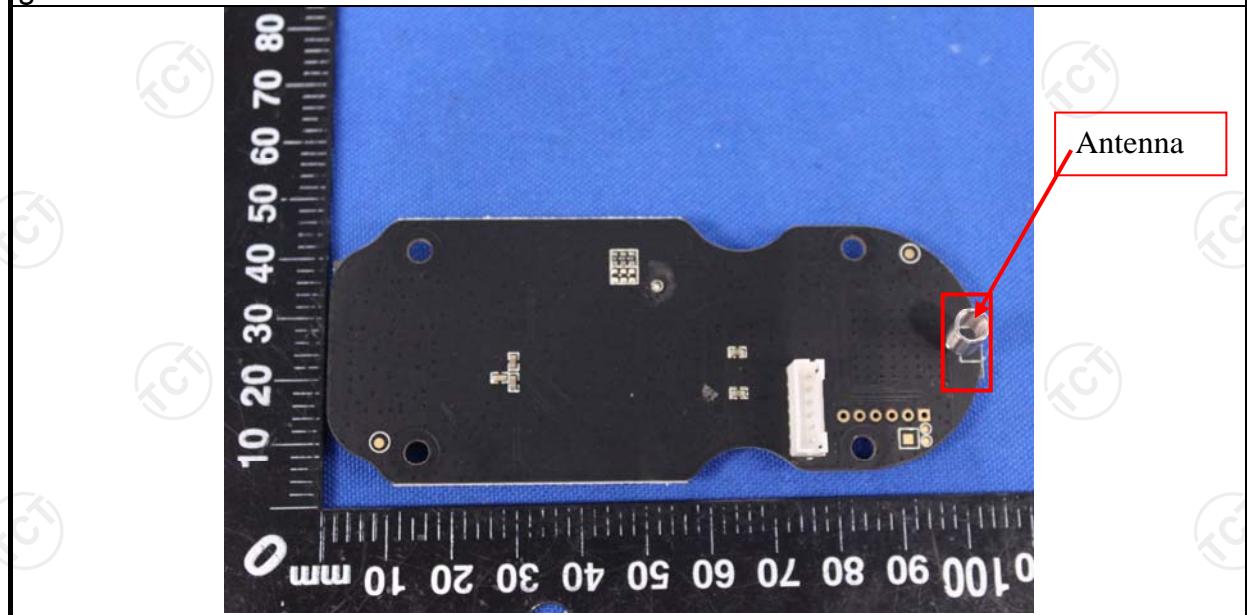
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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 an internal antenna which permanently attached, and the best case gain of the antenna is 1.0dBi.



6.2. Conducted Emission

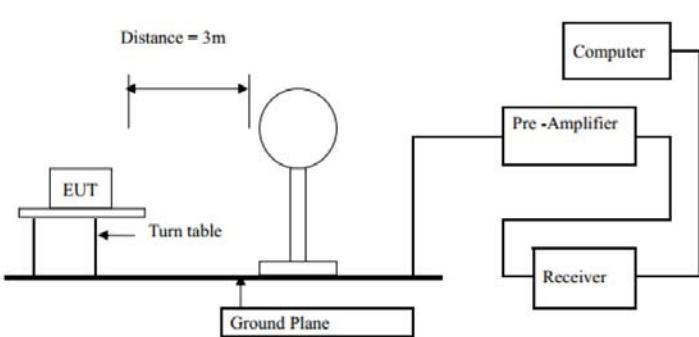
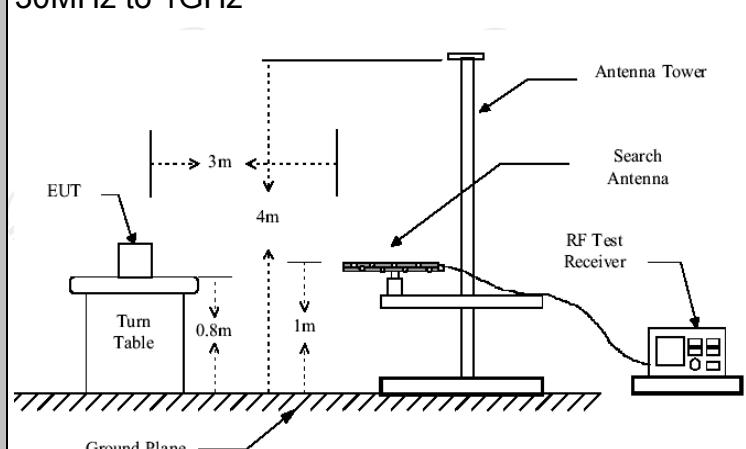
6.2.1. Test Specification

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><i>Remark:</i> E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Mode:	Transmitting mode with modulation														
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														

6.3. Radiated Emission Measurement

6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209								
Test Method:	ANSI C63.10:2013								
Frequency Range:	9 kHz to 25 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	120kHz	300kHz	Quasi-peak Value				
	Above 1GHz	Peak	1MHz	3MHz	Peak Value				
		Peak	1MHz	10Hz	Average Value				
Limit(Field strength of the fundamental signal):	Frequency	Limit (dBuV/m @3m)		Remark					
	902MHz-928MHz	94.00		Average Value					
		114.00		Peak Value					
Limit(Spurious Emissions):	Frequency	Limit (dBuV/m @3m)		Remark					
	0.009-0.490	2400/F(KHz)		Quasi-peak Value					
	0.490-1.705	24000/F(KHz)		Quasi-peak Value					
	1.705-30	30		Quasi-peak Value					
	30MHz-88MHz	40.0		Quasi-peak Value					
	88MHz-216MHz	43.5		Quasi-peak Value					
	216MHz-960MHz	46.0		Quasi-peak Value					
	960MHz-1GHz	54.0		Quasi-peak Value					
	Above 1GHz	54.0		Average Value					
		74.0		Peak Value					
Limit (band edge) :	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 Section 15.209, whichever is the lesser attenuation.								
Test Procedure:	<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 chamber 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. 								

	<p>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.</p> <p>5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>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.</p>
<p>Test setup:</p>	<p>For radiated emissions below 30MHz</p>  <p>30MHz to 1GHz</p>  <p>Above 1GHz</p>

Test results:	PASS

6.3.2. Test Instruments

ESPI Test Receiver	ROHDE&SCHW ARZ	ESVD	100008	Sep. 27, 2018
Spectrum Analyzer	ROHDE&SCHW ARZ	FSEM	848597/001	Sep. 27, 2018
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 27, 2018
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 27, 2018
Pre-amplifier	HP	8447D	2727A05017	Sep. 27, 2018
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 27, 2018
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 27, 2018
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 27, 2018
Horn Antenna	Schwarzbeck	BBHA 9170	373	Jun. 07, 2018
Coax cable (9kHz-40GHz)	TCT	RE-low-01	N/A	Sep. 27, 2018
Coax cable (9kHz-40GHz)	TCT	RE-high-02	N/A	Sep. 27, 2018
Coax cable (9kHz-40GHz)	TCT	RE-low-03	N/A	Sep. 27, 2018
Coax cable (9kHz-40GHz)	TCT	RE-high-04	N/A	Sep. 27, 2018
Antenna Mast	CCS	CC-A-4M	N/A	N/A
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).

6.3.3. Test Data

Field Strength of Fundamental

Frequency (MHz)	Emission PK/AV (dBuV/m)	Horizontal /Vertical	Limits PK/AV (dBuV/m)	Margin (dB)
915	94.25(PK)	H	114/94	-19.75
915	86.02(AV)	H	114/94	-7.98
915	92.67(PK)	V	114/94	-21.33
915	83.98(AV)	V	114/94	-10.02

Spurious Emissions

Frequency Range (9 kHz-30MHz)

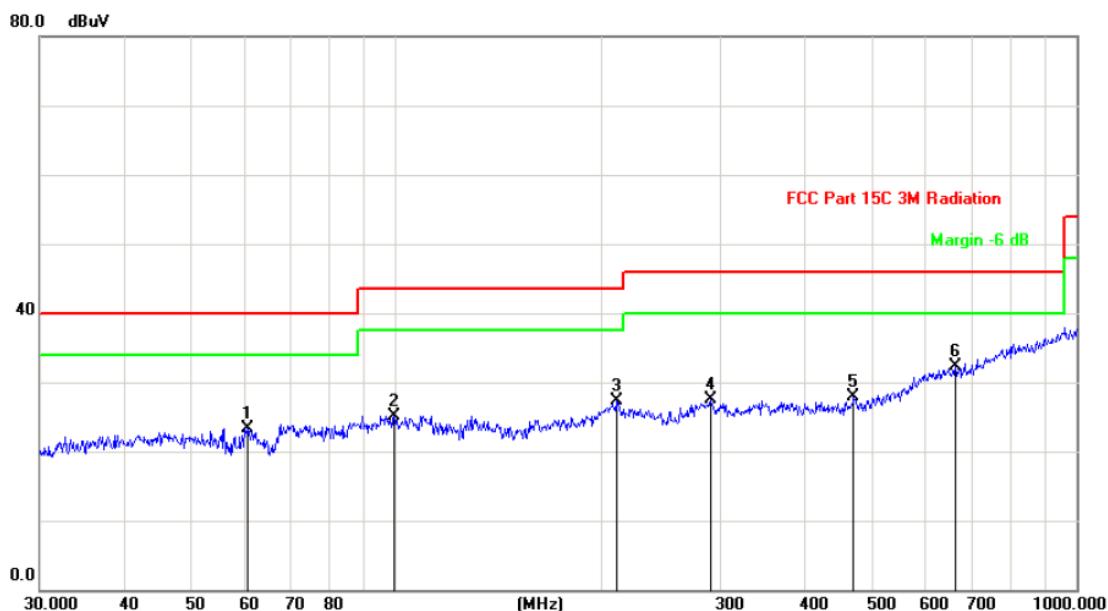
Frequency (MHz)	Level@3m (dB μ V/m)	Limit@3m (dB μ V/m)
--	--	--
--	--	--
--	--	--
--	--	--

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

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

Frequency Range (30MHz-1GHz)

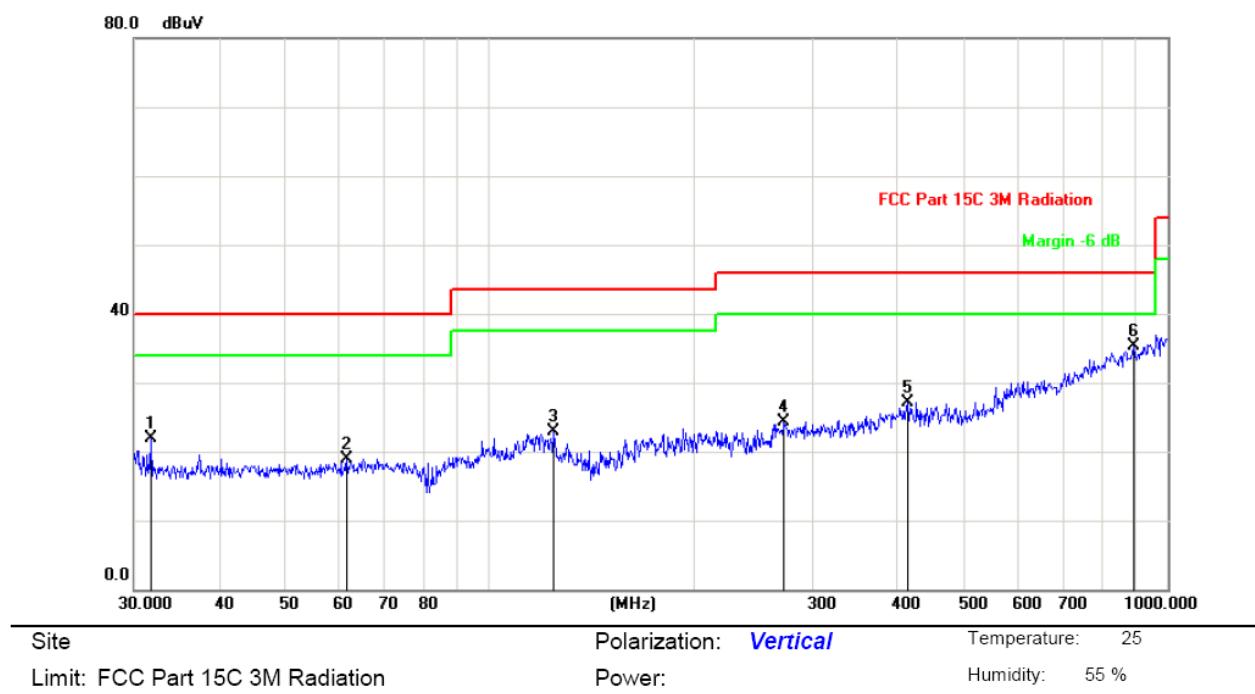
Horizontal:



Site Polarization: **Horizontal** Temperature: 25
Limit: FCC Part 15C 3M Radiation Power: Humidity: 55 %

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dB	Over dB	Detector	Antenna Height cm	Table Degree	Comment
1	60.7044	31.04	-7.69	23.35	40.00	-16.65		peak			
2	99.5281	31.67	-6.48	25.19	43.50	-18.31		peak			
3	210.7860	36.30	-9.08	27.22	43.50	-16.28		peak			
4	290.0172	33.47	-5.99	27.48	46.00	-18.52		peak			
5	470.5232	29.33	-1.51	27.82	46.00	-18.18		peak			
6	*	663.4729	29.32	3.02	32.34	46.00	-13.66	peak			

Vertical:



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dB	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1	31.7313	29.75	-7.85	21.90	40.00	-18.10	peak				
2	61.7781	27.01	-8.09	18.92	40.00	-21.08	peak				
3	124.5690	32.86	-9.87	22.99	43.50	-20.51	peak				
4	272.2776	31.63	-7.35	24.28	46.00	-21.72	peak				
5	414.7223	28.72	-1.57	27.15	46.00	-18.85	peak				
6	*	890.7278	27.79	7.56	35.35	46.00	-10.65	peak			

Above 1GHz

Frequency (MHz)	Ant. Pol. H/V	Peak reading (dB μ V)	AV reading (dB μ V)	Correction Factor (dB/m)	Emission Level		Peak limit (dB μ V/m)	AV limit (dB μ V/m)	Margin (dB)
					Peak (dB μ V/m)	AV (dB μ V/m)			
1830.00	H	51.42	---	-3.95	47.47	---	74	54	-6.53
2745.00	H	50.34	---	0.61	50.95	---	74	54	-3.05
---	---	---	---	---	---	---	---	---	---
1830.00	V	52.34	---	-3.97	48.37	---	74	54	-5.63
2745.00	V	49.66	---	0.58	50.24	---	74	54	-3.76
---	---	---	---	---	---	---	---	---	---

Note:

1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier
2. Margin (dB) = Emission Level (Peak) (dB μ V/m)-Average limit (dB μ V/m)
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.
5. Data of measurement shown “---” in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.

Band Edge Requirement

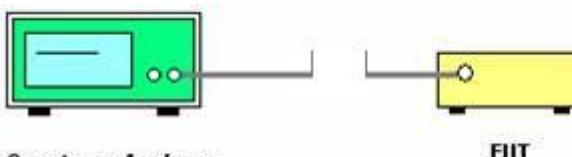
Channel: 915MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dB μ V)	AV reading (dB μ V)	Correction Factor (dB/m)	Emission Level		Peak limit (dB μ V/m)	AV limit (dB μ V/m)	Margin (dB)
					Peak (dB μ V/m)	AV (dB μ V/m)			
902	H	50.23	---	-4.2	46.03	---	74.00	---	-27.97
902	H	---	43.05	-4.2	---	38.85	---	54.00	-15.15
928	H	49.55	---	-4.2	45.35	---	74.00	---	-28.65
928	H	---	40.46	-4.2	---	36.26	---	54.00	-17.74
902	V	52.74	---	-4.2	48.54	---	74.00	---	-25.46
902	V	---	42.10	-4.2	---	37.90	---	54.00	-16.10
928	V	51.68	---	-4.2	47.48	---	74.00	---	-26.52
928	V	---	41.39	-4.2	---	37.19	---	54.00	-16.81

Note:

1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier
2. Margin (dB) = Emission Level (Peak) (dB μ V/m)-Average limit (dB μ V/m)
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.
5. Data of measurement shown “---” in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.

6.4.20dB Occupied Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.215(c)
Test Method:	ANSI C63.10: 2013
Limit:	N/A
	<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\geq1% of the 20 dB bandwidth; VBW\geqRBW; 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 cable. The analyzer has a display screen and two control knobs. The EUT is a simple rectangular box with a single port.</p>
Test Mode:	Transmitting mode with modulation
Test results:	PASS

6.4.2. Test Instruments

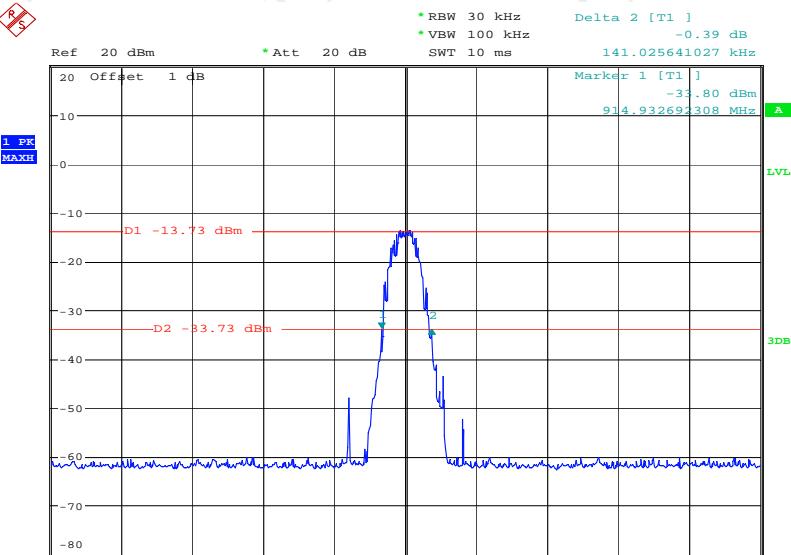
RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 27, 2018

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

Frequency (MHz)	20dB Occupy Bandwidth (kHz)	Limit	Conclusion
915	141.03	---	PASS

Test plots as follows:

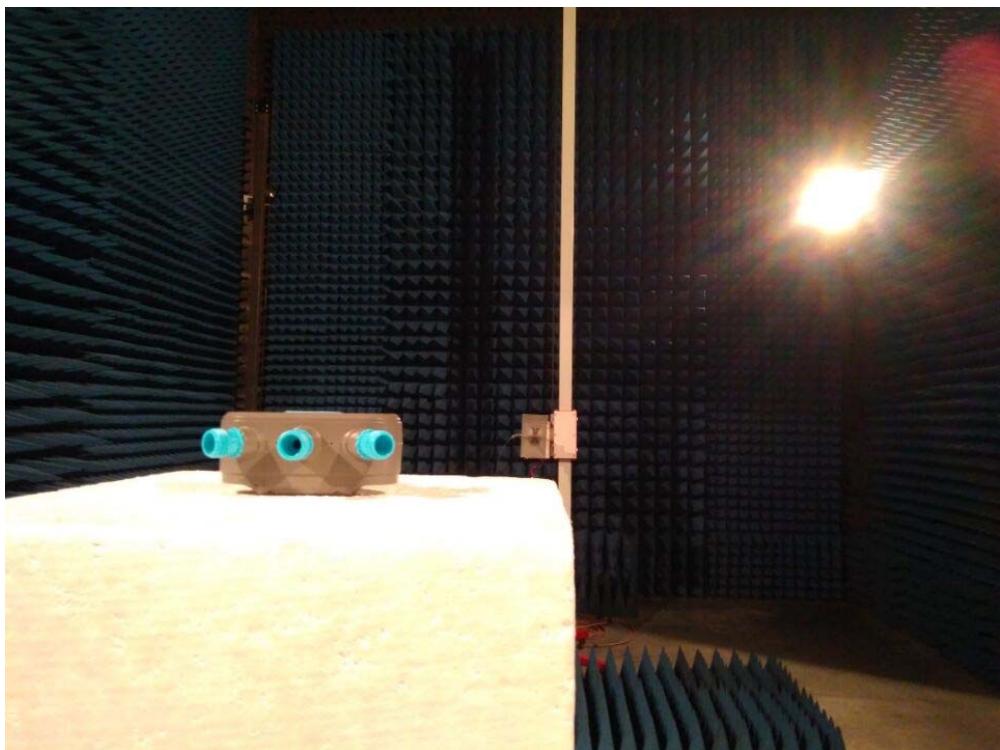
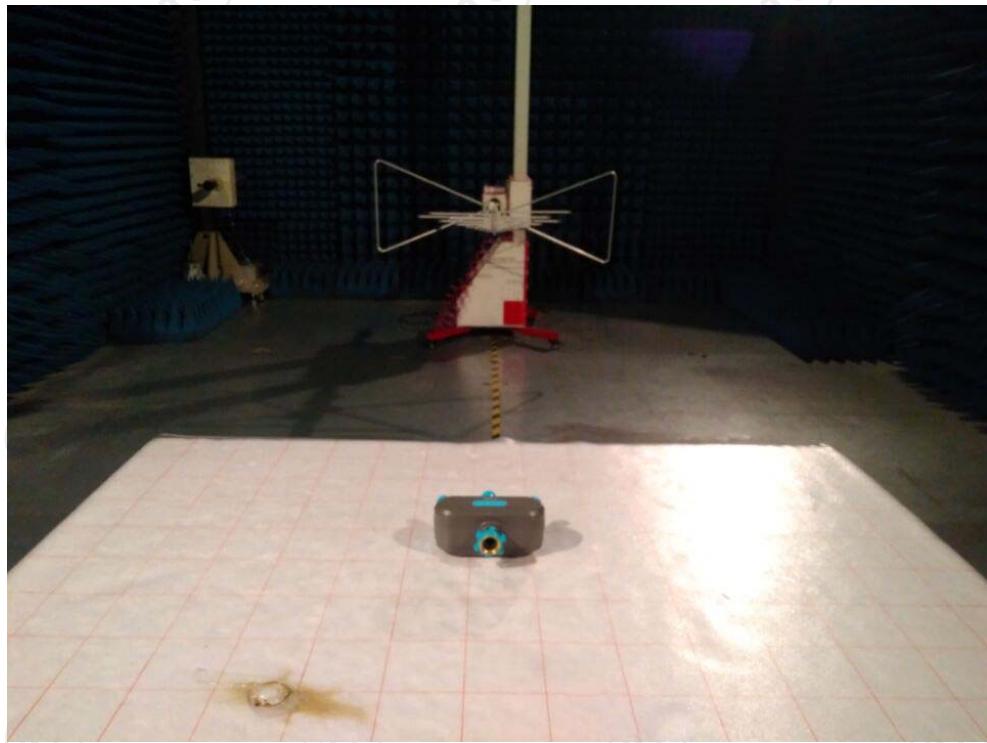


Appendix A: Photographs of Test Setup

Product: Smart Sprinkler Controller

Model: SD-H2405

Radiated Emission



Appendix B: Photographs of EUT

Product: Smart Sprinkler Controller

Model: SD-H2405

External Photos





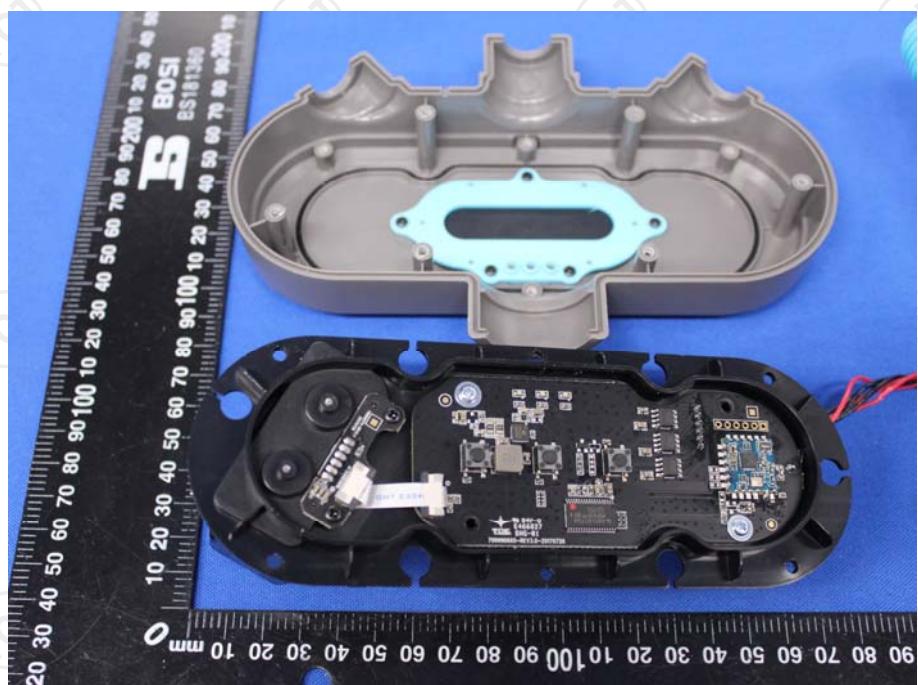
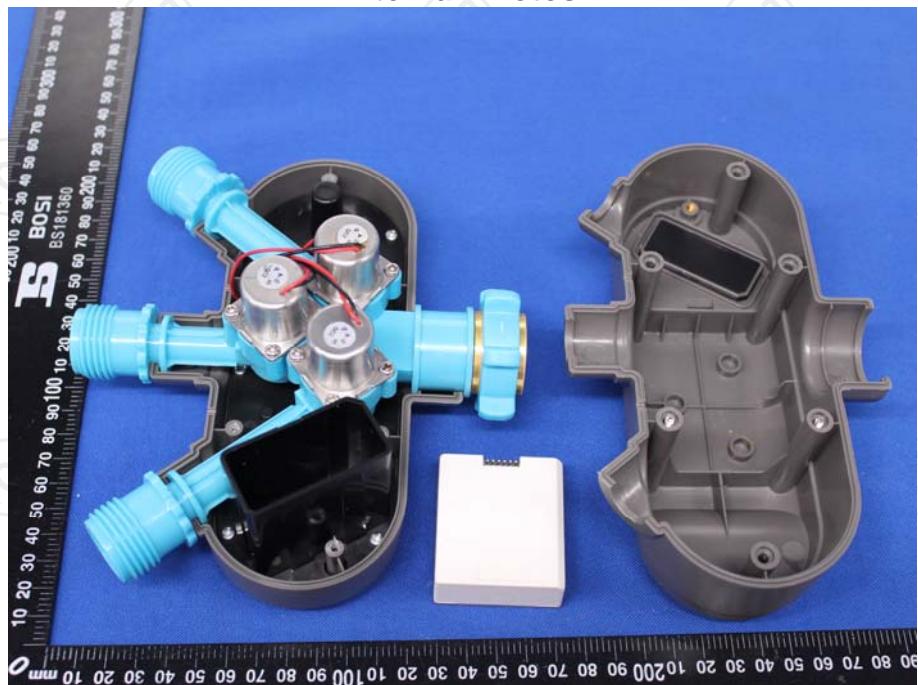


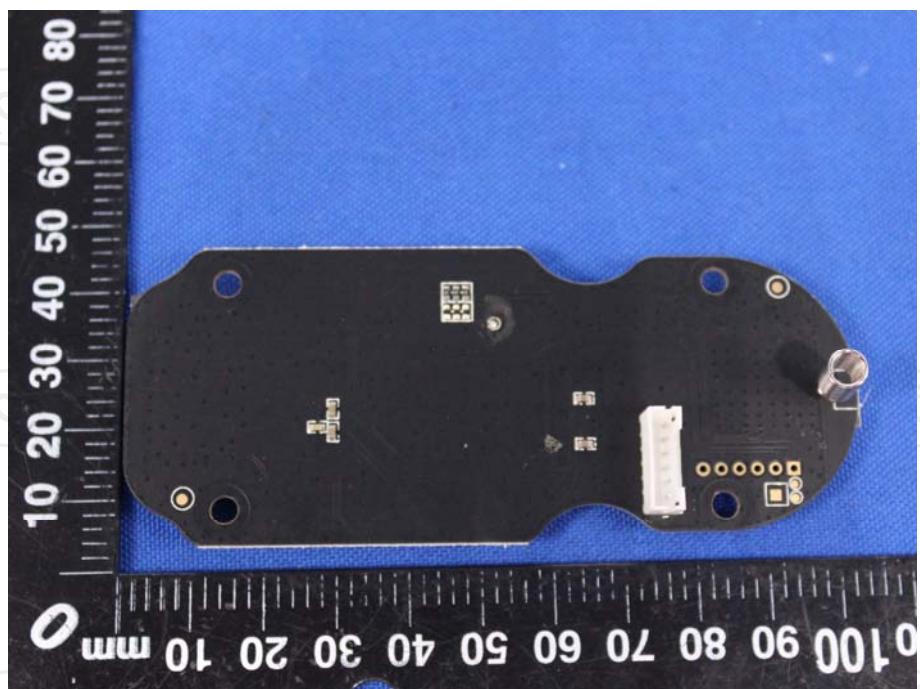
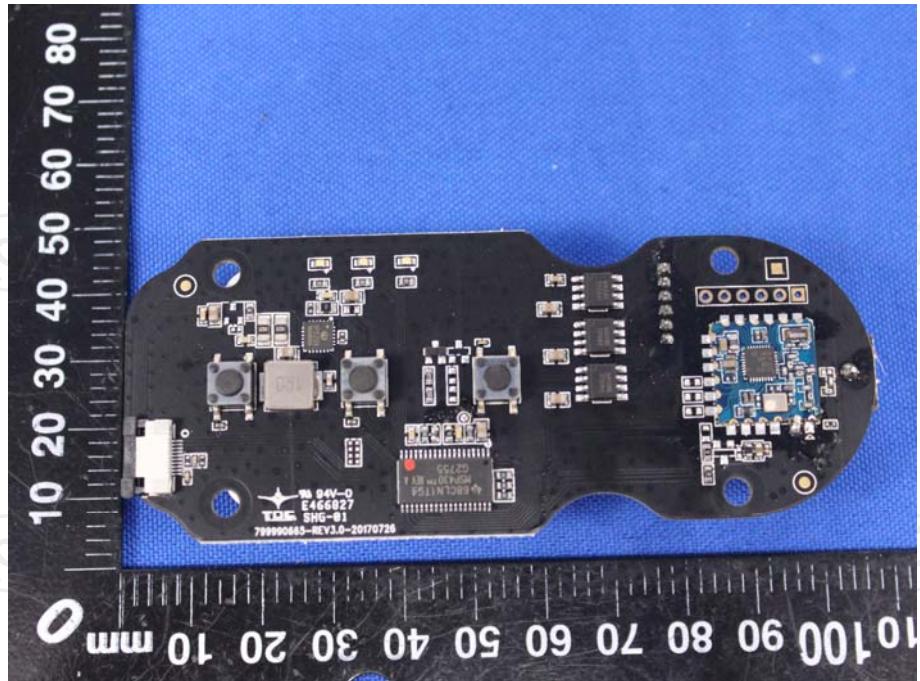
Appendix B: Photographs of EUT

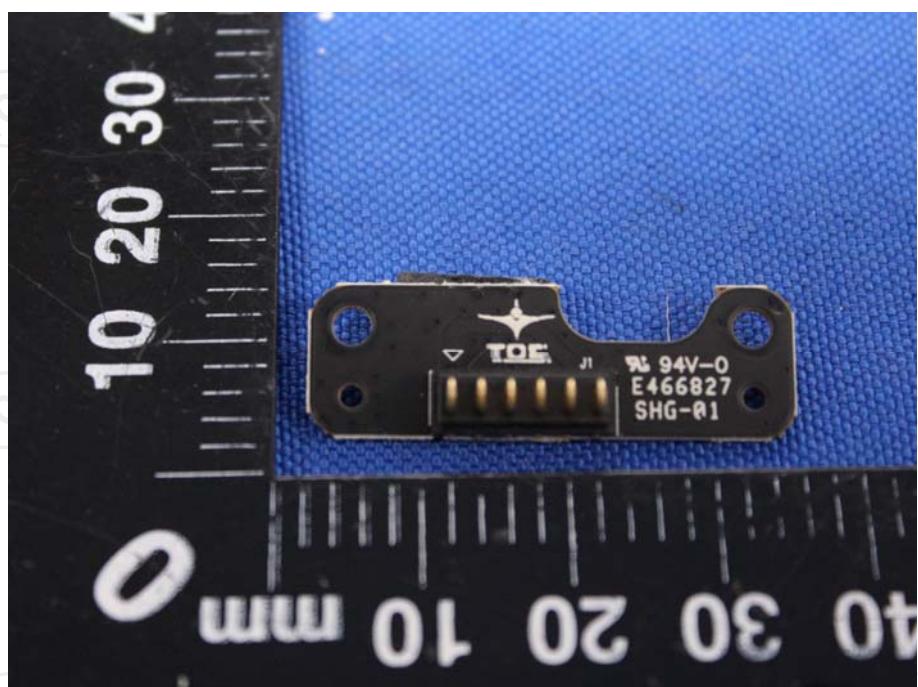
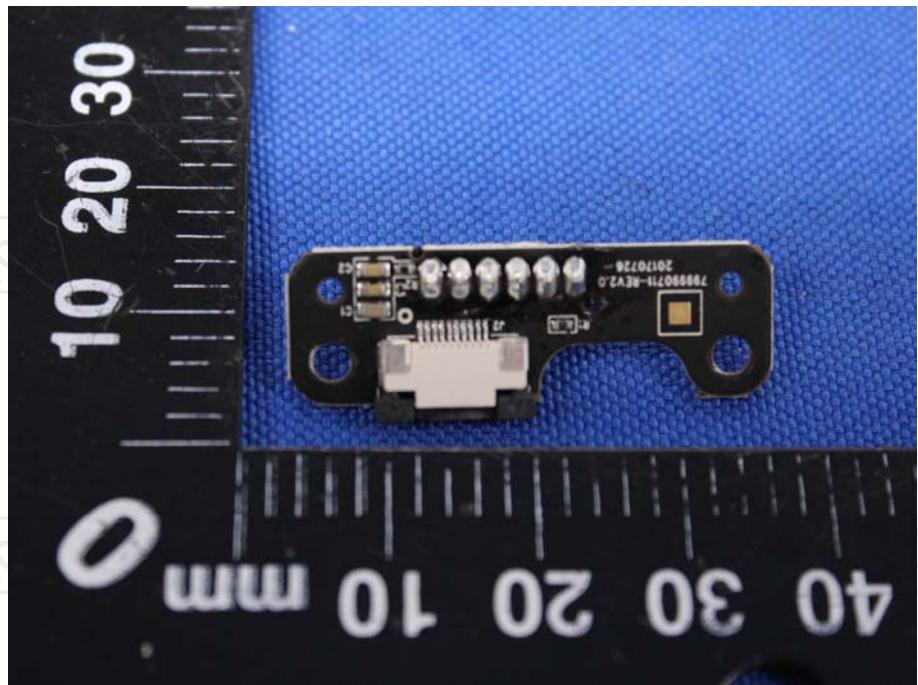
Product: Smart Sprinkler Controller

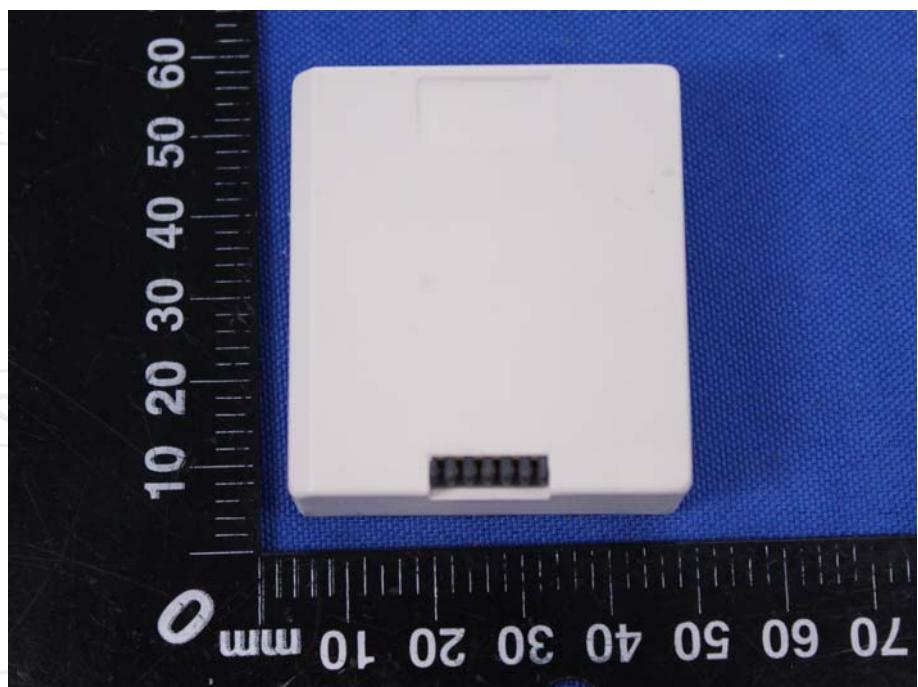
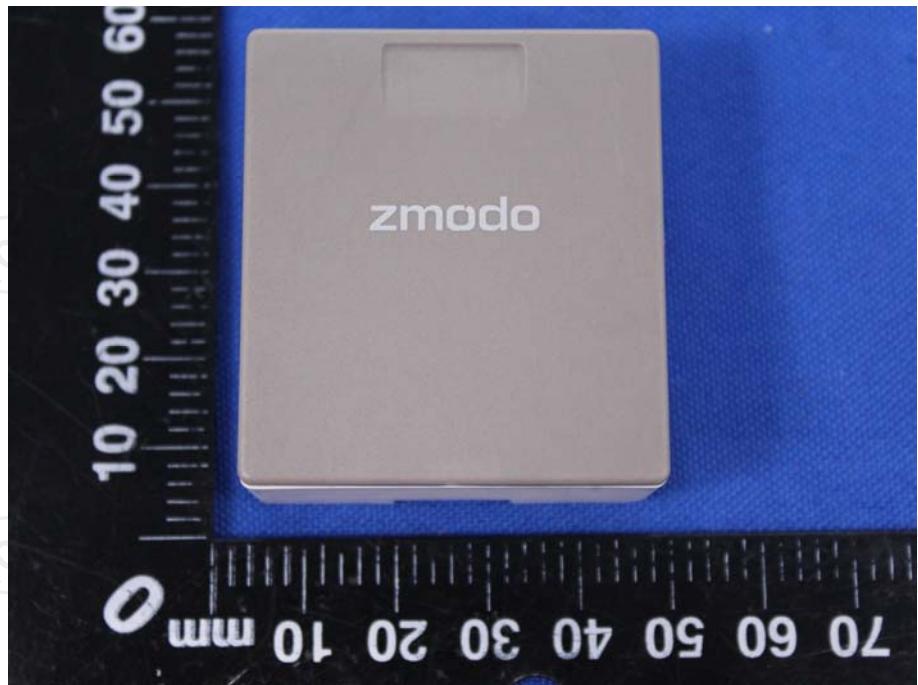
Model: SD-H2405

Internal Photos









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