FCC TEST REPORT

For

ZHONGSHAN BOYING ELECTRONICS CO., Ltd.

Wireless doorbell

Model No.: A101, A101-2, A102, A103, A106, A107, A108, A109, A201, A202, A203, A206, A207, A208, A209, A301, A302, A303, A306, A307, A308, A309, A501, A502, A503, A506, A507, A507-2, A508, A509, A601, A602, A603, A606, A607, A608, A609, A701, A702, A703, A706, A707, A708, A709, A801, A802, A803, A806, A807, A808, A809, A901, A902, A903, A906, A907, A908, A909, A909-2, 9809, 9809-2, 9803

Prepared For	:	ZHONGSHAN BOYING ELECTRONICS CO., Ltd.
Address	:	5/F, Building F, No. 9, Mincheng Road, Xiaolan Town, Zhongshan, Guangdong, China 528415
Prepared By	:	Shenzhen Anbotek Compliance Laboratory Limited
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Report Number	:	SZAWW180623003-01
Date of Test	:	Jun. 23~Jul. 05, 2018
Date of Report	:	Jul. 05, 2018

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TEST REPORT

Applicant	:	ZHONGSHAN BOYING ELECTRONICS CO., Ltd.
Manufacturer	:	ZHONGSHAN BOYING ELECTRONICS CO., Ltd.
Product Name	:	Wireless doorbell
Model No.	:	A101, A101-2, A102, A103, A106, A107, A108, A109, A201, A202, A203, A206, A207, A208, A209, A301, A302, A303, A306, A307, A308, A309, A501, A502, A503, A506, A507, A507-2, A508, A509, A601, A602, A603, A606, A607, A608, A609, A701, A702, A703, A706, A707, A708, A709, A801, A802, A803, A806, A807, A808, A809, A901, A902, A903, A906, A907, A908, A909, A909-2, 9809, 9809-2, 9803
Trade Mark	:	N.A.
Rating(s)	:	Input: DC 12V, 30mA "23A"

Test Standard(s)	**:**	**FCC Part15 Subpart C 2017, Section 15.231**
Test Method(s)	**:**	**ANSI C63.10: 2013**

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

Date of Test: Jun. 23~Jul. 05, 2018

Prepared by: (Engineer / Oliay Yang)

Reviewer: (Supervisor / Calvin Liu)

Approved & Authorized Signer: (Manager / Tom Chen)

1. General Information

1.1. Client Information

Applicant	:	ZHONGSHAN BOYING ELECTRONICS CO., Ltd.
Address	:	5/F, Building F, No. 9, Mincheng Road, Xiaolan Town, Zhongshan, Guangdong, China 528415
Manufacturer	:	ZHONGSHAN BOYING ELECTRONICS CO., Ltd.
Address	:	5/F, Building F, No. 9, Mincheng Road, Xiaolan Town, Zhongshan, Guangdong, China 528415

1.2. Description of Device (EUT)

Product Name	:	Wireless doorbell	
Model No.	:	A101, A101-2, A102, A103, A106, A107, A108, A109, A201, A202, A203, A206, A207, A208, A209, A301, A302, A303, A306, A307, A308, A309, A501, A502, A503, A506, A507, A507-2, A508, A509, A601, A602, A603, A606, A607, A608, A609, A701, A702, A703, A706, A707, A708, A709, A801, A802, A803, A806, A807, A808, A809, A901, A902, A903, A906, A907, A908, A909, A909-2, 9809, 9809-2, 9803 (Note: All samples are the same except the size and appearance, so we prepare "A101" for test only.)	
Test Sample No.	:	S1, S2	
Trade Mark	:	N.A.	
Test Power Supply	:	DC 12V	
Product Description	:	Operation Frequency:	433.92MHz
		Number of Channel:	1 Channels
		Modulation Type:	ASK
		Antenna Type:	PCB Antenna
		Antenna Gain(Peak):	1.5 dBi
Remark: 1)For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.			

1.3. Auxiliary Equipment Used During Test

N/A		

1.4. Description of Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	Keeping TX Mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	Keeping TX Mode

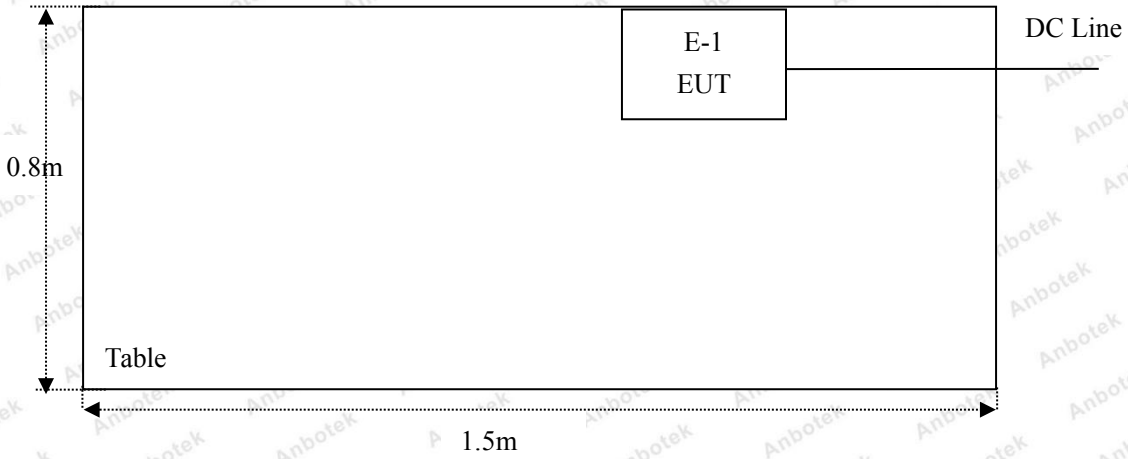
Note: During the test, the EUT was keeping continuous transmission.

1.5. List of channels

Channel	Freq. (MHz)	Note (Modulation Type)
01	433.92	ASK

1.6. Description Of Test Setup

RE



1.7. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	Rohde & Schwarz	ENV216	100055	Nov. 17, 2017	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Nov. 17, 2017	1 Year
3.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Nov. 17, 2017	1 Year
4.	Spectrum Analysis	Agilent	E4407B	US39390582	Nov. 17, 2017	1 Year
5.	Spectrum Analysis	Agilent	N9038A	MY53227295	Nov. 17, 2017	1 Year
6.	Preamplifier	SKET Electronic	BK1G18G30D	KD17503	Nov. 17, 2017	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Nov. 17, 2017	1 Year
8.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Nov. 20, 2017	1 Year
9.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Nov. 20, 2017	1 Year
10.	Loop Antenna	Schwarzbeck	HFH2-Z2	100047	Nov. 17, 2017	1 Year
11.	Horn Antenna	Schewarzbeck	BBHA9170	9170-375	Nov. 17, 2017	1 Year
12.	Pre-amplifier	SONOMA	310N	186860	Nov. 17, 2017	1 Year
13.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A
14.	RF Test Control System	YIHENG	YH3000	2017430	Nov. 18, 2017	1 Year
15.	Power Sensor	DAER	RPR3006W	15I00041SN045	Nov. 17, 2017	1 Year
16.	Power Sensor	DAER	RPR3006W	15I00041SN046	Nov. 17, 2017	1 Year
17.	MXA Spectrum Analysis	Agilent	N9020A	MY51170037	Nov. 18, 2017	1 Year
18.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Nov. 18, 2017	1 Year
19.	Signal Generator	Agilent	E4421B	MY41000743	Nov. 18, 2017	1 Year
20.	DC Power Supply	LW	TPR-6410D	349315	Nov. 01, 2017	1 Year
21.	Constant Temperature Humidity Chamber	Sertep	ZJ-HWHS80B	ZJ-17042804	Nov. 01, 2017	1 Year

1.8. Measurement Uncertainty

Radiation Uncertainty	:	Ur = 3.9 dB (Horizontal)
		Ur = 3.8 dB (Vertical)
Conduction Uncertainty	:	Uc = 3.4dB

1.9. Description of Test Facility

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

FCC-Registration No.: 184111

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registed 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 No. 184111, July 31, 2017.

ISED-Registration No.: 8058A-1

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A-1, June 13, 2016.

Test Location

All Emissions tests were performed at Shenzhen Anbotek Compliance Laboratory Limited. at 1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.518102

2. Summary of Test Results

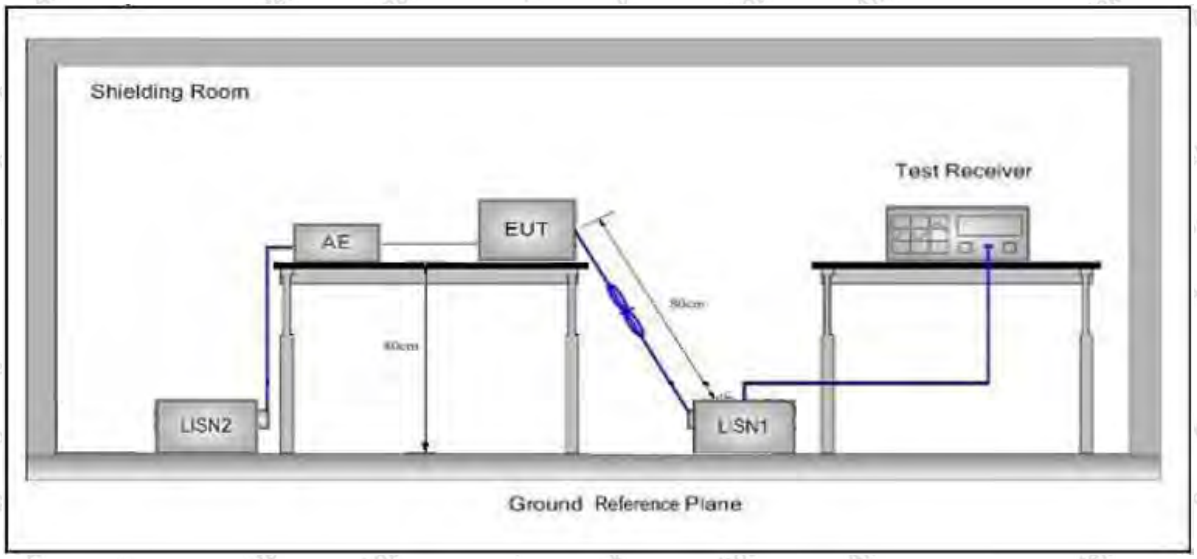
Standard Section	Test Item	Result
15.203	Antenna Requirement	PASS
15.207	Conducted Emission	N/A
15.205/15.209/15.231(b)	Spurious Emission	PASS
15.231(c)	20dB Occupied Bandwidth	PASS
15.231(a)	Dwell time	PASS
Remark: "N/A" is an abbreviation for Not Applicable.		

3. Conducted Emission Test

3.1. Test Standard and Limit

Test Standard	FCC Part15 Section 15.207		
Test Limit	Frequency	Maximum RF Line Voltage (dBuV)	
		Quasi-peak Level	Average Level
	150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
	500kHz~5MHz	56	46
	5MHz~30MHz	60	50
Remark: (1) *Decreasing linearly with logarithm of the frequency. (2) The lower limit shall apply at the transition frequency.			

3.2. Test Setup



3.3. Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10-2013 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

3.4. Test Data

There is DC 12V Battery inside, So there is no need to test

4. Radiation Spurious Emission and Band Edge

4.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.209, 15.205 and 15.231(b)				
Test Limit	Frequency (MHz)	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz~0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz~88MHz	100	40.0	Quasi-peak	3
	88MHz~216MHz	150	43.5	Quasi-peak	3
	216MHz~960MHz	200	46.0	Quasi-peak	3
	960MHz~1000MHz	500	54.0	Quasi-peak	3
	Above 1000MHz	500	54.0	Average	3
		-	74.0	Peak	3
Remark: (1)The lower limit shall apply at the transition frequency. (2) 15.35(b), 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. This peak limit applies to the total peak emission level radiated by the device.					

the formulas for calculating the maximum permitted fundamental field strengths are as follows:
for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333.
The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level

Emission Level (dBuV/m)=20log Emission Level(uV/m)

The field strength of emission limits have been calculated in below table:

Fundamental Frequency (MHz)	Field Strength of Fundamental (dBuV/m)@3m
433.92	80.82 (AVG)
433.92	100.82 (Peak)

4.2. Test Setup

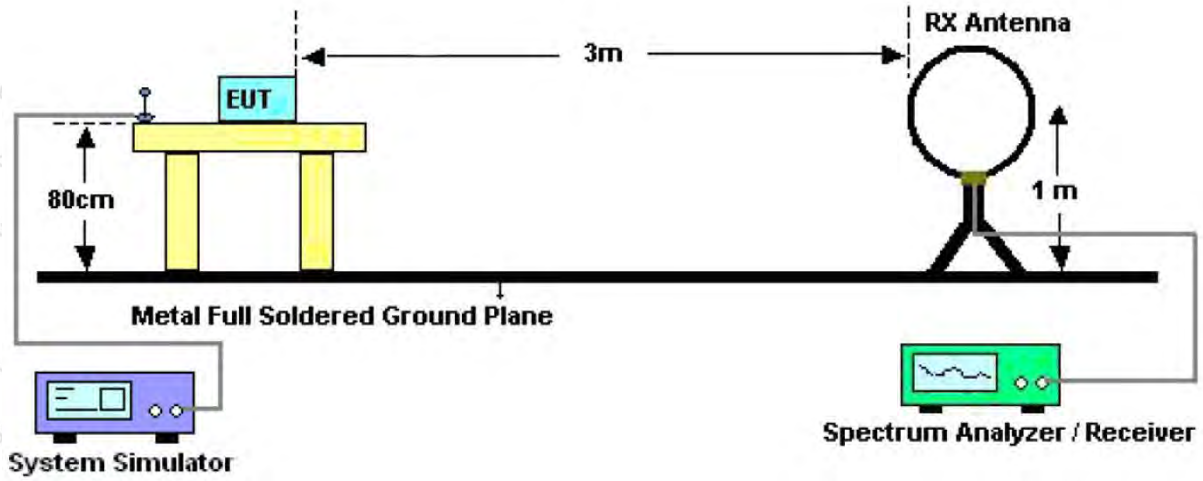


Figure 1. Below 30MHz

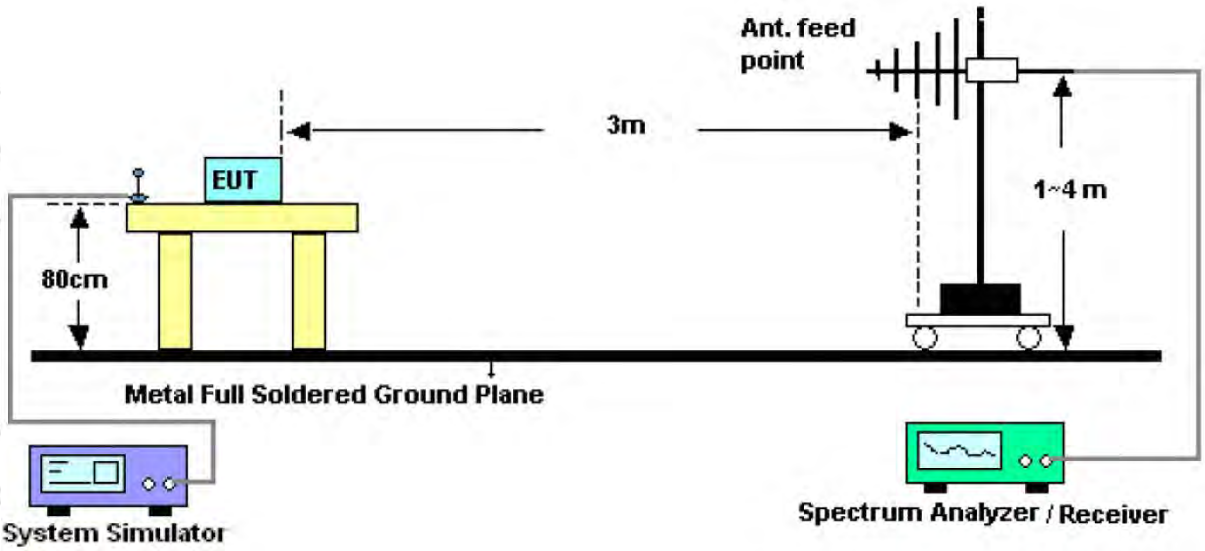


Figure 2. 30MHz to 1GHz

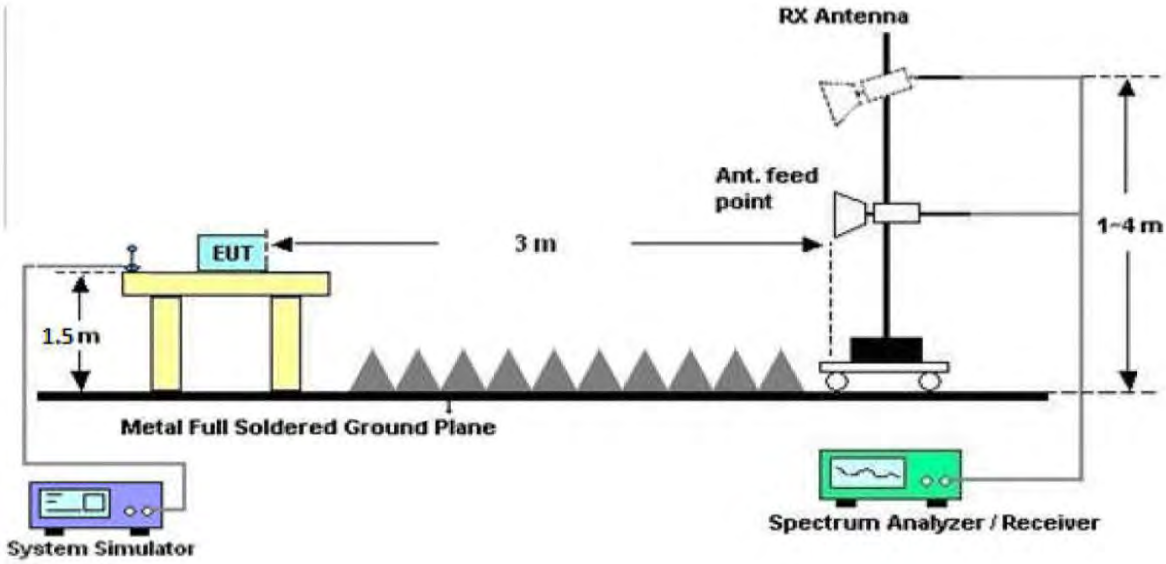


Figure 3. Above 1 GHz

4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.
For above 1GHz: The EUT is placed on a turntable, which is 1.5m above the ground plane.
The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber. The device is evaluated in xyz orientation.
For the radiated emission test above 1GHz:
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.

For 9kHz to 150kHz, Set the spectrum analyzer as:
RBW = 200Hz, VBW =1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:
RBW = 9KHz, VBW =30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 30MHz to 1000MHz, Set the spectrum analyzer as:
RBW = 100kHz, VBW =300kHz,Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For above 1GHz,Set the spectrum analyzer as:
RBW =1MHz, VBW =1MHz, Detector= Peak, Trace mode= Max hold, Sweep- auto couple.
RBW =1MHz, VBW =10Hz, Detector= Average, Trace mode= Max hold, Sweep- auto couple.

4.4. Test Data

PASS

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.

The test results of 9kHz-30MHz was attenuated more than 20dB below the permissible limits, so the results don't record in the report.

Test Results (Fundamental 433.92MHz)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Duty cycle Factor	Results	Limits	Det.
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	Mode
433.92	H	94.52	1.52	12.64	31.45	-	77.23	100.82	PK
433.92	H	94.52	1.52	12.64	31.45	-9.02	68.21	80.82	AV
433.92	V	97.23	1.52	12.64	31.45	-	79.94	100.82	PK
433.92	V	97.23	1.52	12.64	31.45	-9.02	70.92	80.82	AV

Remark:

1. Result = Reading + Cable Loss +Ant Factor –Amplifier + Duty cycle Factor
2. Pulse Desensitization Correction Factor
   Pulse Width (PW)=0.328ms
   2/PW=2/0.328=0.164 kHz
   RBW(1000kHz)＞ 2/PW (0.164 kHz)
   Therefore PDCF is not needed.

3. Duty Cycle Factor

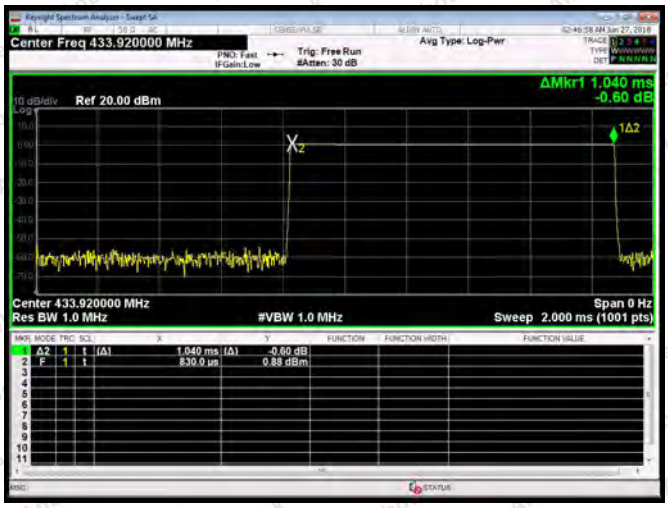
Calculate Formula:

AV=PEAK +Duty Cycle Factor
Duty Cycle Factor=20log(Duty Cycle)
Duty Cycle= on time/ period

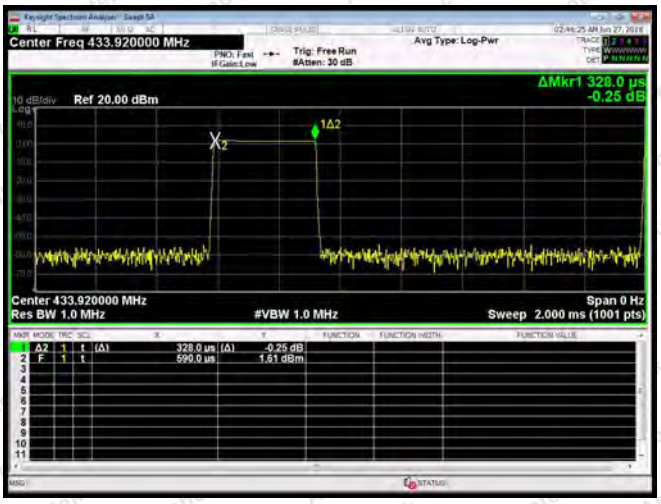
Test Data:

T on time=0.328ms*14+1.04ms*11=16.032ms
T period=45.30ms
Duty Cycle=35.39%
Duty Cycle Factor =20log(Duty Cycle)= -9.02

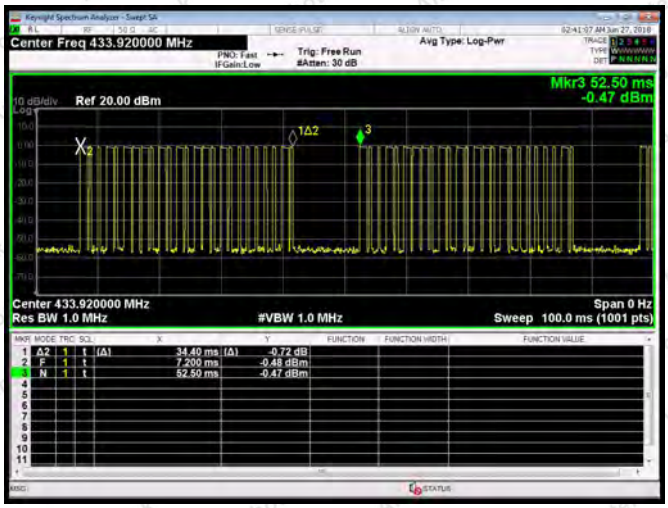
T on time slot-1



T on time slot-2



T period



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Test Results (Harmonics Emissions)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Duty cycle Factor	Results	Limits	Det
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	Mode
867.84	H	74.36	1.92	12.71	31.72	-	57.27	80.82	PK
867.84	H	74.36	1.92	12.71	31.72	-9.02	48.25	60.82	AV
867.84	V	76.23	1.92	12.71	31.72	-	59.14	80.82	PK
867.84	V	76.23	1.92	12.71	31.72	-9.02	50.12	60.82	AV
1301.76	H	63.75	2.38	21.43	32.45	-	55.11	74	PK
1301.76	H	63.75	2.38	21.43	32.45	-9.02	46.09	54	AV
1301.76	V	65.01	2.38	18.56	32.45	-	53.50	74	PK
1301.76	V	65.01	2.38	18.56	32.45	-9.02	44.48	54	AV

Remark ：

1. Result = Reading + Cable Loss +Ant Factor –Amplifier + Duty cycle Factor
2. Pulse Desensitization Correction Factor
   Pulse Width (PW)= 0.328ms
   2/PW=2/0.328=0.164 kHz
   RBW(1000kHz)＞ 2/PW (0.16 kHz)
   Therefore PDCF is not needed.
3. Duty Cycle Factor=-9.02

Test Results (Radiated Emission)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Results	Limits	Margin	Det.
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Mode
54.01	H	56.09	1.03	11.15	40.74	27.53	40	-12.47	QP
127.06	H	59.03	1.24	12.24	40.48	32.03	43.5	-11.47	QP
732.90	H	61.29	1.67	13.75	41.27	35.44	46	-10.56	QP
54.01	V	55.10	1.03	11.15	40.74	26.54	40	-13.46	QP
127.06	V	60.01	1.24	12.24	40.48	33.01	43.5	-10.49	QP
732.90	V	62.35	1.67	13.75	41.27	36.50	46	-9.50	QP

Remark:

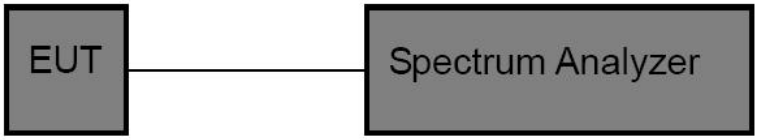
1. Results = Reading + Cable Loss +Ant Factor –Amplifier

5. 20DB Occupy Bandwidth Test

5.1. Test Standard and Limit

<table>
<tr><td>Test Standard</td><td>FCC Part15 C Section 15.231 (c)</td></tr>
<tr><td>Test Limit</td><td>According to FCC Part 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.
So the emission bandwidth limits have been calculated in below table:
<table>
<tr><td>Fundamental Frequency</td><td>Limit of 20dB Bandwidth</td></tr>
<tr><td>433.92 MHz</td><td>433920x0.0025=1084.80 kHz</td></tr>
</table>
</td></tr>
</table>

5.2. Test Setup



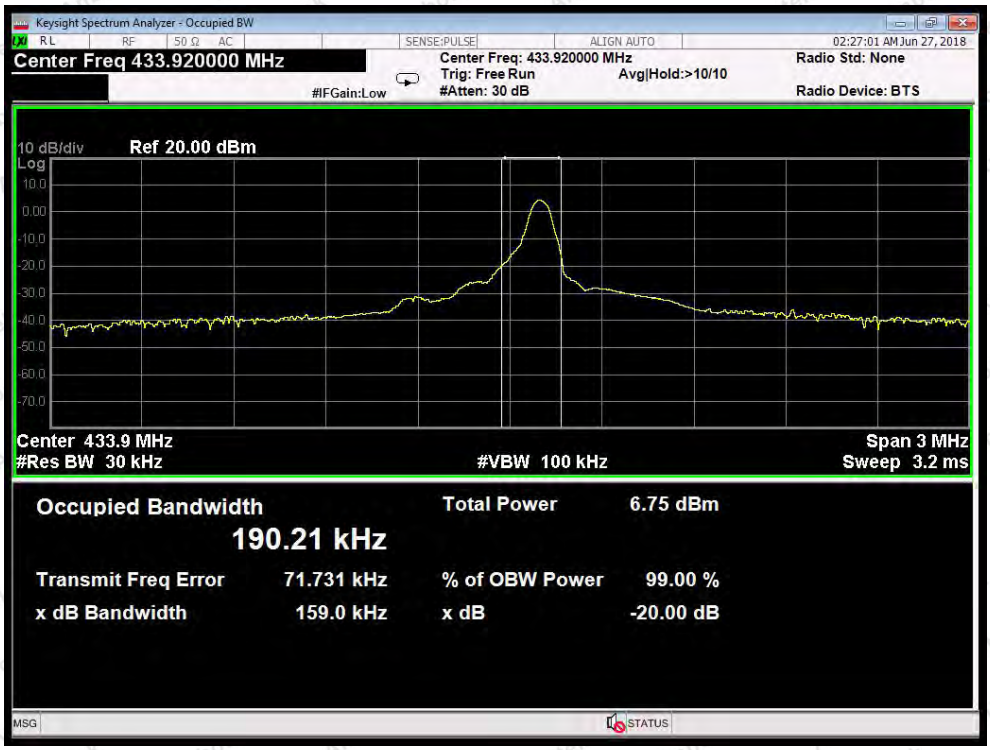
5.3. Test Procedure

1. Place the EUT on the table and set it in the continuously transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as:
   RBW = 30kHz, VBW≥3*RBW =100kHz,
   Span= 3MHz
   Detector= Peak
   Trace mode= Max hold.
   Sweep- auto couple.
4. Mark the peak frequency and –20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

5.4. Test Data

Test Item	:	20dB Bandwidth	Test Mode	:	Continuously transmitting
Test Voltage	:	DC 12V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Freq. (MHz)	Modulation Type	Bandwidth (kHz)	Limit (kHz)	Results
433.92	ASK	159.0	<1084.80	PASS


Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
02:27:01 AM Jun 27, 2018
Center Freq 433.920000 MHz
Center Freq: 433.920000 MHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 433.9 MHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3 MHz
Sweep 3.2 ms
Occupied Bandwidth
190.21 kHz
Total Power
6.75 dBm
Transmit Freq Error
71.731 kHz
% of OBW Power
99.00 %
x dB Bandwidth
159.0 kHz
x dB
-20.00 dB
MSG
STATUS

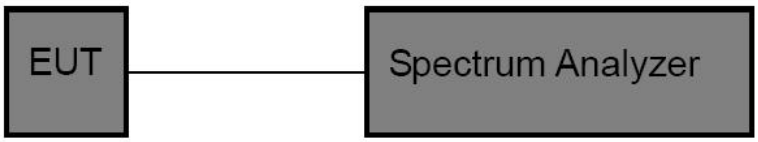
433.92MHz

6. Dwell Time Test

6.1. Test Standard and Limit

Test Standard	FCC Part 15.231(a)(1)
Test Limit	According to FCC Part 15.231(a)(1), A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released

6.2. Test Setup



6.3. Test Procedure

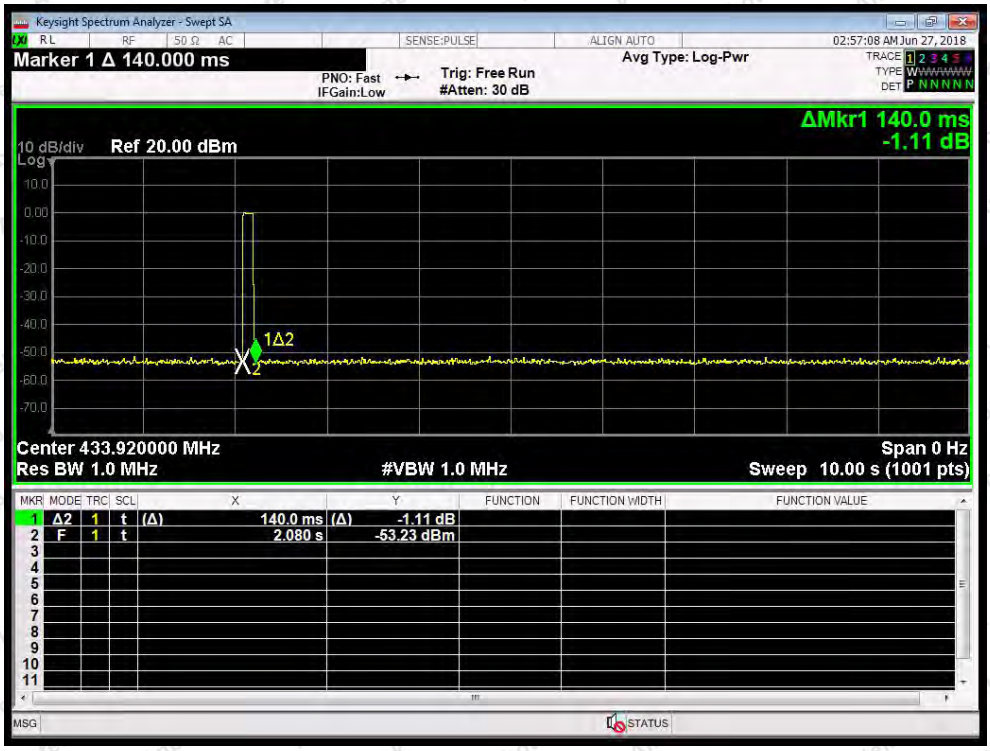
1. Place the EUT on the table and set it in continuously transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as
   RBW=1000kHz, VBW=1000kHz, Span= 0Hz, Sweep Time= 10 Seconds.
3. Record the Delta mark time.

6.4. Test Data

Test Item	:	Dwell Time	Test Mode	:	Continuously transmitting
Test Voltage	:	DC 12V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Test Mode	Transmitting time(s)	Limit(s)	Result
ASK mode	0.140	≤5	PASS

Please refer the following plot.


Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:PULSE
ALIGN AUTO
02:57:08 AM Jun 27, 2018
Marker 1 Δ 140.000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE W W W W W
DET P N N N N
ΔMkr1 140.0 ms
-1.11 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1Δ2
Center 433.920000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 10.00 s (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 Δ2 1 t (Δ) 140.0 ms (Δ) -1.11 dB
2 F 1 t 2.080 s -53.23 dBm
3
4
5
6
7
8
9
10
11
MSG
STATUS

Dwell Time

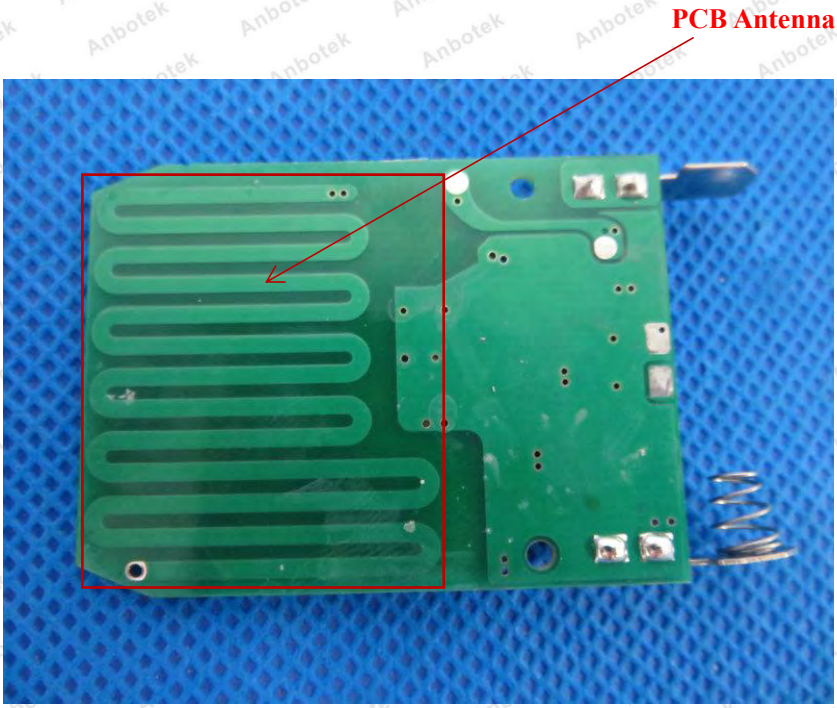
7. Antenna Requirement

7.1. Test Standard and Requirement

Test Standard	FCC Part15 Section 15.203
Requirement	1) 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. Antenna requirement must meet at least one of the following: 1) Antenna must be permanently attached to device. 2) The antenna must use a unique type of connector to attach to the device. 3) Device must be professionally installed. The installer shall be responsible for ensuring that the correct antenna is employed by the device.

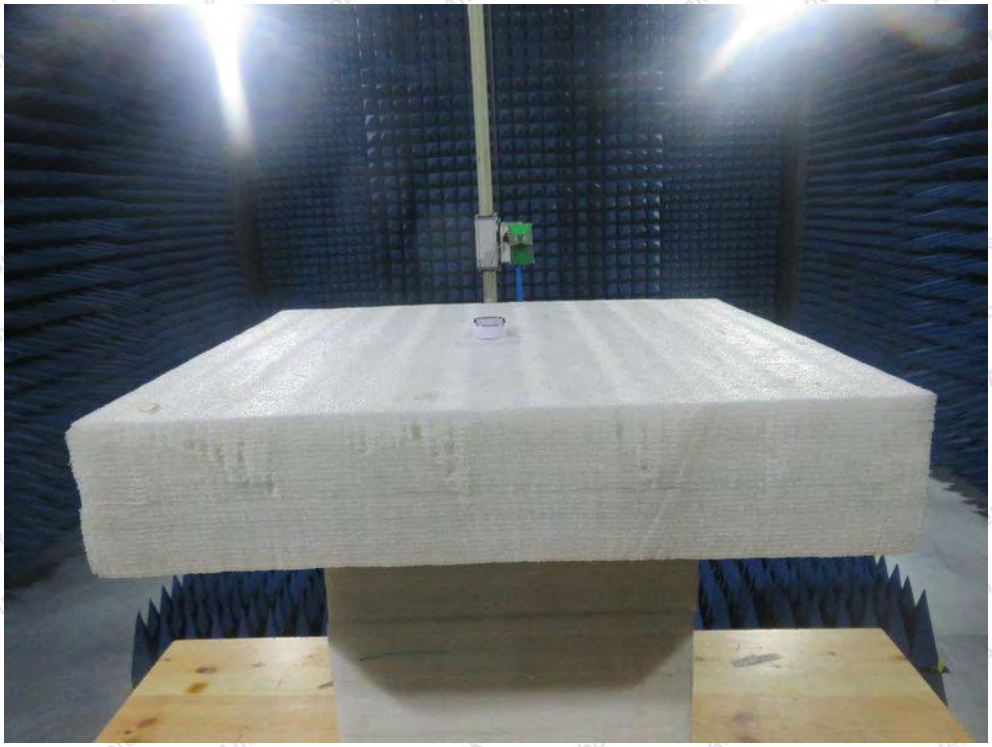
7.2. Antenna Connected Construction

The RF antenna is a PCB Antenna which permanently attached, and the best case gain of the antenna is 1.5 dbi. It complies with the standard requirement.

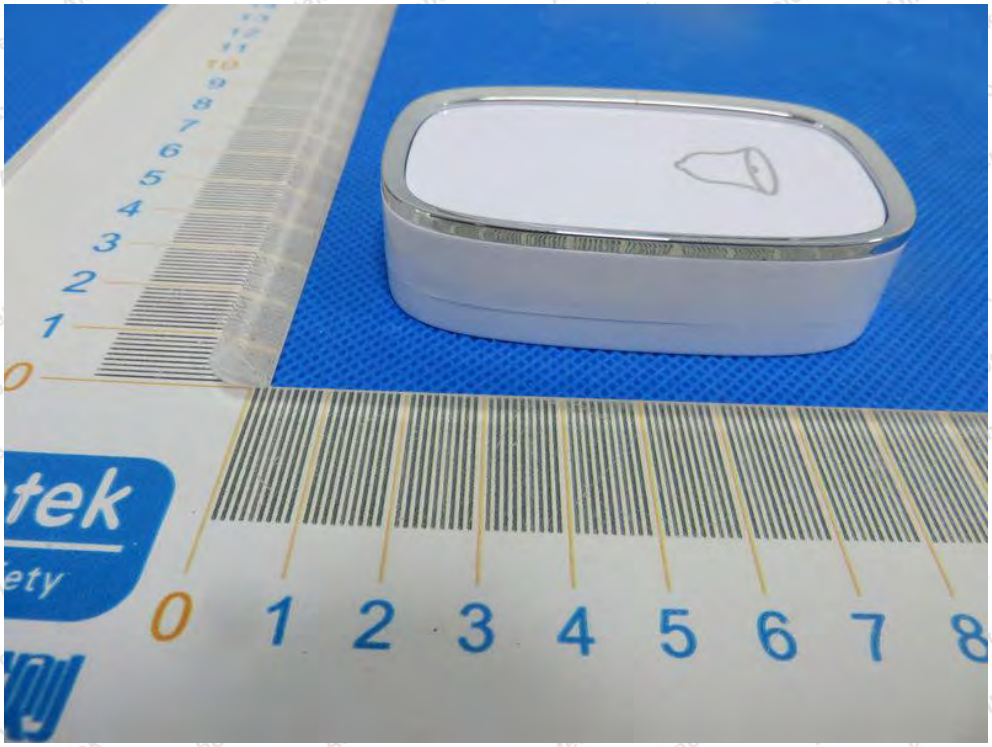


APPENDIX I -- TEST SETUP PHOTOGRAPH

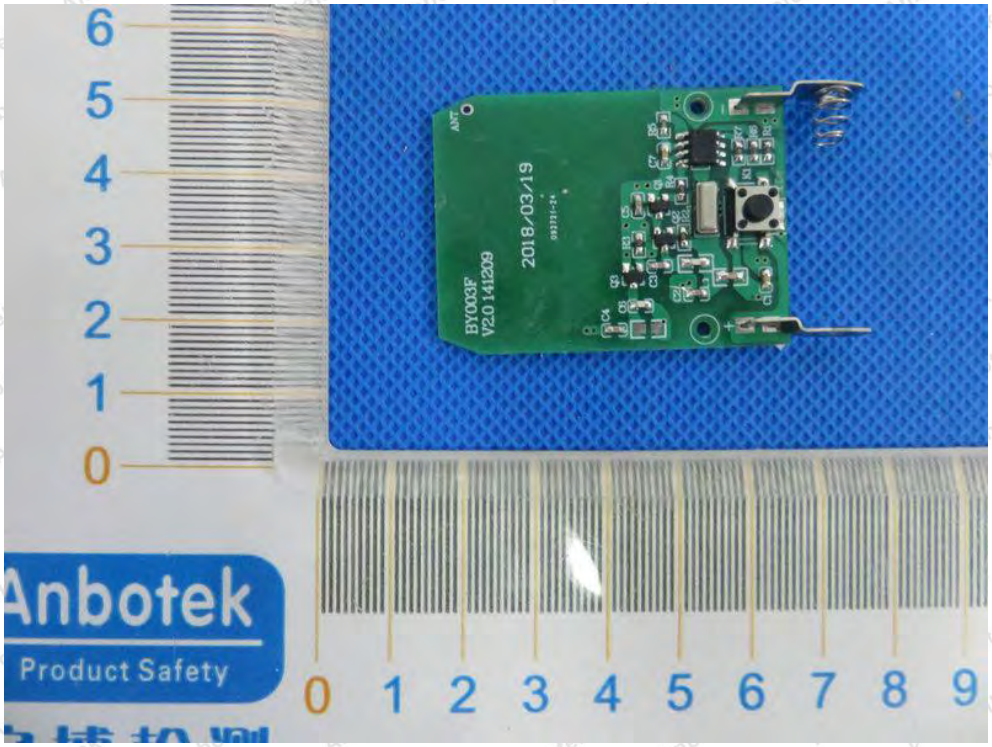
Photo of Radiated Emission Measurement



APPENDIX II -- EXTERNAL PHOTOGRAPH



APPENDIX III -- INTERNAL PHOTOGRAPH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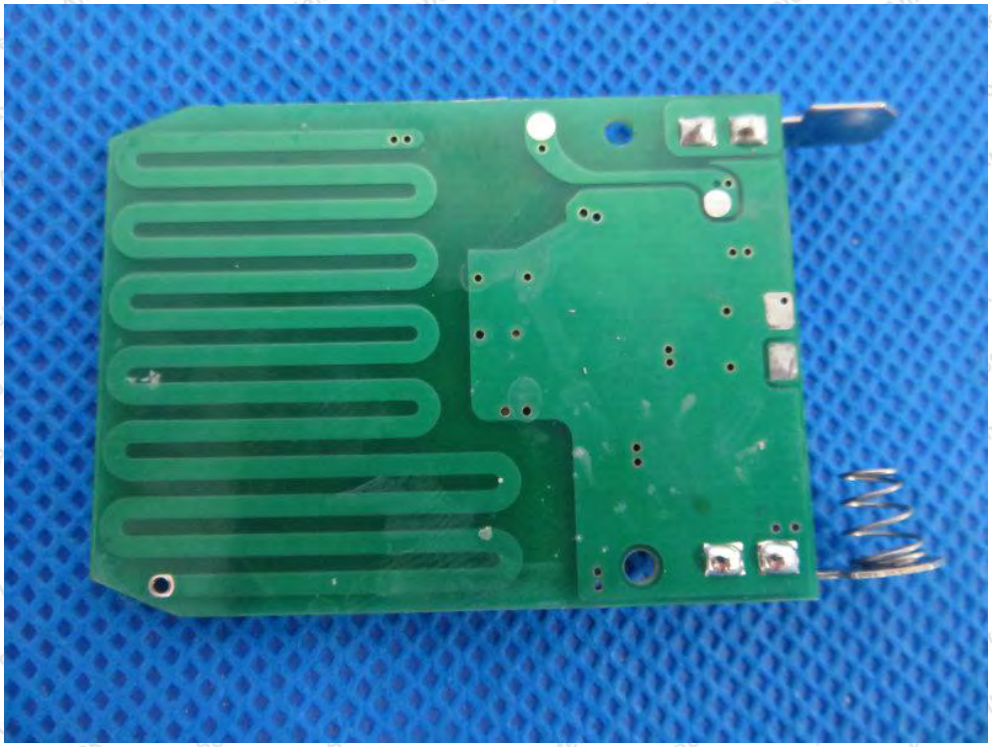
Product Safety

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