EMTEK
Access to the World

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC CFR47 PART 15 Section 15.249
REQUIREMENT

OF

Product Name: Door/Window Sensor Gen5

MODEL No.: ZW120-A

Trademark: N/A

FCC ID: XBAZW120

REPORT NO: ES151027019E

ISSUE DATE: November 12, 2015

Prepared for

Aeon Labs LLC.
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Prepared by

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VERIFICATION OF COMPLIANCE

Applicant:	Aeon Labs LLC. 121 Buckingham Drive Unit 36, Santa Claras, CA, United States
Manufacturer:	Fantem Technologies (Shenzhen) Co., Ltd North,3/F, Yitoa Technology Industrial Park, Baihua Yuan Rd., The Second Industrial Area, Guangming Sub-district Office, Guangming New District, Shenzhen, Guangdong, China
Product Description:	Door/Window Sensor Gen5
Model Number:	ZW120-A
Date of Test:	October 28, 2015 to November 12, 2015

We hereby certify that:
The above equipment was tested by EMTEK (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 conducted and radiated emission limits of FCC Rules Part 15.249.

The test results of this report relate only to the tested sample identified in this report.

Date of Test : October 28, 2015 to November 12, 2015

Prepared by : Yaping Shen

Yaping Shen/Editor

Reviewer : Joe Xia

Joe Xia/Supervisor

Approve & Authorized Signer :

Lisa Wang/Manager

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1. GENERAL INFORMATION

1.1. Product Description

The Door & Window Sensor finds out something very simple – whether a door or a window, or in fact any object in your home, is open or closed. But there's power in simplicity. Power that allows you to inform the rest of your Z-Wave network about your selected doors and windows. Like a thermostat lets your heating and cooling systems know what they should do next, Aeotec's Z-Wave Door & Window Sensor does the same. Perhaps an open door means that your lights should turn on and welcome you home. Perhaps an open window means that an alarm should be trigged. Whatever it means to your home, with door and window sensors installed, your Z-Wave network will have both the power and the intelligence to do it.

Product information:	
Power supply:	DC 3V by 2*AAA battery
Operating Frequency Range:	908.40, 908.42MHz
Modulation:	FSK
Number of Channels:	2 channels
Antenna Type:	Wire antenna(internal antenna)
Antenna Gain:	-3 dBi
Temperature Range:	-10°C ~ +55°C

1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: XBAZW120 filing to comply with Section 15.249 of the FCC Part 15, Subpart C Rules.

1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4. Special Accessories

Not available for this EUT intended for grant.

1.5. Equipment Modifications

Not available for this EUT intended for grant.

1.6. Measurement Uncertainty

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.00dB
Fundamental Fieldstrength	Not Applicable	95%	±2.94dB
Transmitter 20 dB Bandwidth	Not Applicable	95%	±0.92PPm
Radiated Spurious Emissions	30 MHz to 40 GHz	95%	±3.00dB

1.7. Test Facility

Site Description

EMC Lab. : Accredited by CNAS, 2013.10.29
The certificate is valid until 2016.10.28
The Laboratory has been assessed and proved to be in compliance with CNAS-CL01: 2006(identical to ISO/IEC17025: 2005)
The Certificate Registration Number is L2291

Accredited by TUV Rheinland Shenzhen, 2010.5.25
The Laboratory has been assessed according to the requirements ISO/IEC 17025.

Name of Firm : Accredited by FCC, July 24, 2013
The Certificate Registration Number is 406365.

Site Location : Accredited by FCC, April 17, 2013
The Certificate Registration Number is 709623.

2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.3. Test Procedure

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. Emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013

2.4. Description of test modes

The EUT has been tested under normal operating condition.
Pre-scanned tests, X, Y, Z in the three orthogonal panels, were conducted to determine the final configuration from all possible combinations. Let EUT transmit with highest power, and the worst result was recorded with modulation FSK.

3. SUMMARY OF TEST RESULTS

FCC Part15, Subpart C		
Standard Section **FCC**	**Test Item**	**Result**
15.207	Conducted Emission	N/A*
15.209 15.205 15.249	Radiated Emission	Pass
15.35(c)	Periodic Operation	Pass
15.249 15.209 15.205	Band edge test	Pass
15.249	20dB Bandwidth	Pass
15.203	Antenna Requirement	Pass

Note*: The product is powered by 2*AAA battery, so the Conduct emission is not application.

4. RADIATED EMISSION TEST

4.1. Measurement Procedure

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m.The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013

Below 30MHz：

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

30GHz-1GHz：

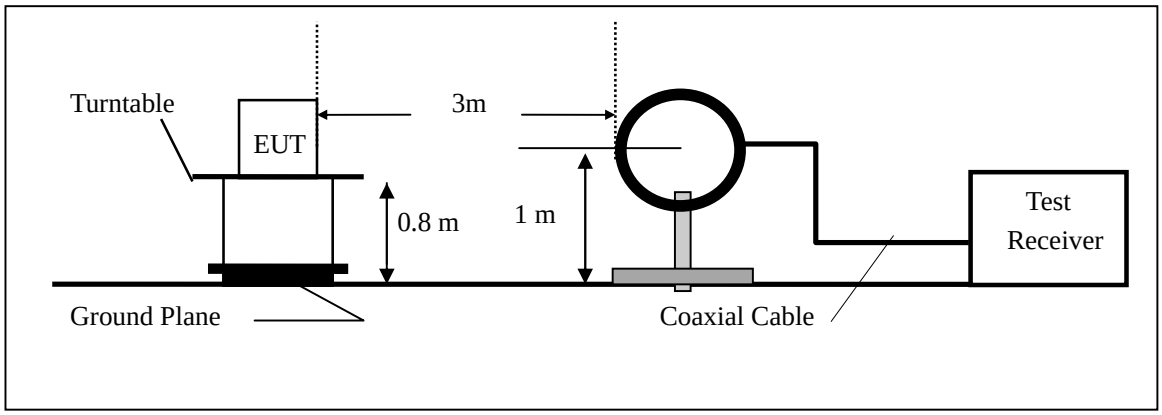
The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Above 1GHz：

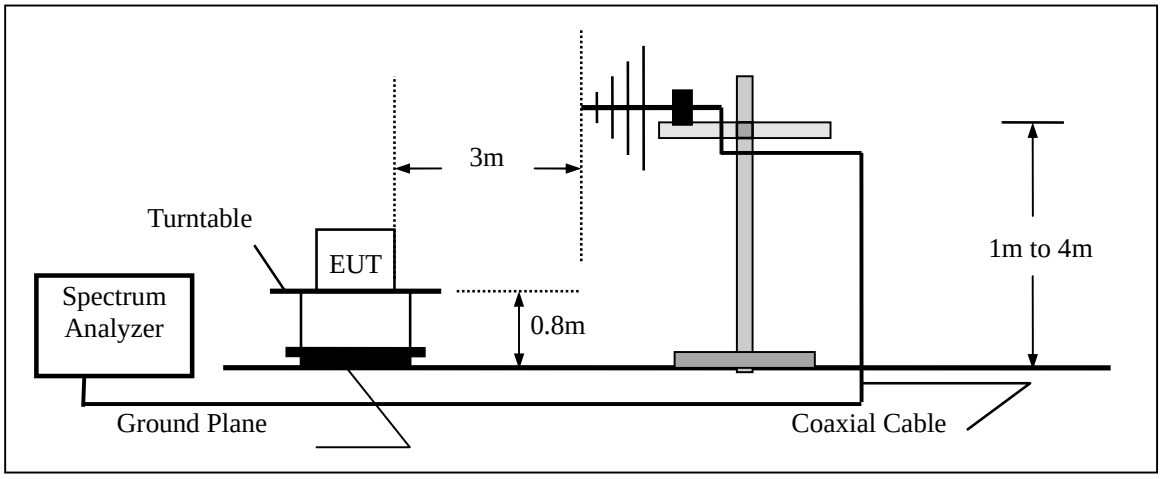
The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

4.2. Test SET-UP (Block Diagram of Configuration)

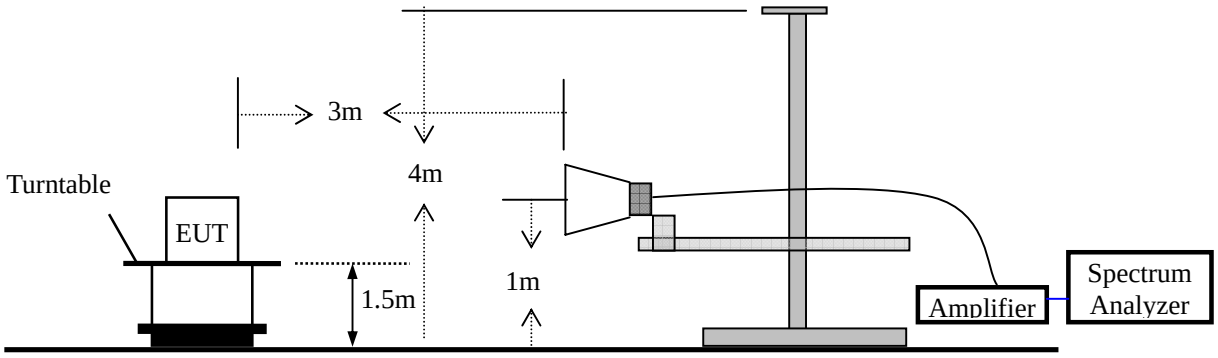
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



5.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	May 16, 2015	May 15, 2016
Spectrum Analyzer	HP	E4407B	839840481	May 16, 2015	May 15, 2016
EMI Test Receiver	Rohde & Schwarz	ESCS30	828985/018	May 16, 2015	May 15, 2016
Pre-Amplifier	HP	8447D	2944A07999	May 16, 2015	May 15, 2016
Bilog Antenna	Schwarzbeck	VULB9163	142	May 16, 2015	May 15, 2016
Loop Antenna	ARA	PLA-1030/B	1029	May 16, 2015	May 15, 2016
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	May 16, 2015	May 15, 2016
Horn Antenna	Schwarzbeck	BBHA 9120	D143	May 16, 2015	May 15, 2016

5.4 Radiated Emission Limit

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

The fundamental limit comply with below 94dBuV/m at 3m, Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other 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 comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Note:

(1) The tighter limit applies at the band edges.

(2) Emission level (dBuV/m)=20log Emission level (uV/m).

Limits of radiated emission measurement (FCC 15.209)

FREQUENCY (MHz)	(dBuV/m) (at 3m)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:
(1) The limit for radiated test was performed according to FCC PART 15C.
(2) The tighter limit applies at the band edges.
(3) Emission level (dBuV/m) =20log Emission level (uV/m).

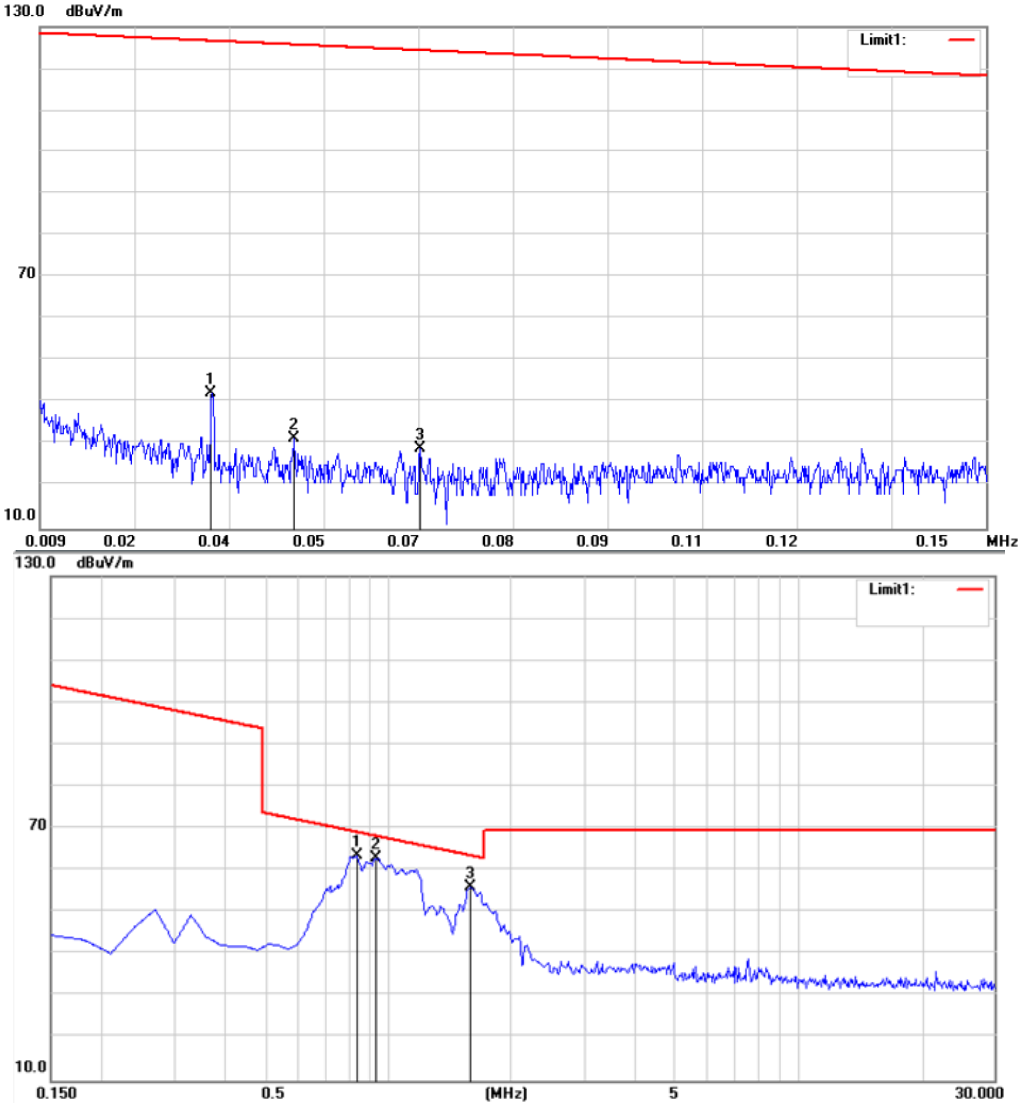
Limits of radiated emission measurement (FCC 15.249)

FCC Part15 (15.249) , Subpart C	
	Limit
Field strength of fundamental	50000uV/m (94 dBV/m) @ 3 m
Field strength of harmonics	500uV/m (54 dBV/m) @ 3 m

5.5 Measurement Result

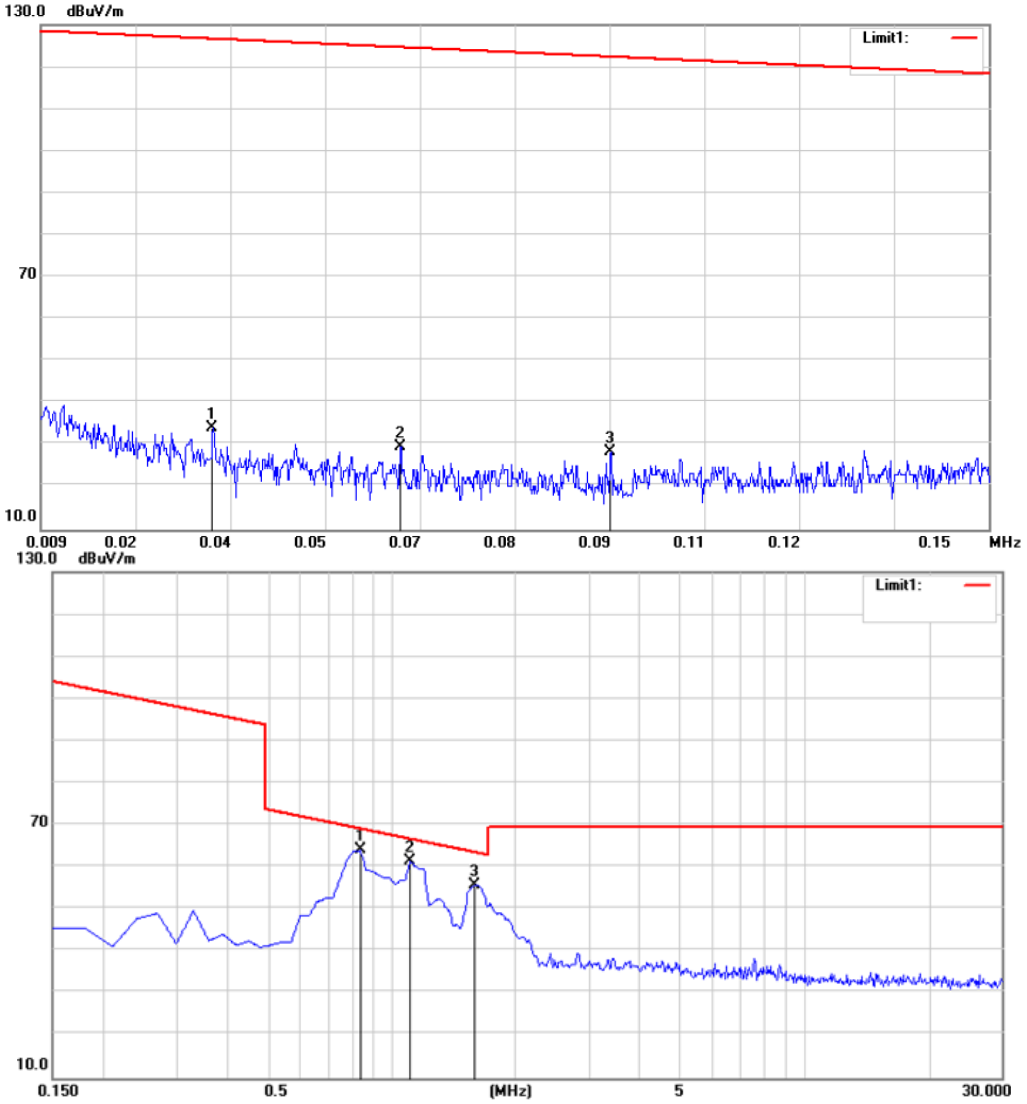
All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Operation Mode:	908.42MHz	Test Date :	October 30, 2015
Frequency Range:	9K~30MHz	Temperature :	24℃
Test Result:	PASS	Humidity :	55 %
Measured Distance:	3m	Test By:	SYP
polarity	H		



Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)	Result
0.0345	H	42.23	126.66	-84.43	Pass
0.0470	H	31.32	125.76	-94.44	Pass
0.0656	H	28.93	124.42	-95.49	Pass
0.8365	H	63.54	-7.15	-7.15	Pass
0.9282	H	63.00	-6.87	-6.87	Pass
1.5827	H	56.05	-7.95	-7.95	Pass

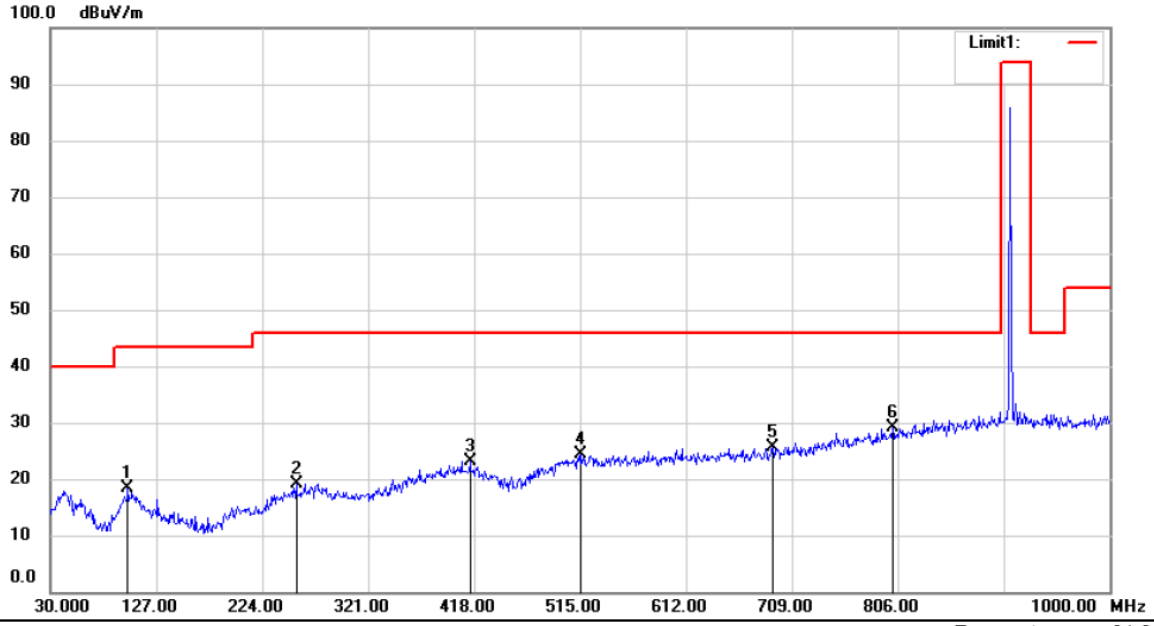
Operation Mode:	908.42MHz	Test Date :	October 30, 2015
Frequency Range:	9K~30MHz	Temperature :	24℃
Test Result:	PASS	Humidity :	55 %
Measured Distance:	3m	Test By:	SYP
polarity	V		



Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)	Result
0.0345	V	34.11	126.66	-92.55	Pass
0.0623	V	29.54	124.65	-95.11	Pass
0.0937	V	28.36	122.39	-94.03	Pass
0.8365	V	64.03	70.69	-6.66	Pass
1.1050	V	61.53	68.28	-6.75	Pass
1.5827	V	55.82	64.00	-8.18	Pass

All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Operation Mode:	908.42MHz	Test Date :	October 30, 2015
Frequency Range:	30~1000MHz	Temperature :	24℃
Test Result:	PASS	Humidity :	55 %
Measured Distance:	3m	Test By:	SYP

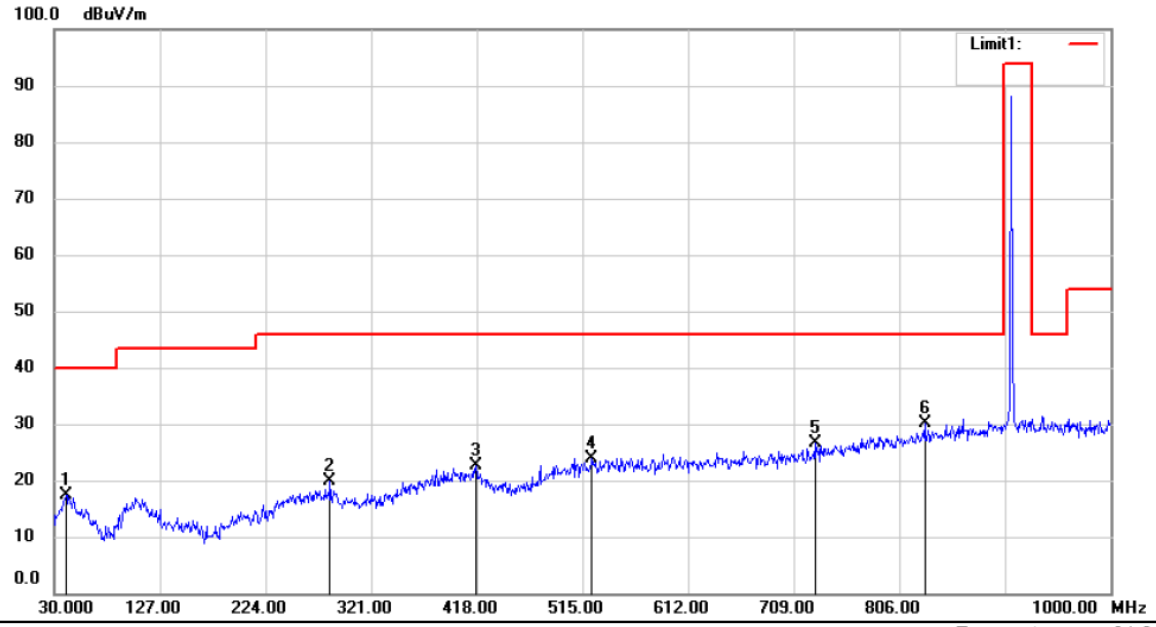


Site 3m Chamber #3 Polarization: *Vertical* Temperature: 24 C

Limit: FCC PART 15.249 Power: DC 3V by battery Humidity: 53 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		100.8100	32.34	-14.02	18.32	43.50	-25.18	QP			
2		255.0400	32.20	-13.06	19.14	46.00	-26.86	QP			
3		414.1200	32.43	-9.27	23.16	46.00	-22.84	QP			
4		515.9700	31.96	-7.67	24.29	46.00	-21.71	QP			
5		691.5400	31.66	-6.06	25.60	46.00	-20.40	QP			
6	*	801.1500	31.86	-2.85	29.01	46.00	-16.99	QP			

*:Maximum data x:Over limit !:over margin Operator:SYP



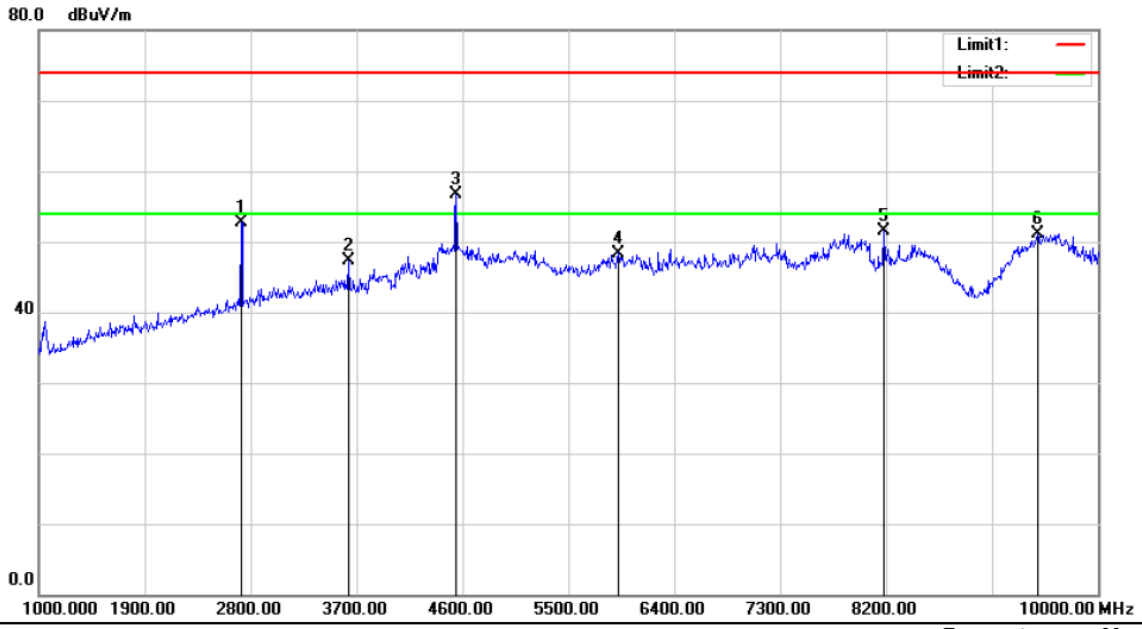
Site 3m Chamber #3 Polarization: ***Horizontal*** Temperature: 24 C

Limit: FCC PART 15.249 Power: DC 3V by battery Humidity: 53 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		40.6700	30.33	-12.87	17.46	40.00	-22.54	QP			
2		283.1700	32.60	-12.78	19.82	46.00	-26.18	QP			
3		417.0300	31.99	-9.34	22.65	46.00	-23.35	QP			
4		523.7300	31.61	-7.61	24.00	46.00	-22.00	QP			
5		728.4000	31.79	-5.10	26.69	46.00	-19.31	QP			
6	*	829.2800	32.43	-2.20	30.23	46.00	-15.77	QP			

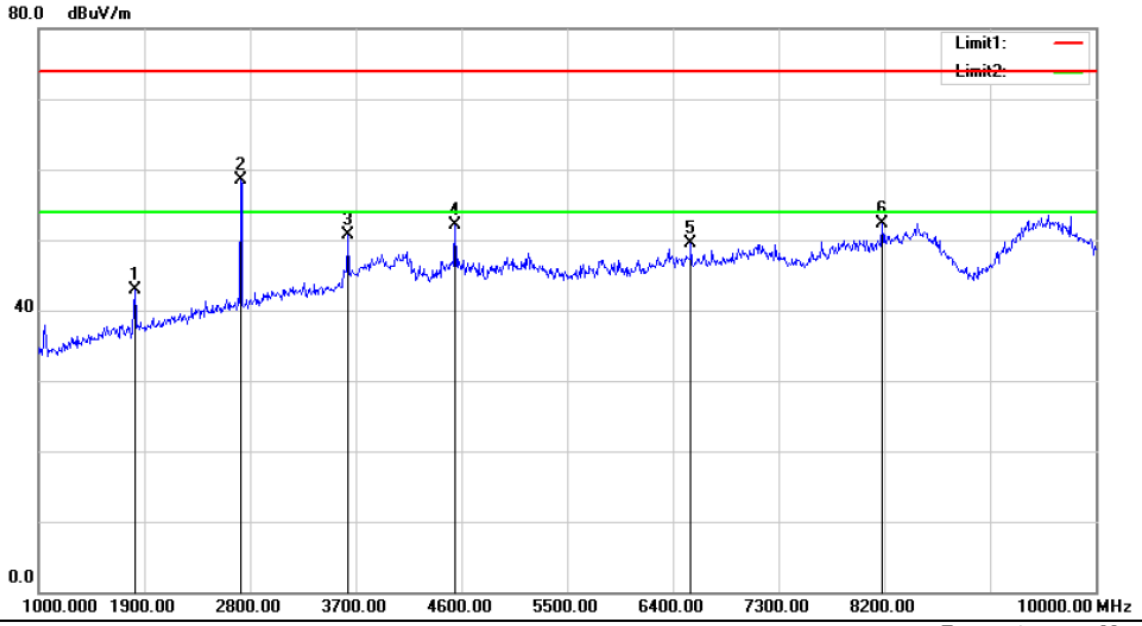
*:Maximum data x:Over limit !:over margin Operator:SYP

Operation Mode:	908.42MHz	Test Date :	October 30, 2015
Frequency Range:	1-10GHz	Temperature :	24℃
Test Result:	PASS	Humidity :	55 %
Measured Distance:	3m	Test By:	SYP



Site :10m Chamber #1 Polarization: *Vertical* Temperature: 22

Limit: (RE)FCC PART 15 CLASS C Power: DC 3V by battery Humidity: 50 %



Site :10m Chamber #1 Polarization: *Horizontal* Temperature: 22

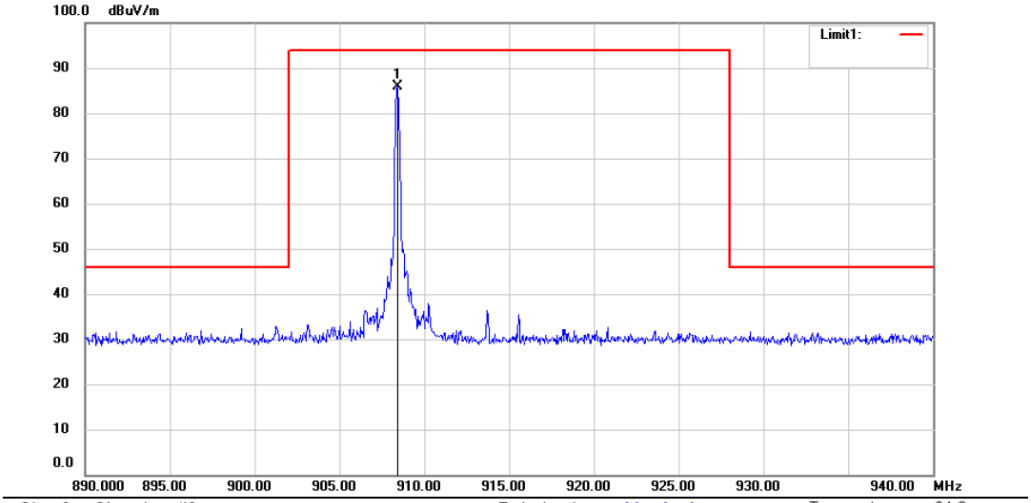
Limit: (RE)FCC PART 15 CLASS C Power: DC 3V by battery Humidity: 50 %

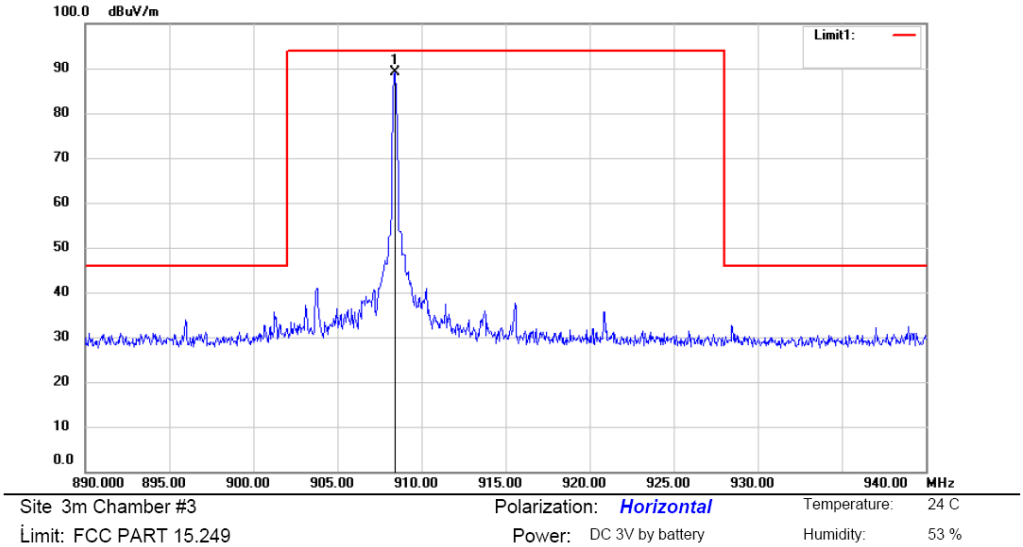
Freq. (MHz)	Ant.Pol. H/V	Emission Level			Limit at 3m		Margin	
		PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
2719	V	52.77	-9.28	43.49	74.00	54.00	-21.23	-10.51
3628	V	47.37	-9.28	38.09	74.00	54.00	-26.63	-15.91
4546	V	56.73	-9.28	47.45	74.00	54.00	-17.27	-6.55
5923	V	48.40	-9.28	39.12	74.00	54.00	-25.60	-14.88
8182	V	51.47	-9.28	42.19	74.00	54.00	-22.53	-11.81
9487	V	51.04	-9.28	41.76	74.00	54.00	-22.96	-12.24
1819	H	42.98	-9.28	33.70	74.00	54.00	-31.02	-20.30
2719	H	58.56	-9.28	49.28	74.00	54.00	-15.44	-4.72
3637	H	50.70	-9.28	41.42	74.00	54.00	-23.30	-12.58
4546	H	52.15	-9.28	42.87	74.00	54.00	-21.85	-11.13
6553	H	49.57	-9.28	40.29	74.00	54.00	-24.43	-13.71
8182	H	52.28	-9.28	43.00	74.00	54.00	-21.72	-11.00

Note: (1) All Readings are Peak Value.
(2) AV Value= Peak Value-AV factor(AV factor= -9.28 from section 5)
(3) Emission Level= Reading Level+Probe Factor +Cable Loss
(4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Transmitter Fundamental Field Strength

Operation Mode:	908.42 MHz	Test Date :	October 30, 2015
FCC Part:	15.249(a)	Temperature :	24℃
Test Result:	PASS	Humidity :	55 %
Measured Distance:	3m	Test By:	SYP





Freq. (MHz)	Ant.Pol. H/V	Emission Level			Limit at 3m		Margin	
		PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
908.42	V	85.96	-9.28	76.68	114	94	-28.04	-17.32
908.42	H	89.01	-9.28	79.73	114	94	-24.99	-14.27

Note: (1) All Readings are Peak Value.
(2) AV Value= Peak Value+AV factor(AV factor= -9.28 from section 5)
(3) Emission Level= Reading Level+Probe Factor +Cable Loss
(4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

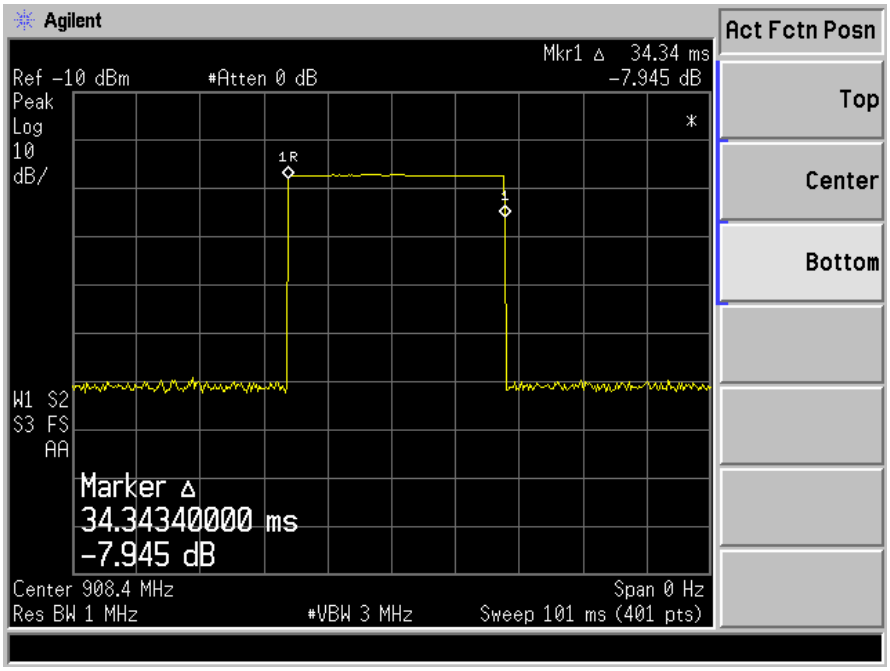
5. Periodic Operation

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

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %
Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle(%))

Total transmission time(ms)	100.00
Length of a complete transmission period(ms)	34.34
Duty Cycle(%)	34.34
Duty Cycle Correction Factor(dB)	-9.28

Refer to the duty cycle plot (as below), This device meets the FCC requirement.
Length of a complete pulse train:
Remark: FCC part 15.35(c) required that a complete pulse train is more than 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 value.

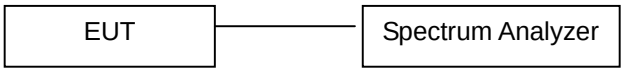


6. BANDWIDTH TEST

6.1. Measurement Procedure

The EUT was operating in normal mode. Printed out the test result from the spectrum by hard copy function.

6.2. Test SET-UP (Block Diagram of Configuration)



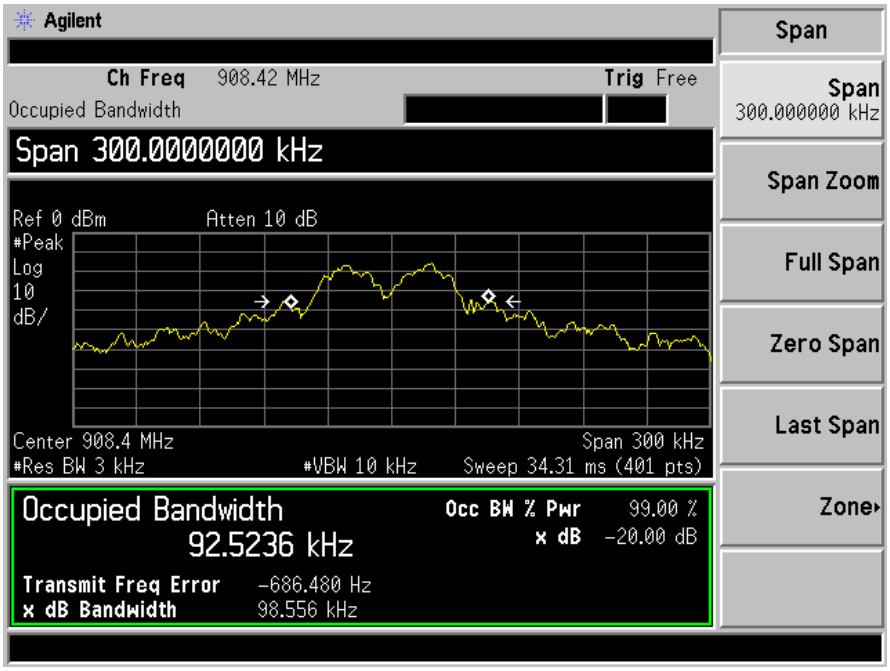
6.3. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/16/2015	05/15/2016

6.4. Measurement Results:

Test By:	SYP	Test Date:	October 30, 2015
Temperature:	24℃	Humidity:	55 %
Modulation:	FSK		

Channel frequency (MHz)	20dB Down BW(kHz)
908.42	98.556



7. BAND EDGE TEST

7.1. Measurement Procedure

1. The EUT was Operating in normal mode. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 1.5 m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.

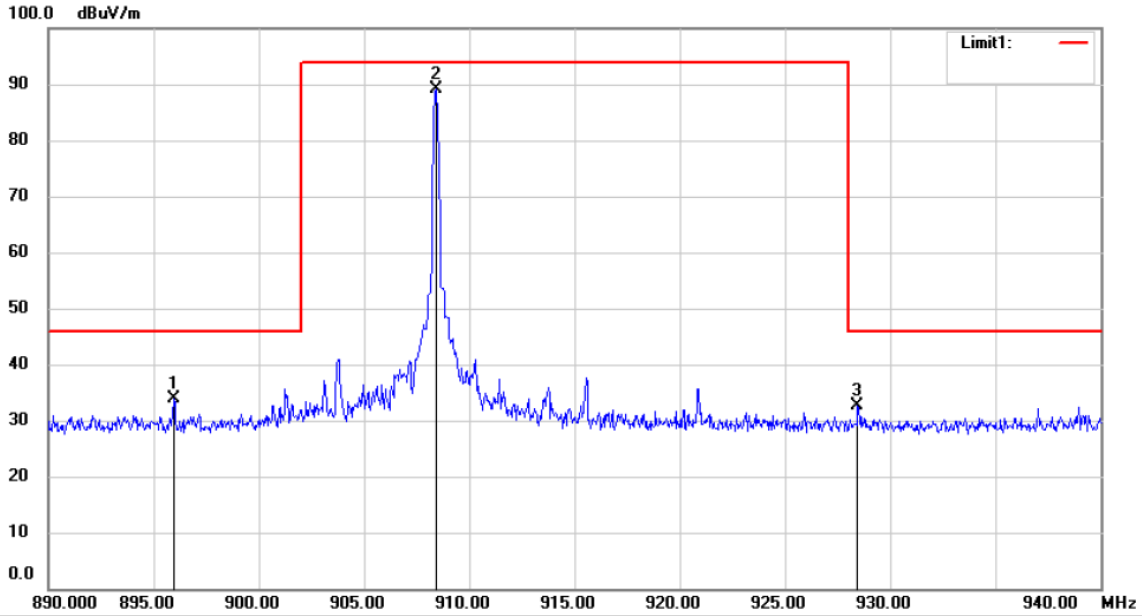
7.2. Test SET-UP (Block Diagram of Configuration)

As 5.2 Test set up (B) and (C)

7.3. Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

7.4. Measurement Results:

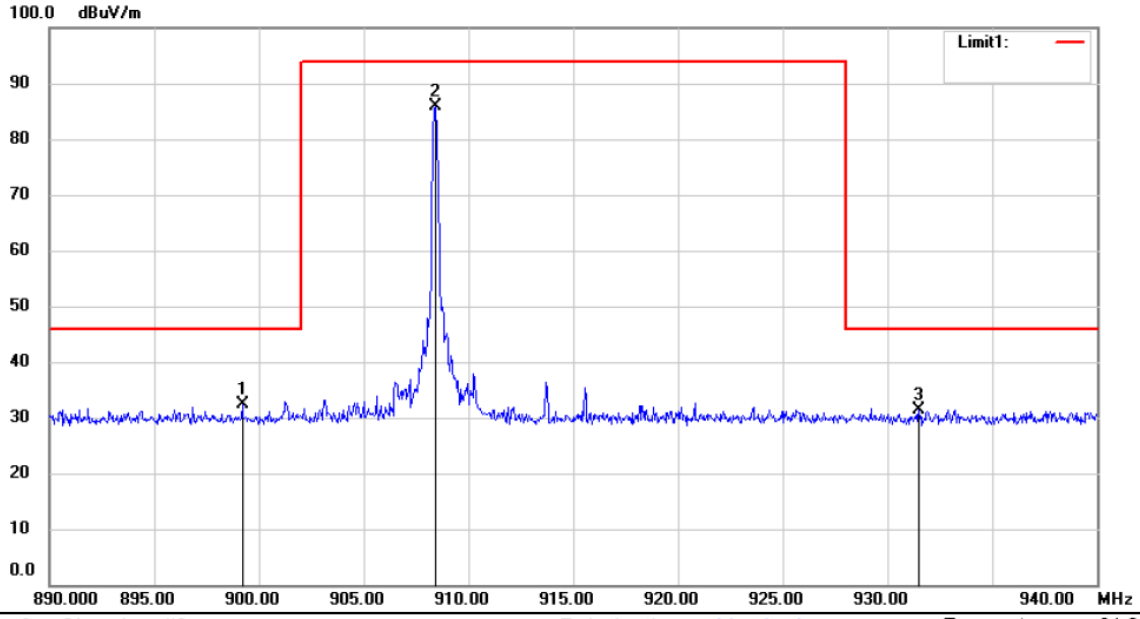


Site 3m Chamber #3 Polarization: ***Horizontal*** Temperature: 24 C

Limit: FCC PART 15.249 Power: DC 3V by battery Humidity: 53 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		895.9500	34.55	-0.71	33.84	46.00	-12.16	QP			
2	*	908.4000	89.65	-0.64	89.01	94.00	-4.99	peak			
3		928.4500	33.37	-0.67	32.70	46.00	-13.30	QP			

*:Maximum data x:Over limit !:over margin Operator:SYP



Site 3m Chamber #3 Polarization: *Vertical* Temperature: 24 C

Limit: FCC PART 15.249 Power: DC 3V by battery Humidity: 53 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		899.2000	32.96	-0.64	32.32	46.00	-13.68	QP			
2	*	908.4000	86.60	-0.64	85.96	94.00	-8.04	peak			
3		931.5000	32.09	-0.67	31.42	46.00	-14.58	QP			

*:Maximum data x:Over limit !:over margin Operator:SYP

8. Antenna Application

8.1. Antenna Requirement

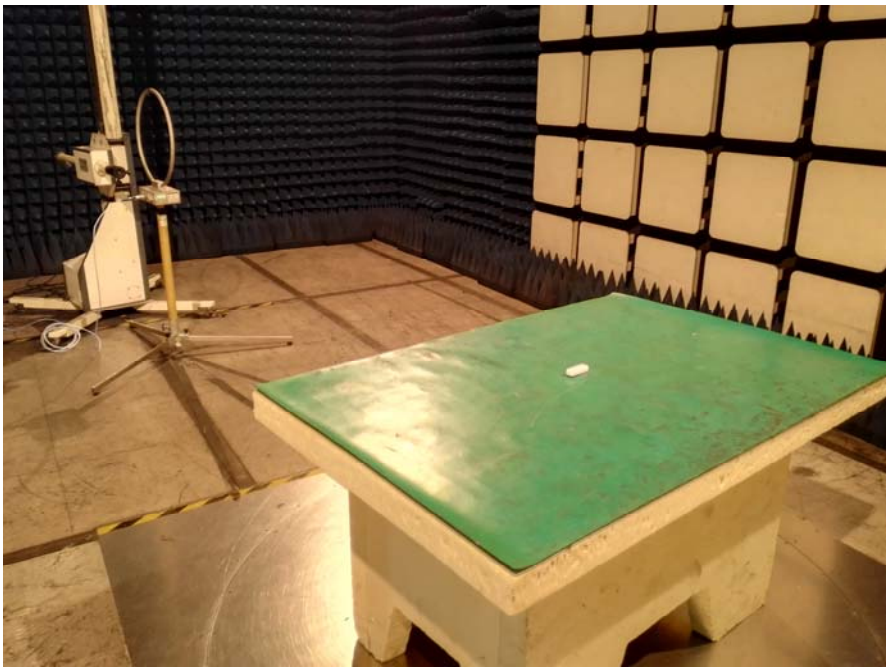
Standard	Requirement
FCC CRF Part 15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

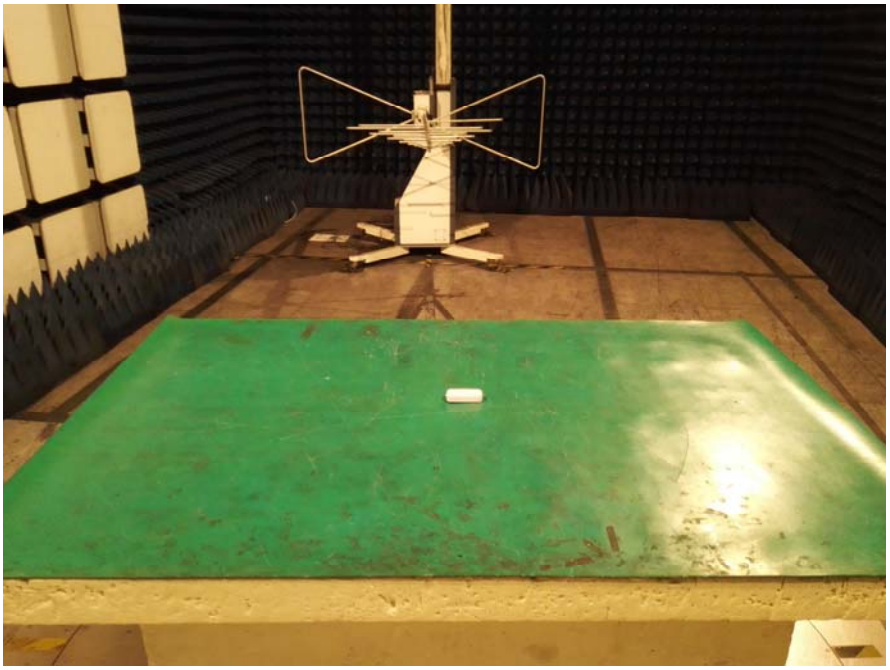
8.2. Result

The EUT has a Wire antenna(internal antenna), the gain is -3dBi, which in accordance to section 15.203, please refer to the internal photos.

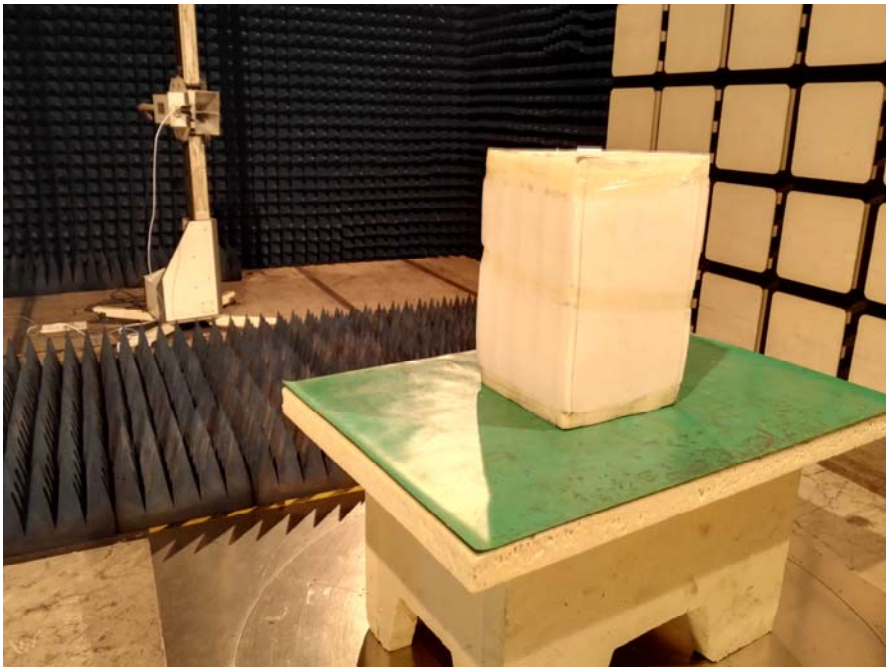
9. APPENDIX I (Photos of Setup)



Radiated Emission (9KHz-30MHz)



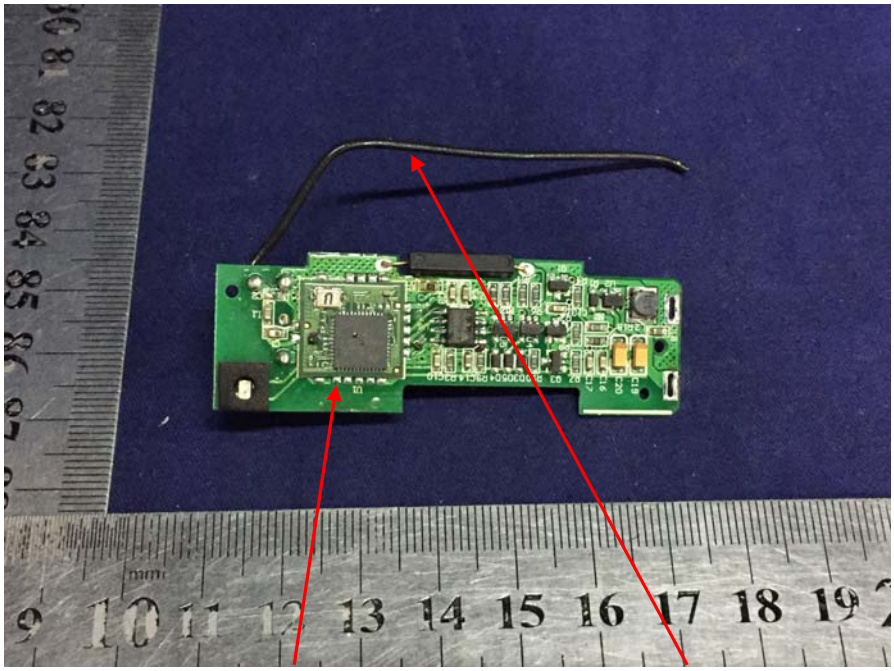
Radiated Emission (30MHz-1GHz)

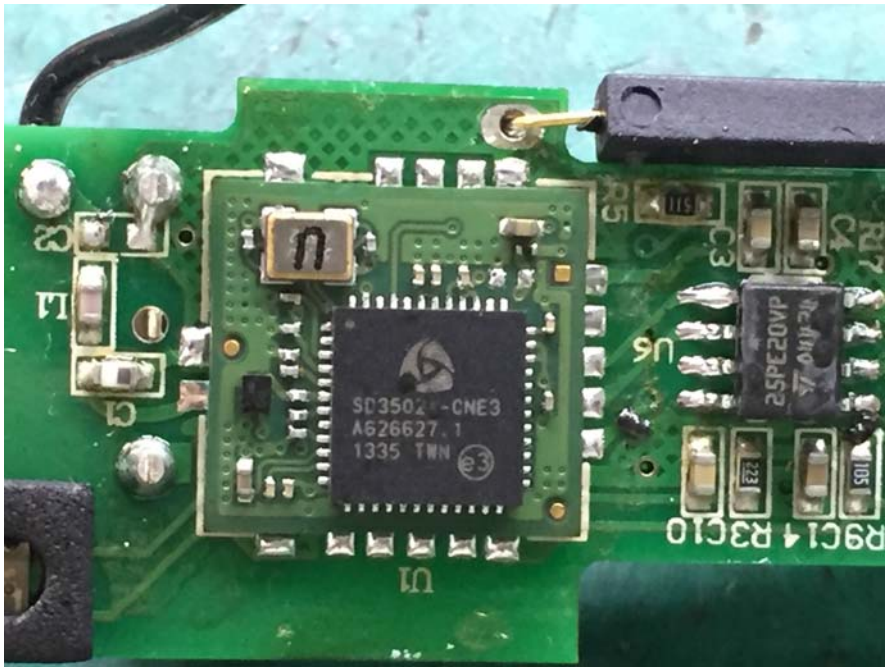


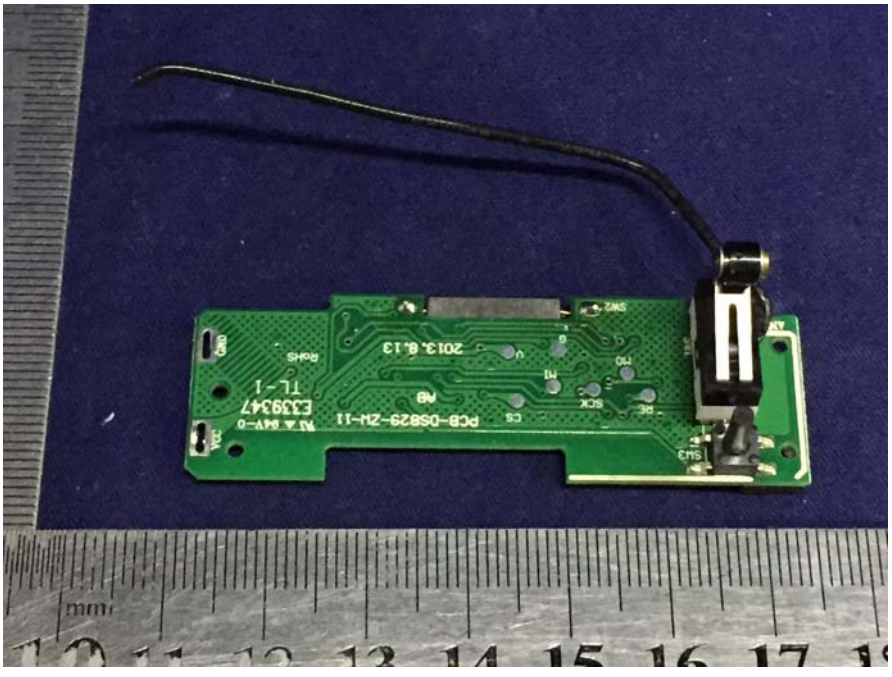
Radiated Emission (1GHz-10GHz)

10. APPENDIX II (Photos of EUT)


AEOTEC


Z-wave Module
Antenna


A626627.1
1335 TWN
U1
U6
C1
C2
C3
C4
L1
R9C14 R3C10


PCB-DS829-ZW-11
2013.6.13
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