TEST REPORT

Reference No......	:	WTS14S0211374E
FCC ID.....	:	XBAZW078
Applicant.....	:	Aeon Labs LLC.
Address.....	:	121 Buckingham Drive Unit 36 Santa Claras California United States
Manufacturer	:	The same as above
Address.....	:	The same as above
Product Name.....	:	Heavy Duty Smart Switch Gen5
Model No.....	:	ZW078-A
Standards.....	:	FCC CFR47 Part 15 Section 15.249: 2012
Date of Receipt sample.....	:	Feb.19,2014
Date of Test.....	:	Feb.21,2014 to Apr.23, 2014
Date of Issue.....	:	May 06, 2014
Test Result.....	:	**Pass ***

*Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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Compiled by:

Zero Zhou / Project Engineer

Approved by:

Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emission	15.249(a) 15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside of Band Emission	15.249 15.205 15.209	PASS
20dB Bandwidth	15:215(c)	PASS
Antenna Requirement	15.203	PASS

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4 General Information

4.1 General Description of E.U.T.

Product Name	: Heavy Duty Smart Switch Gen5
Model No.	: ZW078-A
Model Differences	: N/A
Type of Modulation	: FSK
Frequency Range	: 908.42MHz
The Lowest Oscillator	: 4.096MHz
Antenna installation	: Monopole antenna

4.2 Details of E.U.T.

Technical Data : 220-240V～, 50/60Hz, Max: 40A

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	908.42	2	-	3	-	4	-

4.4 Test Facility

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

- **IC – Registration No.:7760A-1**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A-1, July 12, 2012.

- **FCC – Registration No.: 880581**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered 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 880581, May 26, 2011.

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Lower channel	Middle channel	Upper channel
Transmitting	/MHz	908.42MHz	/MHz

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions at Mains Terminals Disturbance Voltage						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMI Test Receiver	R&S	ESCI	100947	Sep.18,2013	Sep.17,2014
2.	LISN	R&S	ENV216	101215	Nov. 29,2013	Nov. 28,2014
3.	Cable	Top	TYPE16(3.5M)	-	Sep.18,2013	Sep.17,2014
3m Semi-anechoic Chamber for Radiation						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.18,2013	Sep.17,2014
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.18,2013	Sep.17,2014
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2014	Apr.18,2015
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.18,2013	Sep.17,2014
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2014	Apr.18,2015
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2014	Apr.18,2015
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2014	Mar.16,2015
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2014	Apr.09,2015

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Conduction disturbance(150kHz~30MHz)	±3.64dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB(Horn antenna 1000M~25000MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dBμV between 0.15MHz & 0.5MHz
	56 dBμV between 0.5MHz & 5MHz
	60 dBμV between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

6.1 E.U.T. Operation

Operating Environment :

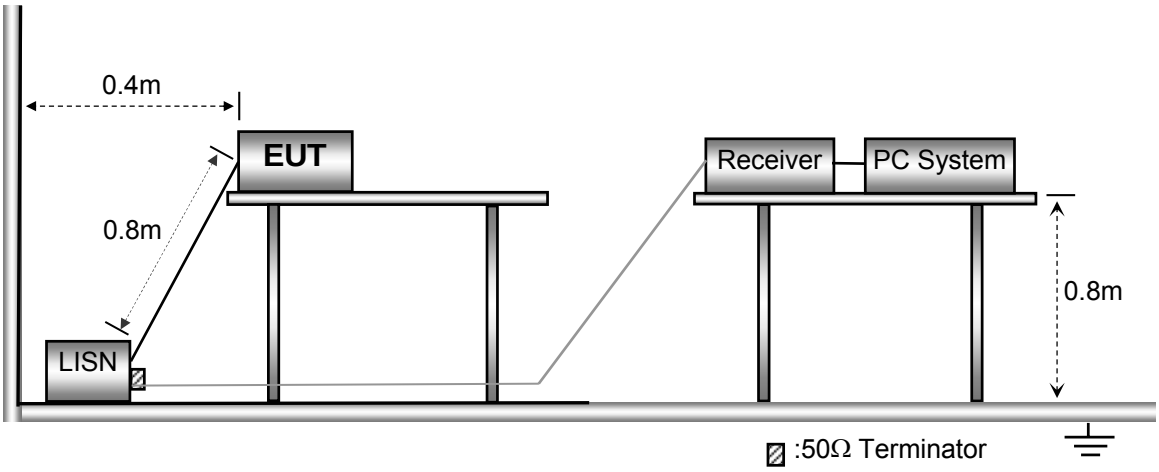
Temperature:	22.5 °C
Humidity:	51.9 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.4:2003.

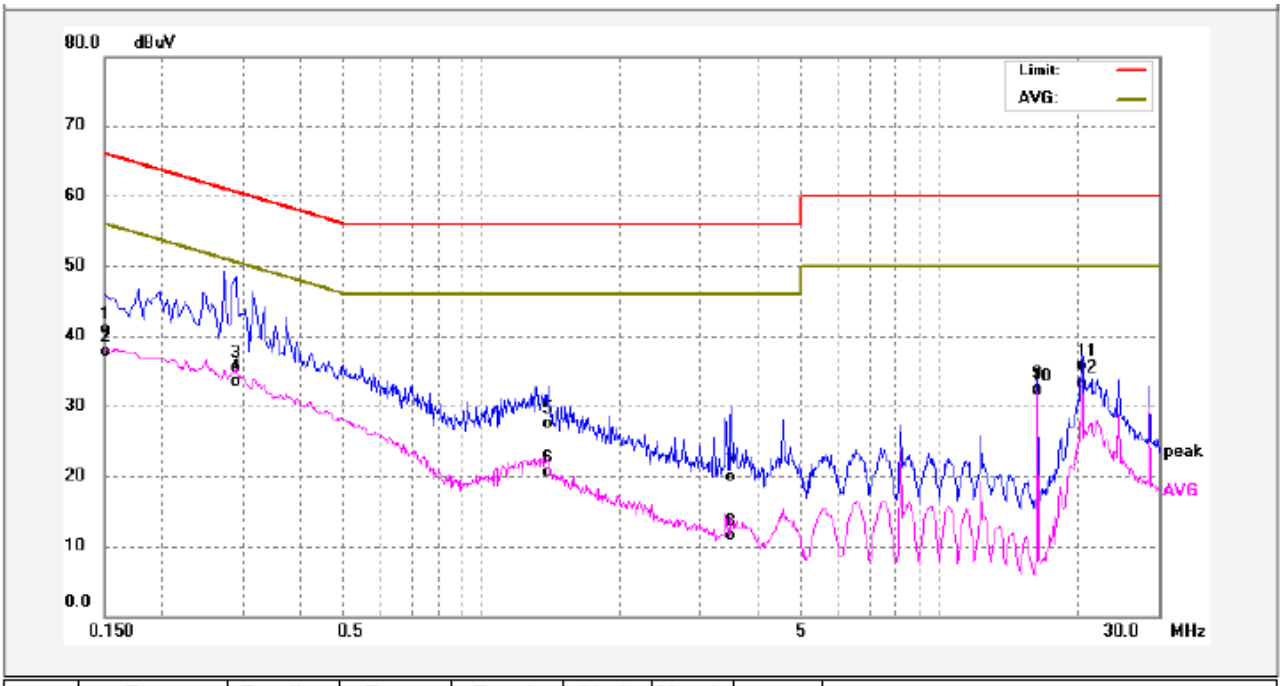


6.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

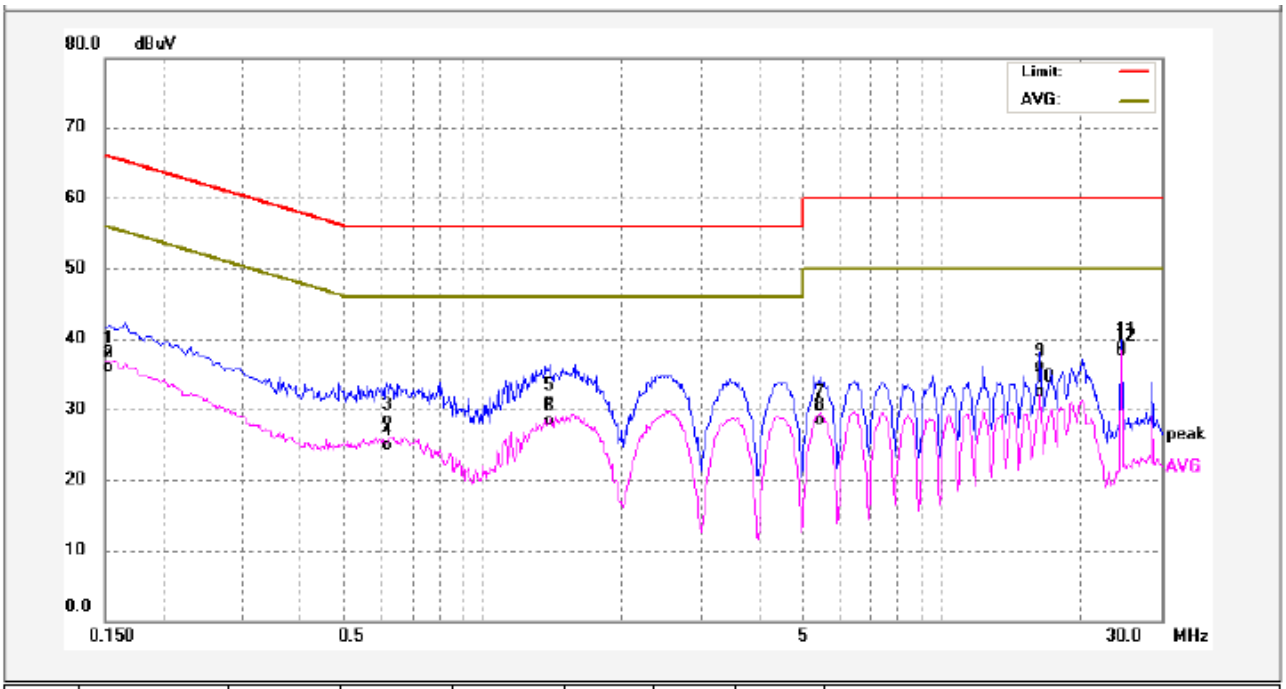
6.4 Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	29.69	11.17	40.86	65.99	-25.13	QP	
2	0.1500	26.48	11.17	37.65	55.99	-18.34	AVG	
3	0.2900	24.30	11.30	35.60	60.52	-24.92	QP	
4	0.2900	22.14	11.30	33.44	50.52	-17.08	AVG	
5	1.3940	16.40	11.19	27.59	56.00	-28.41	QP	
6	1.3940	9.30	11.19	20.49	46.00	-25.51	AVG	
7	3.5020	8.71	11.22	19.93	56.00	-36.07	QP	
8	3.5020	0.29	11.22	11.51	46.00	-34.49	AVG	
9	16.3860	20.94	11.47	32.41	60.00	-27.59	QP	
10	16.3860	20.67	11.47	32.14	50.00	-17.86	AVG	
11	20.4820	24.22	11.50	35.72	60.00	-24.28	QP	
12	20.4820	21.75	11.50	33.25	50.00	-16.75	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1539	26.70	11.18	37.88	65.78	-27.90	QP	
2	0.1539	24.80	11.18	35.98	55.78	-19.80	AVG	
3	0.6140	17.19	11.33	28.52	56.00	-27.48	QP	
4	0.6140	13.66	11.33	24.99	46.00	-21.01	AVG	
5	1.4020	20.19	11.19	31.38	56.00	-24.62	QP	
6	1.4020	17.21	11.19	28.40	46.00	-17.60	AVG	
7	5.4020	19.09	11.24	30.33	60.00	-29.67	QP	
8	5.4020	17.28	11.24	28.52	50.00	-21.48	AVG	
9	16.3860	24.72	11.47	36.19	60.00	-23.81	QP	
10	16.3860	20.95	11.47	32.42	50.00	-17.58	AVG	
11	24.5780	27.48	11.56	39.04	60.00	-20.96	QP	
12	24.5780	26.77	11.56	38.33	50.00	-11.67	AVG	

7 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249

Test Method: ANSI 63.4: 2003

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Note: RF Voltage(dBuV)=20 $\log_{10}$ RF Voltage(uV)

7.1 EUT Operation

Operating Environment **:**

Temperature: 22.4 °C

Humidity: 52.1 % RH

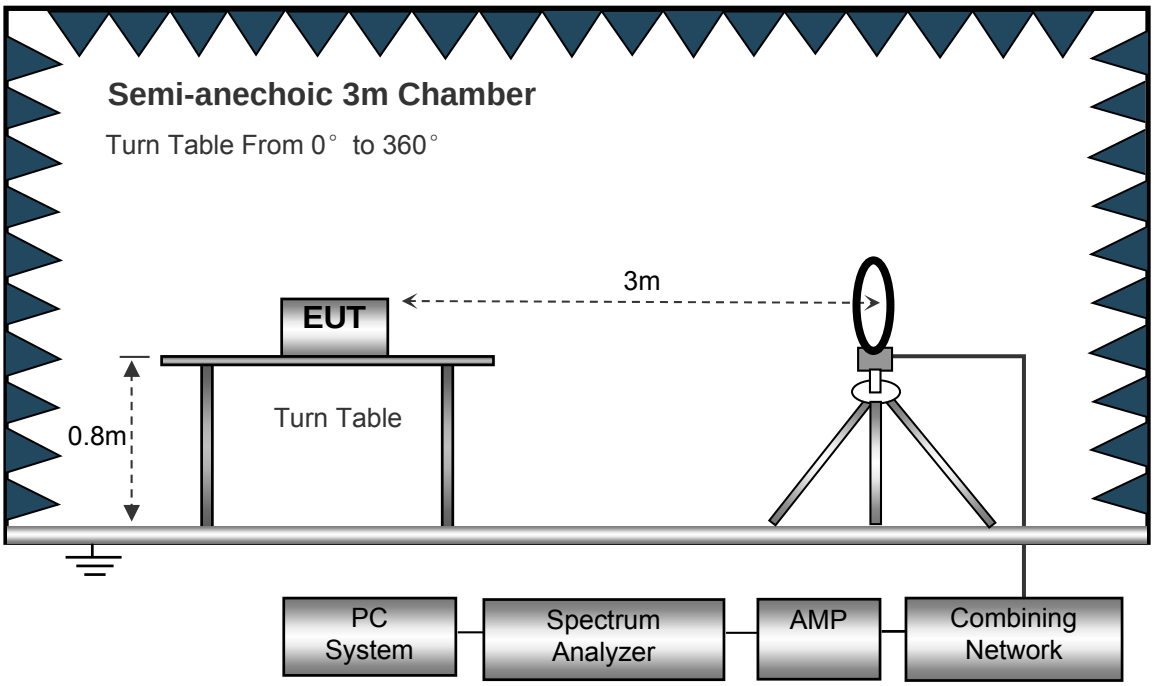
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

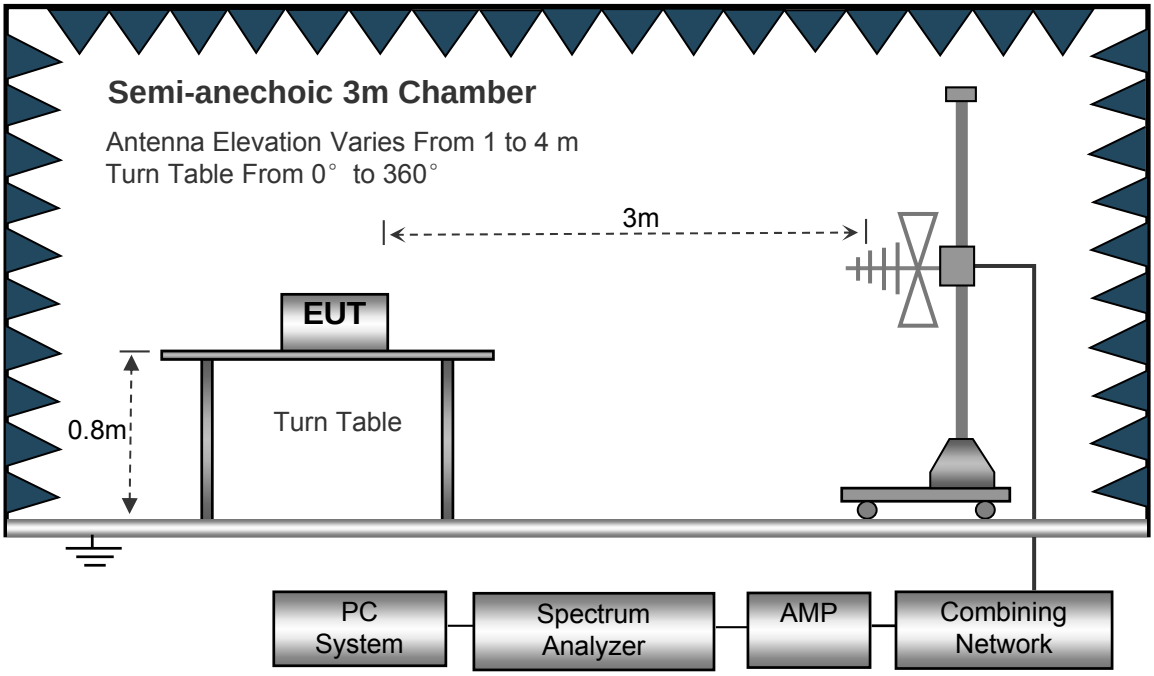
The test was performed in transmitting mode, the test data were shown in the report.

7.2 Test Setup

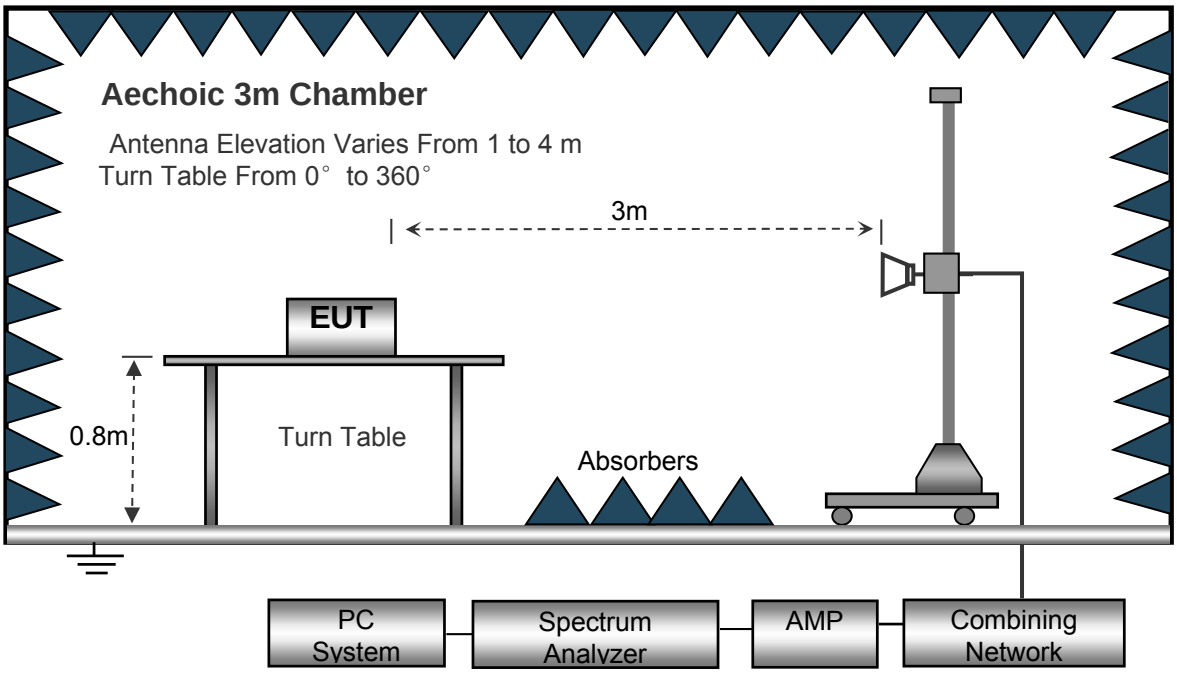
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed..... Auto
IF Bandwidth..... 120 KHz
Video Bandwidth..... 100KHz
Quasi-Peak Adapter Bandwidth..... 120 KHz
Quasi-Peak Adapter Mode..... Normal
Resolution Bandwidth.....100KHz

Above 1GHz

Sweep Speed..... Auto
Detector .....PK
Resolution Bandwidth.....1MHz
Video Bandwidth..... 3MHz
Detector .....Ave.
Resolution Bandwidth.....1MHz
Video Bandwidth..... 10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor – Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Class B Limit

7.6 Test Result

AV = Peak +20Log10(duty cycle) =PK+(-12.89) [refer to section 8 for more detail]

Test Frequency :Below 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 10GHz

Frequency	Receiver Reading	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
	(PK)		Height	Polar		(PK)	Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
32.06	16.4	202	2.0	V	20.43	36.83	40	-3.17
265.80	19.3	151	1.9	V	18.00	37.3	46	-8.7
908.42	68.95	258	1.0	H	30.98	99.93	114	-14.07
908.42	63.47	258	1.0	V	30.98	94.45	114	-19.55
1816.84	53.51	206	1.6	H	-16.38	37.13	74	-36.87
1816.84	48.36	206	1.6	V	-16.38	31.98	74	-42.02
2725.26	50.32	136	1.5	H	-14.87	35.45	74	-38.55
2725.26	45.37	136	1.5	V	-14.87	30.5	74	-43.5
1669.32	42.52	11	1.2	H	-11.77	30.75	74	-43.25
1669.32	37.89	11	1.2	V	-11.77	26.12	74	-47.88

Frequency	PK	RX Antenna	Duty cycle Factor	Calculated AV	FCC Part 15.249/209/205	
		Polar			Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
908.42	99.93	H	-12.89	87.04	94	-6.96
908.42	94.45	V	-12.89	81.56	94	-12.44
1816.84	37.13	H	-12.89	24.24	54	-29.76
1816.84	31.98	V	-12.89	19.09	54	-34.91
2725.26	35.45	H	-12.89	22.56	54	-31.44
2725.26	30.5	V	-12.89	17.61	54	-36.39
1669.32	30.75	H	-12.89	17.86	54	-36.14
1669.32	26.12	V	-12.89	13.23	54	-40.77

8 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 * %

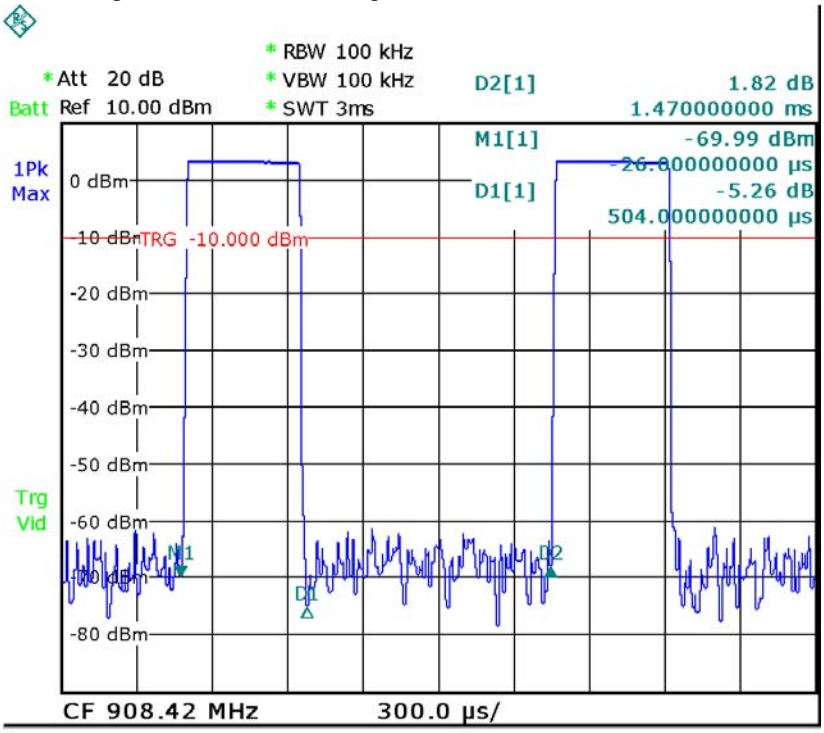
Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle(%))

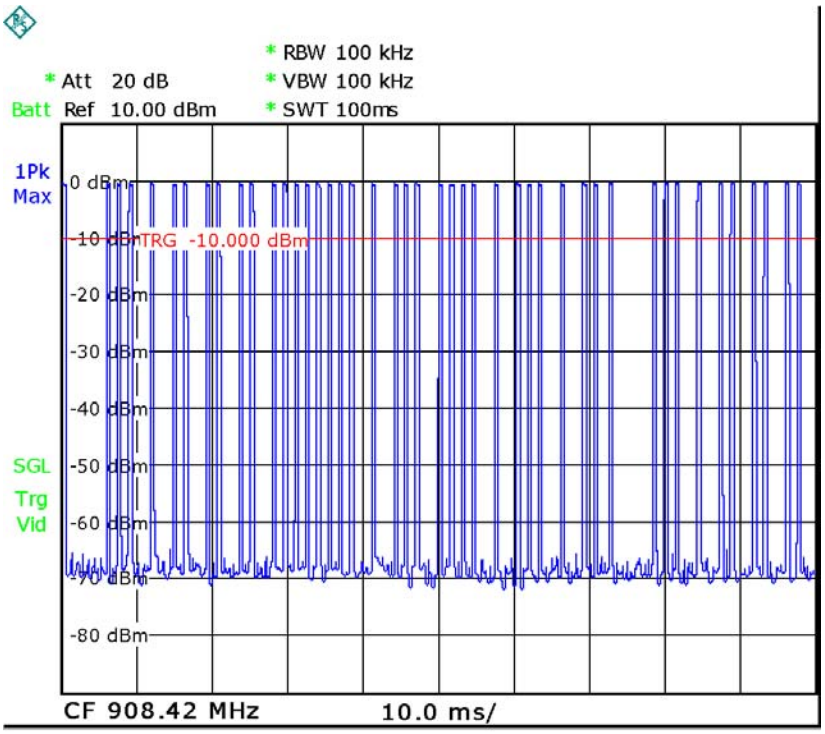
Total transmission time(ms)	0.504*45=22.68
Length of a complete transmission period(ms)	100
Duty Cycle(%)	0.227
Duty Cycle Correction Factor(dB)	-12.89

Refer to the duty cycle plot (as below),This device meets the FCC requirement.

Length of a complete pulse train:

Remark: FCC part15.35(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.




* RBW 100 kHz
* Att 20 dB
* VBW 100 kHz
Batt Ref 10.00 dBm
* SWT 100ms
1Pk
Max
0 dBm
-10 dBm
TRG -10.000 dBm
-20 dBm
-30 dBm
-40 dBm
SGL
-50 dBm
Trg
Vid
-60 dBm
-70 dBm
-80 dBm
CF 908.42 MHz
10.0 ms/

9 Outside of Band Emission

Test Requirement:	15.249(d):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 §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.4:2003
Test Mode:	Transmitting

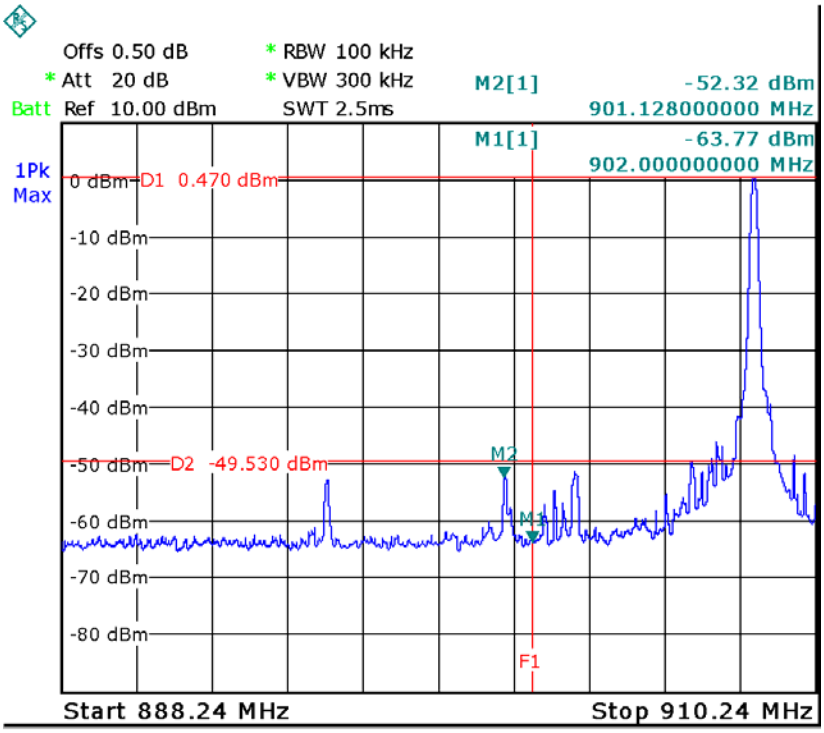
9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
   Detector function = peak, Trace = max hold

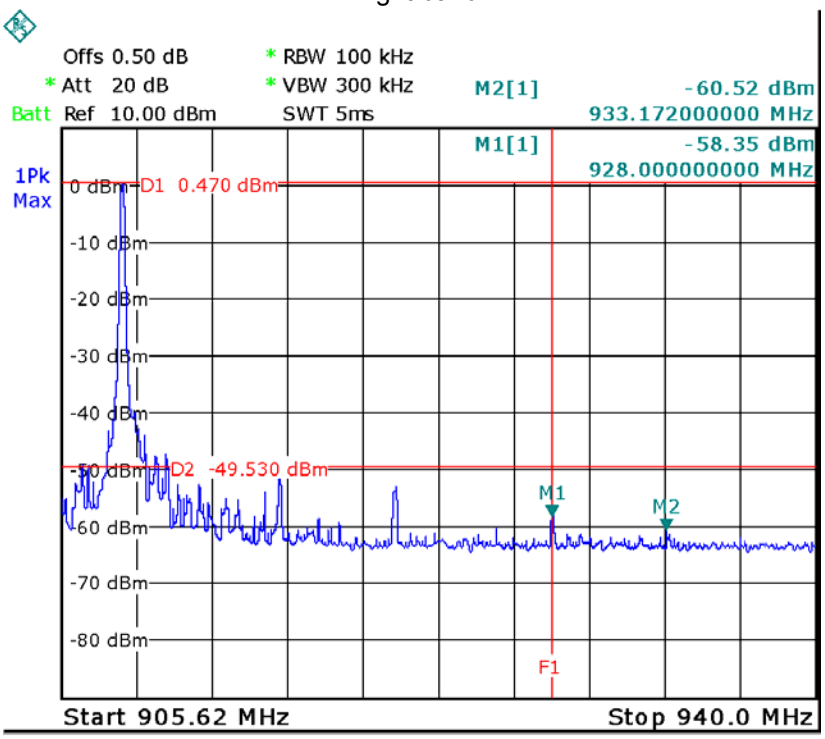
9.2 Test Result

Test plots

Left band



Right band


Offs 0.50 dB
* Att 20 dB
Batt Ref 10.00 dBm
* RBW 100 kHz
* VBW 300 kHz
SWT 5ms
M2[1] -60.52 dBm
933.172000000 MHz
M1[1] -58.35 dBm
928.000000000 MHz
1Pk
Max
0 dBm
D1 0.470 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
D2 -49.530 dBm
-60 dBm
-70 dBm
-80 dBm
M1
M2
F1
Start 905.62 MHz
Stop 940.0 MHz

10 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.215(c)

Test Method: ANSI C63.4:2003

Test Mode: Transmitting

10.1 Test Procedure

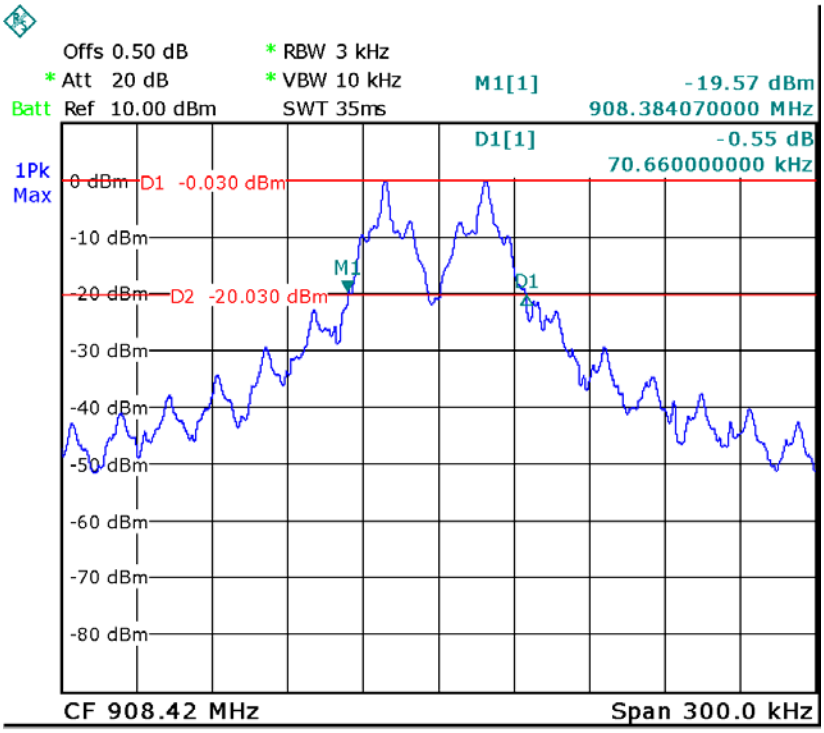
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 3kHz, VBW = 10kHz

10.2 Test Result

Test Channel	Bandwidth
908.42MHz	70.660kHz

Test plots

Low Channel



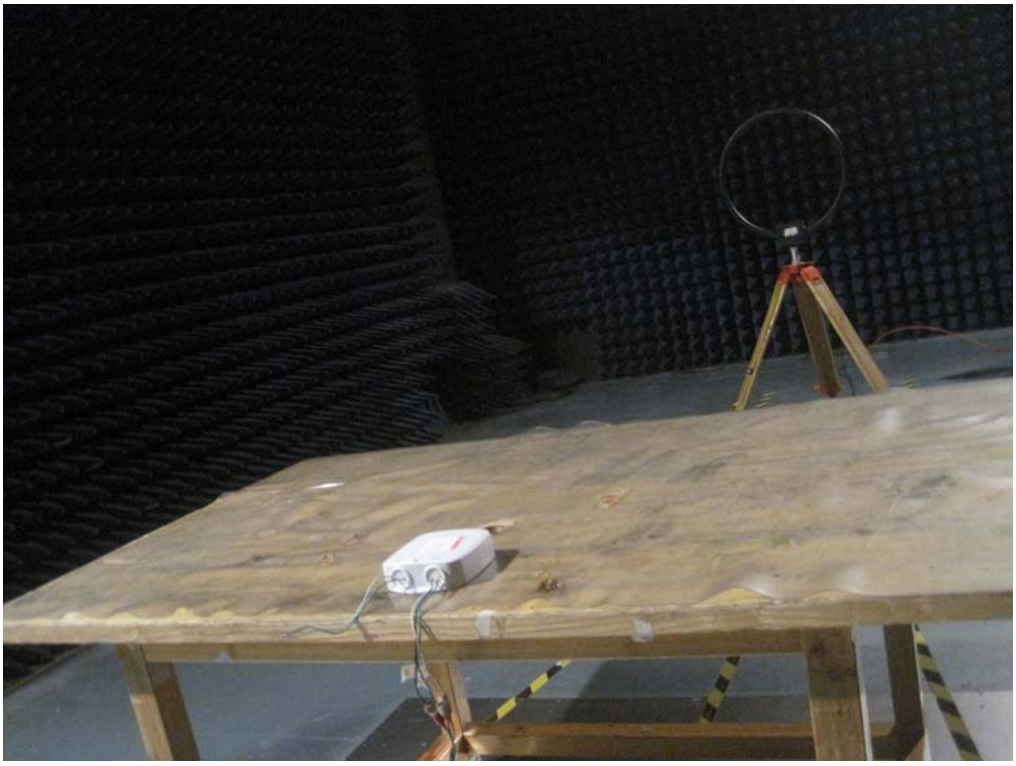
11 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a Monopole antenna, fulfil the requirement of this section.

12 Photographs- Model ZW078-A Test Setup

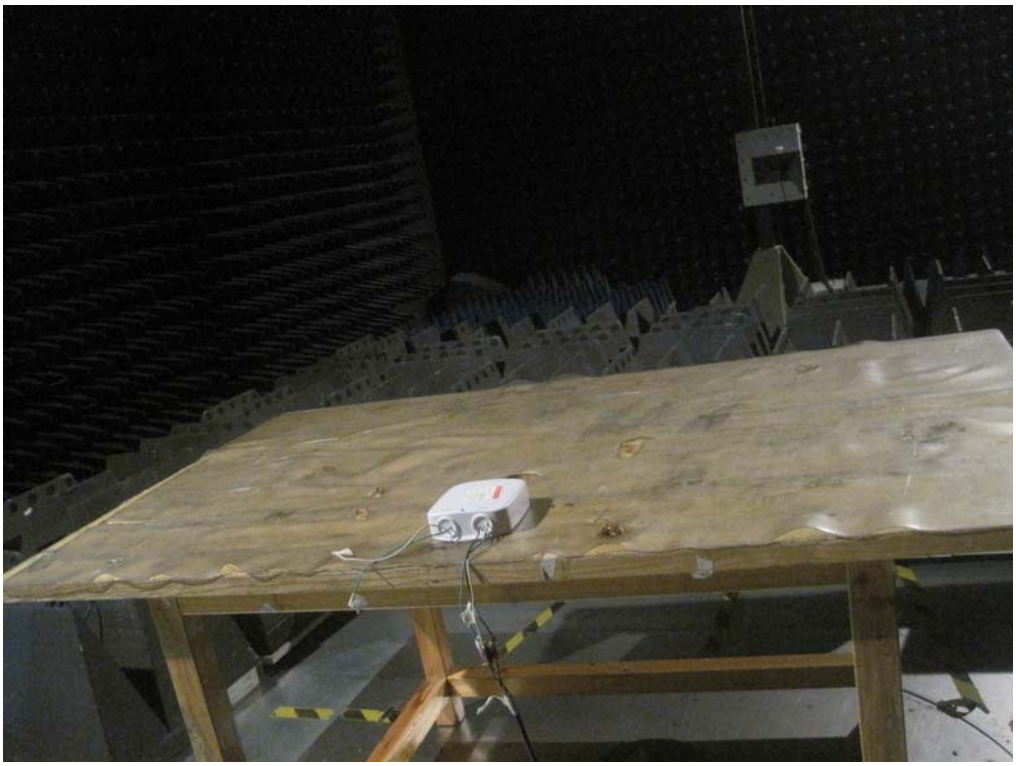
12.1 Conduction Emission

12.2 Radiation Emission below 30MHz



12.3 Radiation Emission From 30MHz-1GHz

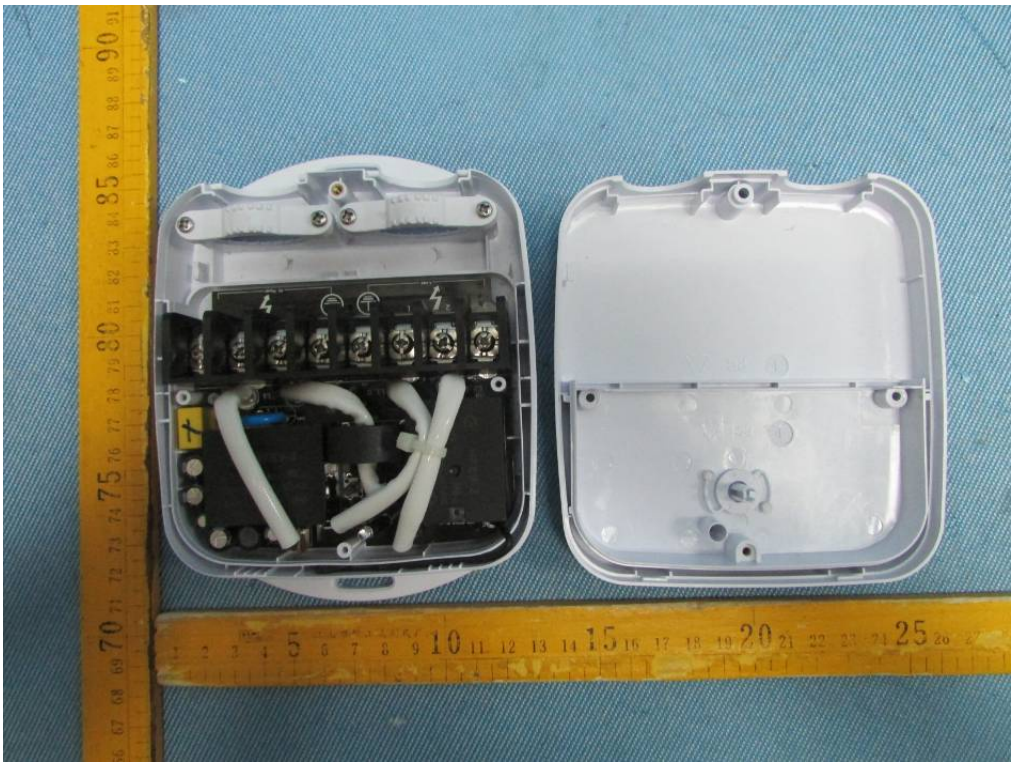
12.4 Radiation Emission Above 1GHz

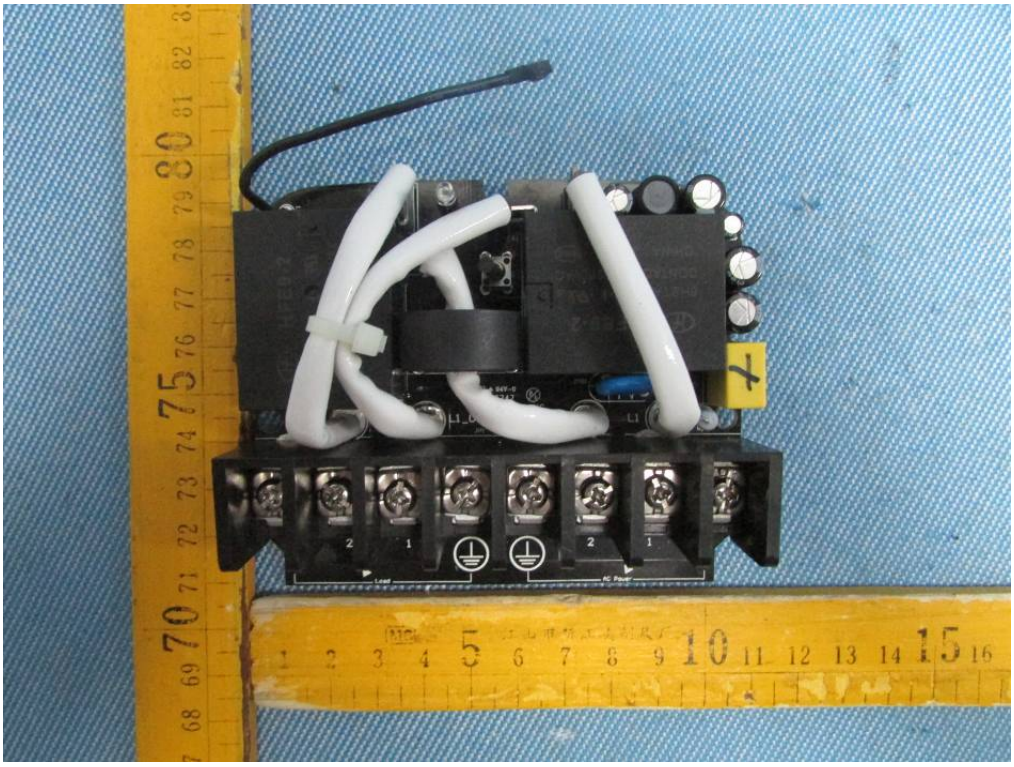


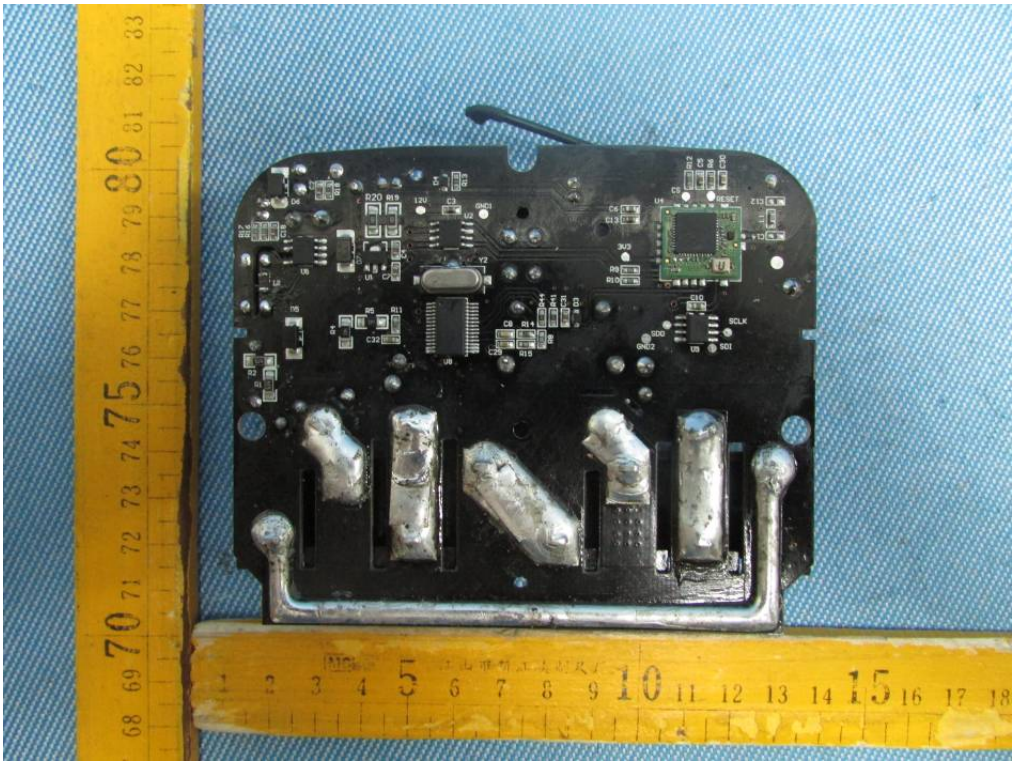
13 Photographs - Constructional Details

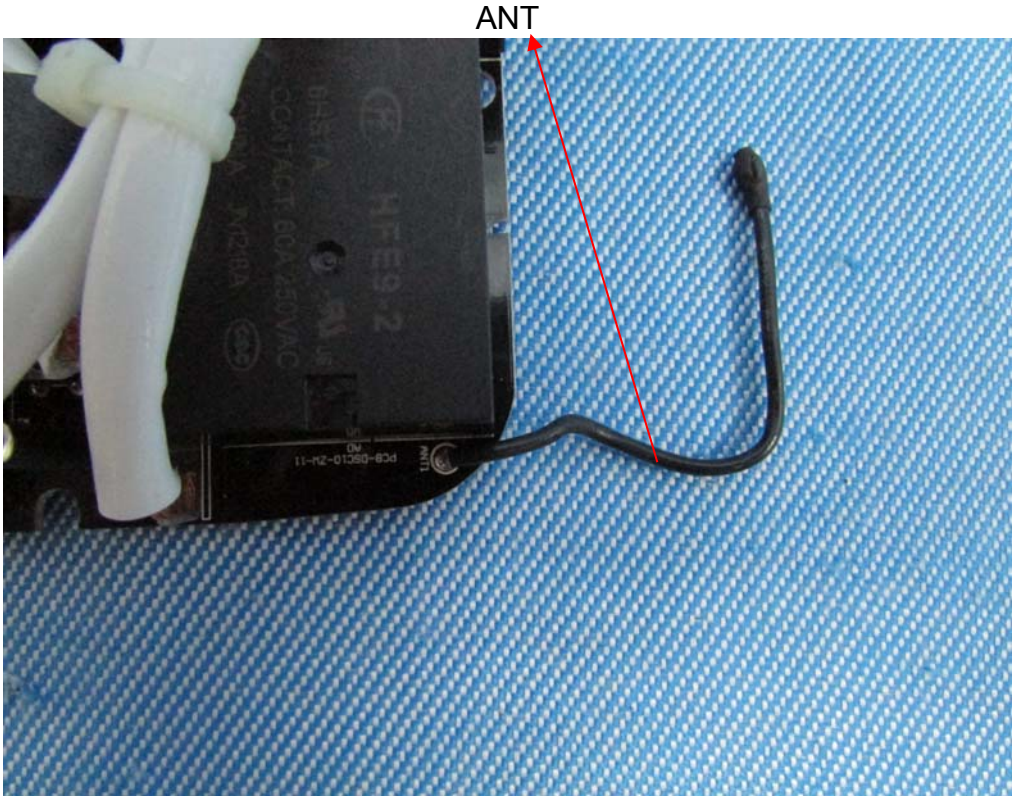
13.1 Model ZW078-A - External View

13.2 Model ZW078-A - Internal View





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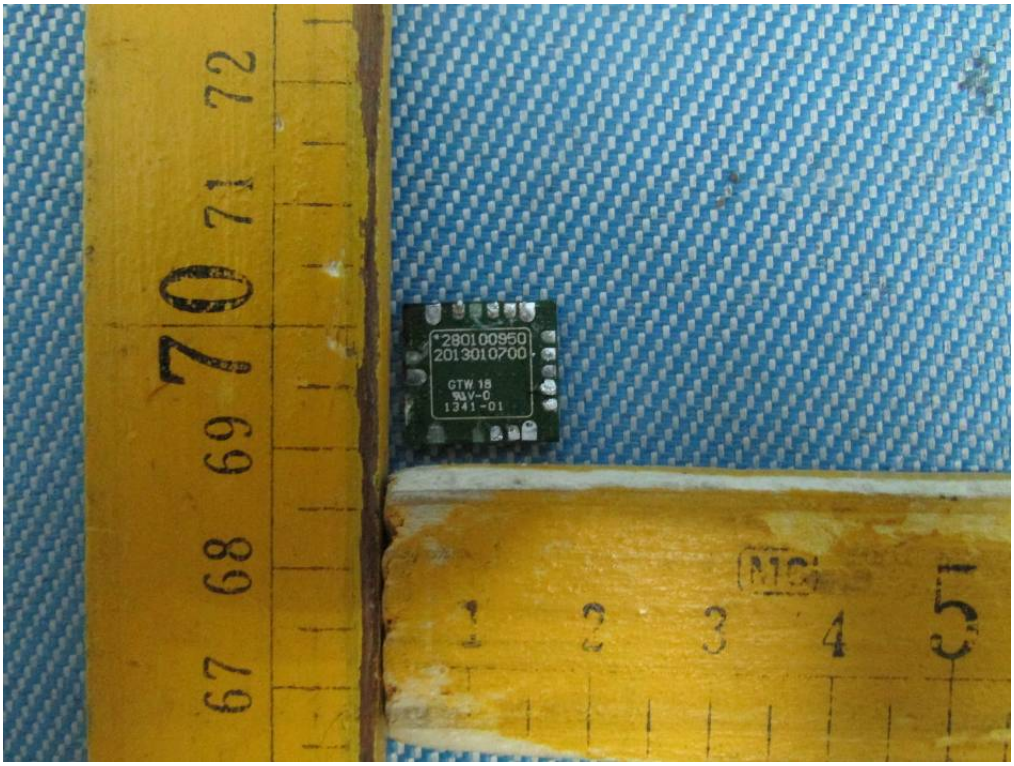
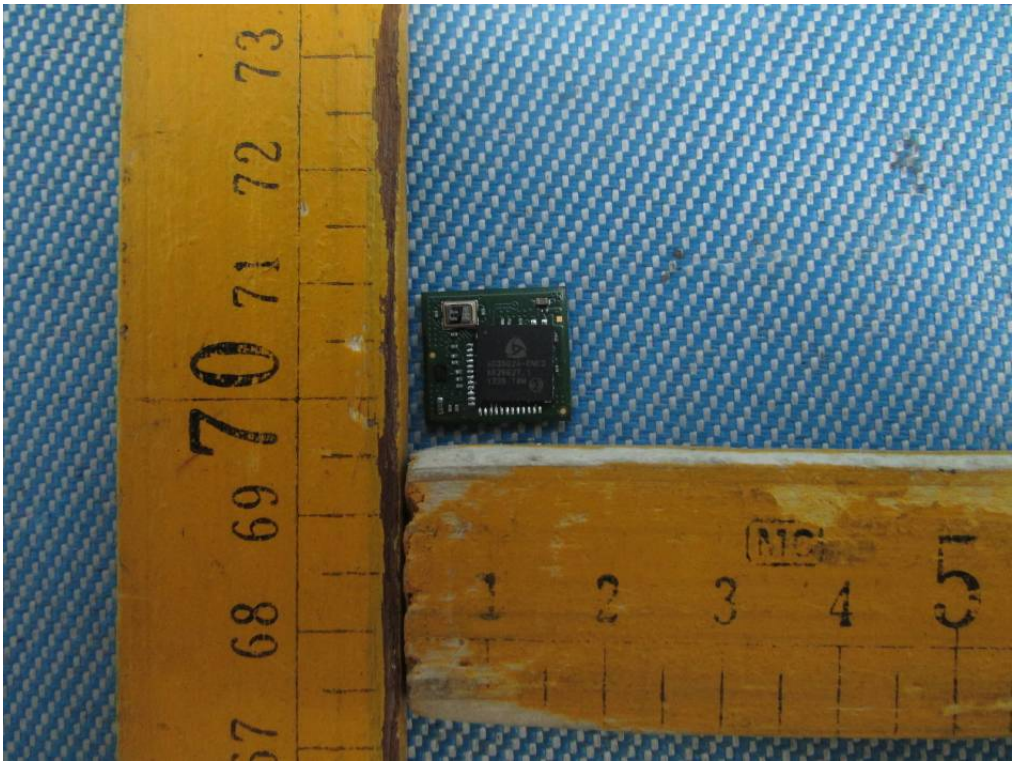
RF Module





======End of Report======