FCC RF Test Report

APPLICANT	**:**	**BYD Precision Manufacture Co.,Ltd.**
EQUIPMENT	**:**	**Trident**
BRAND NAME	**:**	**iRobot**
MODEL NAME	**:**	**AXC-Y1**
FCC ID	**:**	**ZW9AXCY1**
STANDARD	**:**	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	**:**	**(DTS) Digital Transmission System**

The product was received on Jan. 19, 2018 and testing was completed on Feb. 05, 2018. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

James Huang

NVLAP®
TESTING
NVLAP LAB CODE 600155-0

Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.
No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR792901-03B	Rev. 01	Initial issue of report	Feb. 23, 2018

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Not Required	-
-	-	99% Bandwidth	-	Not Required	-
-	15.247(b)	Power Output Measurement	≤ 30dBm	Not Required	-
-	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Not Required	-
-	15.247(d)	Conducted Band Edges	≤ 20dBc	Not Required	-
		Conducted Spurious Emission		Not Required	-
3.1	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 4.34 dB at 2483.510 MHz
-	15.207	AC Conducted Emission	15.207(a)	Not Required	-
-	15.203 & 15.247(b)	Antenna Requirement	N/A	Not Required	-

Remark: Not required means the change does not affected the test result.

1 General Description

1.1 Applicant

BYD Precision Manufacture Co.,Ltd.
No.3001, Bao He Road, Baolong Industry Zone, Longgang, Shenzhen, Guangdong Province, P.R.China

1.2 Manufacturer

Huizhou BYD Electronic Co.,Ltd.
Xiangshui River, Economic Development Zone, Daya Bay, Huizhou, Guangdong Province, P.R.China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Trident
Brand Name	iRobot
Model Name	AXC-Y1
FCC ID	ZW9AXCY1
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.11a/n HT20/HT40/ Bluetooth v4.0 LE /Bluetooth v4.2 LE
HW Version	Trident B2.5
SW Version	Trident_00.00.25_20171223
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This is a variant report for AXC-Y1. The product equality declaration could be referred to Appendix D. Based on the similarity between current and previous project, only the worst cases of RSE from original test report (Sporton Report Number FR792901B) were verified for the differences.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Antenna Type / Gain	Please see Remark 1
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

Remark:

1. The antenna provided to the EUT, please refer to the following table:

2. We only evaluate the Antenna of max Gain to test.

Antenna No.	Brand	Model	Gain(dBi)	Antenna Type	Frequency range (GHz to GHz)	Cable length (mm)
1(External)	Laird	EMN2449A 2S-25UFL	3.50	PCB dipole antenna	2.4-2.4835	250
1(External)	Laird	EMN2449A 2S-25UFL	5.75	PCB dipole antenna	5.15-5.25	250
1(External)	Laird	EMN2449A 2S-25UFL	6.26	PCB dipole antenna	5.25-5.35	250
1(External)	Laird	EMN2449A 2S-25UFL	6.24	PCB dipole antenna	5.47-5.725	250
1(External)	Laird	EMN2449A 2S-25UFL	5.18	PCB dipole antenna	5.725-5.85	250

Antenna No.	Brand	Model	Gain(dBi)	Antenna Type	Frequency range (GHz to GHz)	Cable length (mm)
2(External)	Laird	MAF94264	3.33	PCB dipole antenna	2.4-2.4835	80
2(External)	Laird	MAF94264	5.52	PCB dipole antenna	5.15-5.25	80
2(External)	Laird	MAF94264	6.14	PCB dipole antenna	5.25-5.35	80
2(External)	Laird	MAF94264	6.06	PCB dipole antenna	5.47-5.725	80
2(External)	Laird	MAF94264	5.33	PCB dipole antenna	5.725-5.85	80

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0) and the FCC designation No. is CN5013.

Test Site	Sporton International (Kunshan) Inc.	
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958	
Test Site No.	**Sporton Site No.**	**FCC Test Firm Registration No.**
	03CH03-KS	630927

Note: The test site complies with ANSI C63.4 2014 requirement.

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
- ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiated emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the worst cases were recorded in this report.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437	-	-

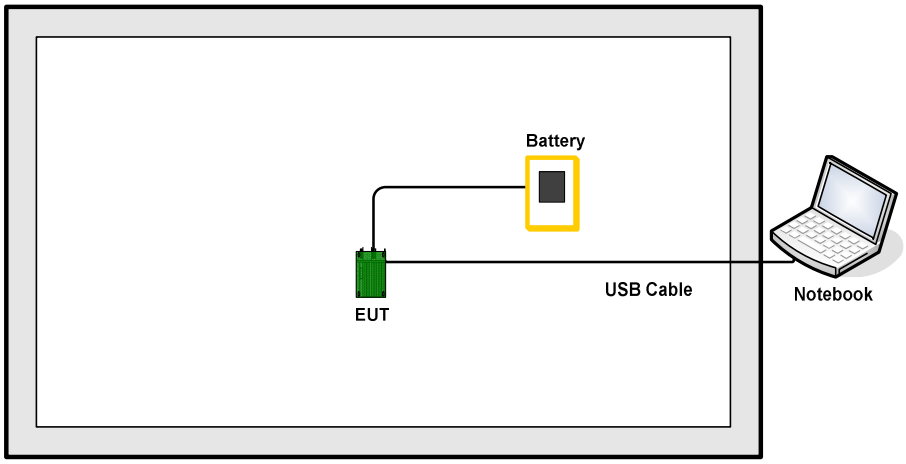
2.2 Test Mode

Final test mode of radiated spurious emissions are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11g	6 Mbps

2.3 Connection Diagram of Test System

<WLAN Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Battery	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Dell	Latitude3440	N/A	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
3.	USB Cable	N/A	N/A	N/A	Unshielded, 1.2m	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuously transmit/receive.

3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/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
Above 960	500	3

3.1.2 Measuring Instruments

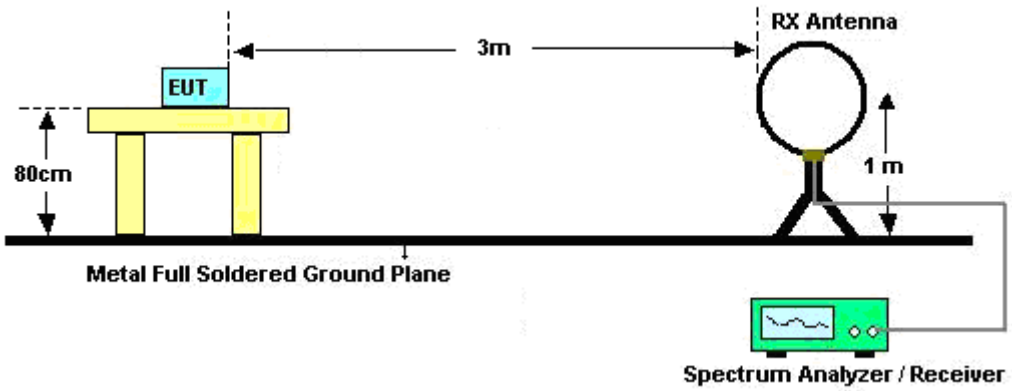
The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

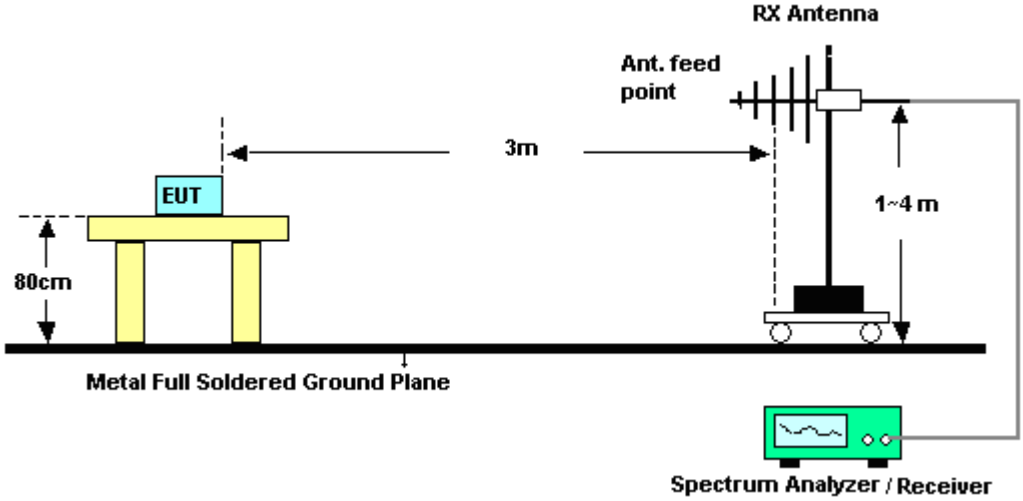
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.1.4 Test Setup

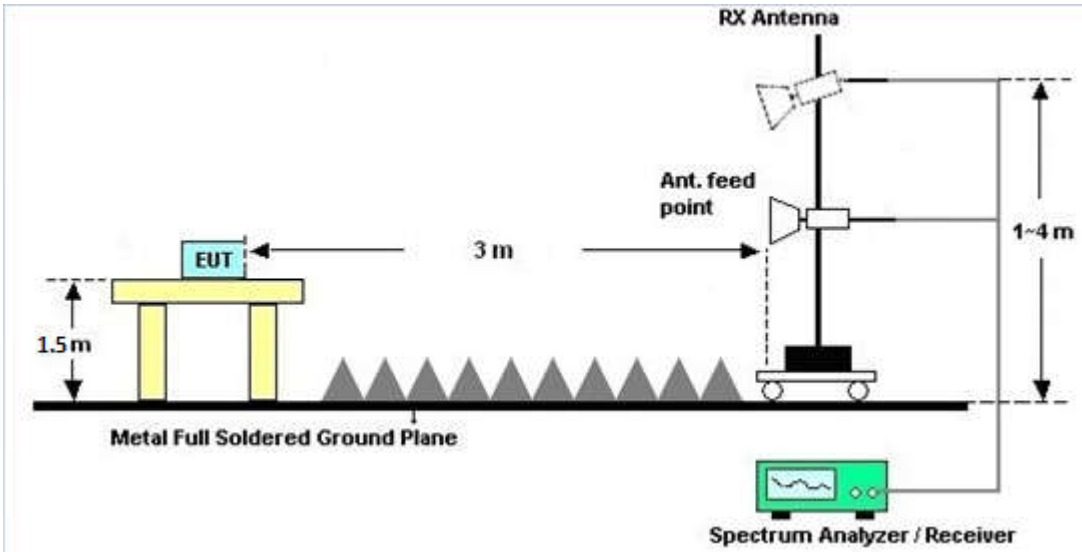
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

3.1.7 Duty Cycle

Please refer to Appendix B.

3.1.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 19, 2017	Feb. 04, 2018~ Feb. 05, 2018	Oct. 18, 2018	Radiation (03CH03-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz~44GHz	Apr. 18, 2017	Feb. 04, 2018~ Feb. 05, 2018	Apr. 17, 2018	Radiation (03CH03-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 22, 2017	Feb. 04, 2018~ Feb. 05, 2018	Oct.21, 2018	Radiation (03CH03-KS)
Bilog Antenna	TeseQ	CBL6112D	35406	25MHz~2GHz	Apr. 22, 2017	Feb. 04, 2018~ Feb. 05, 2018	Apr. 21, 2018	Radiation (03CH03-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1356	1GHz~18GHz	Apr. 22, 2017	Feb. 04, 2018~ Feb. 05, 2018	Apr. 21, 2018	Radiation (03CH03-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA170249	15GHz~40GHz	Feb. 15, 2017	Feb. 04, 2018~ Feb. 05, 2018	Feb. 14, 2018	Radiation (03CH03-KS)
Amplifier	com-power	PA-103A	161069	1MHz~1000MHz / 32 dB	Apr. 18, 2017	Feb. 04, 2018~ Feb. 05, 2018	Apr. 17, 2018	Radiation (03CH03-KS)
Amplifier	MITEQ	TTA1840-35-HG	1887435	18GHz~40GHz	Oct. 12, 2017	Feb. 04, 2018~ Feb. 05, 2018	Oct. 11, 2018	Radiation (03CH03-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1GHz~18GHz	Apr. 18. 2017	Feb. 04, 2018~ Feb. 05, 2018	Apr. 17, 2018	Radiation (03CH03-KS)
Amplifier	Agilent	8449B	3008A02370	1GHz~26.5GHz	Oct. 12, 2017	Feb. 04, 2018~ Feb. 05, 2018	Oct. 11, 2018	Radiation (03CH03-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Feb. 04, 2018~ Feb. 05, 2018	NCR	Radiation (03CH03-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Feb. 04, 2018~ Feb. 05, 2018	NCR	Radiation (03CH03-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Feb. 04, 2018~ Feb. 05, 2018	NCR	Radiation (03CH03-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5dB**

Appendix A. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 11 2462MHz	*	2466	102.14	-	-		31.93	7.69	36.67	256	0	P	H
	*	2466	94.24	-	-		31.93	7.69	36.67	256	0	A	H
		2483.51	62.03	-11.97	74	59	31.99	7.72	36.68	256	0	P	H
		2483.51	49.66	-4.34	54	46.63	31.99	7.72	36.68	256	0	A	H
	*	2456	99.38	-	-	96.43	31.93	7.69	36.67	370	217	P	V
	*	2456	91.68	-	-	88.73	31.93	7.69	36.67	370	217	A	V
		2483.51	58.71	-15.29	74	55.68	31.99	7.72	36.68	370	217	P	V
		2483.8	48.18	-5.82	54	45.15	31.99	7.72	36.68	370	217	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 11 2462MHz		4926	38.02	-35.98	74	56.05	35.03	11.62	64.68	100	360	P	H
		7386	37.21	-36.79	74	52.65	35.64	13.97	65.05	100	360	P	H
		4926	38.91	-35.09	74	56.94	35.03	11.62	64.68	100	360	P	V
		7386	38.64	-35.36	74	54.08	35.64	13.97	65.05	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

Emission below 1GHz

2.4GHz WIFI 802.11g (LF)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11g LF		30.97	28.06	-11.94	40	32.8	26.86	0.69	32.29	210	230	P	H
		69.77	22.61	-17.39	40	39.86	13.7	1.23	32.18	-	-	P	H
		224	31.36	-14.64	46	44.91	16.43	2.2	32.18	-	-	P	H
		288.02	23.5	-22.5	46	34.51	18.55	2.51	32.07	-	-	P	H
		461.65	25.93	-20.07	46	29.67	24.98	3.22	31.94	-	-	P	H
		556.71	28.42	-17.58	46	31.87	24.76	3.54	31.75	-	-	P	H
		30	29.22	-10.78	40	33.66	27.2	0.65	32.29	-	-	P	V
		66.86	33.27	-6.73	40	50.84	13.46	1.2	32.23	100	231	P	V
		93.05	25.26	-18.24	43.5	38.04	18.1	1.37	32.25	-	-	P	V
		305.48	28.88	-17.12	46	39.04	19.27	2.64	32.07	-	-	P	V
		323.91	27.07	-18.93	46	36.14	20.13	2.88	32.08	-	-	P	V
		556.71	28.73	-17.27	46	32.18	24.76	3.54	31.75	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

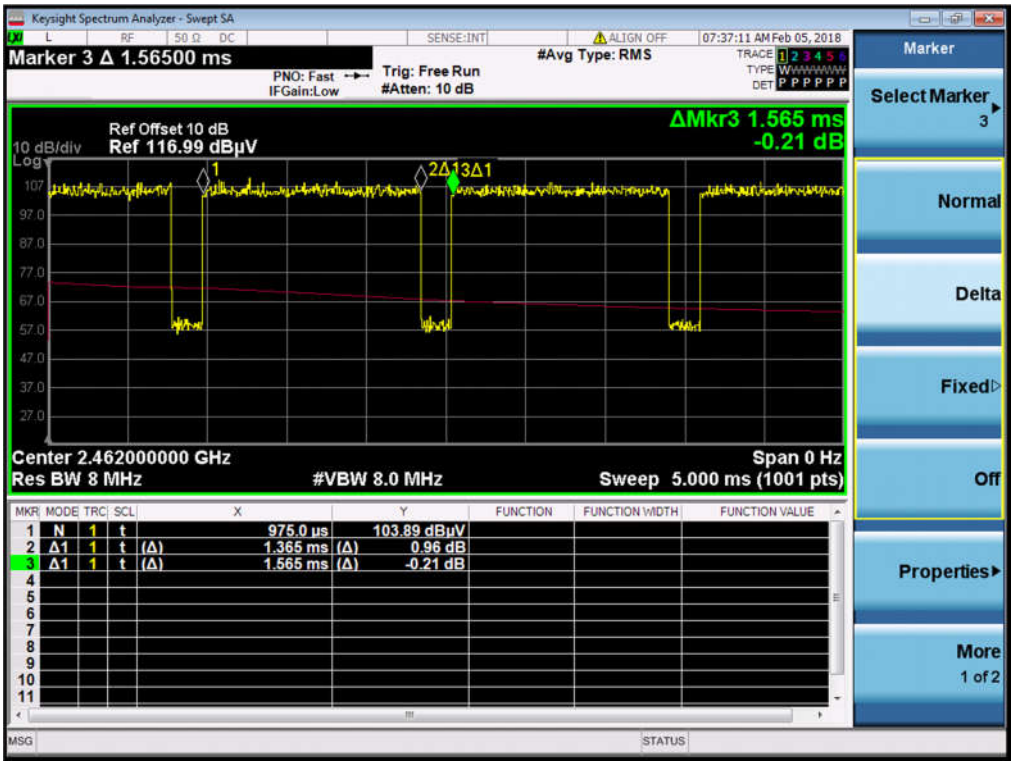
= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix B. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(KHz)	VBW Setting
802.11g	87.22	1.365	0.733	1KHz



Appendix D. Product Equality Declaration

BYD Precision Manufacture Co.,Ltd.

Add: No.3001,Bao He Road,Baolong Industry Zone,Longgang,Shenzhen,Guangdong Province,P.R.China

Product Equality Declaration

We, BYD Precision Manufacture Co.,Ltd. **, declare on our sole responsibility for the product of** AXC-Y1 **as below:**

The differences between AXC-Y1 B2 and B2.5 are as below:

Category	First Supplier	Specification	Second Supplier	Specification
PCB	GCE	8layers_FR-4	Elec&Eltek	8layers_FR-4
Capacitance	Eyang	10nF_±10%_10V_X5R	Eyang	10nF_±10%_10V_X7R
Capacitance	Eyang	100nF_±10%_ 6.3V_X5R	Eyang	100nF_±10%_10V_X6S
Capacitance	Eyang	470nF_±10%_4V_-55℃~85℃	Eyang	470nF_±10%_6.3V_X6S
Capacitance	SAMSUNG	1uF_±20%_6.3V_X5R	Murata	1uF_±20%_6.3V_X6S
Capacitance	Eyang	1uF_±10%_10V_-55~125℃	Eyang	1uF_±10%_10V_X6S
Capacitance	Eyang	2.2uF_±10%_ 10V_X5R	Murata	2.2uF_±10%_10V_X7S
Capacitance	Murata	4.7uF_±20%_10V_X5R	Murata	4.7uF_±20%_6.3V_X6S
Capacitance	Eyang	10uF_±20%_6.3V_X5R	Eyang	10uF_±20%_10V_X5R
			Murata	10uF_±20%_6.3V_X6S
Capacitance	TAIYO	22uF_±20%_6.3V_X5R	Murata	22uF_±20%_10V_X5R
Capacitance	Eyang	47uF_±20%_6.3V_X5R	Murata	47uF_±20%_2.5V_X6S
Crystal	TXC	48MHz_±20PPM	KYOCERA	48MHz_±20PPM
External PCB Dipole Antenna	Laird	Antenna Model No：MAF94109 Cable Length：100mm Peak Gain(dBi): 2400~2483.5MHz:3.2 5150~5250MHz:2.7 5250~5350MHz:3.1 5470~5725MHz:2.7 5725~5850MHz:2.6	Laird	Antenna Model No：EMN2449A2S-25UFL Cable Length：250mm Peak Gain(dBi): 2400~2483.5MHz:3.50 5150~5250MHz:5.75 5250~5350MHz:6.26 5470~5725MHz:6.24 5725~5850MHz:5.18
				Antenna Model No：MAF94264 Cable Length：80mm Peak Gain(dBi): 2400~2483.5MHz:3.33 5150~5250MHz:5.52

				5250~5350MHz:6.14 5470~5725MHz:6.06 5725~5850MHz:5.33

Except listings above, the others are all the same as previous version.
Should you have any questions or comments regarding this matter, please have my best attention.

Sincerely yours,

Xu Pengfei

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