

# FCC Test Report

## Part 15 subpart C

### Client Information:

Applicant: Well Shin Technology Co., Ltd.  
Applicant add.: No.196, Xin Hu 3rd Road, Nei Hu District Taipei City 114 Taiwan

### Product Information:

Product Name: RF PCBA Module  
Model No.: WS-SHWIFI-04E  
Brand Name: WELL SHIN  
FCC ID: QT4-WSSHWIFI04E

Standards: CFR 47 FCC PART 15 SUBPART C:2017 section 231

### Prepared By:

**Dongguan Yaxu (AiT) Technology Limited**

Add. : No. 22, Jinqianling Third Street, Jitigang, Huangjiang, Dongguan,  
Guangdong, China.

Date of Receipt: April 23, 2017      Date of Test: April 23~ May 20, 2017  
Date of Issue: May 22, 2017      Test Result: Pass

This device described above has been tested by Dongguan Yaxu (AiT) Technology Limited, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

\*This test report must not be used by the client to claim product endorsement by any agency of the U.S. government.

Reviewed by: Seal-Chen

Approved by: Jm

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## 2 Test Summary

### 2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2017	Section 15.203	<b>PASS</b>
Conduction Emissions	FCC Part 15 C:2017	Section 15.207(a)	<b>PASS</b>
Radiated Emissions	FCC Part 15 C:2017	Section 15.209,15.231(b)	<b>PASS</b>
Occupied Bandwidth	FCC Part 15 C:2017	Section 15.231(c)	<b>PASS</b>
Transmit time	FCC Part 15 C:2017	Section 15.231(a)	<b>PASS</b>

**Remark:**

EUT: In this whole report EUT means Equipment Under Test.

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radio Frequency.

ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.

### 2.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, the maximum value of the uncertainty as below:

No.	Item	Uncertainty
1	Conducted Emission Test	1.20dB
2	Radiated Emission Test	3.30dB
3	RF power,conducted	0.16dB
4	RF power density,conducted	0.24dB
5	Spurious emissions,conducted	0.21dB
6	All emissions,radiated(<1G)	4.68dB
7	All emissions,radiated(>1G)	4.89dB

### 3 Test Facility

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

**.CNAS- Registration No: L6177**

Dongguan Yaxu (AiT) technology Limited is accredited to ISO/IEC 17025:2005 general Requirements for the competence of testing and calibration laboratories (CNAS-CL01 Accreditation Criteria for the competence of testing and calibration laboratories) on Jun. 18, 2013

**.FCC- Registration No: 248337**

The 3m Semi-Anechoic Chamber, 3m/10m Open Area Test Site and Shielding Room of Asia Institute Technology (Dongguan) Limited have been registered by Federal Communications Commission (FCC) on Aug.29, 2014.

**.Industry Canada(IC)-Registration No: IC6819A**

The 3m Semi-Anechoic Chamber and 3m/10m Open Area Test Site of Asia Institute Technology (Dongguan) Limited have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing on Oct. 01, 2014.

#### 3.1 Deviation from standard

None

#### 3.2 Abnormalities from standard conditions

None

## 4 General Information

### 4.1 General Description of EUT

Applicant:	Well Shin Technology Co., Ltd.
Applicant add.:	No.196, Xin Hu 3rd Road, Nei Hu District Taipei City 114 Taiwan
Manufacturer:	Dong Guan Well Shin Electronic Products Co.,Ltd.
Manufacturer Address:	Changlong Village Huangjiang Town Dongguan Guangdong 523766 China
EUT Name:	RF PCBA Module
Model No.:	WS-SHWIFI-04E
Model Description:	N/A
Brand Name:	WELL SHIN
Operation frequency:	433.50MHz
Modulation Technology:	433.50MHz: FSK
Antenna Type:	Spring antenna & Wire antenna
Antenna Gain:	Spring antenna: Maximum 0 dBi Wire antenna: Maximum 0 dBi
H/W No.:	REV2.0
S/W No.:	REV2.0
Serial No.:	N/A
Power Supply Range:	DC 5V, 0.1A
Power Supply:	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA) Testing Adapter Board(PCBA): Input: AC100-240V 50/60Hz, 0.03A Output: DC 5V, 0.1A
Model different:	N/A

### 4.2 Test Location

All tests were performed at:

Dongguan Yaxu (AiT) Technology Limited  
No. 22, Jinqianling Third Street, Jitigang, HuangJiang, Dongguan, Guangdong, China.

Tel.: +86.769.82020499 Fax.: +86.769.82020495

Dongguan Yaxu (AiT) Technology Limited  
No. 22, Jinqianling Third Street, Jitigang,  
Huangjiang, Dongguan, Guangdong, China.

Description of Channel:	
Channel	Frequency (MHz)
01	433.50

## 5 Description of Test conditions

### 5.1 E.U.T. Operation

<b>Test Voltage:</b>	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA)
Requirements:	<b>15.31(e):</b> For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.
<b>Temperature:</b>	20.0 -25.0 °C
<b>Humidity:</b>	38-50 % RH
<b>Atmospheric Pressure:</b>	1000 -1010 mbar
<b>Test frequencies and frequency range:</b>	According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

#### Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

#### Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Remark: Test frequency is 433.50 MHz .



## 5.2 EUT Peripheral List

No.	Equipment	Manufacturer	Model No.	Serial No.	Power cord	signal cable
1	N/A	N/A	N/A	N/A	N/A	N/A

## 5.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	Testing Adapter Board (PCBA)	N/A	N/A	N/A	N/A	N/A	N/A

## 6 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	SIGNAL ANALYZER	R&S	FSV40	101470	2016.06.29	2017.06.28
2	EMI Measuring Receiver	R&S	ESR	101660	2016.06.29	2017.06.28
3	Low Noise Pre Amplifier	Tsj	MLA-10K01-B01-27	1205323	2016.06.29	2017.06.28
4	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2016.06.29	2017.06.28
5	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2016.06.29	2017.06.28
6	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2016.06.29	2017.06.28
7	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2016.06.29	2017.06.28
8	Loop Antenna	ETS	6512	00165355	2016.06.29	2017.06.28
9	Radiated Cable 1# (30MHz-1GHz)	FUJIKURA	5D-2W	01	2016.12.25	2017.12.24
10	Radiated Cable 2# (1GHz -40GHz)	FUJIKURA	10D2W	02	2016.12.25	2017.12.24
11	Conducted Cable 1#(9KHz-30MHz)	FUJIKURA	1D-2W	01	2016.12.25	2017.12.24
12	SMA Antenna connector	Dosin	Dosin-SMA	N/A	N/A	N/A

Note: The SMA antenna connector is soldered on the PCB board in order to perform conducted tests and this SMA antenna connector is listed in the equipment list.

## 7 Test Result

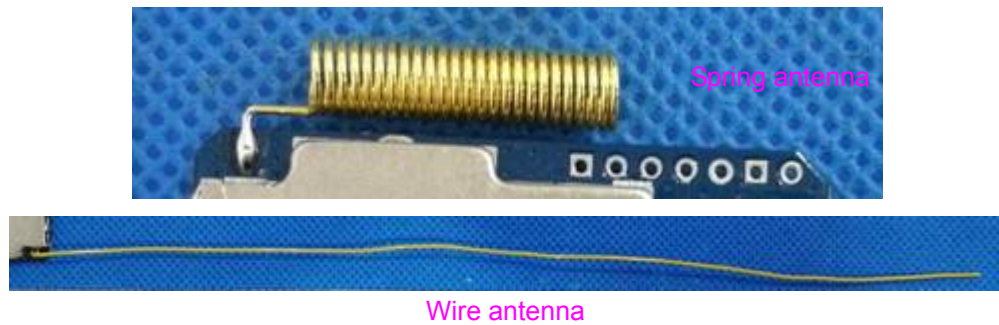
### 7.1 Antenna Requirement

#### 7.1.1 Standard requirement

15.203 Requirement: For intentional device, according to 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.

#### 7.1.2 EUT Antenna

The antenna is Spring antenna & Wire antenna. The maximum gain of the antenna is Spring antenna: 0 dBi & Wire antenna: 0 dBi.



**Test result: The unit does meet the FCC requirements.**

## 7.2 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

**Test Requirement:** FCC Part 15 C section 15.207  
**Test Method:** ANSI C63.10: Clause 6.2  
**Frequency Range:** 150 kHz to 30 MHz  
**Detector:** Peak for pre-scan (9 kHz Resolution Bandwidth)  
**Test Limit**

**Limits for conducted disturbance at the mains ports**

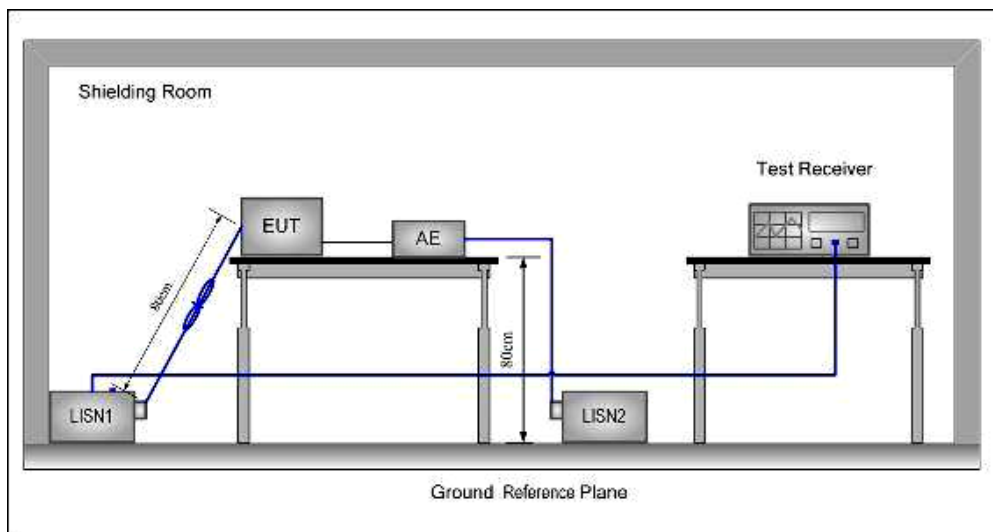
Frequency Range (MHz)	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

**EUT Operation:** Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

### Test Configuration:

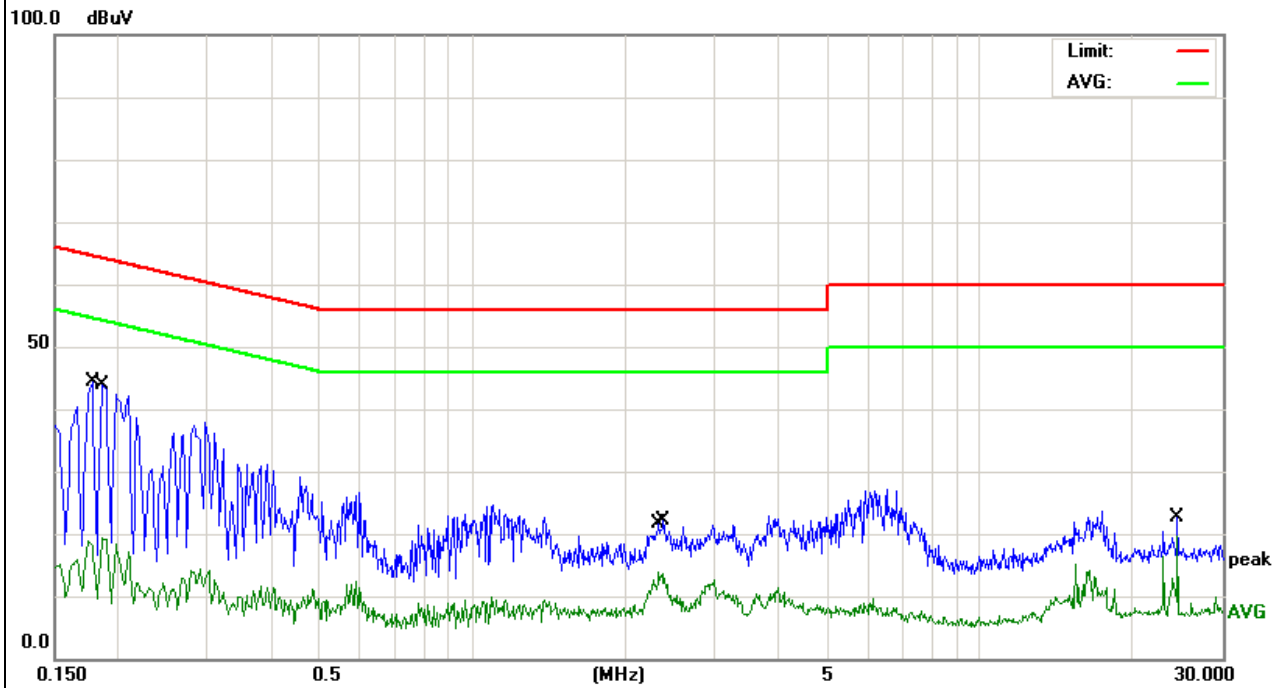


**Test procedure:**

1. The mains terminal disturbance voltage test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a  $50\Omega/50\mu\text{H} + 5\Omega$  linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

### 7.2.1 Test results

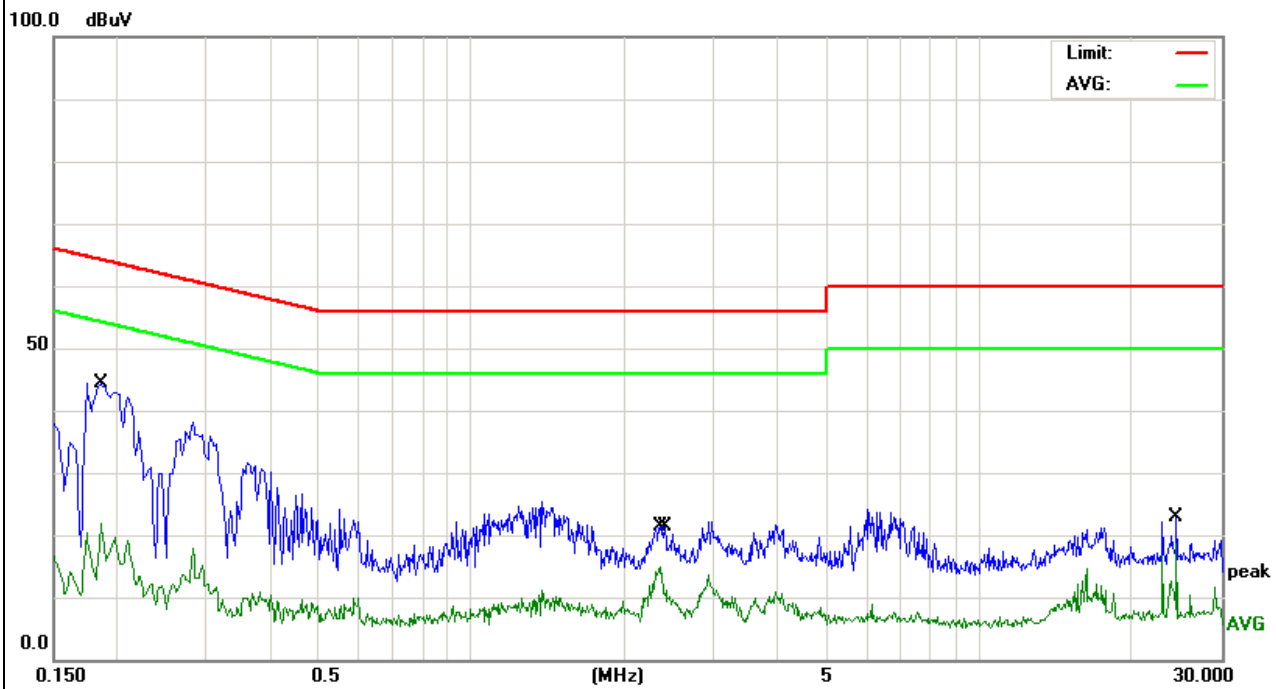
Model name:	WS-SHWIFI-04E	Test Date :	2017-04-25
Temperature:	26 °C	Relative Humidity:	54%
Mode:	CH 01(Spring antenna)	Phase :	Line
Test Voltage:	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA)		



Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV	dBuV	dB	
1	*	0.1780	32.86	11.41	44.27	64.57	-20.30	QP
2		0.1860	8.00	11.31	19.31	54.21	-34.90	AVG
3		2.3220	3.97	10.00	13.97	46.00	-32.03	AVG
4		2.3740	12.12	10.00	22.12	56.00	-33.88	QP
5		24.4900	20.57	2.11	22.68	60.00	-37.32	QP
6		24.4900	17.41	2.11	19.52	50.00	-30.48	AVG

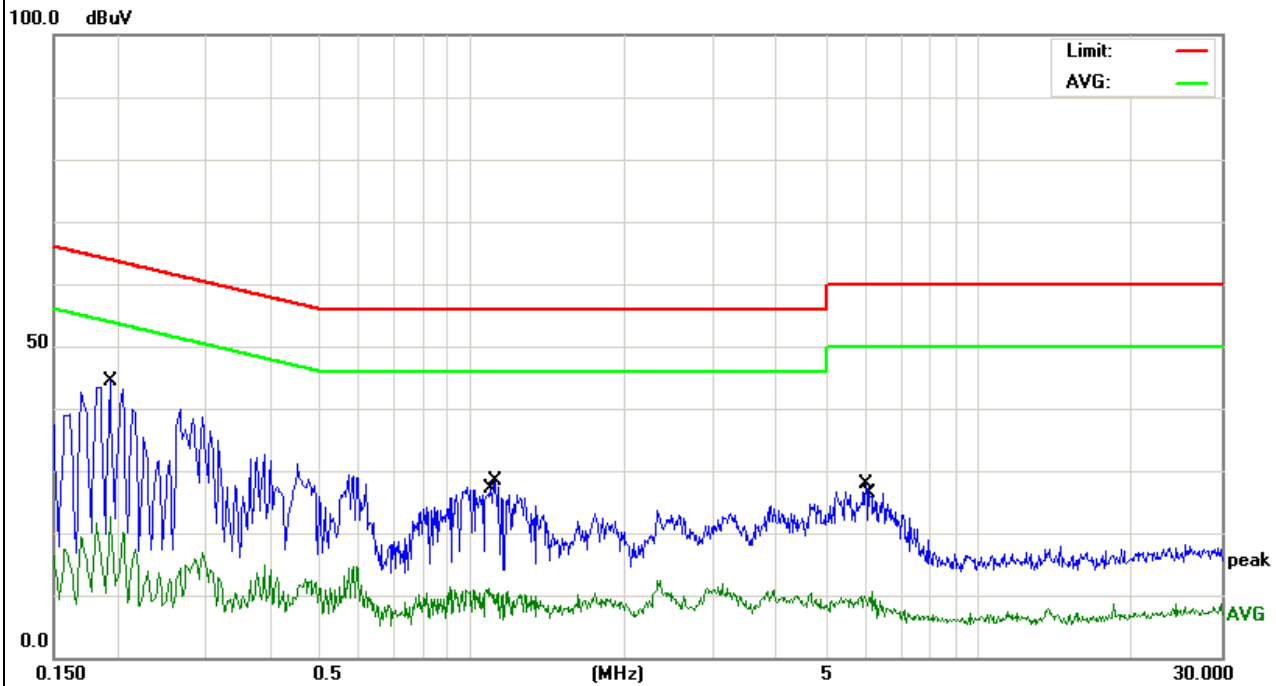
Model name:	WS-SHWIFI-04E	Test Date :	2017-04-25
Temperature:	26 °C	Relative Humidity:	54%
Mode:	CH 01(Spring antenna)	Phase :	Neutral
Test Voltage:	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA)		



Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1	*	0.1860	33.11	11.31	44.42	64.21	-19.79	QP
2		0.1860	10.56	11.31	21.87	54.21	-32.34	AVG
3		2.3500	4.93	10.00	14.93	46.00	-31.07	AVG
4		2.4060	11.40	10.01	21.41	56.00	-34.59	QP
5		24.4900	20.66	2.11	22.77	60.00	-37.23	QP
6		24.4900	16.61	2.11	18.72	50.00	-31.28	AVG

Model name:	WS-SHWIFI-04E	Test Date :	2017-04-25
Temperature:	26 °C	Relative Humidity:	54%
Mode:	CH 01(Wire antenna)	Phase :	Line
Test Voltage:	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA)		

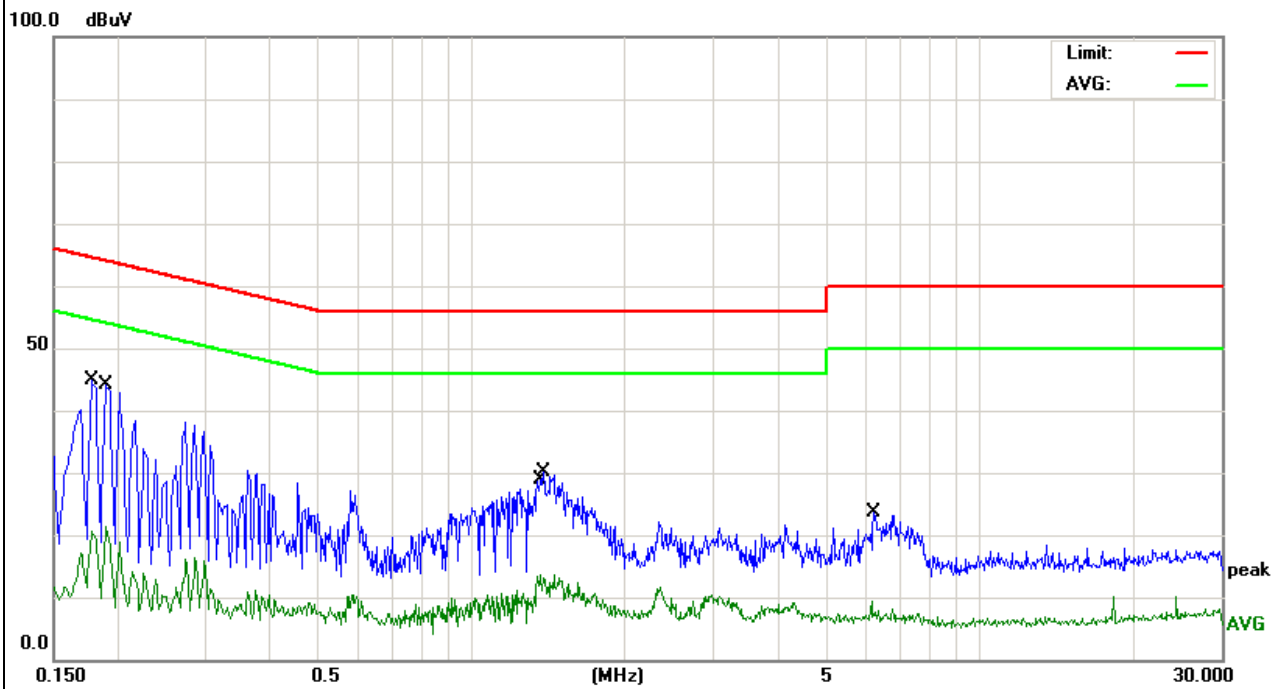


Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1	*	0.1940	33.20	11.21	44.41	63.86	-19.45	QP
2		0.1940	11.40	11.21	22.61	53.86	-31.25	AVG
3		1.0859	1.24	9.94	11.18	46.00	-34.82	AVG
4		1.1140	18.41	9.94	28.35	56.00	-27.65	QP
5		5.9820	17.65	10.12	27.77	60.00	-32.23	QP
6		6.1220	0.45	10.13	10.58	50.00	-39.42	AVG



Model name:	WS-SHWIFI-04E	Test Date :	2017-04-25
Temperature:	26 °C	Relative Humidity:	54%
Mode:	CH 01(Wire antenna)	Phase :	Neutral
Test Voltage:	5V from Testing Adapter Board(PCBA), AC 120V/60Hz for Testing Adapter Board(PCBA)		



Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.

lo.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV	dBuV	dB	
1	*	0.1780	33.38	11.41	44.79	64.57	-19.78	QP
2		0.1900	10.17	11.26	21.43	54.03	-32.60	AVG
3		1.3619	3.69	9.96	13.65	46.00	-32.35	AVG
4		1.3820	20.17	9.96	30.13	56.00	-25.87	QP
5		6.1220	-0.81	10.13	9.32	50.00	-40.68	AVG
6		6.2100	13.51	10.13	23.64	60.00	-36.36	QP

## 7.3 Transmit time

### 7.3.1 Applied procedures / Limit

**Regulation 15.231 (a)** A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

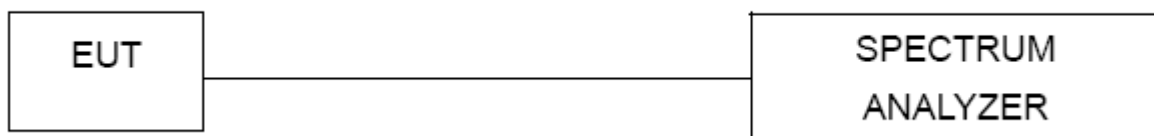
### 7.3.2 Test procedure

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW=100kHz, VBW $\geq$ RBW, Sweep time=10s, Detector Function=Peak.

### 7.3.3 Deviation from standard

No deviation.

### 7.3.4 Test setup

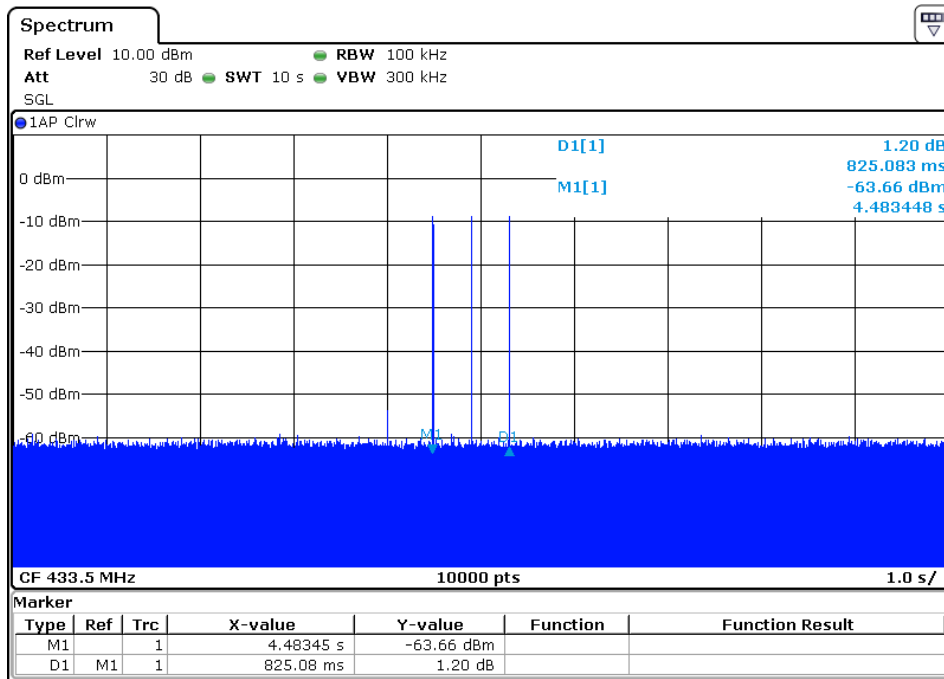


### 7.3.5 Test results

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Relative Humidity:	60%
Pressure:	1010 hPa	Test Power :	5V from Testing Adapter Board(PCBA)
Test Mode :	TX CH01		

Item	Duration of each transmission (Td)	Limit
Time	0.82508 s	≤5 s

#### Channel 01: 433.50MHz



## 7.4 Radiated Emissions Measurement

### 7.4.1 Applied procedures / Limit

<b>Test Requirement:</b>	FCC Part15 C section 15.231(a)			
<b>Test Method:</b>	ANSI C63.10: Clause 6.4, 6.5 and 6.6			
<b>Measurement Distance:</b>	3 m (Semi-Anechoic Chamber)			
<b>Test Status:</b>	Test in transmitting mode.			
<b>Requirements:</b>	the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:			
Fundamental Frequency MHz	Field Strength of Fundamental		Field Strength of Harmonics and Spurious Emissions	
	$\mu\text{V/m @ 3 m}$	$\text{dB}\mu\text{V/m @ 3 m}$	$\mu\text{V/m @ 3 m}$	$\text{dB}\mu\text{V/m @ 3 m}$
40.66 to 40.70	2250	67.00	225	47.00
70 to 130	1250	61.9	125	41.9
130 to 174	1250 to 3750	61.9 to 71.5	125 to 375	41.9 to 51.5
174 to 260	3750	71.5	375	51.5
260 to 470	3750 to 12500	71.5 to 81.94	375 to 1250	51.5 to 61.94
Above 470	12500	81.94	1250	61.94
<b>Detector:</b>	Peak for pre-scan			
	QP for 30MHz to1000 MHz:120 kHz resolution bandwidth Peak for Above 1 GHz: 1 MHz resolution bandwidth			
<p>** linear interpolations</p> <p>[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, <math>\mu\text{V/m}</math> at 3 meters = <math>51.81818(F) - 6136.3636</math>; for the band 260-470 MHz, <math>\mu\text{V/m}</math> at 3 meters = <math>41.6667(F) - 7083.3333</math>. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level</p> <p>The fundamental frequency of the EUT is 433.50 MHz</p> <p>The limit for average or QP field strength <math>\text{dB}\mu\text{V/m}</math> for the fundamental emission= 80.81 <math>\text{dB}\mu\text{V/m}</math></p> <p>No fundamental is allowed in the restricted bands.</p> <p>The limit for average field strength <math>\text{dB}\mu\text{V/m}</math> for the spurious emission=61.81 <math>\text{dB}\mu\text{V/m}</math> (433.50MHz). Spurious in the restricted bands must be less than average field strength or 15.209, whichever limit permits a higher field strength.</p>				

And according 15.35(a)

15.35(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.

Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.

According to 15.35 (b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.255, and 15.509-15.519 of this part, the limit on peak radio frequency emissions is 20 dB 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, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

The average correction factor is computed by analyzing the on time in 100ms over one complete pulse train. Analysis of the remote transmitter on time in one complete pulse train, therefore the average value of fundamental frequency is: Average = Peak value + 20log (Duty cycle), where the duty factor is calculated from following formula:

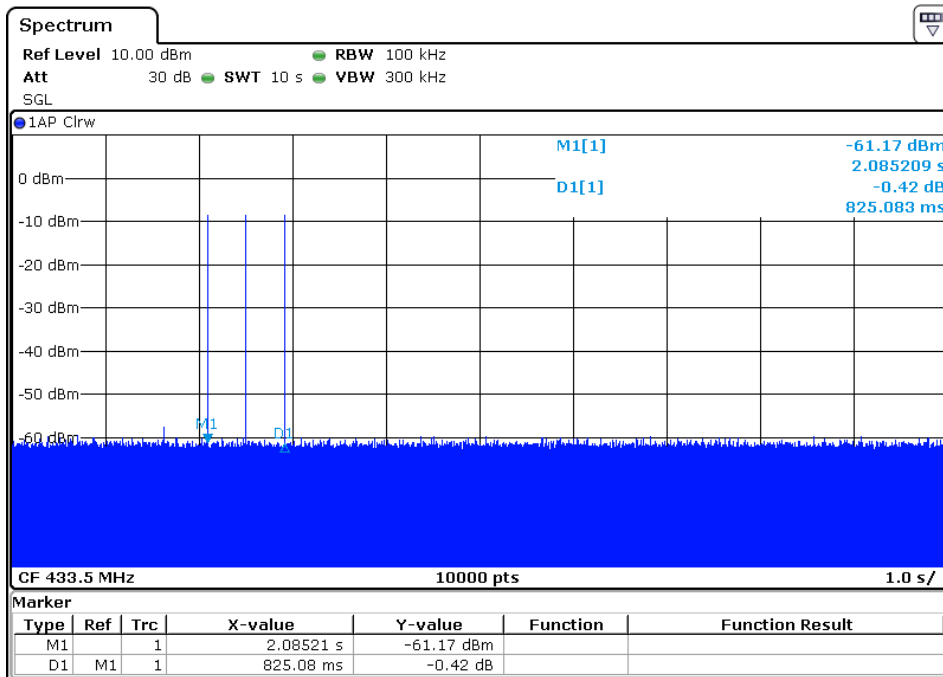
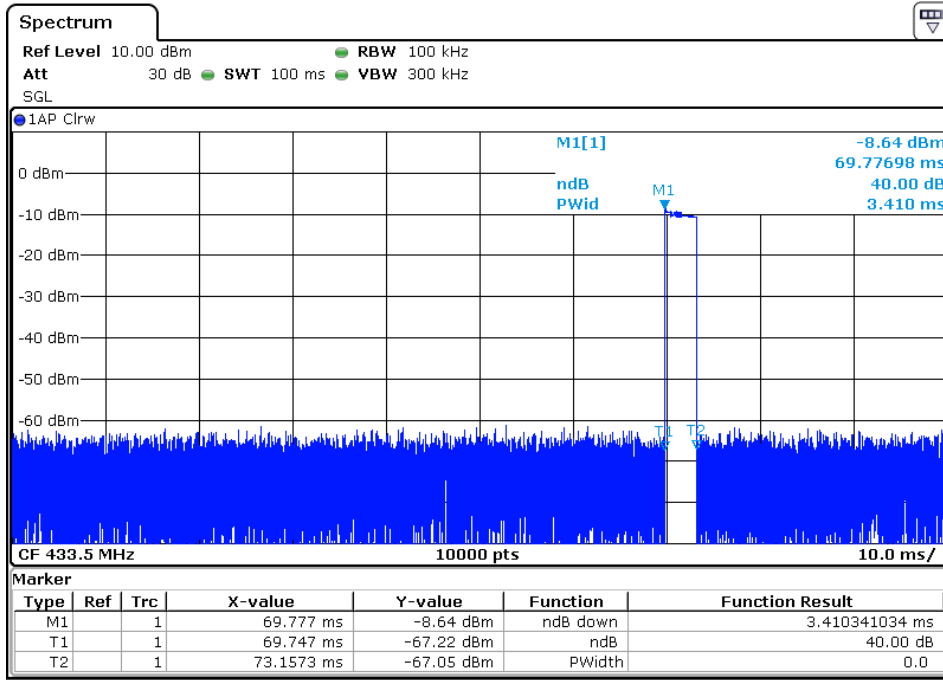
For 433.50 MHz:

$$20\log (\text{Duty cycle}) = 20\log(T_{pulse} / 100) = 20\log(0.034103) = -29.34\text{dB}$$

Here  $T_{pulse} = 3.4103$  (ms)

Please refer to below plots for more details.

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Test Data	2017-04-25
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX CH01	Test Voltage :	5V from Testing Adapter Board(PCBA)



## 7.4.2 Test procedure

### Test Procedure:

1)9 kHz to 30 MHz emissions:

For testing performed with the loop antenna, testing was performed in accordance to ANSI C63.10. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the specified distance from the EUT, During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2)30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna, testing was performed in accordance to ANSI C63.10. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3)1 GHz to 25 GHz emissions:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

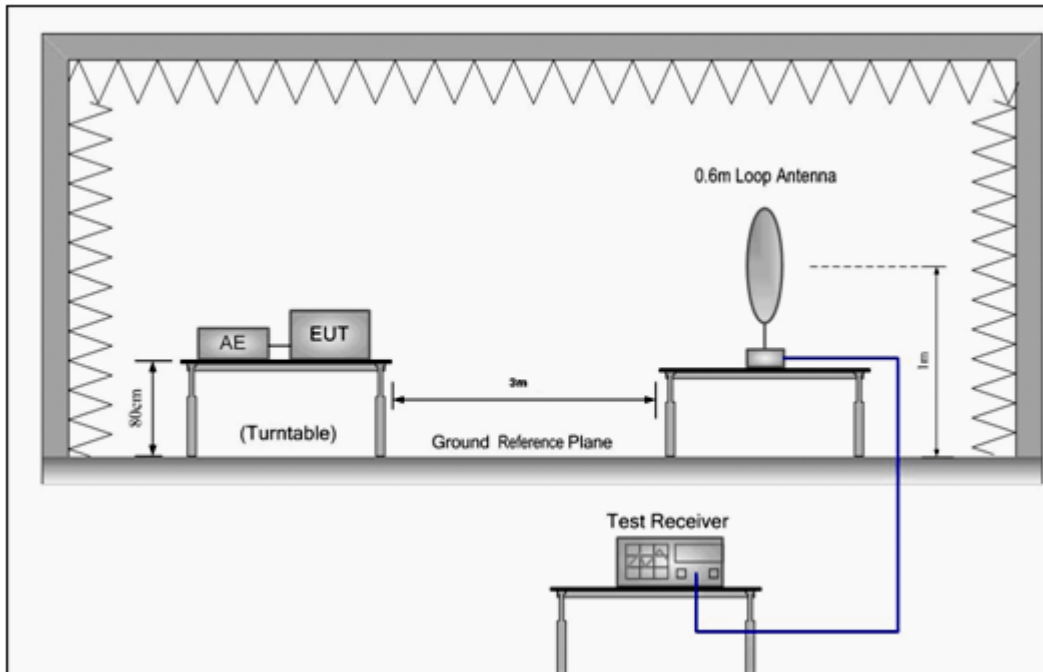
For testing performed with the horn antenna, testing was performed in accordance to ANSI C63.10. The measurement is performed with the EUT rotated 360°, the antenna height scan between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

For the radiated emission test above 1GHz:

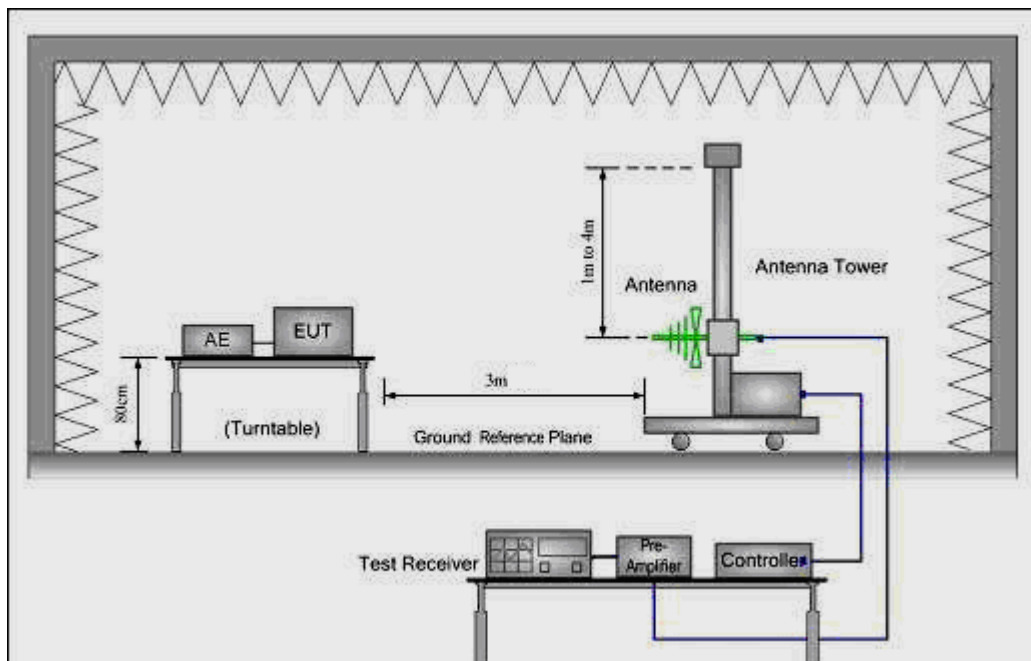
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. 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.

**Test Configuration:**

- 1) 9 kHz to 30 MHz emissions:

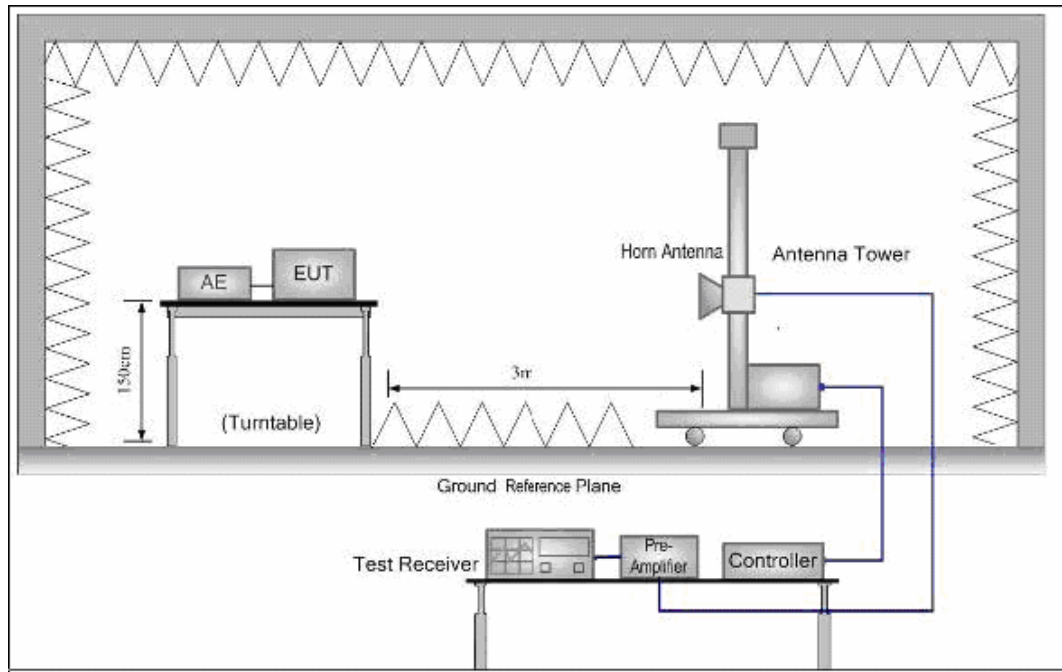


- 2) 30 MHz to 1 GHz emissions:





3) 1 GHz to 5 GHz emissions:



The field strength is calculated by adding the Antenna Factor, Cable Loss & Per-amplifier. The basic equation with a sample calculation is as follows:

$$\text{Final Test Level} = \text{Receiver Reading} + \text{Antenna, Factor} + \text{Cable Loss} - \text{Preamplifier Factor}$$

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Test Data	2017-04-27
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX CH 01(Spring antenna)	Test Voltage :	5V from Testing Adapter Board(PCBA)
Measurement Distance	3 m	Frenqucy Range	30MHz to 5GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

**Antenna polarization: Horizontal:**

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
433.5000	101.72	-6.60	95.12	100.81	-5.69	Peak
867.0000	57.76	1.80	59.56	80.81	-21.25	Peak
1012.959	40.23	-10.97	29.26	74.00	-44.74	Peak
1495.349	39.03	-9.88	29.15	74.00	-44.85	Peak
2609.673	42.54	-4.13	38.41	74.00	-35.59	Peak
3397.952	43.75	-0.91	42.84	74.00	-31.16	Peak
4243.020	45.29	4.22	49.51	74.00	-24.49	Peak
4951.949	43.72	5.21	48.93	74.00	-25.07	Peak

Frequency (MHz)	20log (Duty cycle) (dB)	Peak Level (dB $\mu$ V)	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector Type
433.5000	-29.34	95.12	65.78	80.81	-15.03	AVG
867.0000	-29.34	59.56	30.22	60.81	-30.59	AVG

**Antenna polarization: Vertical:**

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
433.5000	98.62	-6.60	92.02	100.81	-8.79	Peak
867.0000	50.05	1.80	51.85	80.81	-28.96	Peak
1044.413	39.69	-10.85	28.84	74.00	-45.16	Peak
1692.634	40.50	-9.65	30.85	74.00	-43.15	Peak
2580.437	42.61	-4.31	38.30	74.00	-35.70	Peak
3381.585	43.13	-0.94	42.19	74.00	-31.81	Peak
4182.003	43.84	4.11	47.95	74.00	-26.05	Peak
4943.986	43.27	5.21	48.48	74.00	-25.52	Peak

Frequency (MHz)	20log (Duty cycle) (dB)	Peak Level (dB $\mu$ V)	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector Type
433.5000	-29.34	92.02	62.68	80.81	-18.13	AVG
867.0000	-29.34	51.85	22.51	60.81	-38.30	AVG

Y: rotate EUT by 90° vertically.

X: rotate EUT by 90° clockwise.

Z: EUT as Radiated Emission test setup photograph in section 8 of this report.

Remark: Radiated Emission test setup photograph in section 8 of this report is the worst case and reported.

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Test Data	2017-04-27
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX CH01(Wire antenna)	Test Voltage :	5V from Testing Adapter Board(PCBA)
Measurement Distance	3 m	Frenqucy Range	30MHz to 5GHz
RBW/VBW	1MHz/1MHz for Peak.		

**Antenna polarization: Horizontal:**

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
433.5000	103.96	-6.60	97.36	100.81	-3.45	Peak
867.0000	72.41	1.82	74.23	80.81	-6.58	Peak
1244.686	42.52	-10.48	32.04	74.00	-41.96	Peak
1687.195	41.51	-9.66	31.85	74.00	-42.15	Peak
1959.609	42.15	-9.25	32.90	74.00	-41.10	Peak
2454.852	42.19	-5.22	36.97	74.00	-37.03	Peak
3145.333	43.48	-1.33	42.15	74.00	-31.85	Peak
4810.550	44.25	5.07	49.32	74.00	-24.68	Peak

Frequency (MHz)	20log (Duty cycle) (dB)	Peak Level (dBμV)	Average Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna polarization
433.500	-29.34	97.36	68.02	80.81	-12.79	AVG
867.000		74.23	44.89	60.81	-15.92	AVG

**Antenna polarization: Vertical:**

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
433.5000	98.25	-6.61	91.64	100.81	-9.17	Peak
867.0000	58.45	1.82	60.27	80.81	-20.54	Peak
1300.500	42.09	-10.36	31.73	74.00	-42.27	Peak
1734.000	42.40	-9.43	32.97	74.00	-41.03	Peak
2601.000	42.36	-3.96	38.40	74.00	-35.60	Peak
3150.399	43.55	-1.32	42.23	74.00	-31.77	Peak
3901.500	43.78	2.89	46.67	74.00	-27.33	Peak
4768.500	44.69	5.06	49.75	74.00	-24.25	Peak

Frequency (MHz)	20log (Duty cycle) (dB)	Peak Level (dB $\mu$ V)	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Antenna polarization
433.500	-29.34	91.64	62.30	80.81	-18.51	AVG
867.000		60.27	30.93	60.81	-29.88	AVG

Y: rotate EUT by 90° vertically.

X: rotate EUT by 90° clockwise.

Z: EUT as Radiated Emission test setup photograph in section 8 of this report.

Remark: Radiated Emission test setup photograph in section 8 of this report is the worst case and reported.

**other emissions:**

The receive was scanned from the lowest frequency generated within the EUT to 5 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. The worst case emissions were reported.

An initial pre-scan was performed in the 3 m chamber using the spectrum analyzer in peak detection mode. Quasi-peak measurements were conducted based on the peak sweep graph. The EUT was measured by Bilog antenna with 2 orthogonal polarities.

The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Peramplifier Factor.

The following test results were performed on the EUT.

Since the peak emission level is lower than the average limit, the average emission level does not need to show.

Test the EUT in transmitting mode.

### 7.4.3 Test Result

9 kHz~30 MHz Field Strength of Unwanted Emissions.Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Test Data	2017-04-27
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX CH 01(Spring antenna)	Test Voltage :	5V from Testing Adapter Board(PCBA)
Measurement Distance	3 m	Frenqucy Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
48.1626	31.37	-14.22	17.15	40.00	-22.85	QUASIPeAK
98.8326	37.38	-16.13	21.25	43.50	-22.25	QUASIPeAK
141.8262	42.38	-15.03	27.35	43.50	-16.15	QUASIPeAK
251.1804	46.77	-13.51	33.26	46.00	-12.74	QUASIPeAK
318.8170	49.32	-8.85	40.47	46.00	-5.53	QUASIPeAK
344.3855	49.95	-8.34	41.61	46.00	-4.39	QUASIPeAK

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
88.6524	38.85	-18.60	20.25	43.50	-23.25	QUASIPeAK
110.9571	42.76	-13.55	29.21	43.50	-14.29	QUASIPeAK
149.4857	47.51	-15.47	32.04	43.50	-11.46	QUASIPeAK
252.0627	40.71	-13.44	27.27	46.00	-18.73	QUASIPeAK
295.1469	41.61	-10.27	31.34	46.00	-14.66	QUASIPeAK
804.6028	30.37	2.82	33.19	46.00	-12.81	QUASIPeAK

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Test Data	2017-04-27
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX CH 01(Wire antenna)	Test Voltage :	5V from Testing Adapter Board(PCBA)
Measurement Distance	3 m	Frenqucy Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

(b) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
204.2377	51.52	-16.86	34.66	43.50	-8.84	QUASIPeAK
242.5253	48.75	-14.02	34.73	46.00	-11.27	QUASIPeAK
305.4600	51.90	-9.39	42.51	46.00	-3.49	QUASIPeAK
318.3980	51.20	-8.86	42.34	46.00	-3.66	QUASIPeAK
344.3855	49.78	-8.34	41.44	46.00	-4.56	QUASIPeAK
480.5276	37.33	-5.90	31.43	46.00	-14.57	QUASIPeAK

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
106.0126	41.13	-13.52	27.61	43.50	-15.89	QUASIPeAK
137.4202	41.19	-14.80	26.39	43.50	-17.11	QUASIPeAK
239.1473	39.03	-14.15	24.88	46.00	-21.12	QUASIPeAK
318.8170	45.53	-8.85	36.68	46.00	-9.32	QUASIPeAK
331.3546	44.49	-8.69	35.80	46.00	-10.20	QUASIPeAK
535.7073	37.24	-4.39	32.85	46.00	-13.15	QUASIPeAK

Remark:

According to 15.35 (b) When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules, e.g., see Section 15.255.



## 7.5 BANDWIDTH TEST

### 7.5.1 Applied procedures / Limit

15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Bandwidth (20dB) Limit =  $0.25\% * f(\text{MHz}) = 0.25\% * 433.50\text{MHz} = 1083.75\text{kHz}$

### 7.5.2 Test procedure

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW= 30KHz, VBW $\geq$ RBW, Sweep time = Auto.

### 7.5.3 Deviation from standard

No deviation.

### 7.5.4 Test setup



### 7.5.5 Test results

EUT:	RF PCBA Module	Model Name :	WS-SHWIFI-04E
Temperature:	23 °C	Relative Humidity:	60%
Pressure:	1010 hPa	Test Power :	5V from Testing Adapter Board(PCBA)
Test Mode :	TX CH01		

Test Mode	Test Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	Limit (kHz)	Result
TX	CH 01	433.50	231.85	1083.75	Pass

Channel 01: 433.50MHz

