



# TEST REPORT

## FCC PART 15 SUBPART E 15.407 & RSS 247

Report Reference No. ....: CTL1712278061-WF

Compiled by:  
( position+printed name+signature)

Allen Wang  
(File administrators)

*Allen Wang*

Tested by:  
( position+printed name+signature)

Nice Nong  
(Test Engineer)

*Nice Nong*

Approved by:  
( position+printed name+signature)

Ivan Xie  
(Manager)

*Ivan Xie*

Product Name.....: GEIO

Model/Type reference .....: GEIO

List Model(s).....: N/A

Trade Mark .....: N/A

FCC ID .....: 2A14F-GEIO

Applicant's name .....: **Shenzhen GJS technology co., LTD**  
102, Qianhai Innovation and Entrepreneur Hub, Bldg. A Qianwan  
Address of applicant .....: 1st Rd., Nanshan District, Shenzhen, Guangdong Province,  
China

Test Firm .....: **Shenzhen CTL Testing Technology Co., Ltd.**  
Address of Test Firm .....: Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road,  
Nanshan District, Shenzhen, China 518055

Test specification .....:  
Standard.....: **47 CFR FCC Part 15 Subpart E 15.407 &  
RSS 247 Issue 2, February 2017**  
TRF Originator .....: Shenzhen CTL Testing Technology Co., Ltd.  
Master TRF .....: Dated 2011-01

Date of Receipt.....: Jan. 02, 2018  
Date of Test Date.....: Jan. 02, 2018 –Jan. 31, 2018  
Data of Issue.....: Jan. 31, 2018

Result .....: Pass

**Shenzhen CTL Testing Technology Co., Ltd. All rights reserved.**  
This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen CTL Testing Technology Co., Ltd. is acknowledged as copyright owner and source of the material. Shenzhen CTL Testing Technology Co., Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

# TEST REPORT

<b>Test Report No. :</b>	<b>CTL1712278061-WF</b>	Jan. 31, 2018 Date of issue
--------------------------	-------------------------	--------------------------------

Equipment under Test : GEIO

Model /Type : GEIO

Listed Models : N/A

**Applicant** : **Shenzhen GJS technology co., LTD**

Address : 102, Qianhai Innovation and Entrepreneur Hub, Bldg. A  
Qianwan 1st Rd., Nanshan District, Shenzhen, Guangdong  
Province, China

**Manufacturer** : **Shenzhen GJS technology co., LTD**

Address : 102, Qianhai Innovation and Entrepreneur Hub, Bldg. A  
Qianwan 1st Rd., Nanshan District, Shenzhen, Guangdong  
Province, China

<b>Test result</b>	<b>Pass *</b>
--------------------	---------------

\* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**\*\* Modified History \*\***

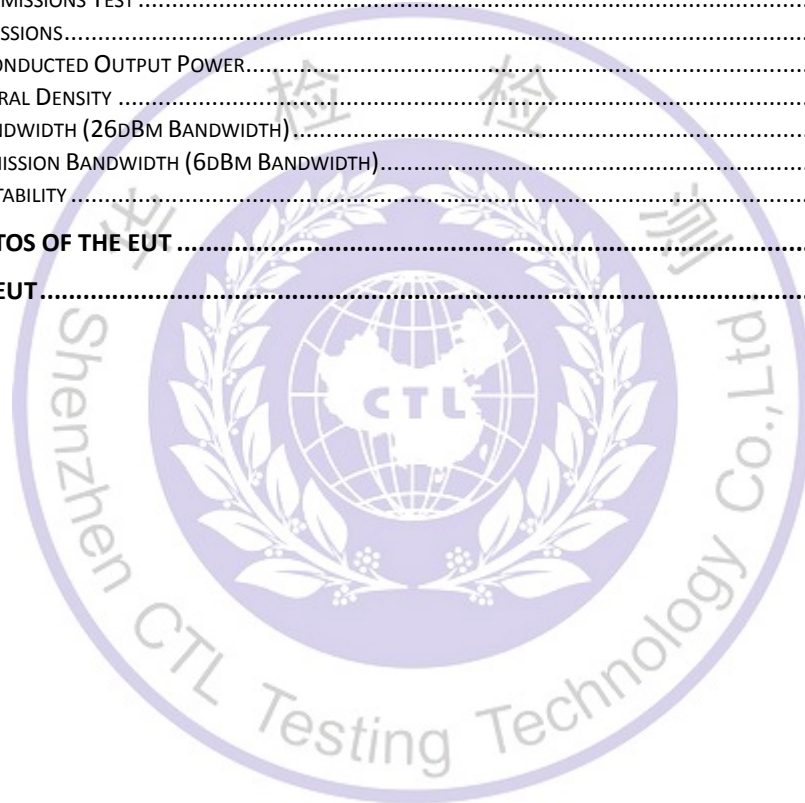
Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2018-01-31	CTL1712278061-WF	Tracy Qi



## Table of Contents

Page

<b>1. SUMMARY.....</b>	<b>5</b>
1.1. TEST STANDARDS.....	5
1.2. TEST DESCRIPTION.....	5
1.3. TEST FACILITY.....	6
1.4. STATEMENT OF THE MEASUREMENT UNCERTAINTY.....	6
<b>2. GENERAL INFORMATION.....</b>	<b>7</b>
2.1. ENVIRONMENTAL CONDITIONS.....	7
2.2. GENERAL DESCRIPTION OF EUT.....	7
2.3. DESCRIPTION OF TEST MODES AND TEST FREQUENCY.....	8
2.4. EQUIPMENTS USED DURING THE TEST.....	9
2.5. RELATED SUBMITTAL(S) / GRANT (S).....	9
2.6. MODIFICATIONS.....	9
<b>3. TEST CONDITIONS AND RESULTS.....</b>	<b>10</b>
3.1. CONDUCTED EMISSIONS TEST.....	10
3.2. RADIATED EMISSIONS.....	13
3.3. MAXIMUM CONDUCTED OUTPUT POWER.....	19
3.4. POWER SPECTRAL DENSITY.....	22
3.5. EMISSION BANDWIDTH (26dBm BANDWIDTH).....	29
3.6. MINIMUM EMISSION BANDWIDTH (6dBm BANDWIDTH).....	32
3.7. FREQUENCY STABILITY.....	35
<b>4. TEST SETUP PHOTOS OF THE EUT.....</b>	<b>37</b>
<b>5. PHOTOS OF THE EUT.....</b>	<b>38</b>



# 1. SUMMARY

## 1.1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15 Subpart E](#)—Unlicensed National Information Infrastructure Devices

[RSS-247-Issue 2](#): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

[RSS-Gen Issue 4](#): — General Requirements for Compliance of Radio Apparatus

[ANSI C63.10:2013](#) : American National Standard for Testing Unlicensed Wireless Devices

[KDB789033 D02](#): General UNII Test Procedures New Rules v02r01

[KDB 662911 D01](#): Multiple Transmitter Output v02r01

## 1.2. Test Description

FCC Requirement		
FCC Part 15.207 RSS-Gen 8.8	AC Power Conducted Emission	PASS
FCC Part 15.407(a) RSS 247	Emission Bandwidth(26dBm Bandwidth)	PASS <sup>Note1</sup>
FCC Part 15.407(e) RSS-247 6.2.4	Minimum Emission Bandwidth(6dBm Bandwidth)	PASS <sup>Note2</sup>
FCC Part 15.407(a) RSS-247 6.2.1 RSS-247 6.2.4	Maximum Conducted Output Power	PASS
FCC Part 15.407(a) RSS-247 6.2.1 RSS-247 6.2.4	Peak Power Spectral Density	PASS
FCC Part 15.407(g) RSS-Gen	Frequency Stability	PASS
FCC Part 15.407(b) RSS-247 6.2.1 RSS-247 6.2.4	Undesirable emission	PASS
FCC Part 15.407(b)/15.205/15.209 RSS-Gen RSS-247 6.2.1 RSS-247 6.2.4	Radiated Emissions	PASS
FCC Part 15.407(h) RSS-247 6.3	Dynamic Frequency Selection	N/A
FCC Part 15.203/15.247(b) RSS-Gen	Antenna Requirement	PASS

Note 1: Apply to U-NII 1, U-NII 2A, and U-NII 2C band.

Note 2: Apply to U-NII 3 band only.

## 1.3. Test Facility

### 1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 32/EN 55032 requirements.

### 1.3.2 Laboratory accreditation

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

#### IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

#### FCC-Registration No.: 399832

Shenzhen CTL Testing Technology 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 399832, December 08, 2017.

## 1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 2. GENERAL INFORMATION

### 2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

### 2.2. General Description of EUT

Product Name:	GEIO			
Model:	GEIO			
Power supply:	DC 7.4V from battery			
<b>WIFI</b>				
	20MHz system	40MHz system	80MHz system	160MHz system
Supported type:	802.11a (SISO only) 802.11n (MIMO only)	N/A	N/A	N/A
Operation frequency:	5180MHz-5240MHz 5745MHz-5825MHz	N/A	N/A	N/A
Modulation:	OFDM	N/A	N/A	N/A
Channel number:	9	N/A	N/A	N/A
Channel separation:	20MHz	N/A	N/A	N/A
Antenna type/gain:	2 FPC Antenna: 1.09dBi on 5GHz			

Note: For more details, please refer to the user's manual of the EUT.

Directional gain of MIMO mode :  $1.09+10\log 2=1.09+3.01=4.1\text{dBi}$

## 2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

All test performed at the low, middle and high of operational frequency range of each mode.

Operation Frequency List WIFI on 5G Band:

Operating band	20MHz		40MHz		80MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII 1 (5150MHz-5250MHz)	36	5180	--	--	--	--
	40	5200				
	44	5220				
	48	5240				
U-NII 3 (5725MHz-5850MHz)	149	5745	--	--	--	--
	153	5765				
	157	5785				
	161	5805				
	165	5825				

Note:

1. "--"Means no channel(s) available any more.
2. The line display in grey is those Channels/Frequencies select to test is this report for each operation mode.

### Data Rate Used:

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate
Maximum Conducted Output Power Power Spectral Density Emission Bandwidth(26dBm Bandwidth) Minimum Emission Bandwidth(6dBm Bandwidth)	11a/OFDM	6 Mbps
Undesirable emission Frequency Stability	11n(20MHz)/OFDM	7.2 Mbps



## 2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2017/06/02	2018/06/01
LISN	R&S	ESH2-Z5	860014/010	2017/06/02	2018/06/01
Power Meter	Agilent	U2531A	TW53323507	2017/06/02	2018/06/01
Power Sensor	Agilent	U2021XA	MY5365004	2017/05/21	2018/05/20
EMI Test Receiver	R&S	ESCI	103710	2017/06/02	2018/06/01
Spectrum Analyzer	Agilent	E4407B	MY41440676	2017/05/21	2018/05/20
Spectrum Analyzer	Agilent	N9020	US46220290	2018/01/17	2019/01/16
Controller	EM Electronics	Controller EM 1000	N/A	2017/05/21	2018/05/20
Active Loop Antenna	Daze	ZN30900A	N/A	2017/05/19	2018/05/18
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2017/05/19	2018/05/18
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2017/05/19	2018/05/18
Horn Antenna	SCHWARZBACK	BBHA 9170	BBHA9170184	2017/05/19	2018/05/18
Amplifier	Agilent	8449B	3008A02306	2017/05/19	2018/05/18
Amplifier	Agilent	8447D	2944A10176	2017/05/19	2018/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2017/05/20	2018/05/19
High-Pass Filter	K&L	9SH10-2700/ X12750-O/O	N/A	2017/05/20	2018/05/19
High-Pass Filter	K&L	41H10-1375/ U12750-O/O	N/A	2017/05/20	2018/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2017/06/02	2018/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01
RF Cable	Megalon	RF-A303	N/A	2017/06/02	2018/06/01

The calibration interval was one year

## 2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

## 2.6. Modifications

No modifications were implemented to meet testing criteria.

### 3. TEST CONDITIONS AND RESULTS

#### 3.1. Conducted Emissions Test

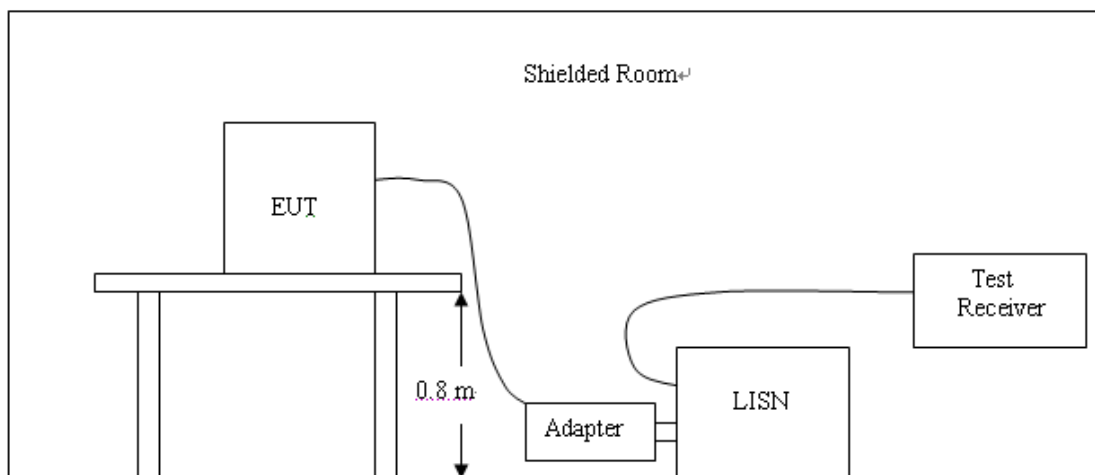
##### LIMIT

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207 and RSS Gen 8.8, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

##### TEST CONFIGURATION



##### TEST PROCEDURE

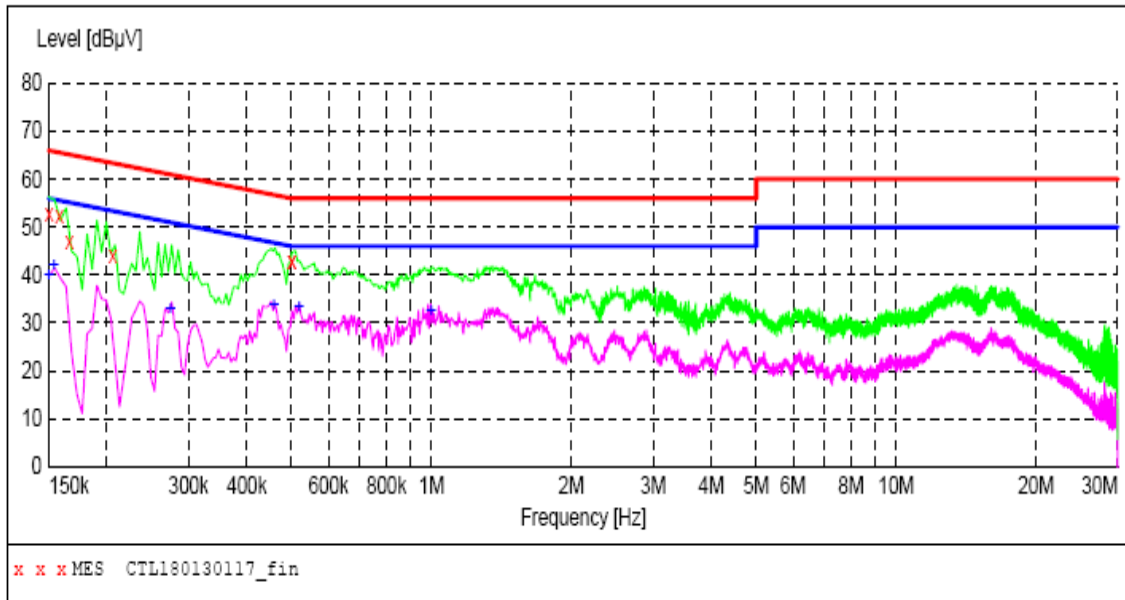
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The EUT received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

**TEST RESULTS**

Remark: Both 802.11a and 802.11n (HT20) mode have been tested, only worse case 802.11n (HT20) low channel of U-NII 1 band was reported

**SCAN TABLE: "Voltage (9K-30M)FIN"**

Short Description: 150K-30M Voltage



**MEASUREMENT RESULT: "CTL180130117\_fin"**

30/01/2018 11:34

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.150000	52.90	10.2	66	13.1	QP	L1	GND
0.158000	52.50	10.2	66	13.1	QP	L1	GND
0.166000	46.80	10.2	65	18.4	QP	L1	GND
0.206000	43.90	10.2	63	19.5	QP	L1	GND
0.500000	43.00	10.2	56	13.0	QP	L1	GND
0.500000	42.90	10.2	56	13.1	QP	L1	GND

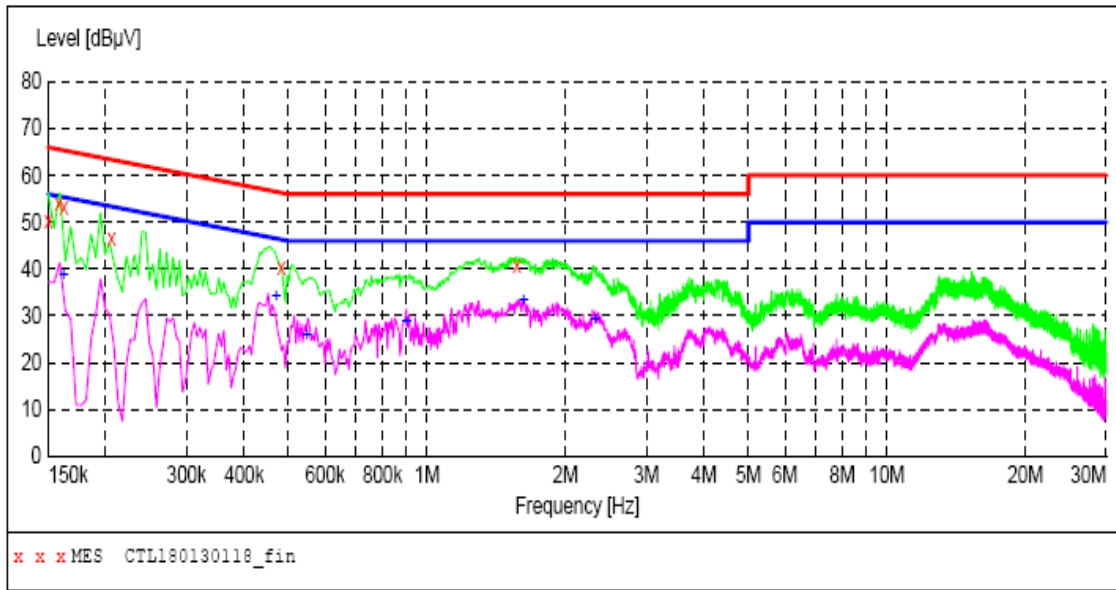
**MEASUREMENT RESULT: "CTL180130117\_fin2"**

30/01/2018 11:34

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.150000	40.10	10.2	56	15.9	AV	L1	GND
0.154000	42.20	10.2	56	13.6	AV	L1	GND
0.274000	32.90	10.2	51	18.1	AV	L1	GND
0.458000	33.80	10.2	47	12.9	AV	L1	GND
0.518000	33.40	10.2	46	12.6	AV	L1	GND
0.998000	32.60	10.3	46	13.4	AV	L1	GND

**SCAN TABLE: "Voltage (9K-30M) FIN"**

Short Description: 150K-30M Voltage



**MEASUREMENT RESULT: "CTL180130118\_fin"**

30/01/2018 11:37

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	50.40	10.2	66	15.6	QP	N	GND
0.158000	54.10	10.2	66	11.5	QP	N	GND
0.162000	53.30	10.2	65	12.1	QP	N	GND
0.206000	46.60	10.2	63	16.8	QP	N	GND
0.482000	40.50	10.2	56	15.8	QP	N	GND
1.568000	40.60	10.3	56	15.4	QP	N	GND

**MEASUREMENT RESULT: "CTL180130118\_fin2"**

30/01/2018 11:37

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.162000	38.60	10.2	55	16.8	AV	N	GND
0.470000	33.90	10.2	47	12.6	AV	N	GND
0.548000	26.00	10.2	46	20.0	AV	N	GND
0.902000	28.70	10.2	46	17.3	AV	N	GND
1.622000	33.20	10.3	46	12.8	AV	N	GND
2.324000	28.90	10.4	46	17.1	AV	N	GND

## 3.2. Radiated Emissions

### Limit

The maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

#### Undesirable emission limits

Requirement	Limit(EIRP)	Limit (Field strength at 3m) <sup>Note1</sup>
15.407(b)(1)	PK:-27(dBm/MHz)	PK:68.2(dBμV/m)
15.407(b)(2)		
15.407(b)(3)		
15.407(b)(4)		

Note1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V/m, where } P \text{ is the eirp (Watts)}$$

(5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209

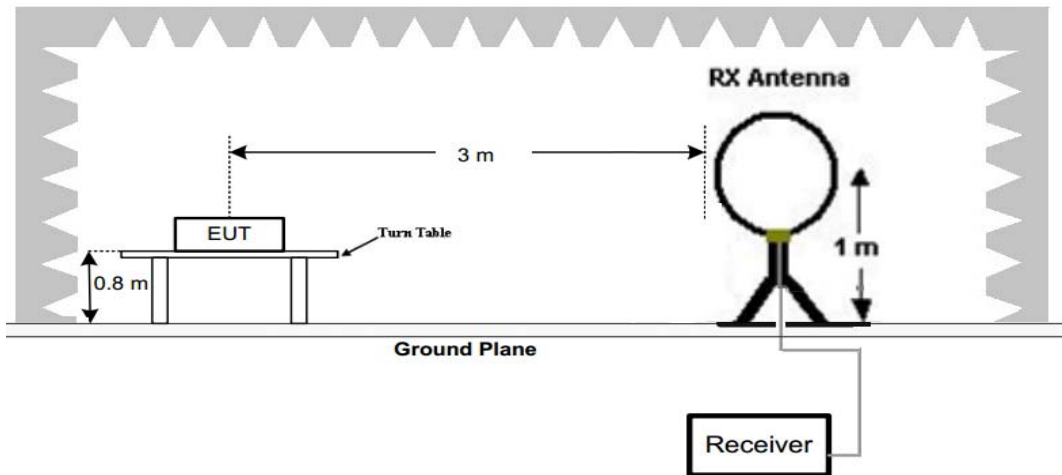
(6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

#### Radiated emission limits

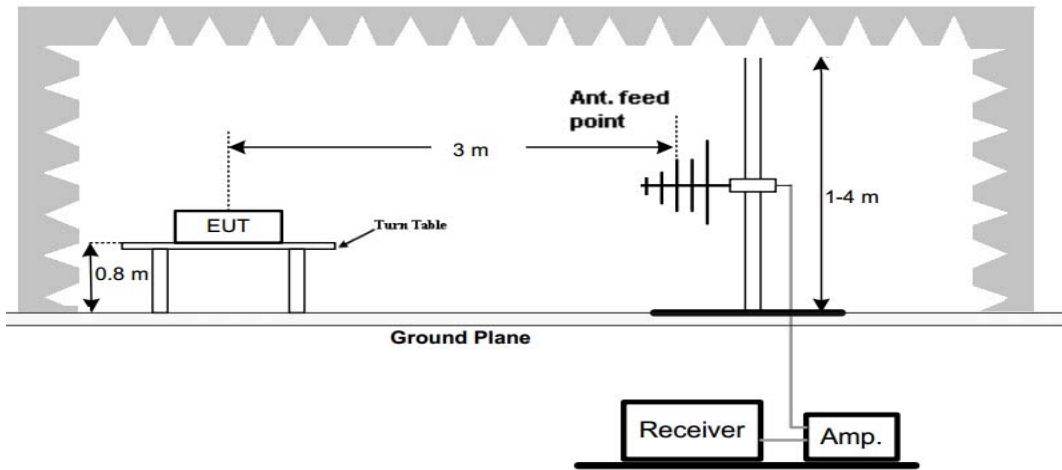
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

**TEST CONFIGURATION**

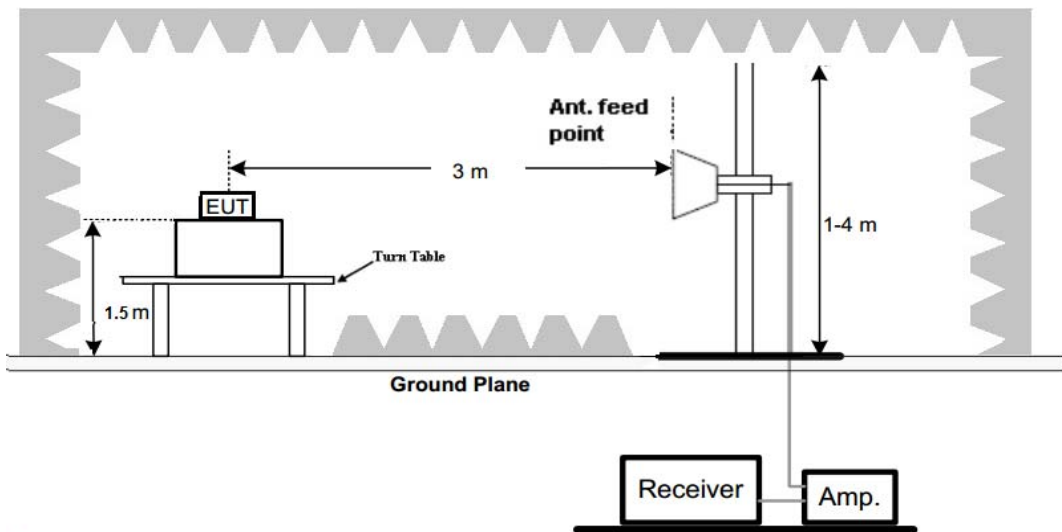
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



### **Test Procedure**

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
4. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.
5. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measurements have been completed.

### **TEST RESULTS**

Remark:

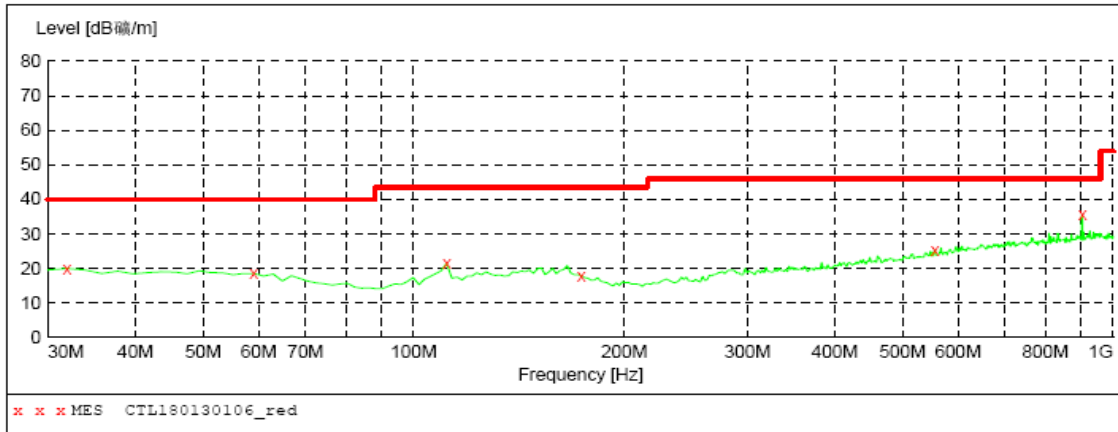
1. Both 802.11a SISO and 802.11n (HT20) MIMO modes have been tested for below 1GHz test, only the worst case 802.11n (HT20) MIMO mode low channel of U-NII 1 band was recorded.
2. Both 802.11a SISO and 802.11n (HT20) MIMO modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) MIMO mode was recorded.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal

**SWEEP TABLE: "test (30M-1G)"**

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	100 kHz	VULB 9168



**MEASUREMENT RESULT: "CTL180130106\_red"**

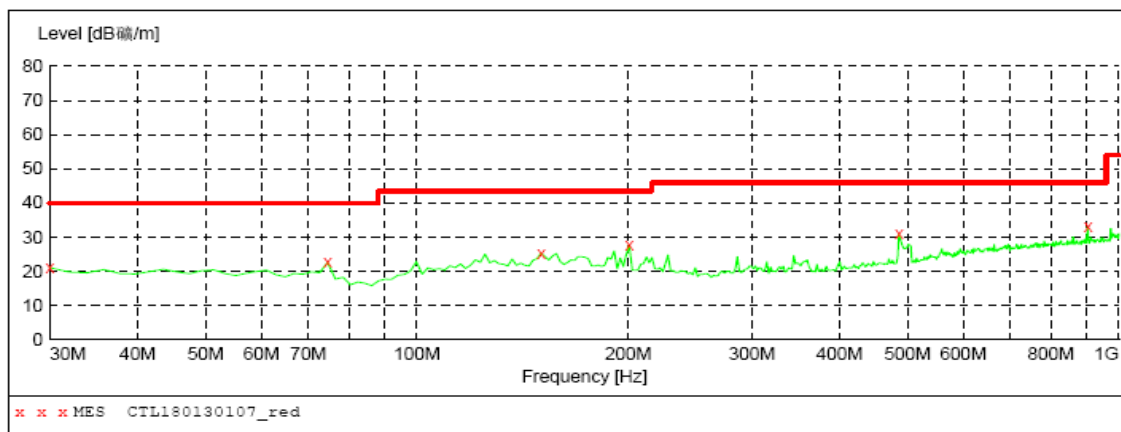
2018-1-30 9:25

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
31.940000	20.00	14.9	40.0	20.0	---	0.0	0.00	HORIZONTAL
59.100000	18.60	14.4	40.0	21.4	---	0.0	0.00	HORIZONTAL
111.480000	21.50	13.2	43.5	22.0	---	0.0	0.00	HORIZONTAL
173.560000	17.90	14.7	43.5	25.6	---	0.0	0.00	HORIZONTAL
555.740000	25.40	20.4	46.0	20.6	---	0.0	0.00	HORIZONTAL
903.000000	35.60	25.0	46.0	10.4	---	0.0	0.00	HORIZONTAL

Vertical

**SWEEP TABLE: "test (30M-1G)"**

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	100 kHz	VULB 9168



**MEASUREMENT RESULT: "CTL180130107\_red"**

2018-1-30 9:28

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	21.10	14.8	40.0	18.9	---	0.0	0.00	VERTICAL
74.620000	22.60	11.8	40.0	17.4	---	0.0	0.00	VERTICAL
150.280000	25.40	16.2	43.5	18.1	---	0.0	0.00	VERTICAL
200.720000	27.60	12.0	43.5	15.9	---	0.0	0.00	VERTICAL
485.900000	30.90	19.1	46.0	15.1	---	0.0	0.00	VERTICAL
903.000000	33.10	25.0	46.0	12.9	---	0.0	0.00	VERTICAL



**For 1GHz to 25GHz**

Note: Both 802.11a and 802.11n (HT20) modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) MIMO was recorded.

**U-NII 1 & 802.11n (HT20) Mode (above 1GHz)**

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	58.17	PK	H	68.20	10.03	50.89	34.44	7.12	34.28	7.28
	5150.00	50.64	AV	H	54.00	3.36	43.36	34.44	7.12	34.28	7.28
	10360.00	50.14	PK	H	68.20	18.06	34.41	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	51.70	PK	H	68.20	16.50	35.50	39.22	11.87	34.89	16.20
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	51.91	PK	H	68.20	16.29	39.55	35.25	11.58	34.47	12.36
	10480.00	49.24	PK	H	68.20	18.96	32.54	39.87	11.94	35.11	16.70
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	57.39	PK	V	68.20	10.81	50.11	34.44	7.12	34.28	7.28
	5150.00	48.75	AV	V	54.00	5.25	41.47	34.44	7.12	34.28	7.28
	10360.00	48.22	PK	V	68.20	19.98	32.49	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	49.95	PK	V	68.20	18.25	33.75	39.22	11.87	34.89	16.20
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	52.11	PK	V	68.20	16.09	39.75	35.25	11.58	34.47	12.36
	10480.00	51.84	PK	V	68.20	16.36	35.14	39.87	11.94	35.11	16.70
	--	--	--	--	--	--	--	--	--	--	--

**REMARKS:**

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the other emission levels were very low against the limit.
5. RBW1MHz VBW3MHz Peak detector is for PK value; RMS detector is for AV value.

**U-NII 3 & 802.11n (HT20) Mode (above 1GHz)**

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5725.00	52.37	PK	H	68.20	15.83	43.82	35.22	7.85	34.52	8.55
	11490.00	51.49	PK	H	68.20	16.71	34.52	40.57	11.97	35.57	16.97
	--	--	--	--	--	--	--	--	--	--	--
157 (5785MHz)	11570.00	51.32	PK	H	68.20	16.88	34.25	40.68	12.05	35.66	17.07
	--	--	--	--	--	--	--	--	--	--	--
165 (5825MHz)	5850.00	50.07	PK	H	68.20	18.13	41.35	35.43	7.91	34.62	8.72
	11650.00	52.13	PK	H	68.20	16.07	34.73	40.75	12.43	35.78	17.40
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5725.00	51.21	PK	V	68.20	16.99	42.66	35.22	7.85	34.52	8.55
	11490.00	48.17	PK	V	68.20	20.03	31.20	40.57	11.97	35.57	16.97
	--	--	--	--	--	--	--	--	--	--	--
157 (5785MHz)	11570.00	49.64	PK	V	68.20	18.56	32.57	40.68	12.05	35.66	17.07
	--	--	--	--	--	--	--	--	--	--	--
165 (5825MHz)	5850.00	48.76	PK	V	68.20	19.44	40.04	35.43	7.91	34.62	8.72
	11650.00	50.28	PK	V	68.20	17.92	32.88	40.75	12.43	35.78	17.40
	--	--	--	--	--	--	--	--	--	--	--

**REMARKS:**

6. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
7. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
8. Margin value = Limit value- Emission level.
9. -- Mean the other emission levels were very low against the limit.
10. RBW1MHz VBW3MHz Peak detector is for PK value; RMS detector is for AV value.

### 3.3. Maximum Conducted Output Power

#### Limit

#### (1) For the band 5.15-5.25 GHz.

##### **FCC requirement:**

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

##### **IC requirement:**

The maximum e.i.r.p. shall not exceed 200 mW or  $10 + 10 \log_{10} B$ , dBm, whichever power is less. B is the 99% emission bandwidth in megahertz

#### (2) For the band 5.725-5.850 GHz.

##### **FCC requirement:**

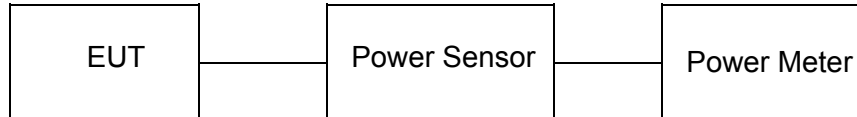
For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

##### **IC requirement:**

The maximum conducted output power shall not exceed 1W.

#### Test Procedure

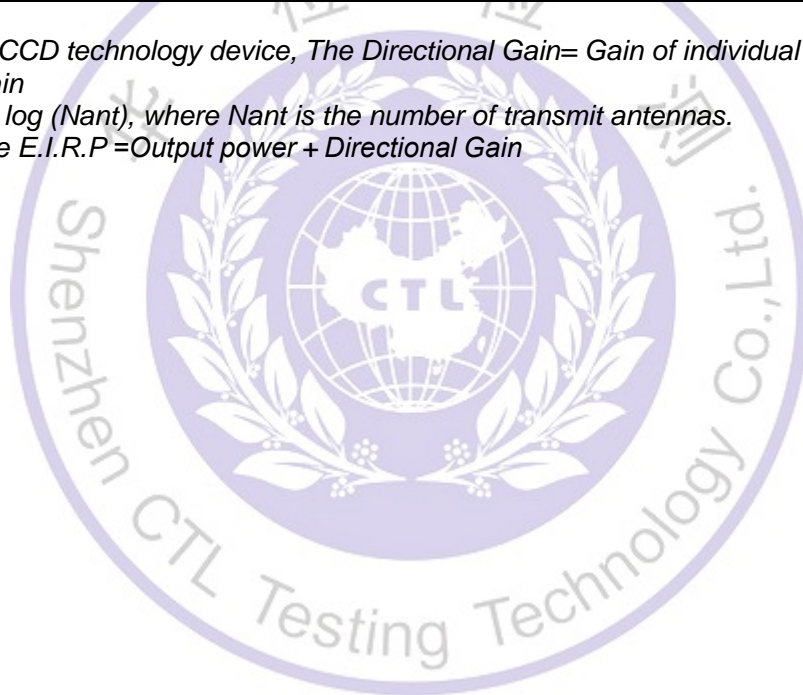
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

**Test Configuration****Test Results****U-NII 1**

Type	Channel	Output power (dBm)			Antenna Gain (dBi)		Directional gain (dBi)	EIRP (dBm)			Limit (dBm)	Result
		Ant1	Ant2	SUM	Ant1	Ant2		Ant1	Ant2	SUM		
802.11a	36	12.90	14.23	/	1.09	1.09	/	13.99	15.32	/	FCC:30.00	Pass
	40	12.85	14.25	/	1.09	1.09	/	13.94	15.34	/		
	48	13.24	15.00	/	1.09	1.09	/	14.33	16.09	/		
802.11n(HT20) MIMO	36	13.67	13.52	16.61	1.09	1.09	4.1	/	/	20.71	FCC:30.00	Pass
	40	13.51	13.64	16.59	1.09	1.09	4.1	/	/	20.69		
	48	13.67	14.36	17.04	1.09	1.09	4.1	/	/	21.14		

**Remark:**

- For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain  
Array gain =  $10 \log(N_{ant})$ , where  $N_{ant}$  is the number of transmit antennas.
- For MIMO mode E.I.R.P=Output power + Directional Gain



## U-NII 3

Type	Channel	Output power Ant1 (dBm)	Output power Ant2 (dBm)	Output power Total (dBm)	Limit (dBm)	Result
802.11a	149	12.22	12.55	/	30.00	Pass
	157	12.24	13.66	/		
	165	11.83	11.34	/		
802.11n(HT20) MIMO	149	12.16	12.90	15.56	30.00	
	157	12.20	12.33	15.28		
	165	11.64	11.03	14.36		

Note: 1.The test results including the cable lose.



### 3.4. Power Spectral Density

#### Limit

(1) For the band 5.15 - 5.25 GHz.

#### **FCC requirement:**

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.<sup>note1</sup>

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.<sup>note1</sup>

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band.<sup>note1</sup>

#### **IC requirement:**

The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

(2) For the band 5.725 - 5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.<sup>note1, note2</sup>

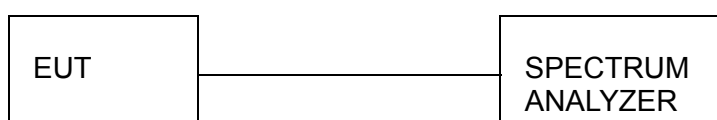
Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

#### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW  $\geq 3 \times$  RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

#### Test Configuration



**Test Results**

**U-NII 1**

Type	Channel	P.S.D (dBm/MHz)			Antenna Gain (dBi)		Directional gain (dBi)	EIRP P.S.D (dBm/ MHz)			Output power Limit (dBm/MHz)	Result
		Ant1	Ant2	Sum	Ant1	Ant2		Ant1	Ant2	Sum		
802.11a SISO	36	8.321	6.845	/	1.09	1.09	/	9.411	7.935	/	FCC:11 dBm	Pass
	40	5.669	6.756	/	1.09	1.09	/	6.759	7.846	/		
	48	6.307	7.182	/	1.09	1.09	/	7.397	8.272	/		
802.11n (HT20) MIMO	36	5.475	5.121	8.31	1.09	1.09	4.1	/	/	12.41		
	40	5.016	5.625	8.34	1.09	1.09	4.1	/	/	12.44		
	48	6.320	6.010	9.18	1.09	1.09	4.1	/	/	13.28		

**Remark:**

- For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain  
 $Array\ gain = 10\ log(Nant)$ , where Nant is the number of transmit antennas.
- For MIMO mode E.I.R.P =Output power + Directional Gain



**U-NII 3**

Type	Channel	Power Spectral Density Ant1 (dBm/500KHz)	Power Spectral Density Ant2 (dBm/500KHz)	Power Spectral Density Total (dBm/ 500KHz)	Limit (dBm/500KHz)	Result
802.11a SISO	149	0.601	0.982	/	30	Pass
	157	0.197	0.892	/		
	165	-0.378	0.108	/		
802.11n (HT20) MIMO	149	1.641	1.702	4.68		
	157	1.012	1.190	4.11		
	165	0.363	0.462	3.42		

Test plot as follows:





ANT1  
802.11a

U-NII 1



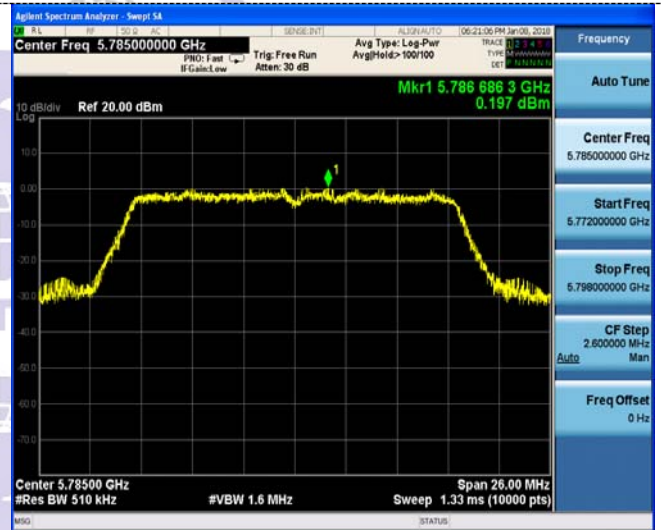
U-NII 3



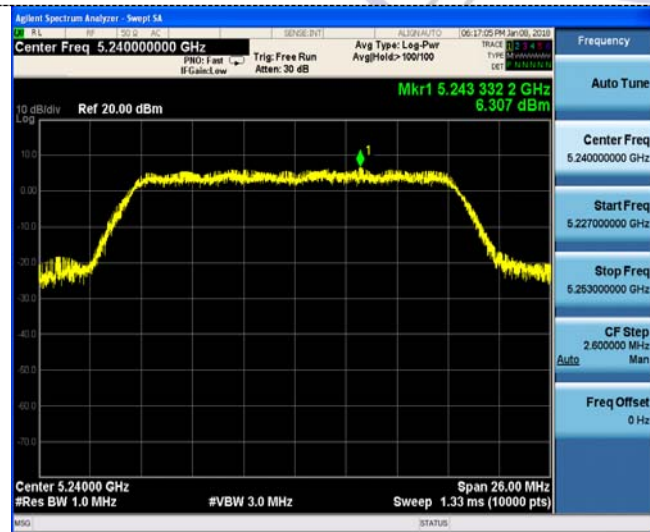
CH36



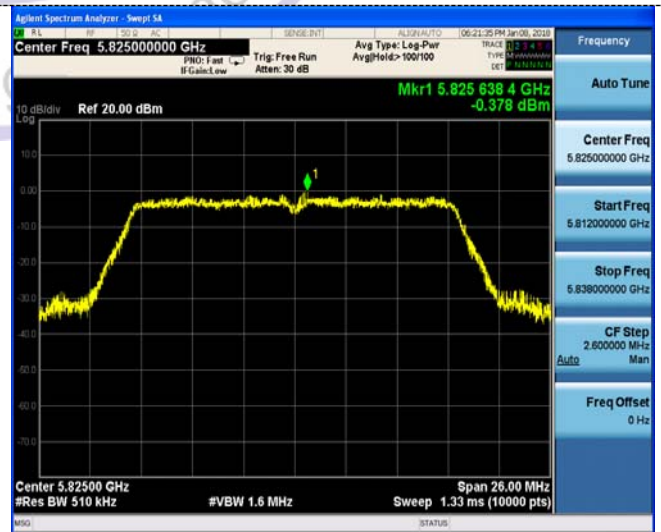
CH149



CH40



CH157



CH48

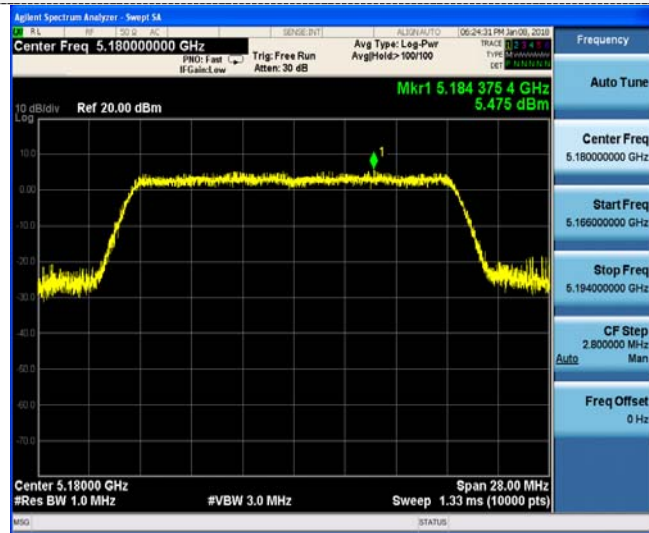


CH165

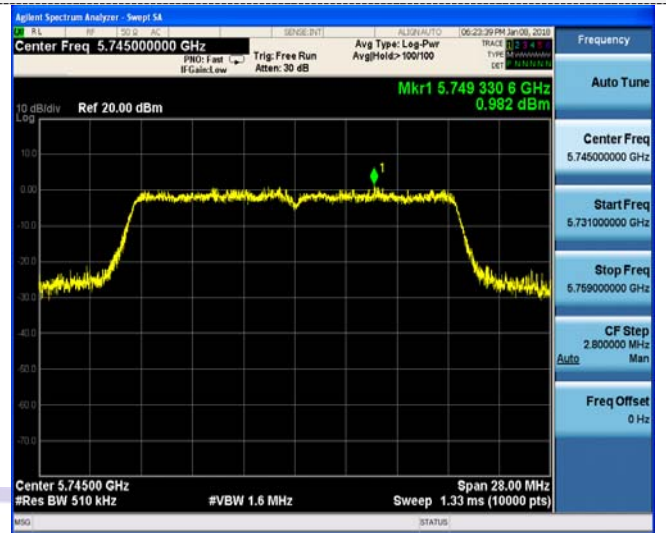


802.11n(HT20)

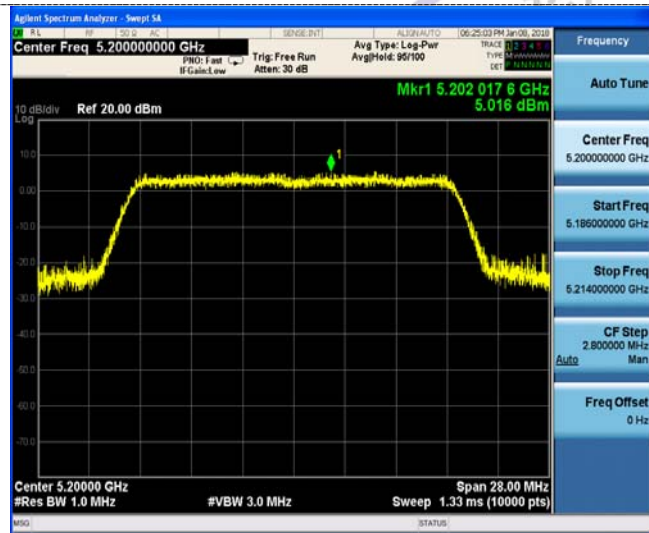
U-NII 1



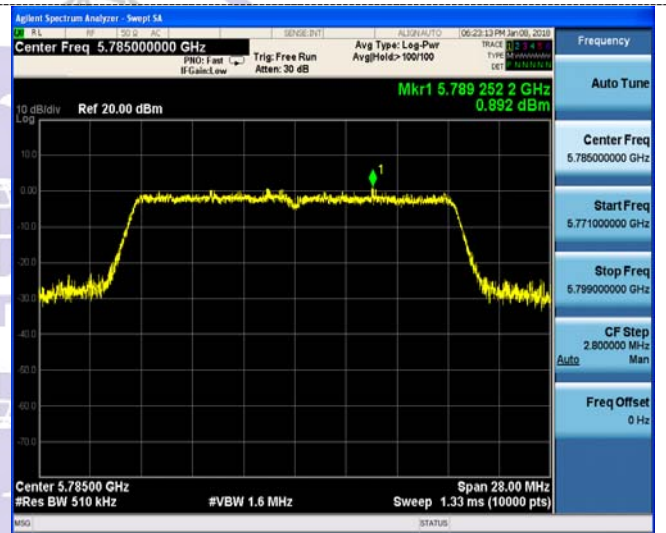
U-NII 3



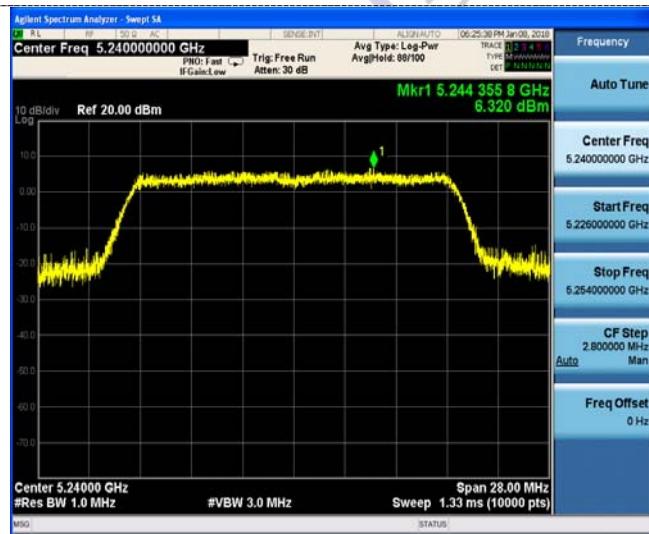
CH36



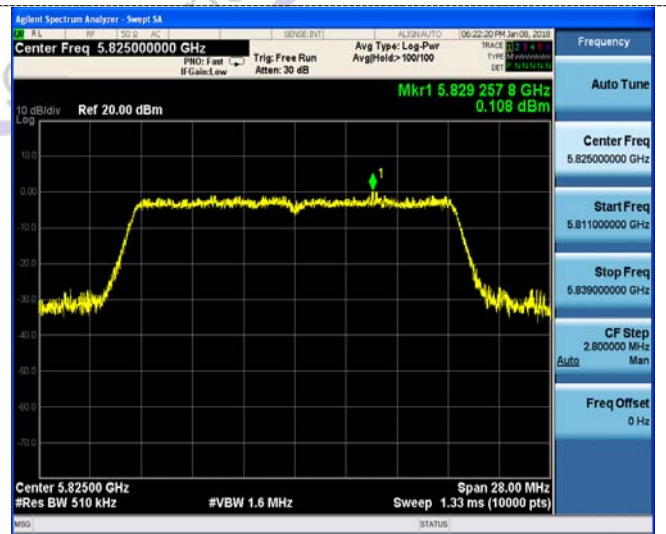
CH149



CH40



CH157



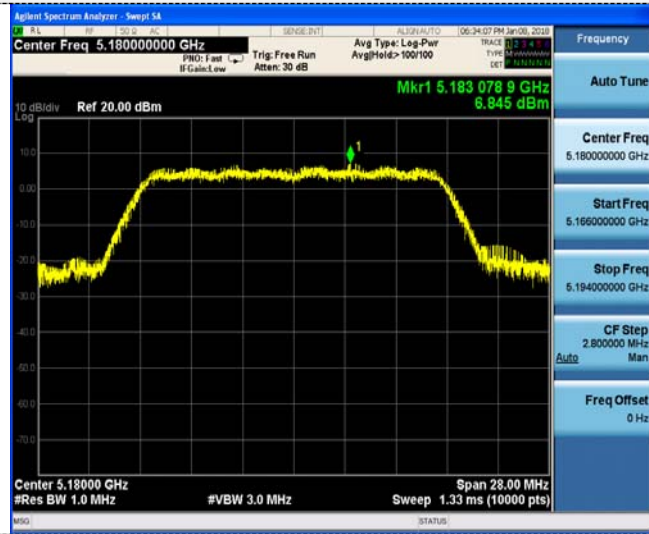
CH48

CH165

ANT2  
802.11a

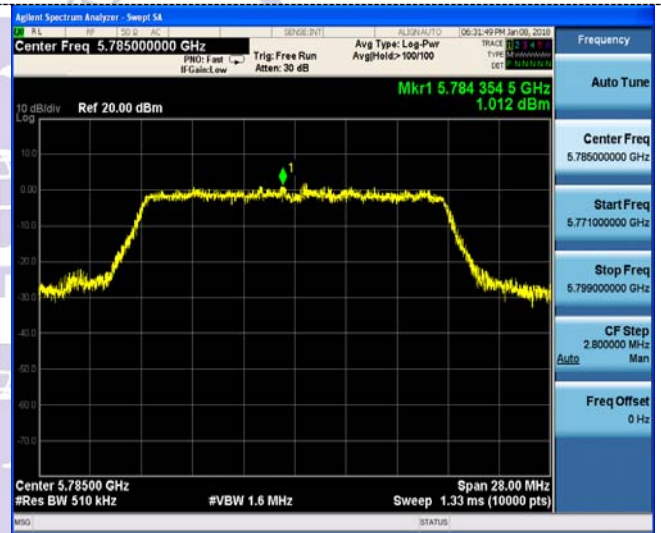
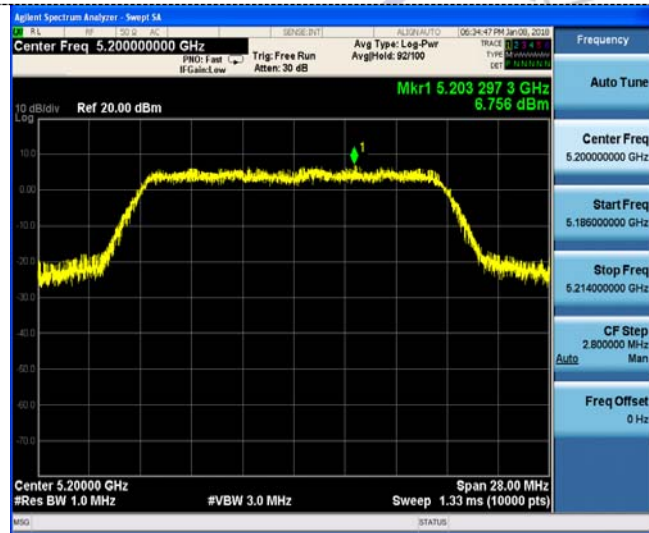
U-NII 1

U-NII 3



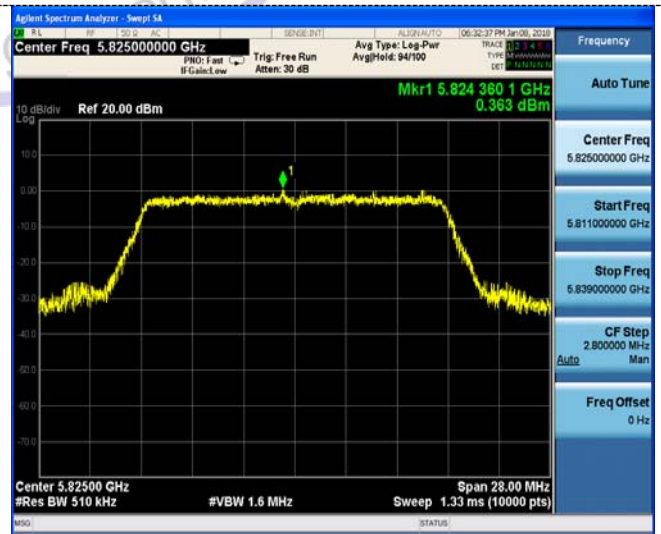
CH36

CH149



CH40

CH157

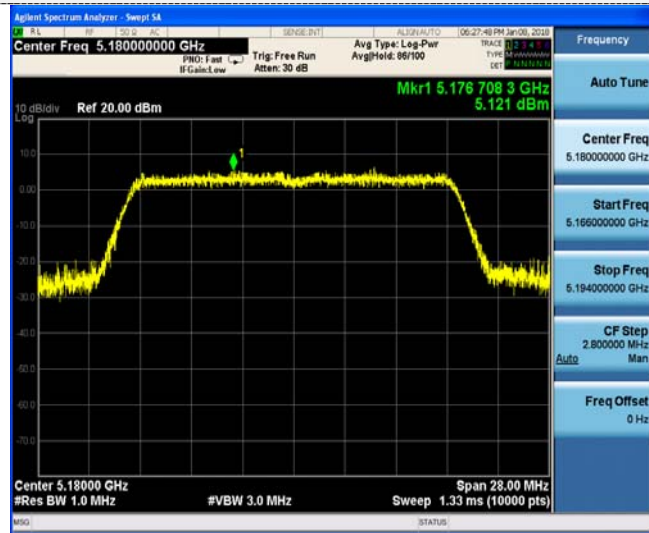


CH48

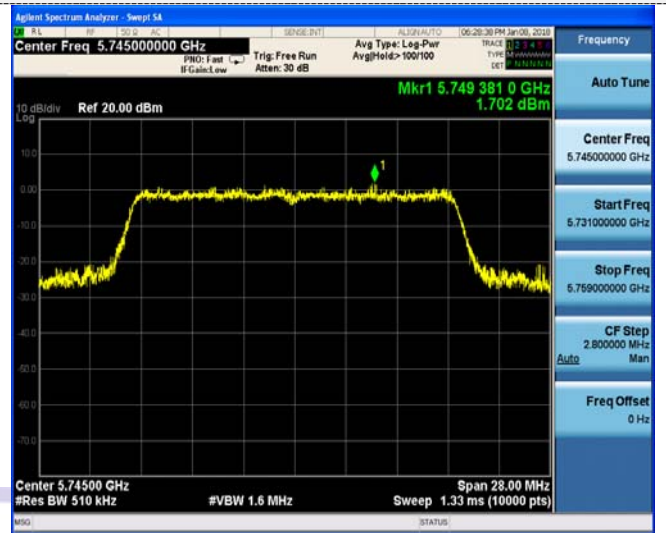
CH165

802.11n(HT20)

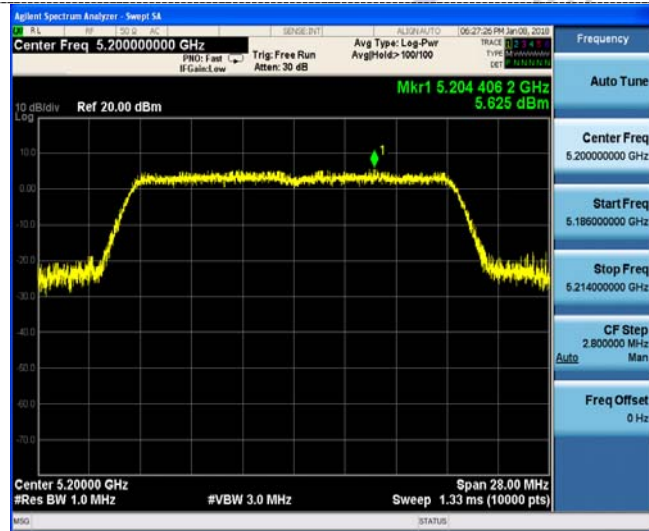
U-NII 1



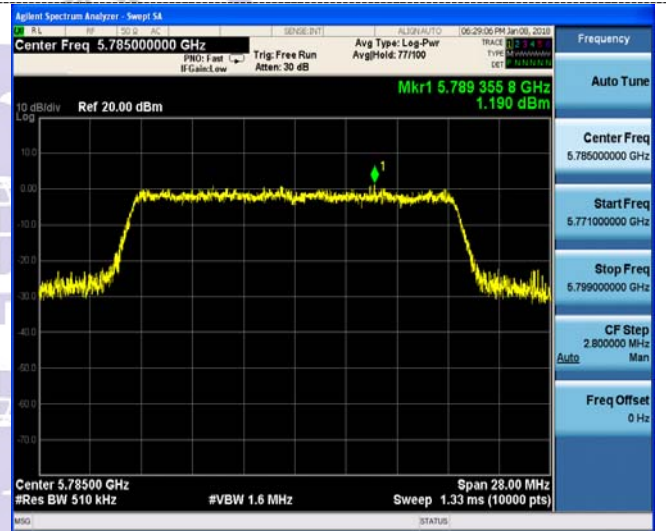
U-NII 3



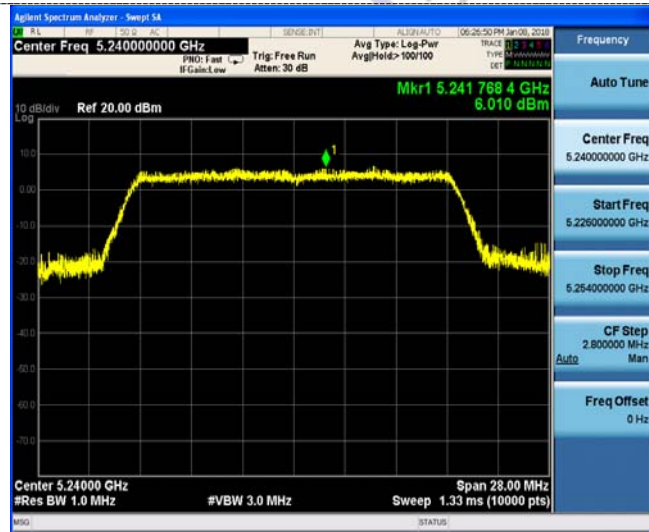
CH36



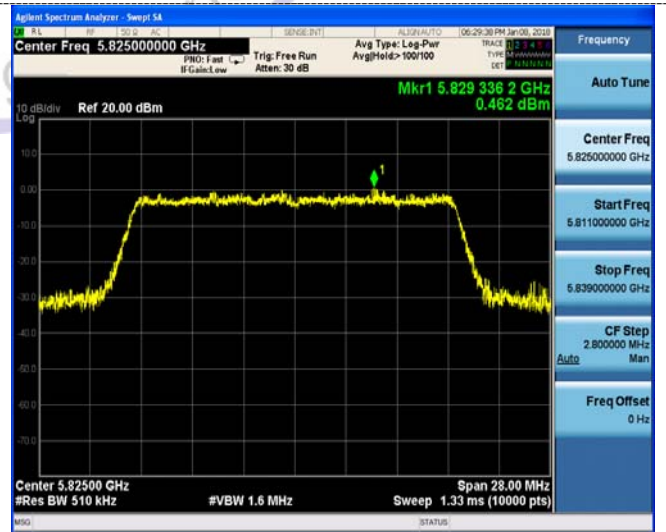
CH149



CH40



CH157



CH48

CH165

### 3.5. Emission Bandwidth (26dBm Bandwidth)

#### Limit

N/A

#### Test Procedure

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW / EBW ratio is approximately 1 %.

#### Test Configuration



#### Test Results

<i>ANT1</i>						
Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	19.57	16.502	N/A	Pass
		40	19.61	16.613		
		48	19.59	16.589		
802.11n(HT20)	U-NII 1	36	19.57	17.588		
		40	19.58	17.629		
		48	19.78	17.723		

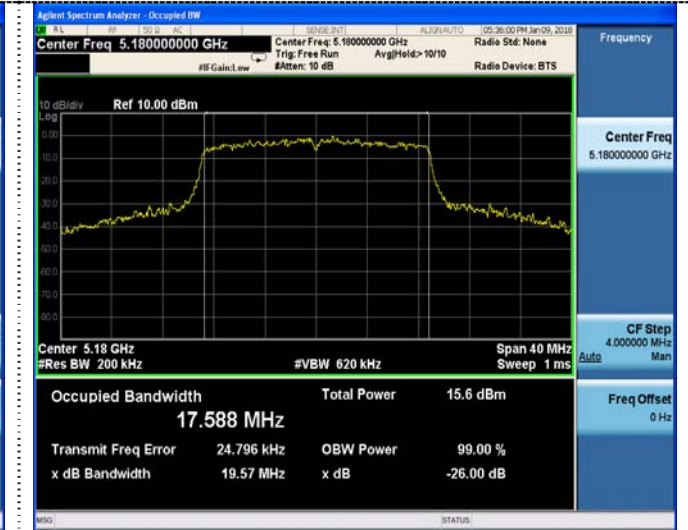
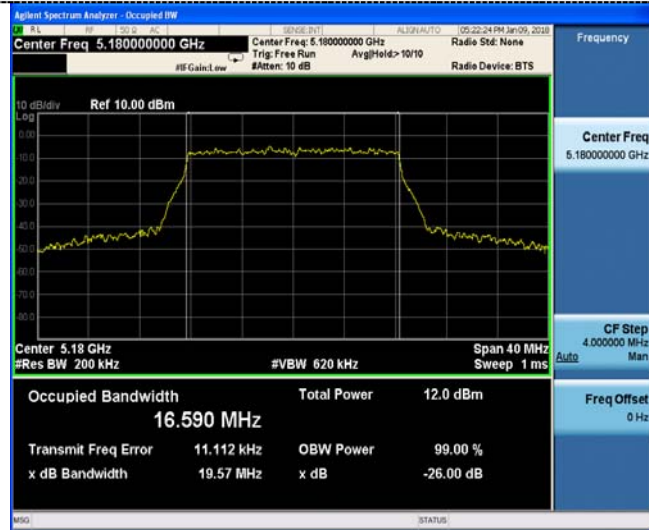
<i>ANT2</i>						
Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	19.54	16.574	N/A	Pass
		40	19.47	16.586		
		48	19.54	16.578		
802.11n(HT20)	U-NII 1	36	19.86	17.706		
		40	19.83	17.718		
		48	19.78	17.709		

Test plot as follows:

ANT1

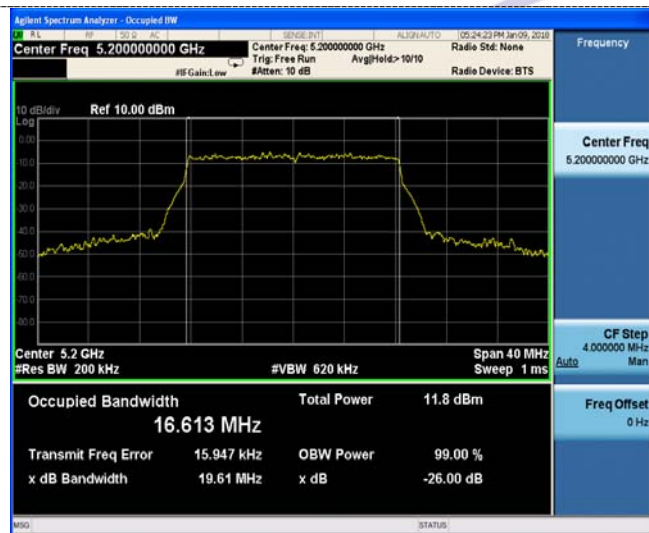
802.11a

802.11n(HT20)



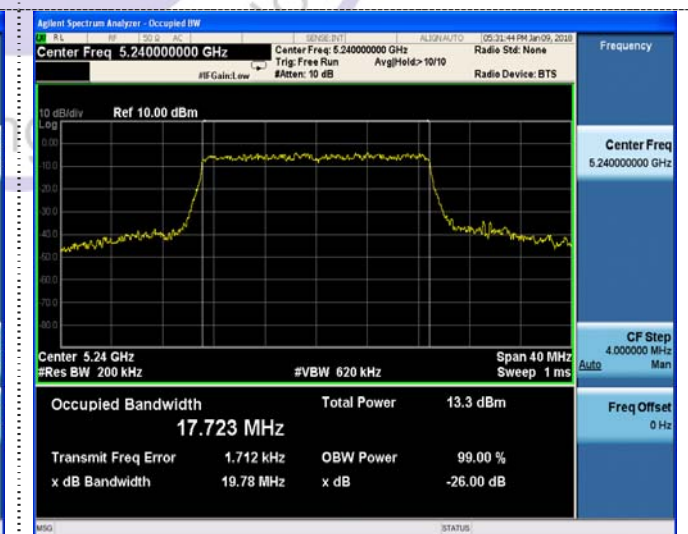
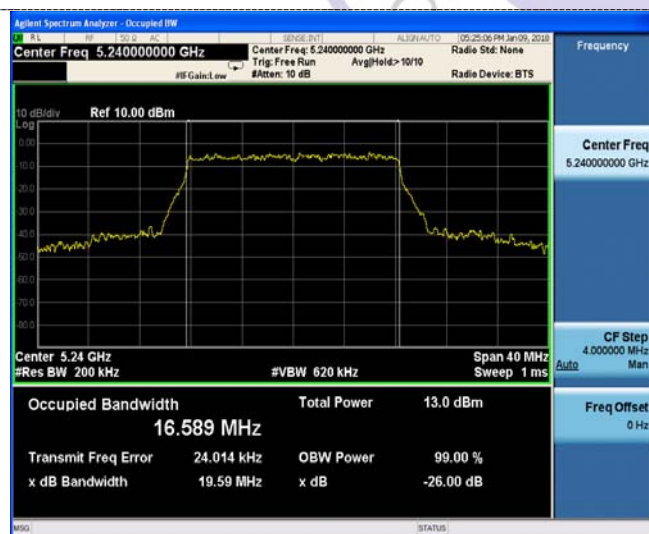
CH36

CH36



CH40

CH40

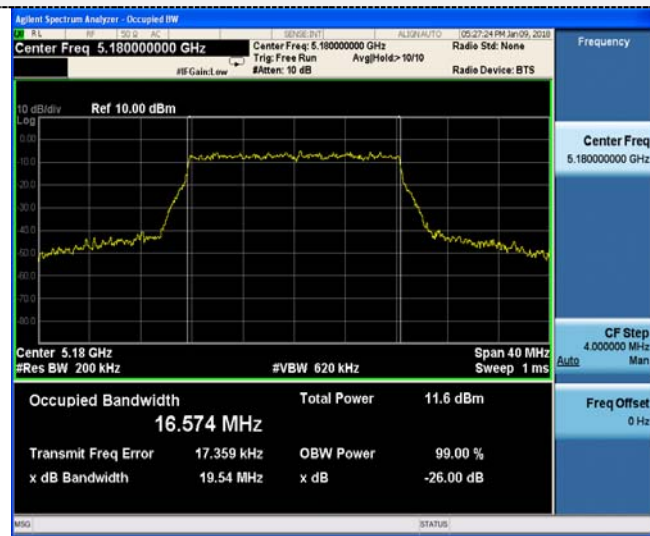


CH48

CH48

ANT2

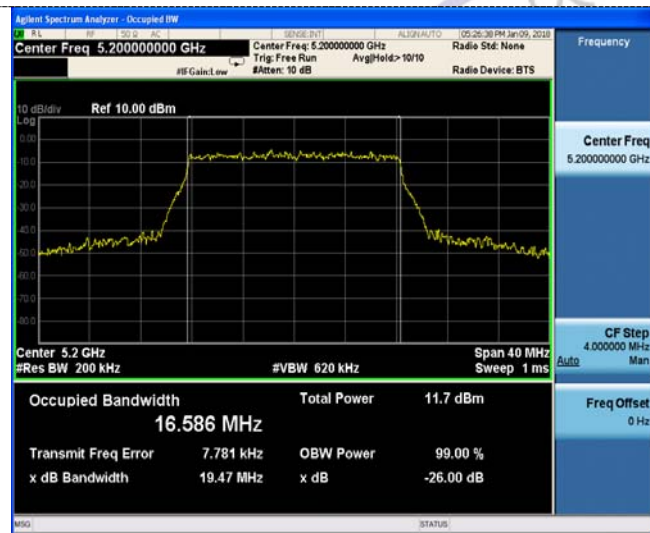
802.11a



802.11n(HT20)



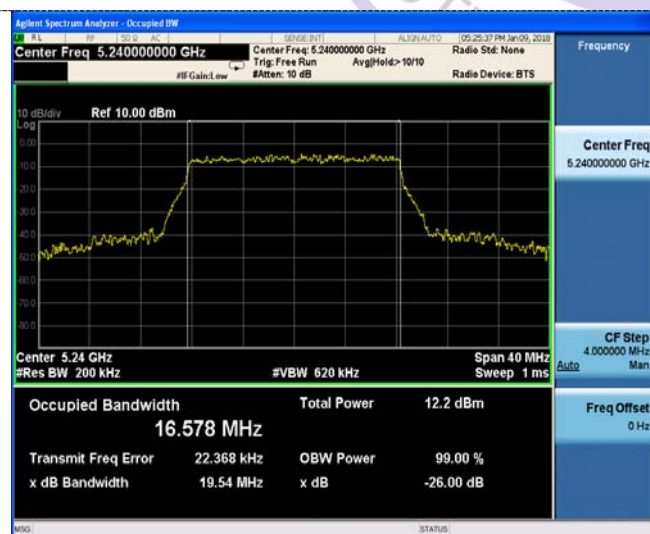
CH36



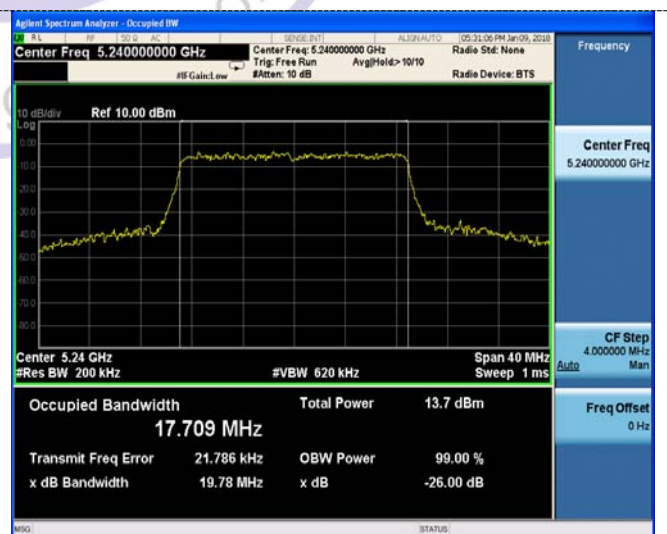
CH36



CH40



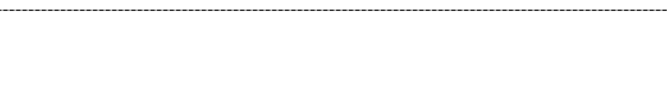
CH40



CH48



CH48



### 3.6. Minimum Emission Bandwidth (6dB Bandwidth)

#### Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

#### Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### Test Configuration



#### Test Results

##### *ANT1*

Type	Bands	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	16.58	16.857	≥500KHz	Pass
		157	16.56	16.608		
		165	16.59	16.570		
802.11n(HT20)	U-NII 3	149	17.85	18.411		
		157	17.83	17.893		
		165	17.82	17.769		

##### *ANT2*

Type	Bands	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	16.56	16.733	≥500KHz	Pass
		157	16.57	16.595		
		165	16.56	16.555		
802.11n(HT20)	U-NII 3	149	17.83	17.924		
		157	17.80	17.753		
		165	17.82	17.724		

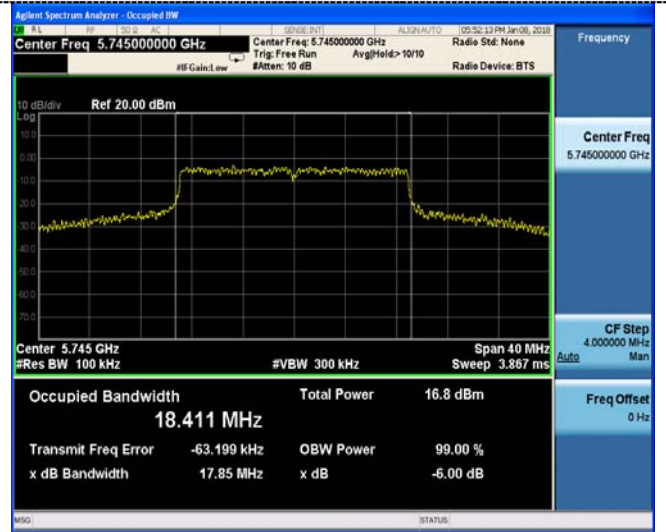
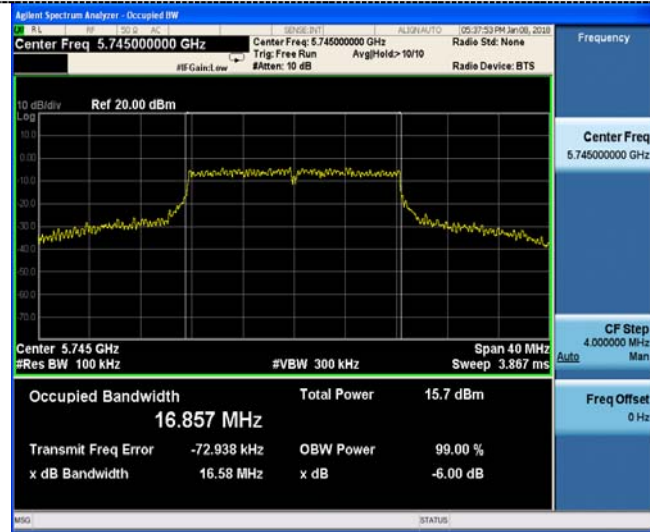
Test plot as follows:



ANT1

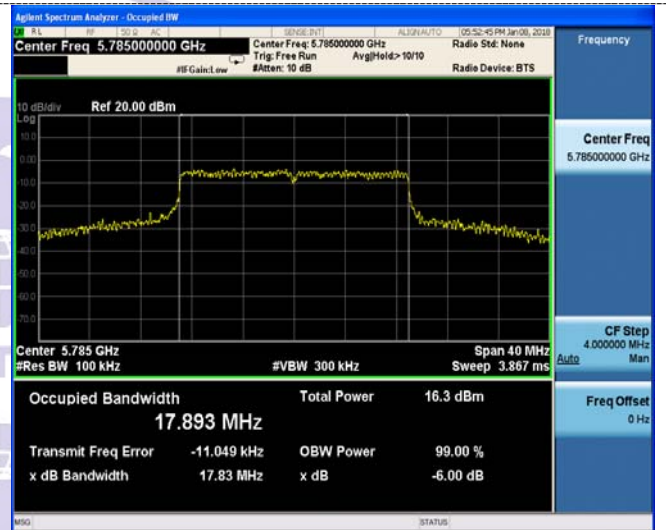
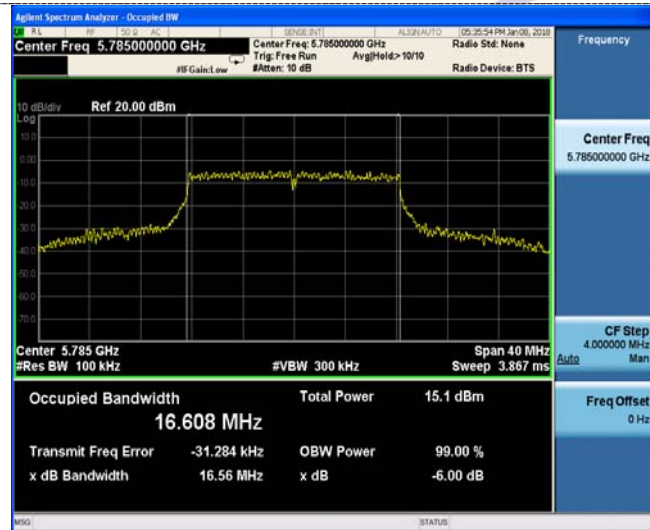
802.11a

802.11n(HT20)



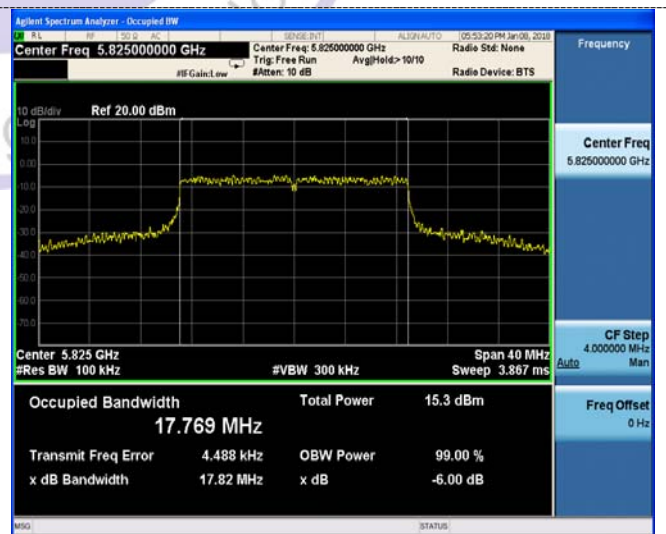
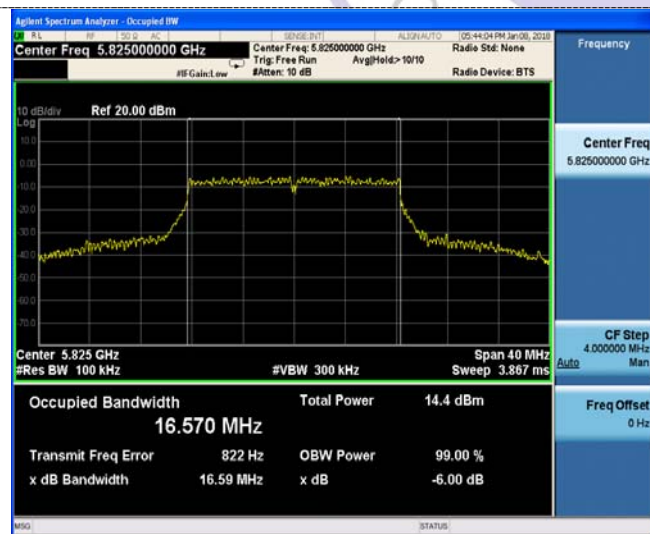
CH149

CH149



CH157

CH157



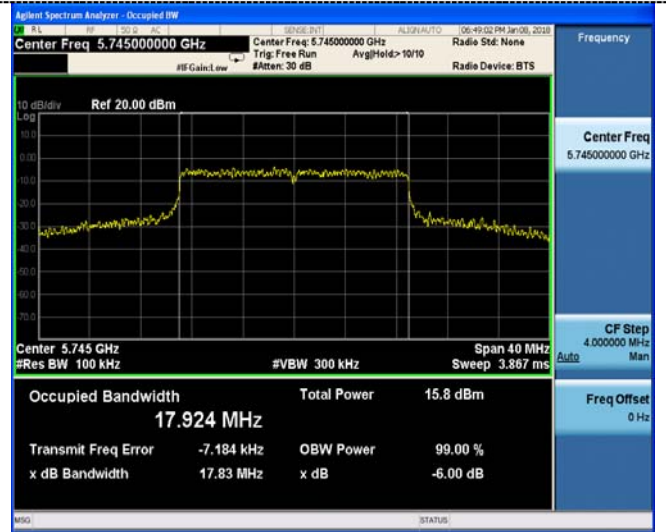
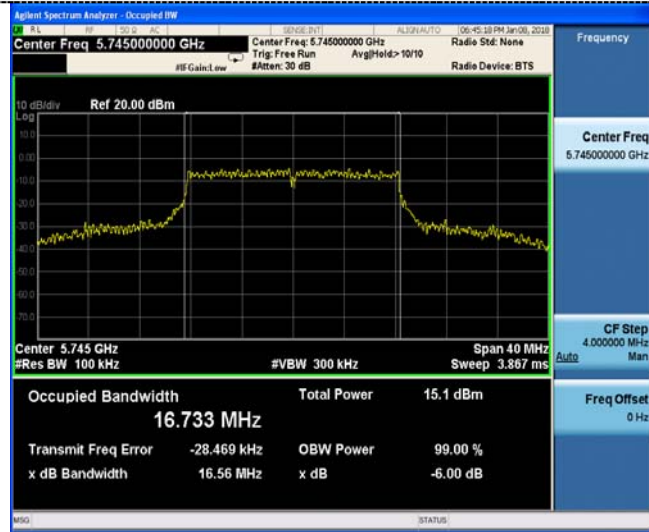
CH165

CH165

ANT2

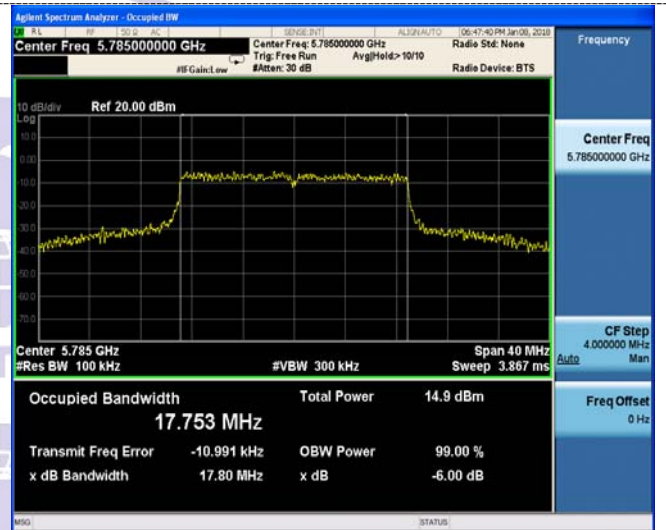
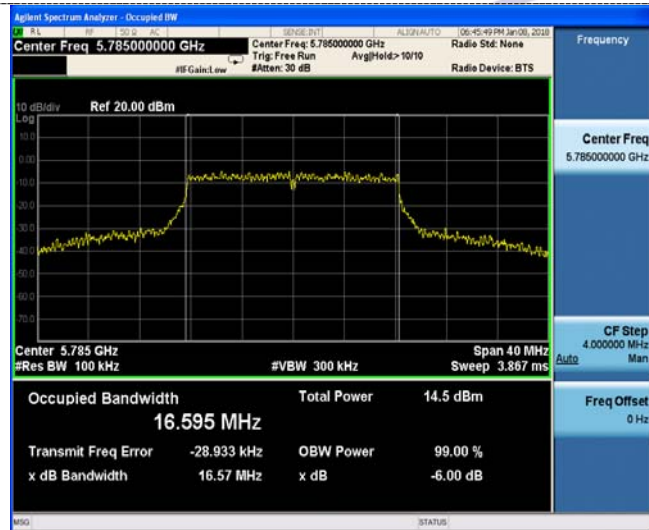
802.11a

802.11n(HT20)



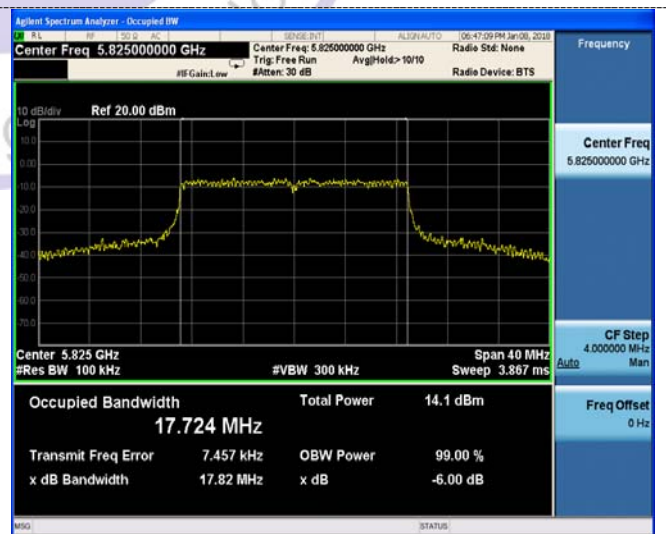
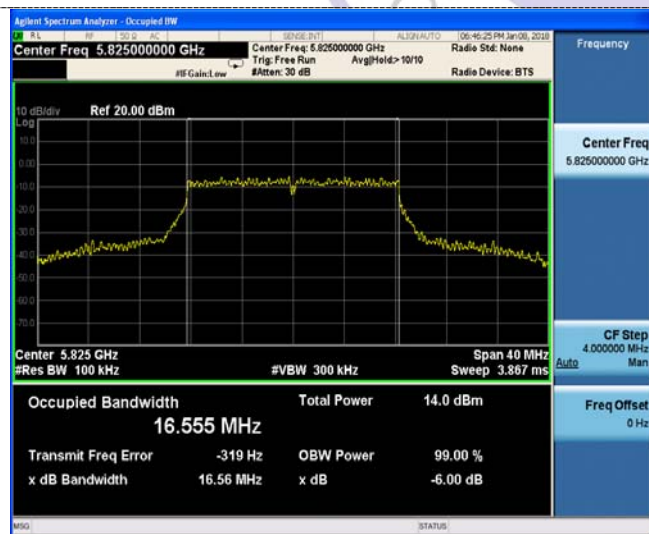
CH149

CH149



CH157

CH157



CH165

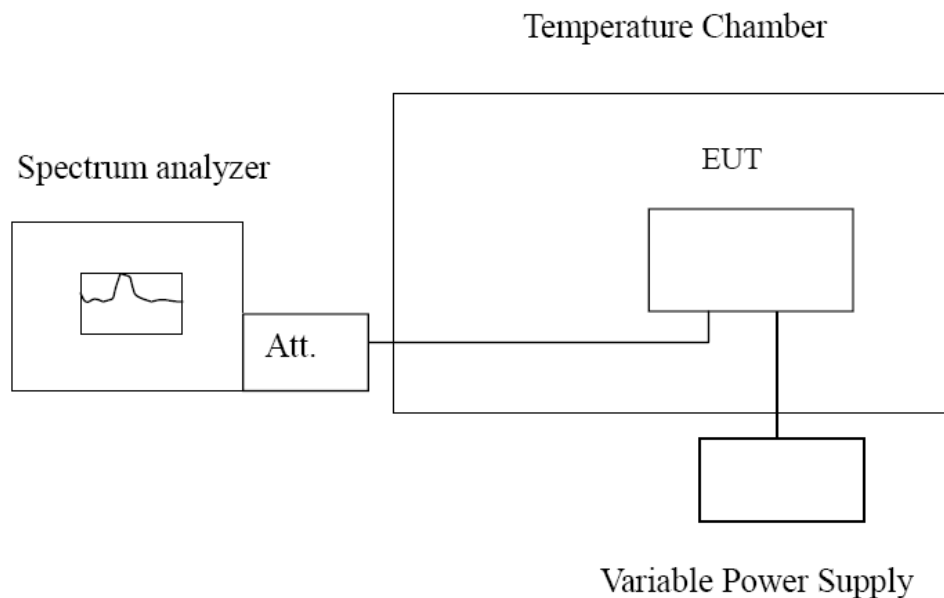
CH165

### 3.7. Frequency Stability

#### LIMIT

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

#### TEST CONFIGURATION



#### TEST PROCEDURE

##### **Frequency Stability under Temperature Variations:**

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

##### **Frequency Stability under Voltage Variations:**

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ( $\pm 15\%$ ) and endpoint, record the maximum frequency change.

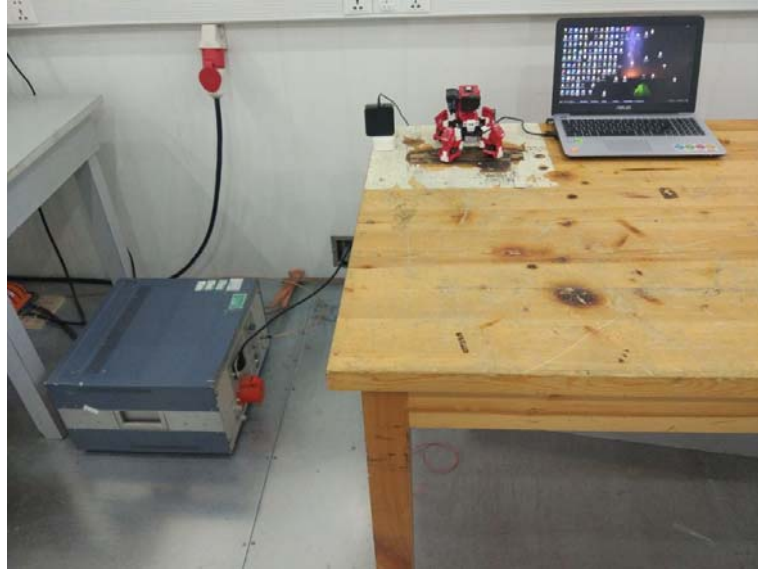
#### TEST RESULTS

Record worst case as below:

Reference Frequency: 802.11a channel=36 frequency=5180MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
7.40	-30	-5000	-0.97	Within the band of operation	Pass
	-20	-5000	-0.97		
	-10	-4750	-0.92		
	0	-4500	-0.87		
	10	-4500	-0.87		
	20	-4500	-0.87		
	30	-4750	-0.92		
	40	-4700	-0.91		
	50	-4900	-0.95		
8.51	25	-4750	-0.92		
6.29	25	-4950	-0.96		

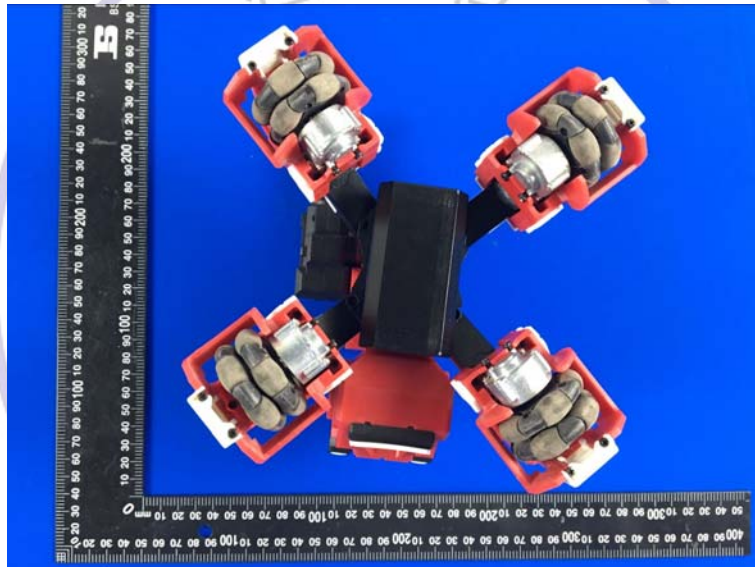
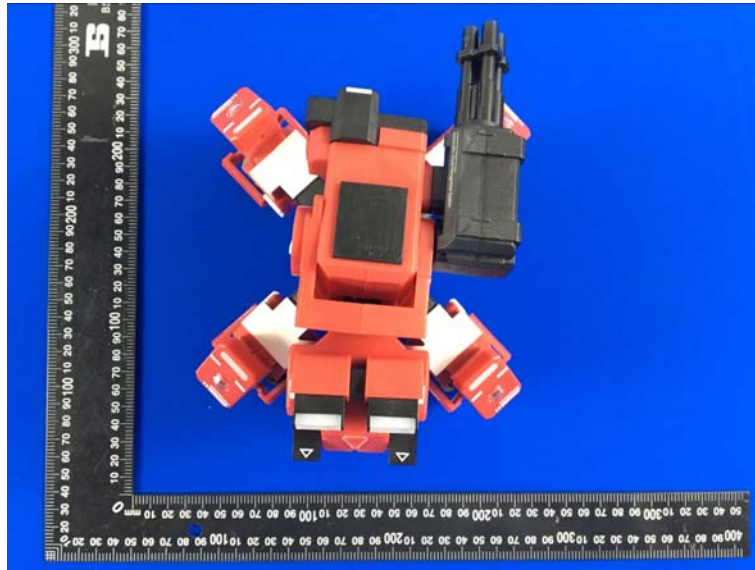
Reference Frequency: 802.11a channel=149 frequency=5745MHz					
Voltage ( V )	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
7.40	-30	-4800	-0.84	Within the band of operation	Pass
	-20	-4750	-0.83		
	-10	-4500	-0.79		
	0	-4250	-0.74		
	10	-4250	-0.74		
	20	-4250	-0.74		
	30	-4500	-0.78		
	40	-4850	-0.84		
	50	-4950	-0.86		
8.51	25	-4300	-0.75		
6.29	25	-4700	-0.82		

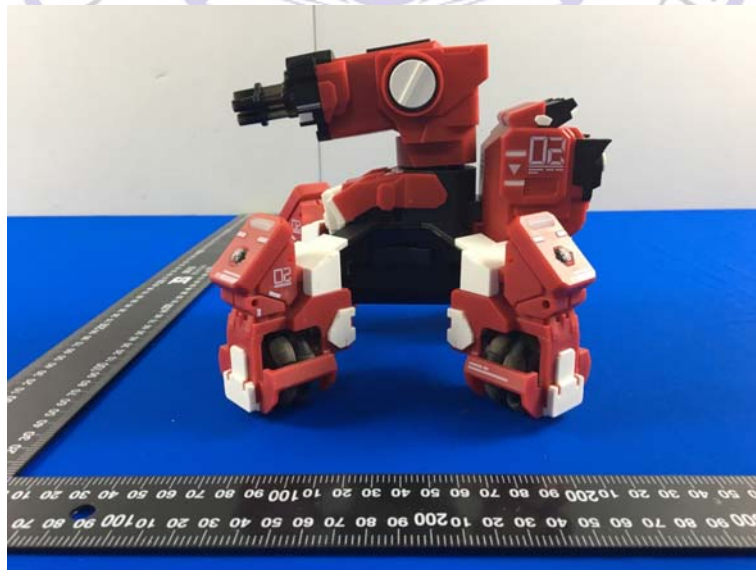
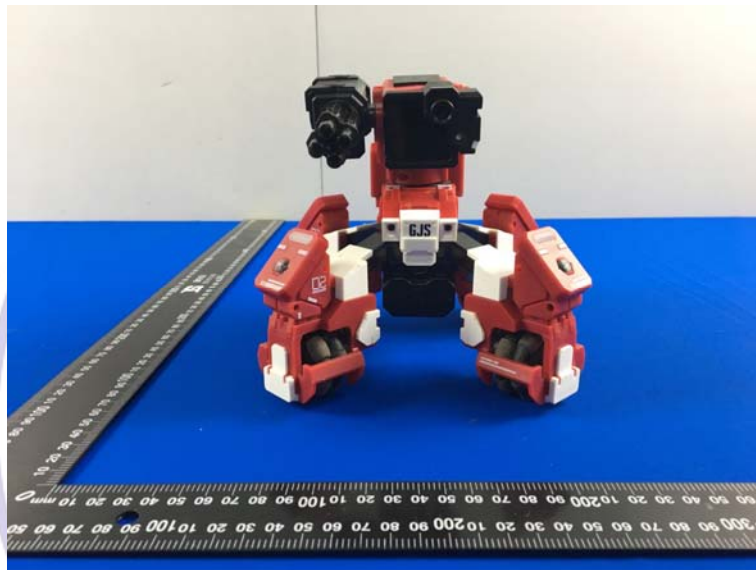
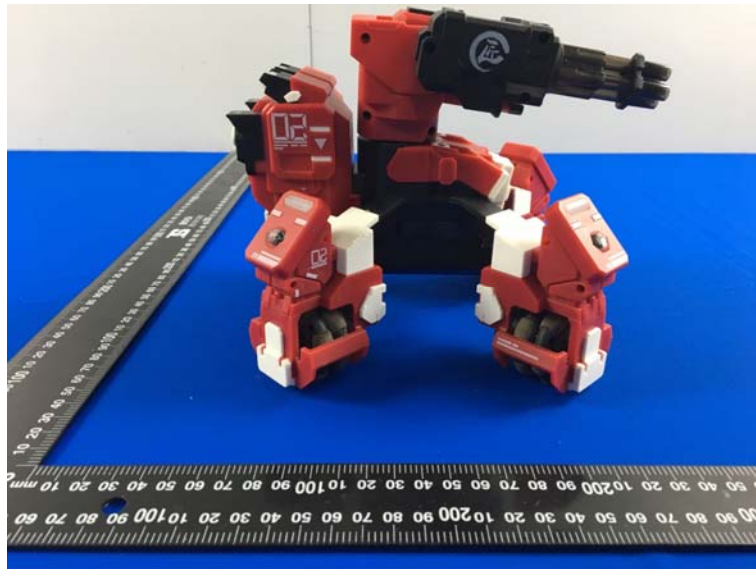
### 4. Test Setup Photos of the EUT



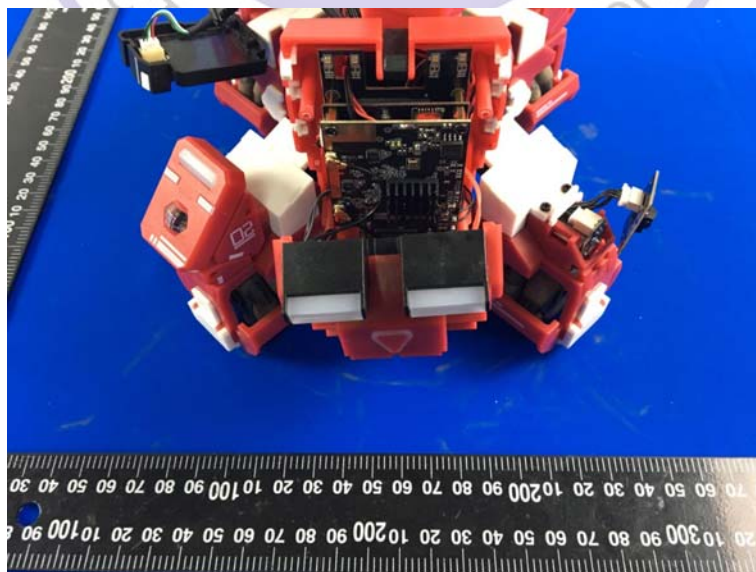
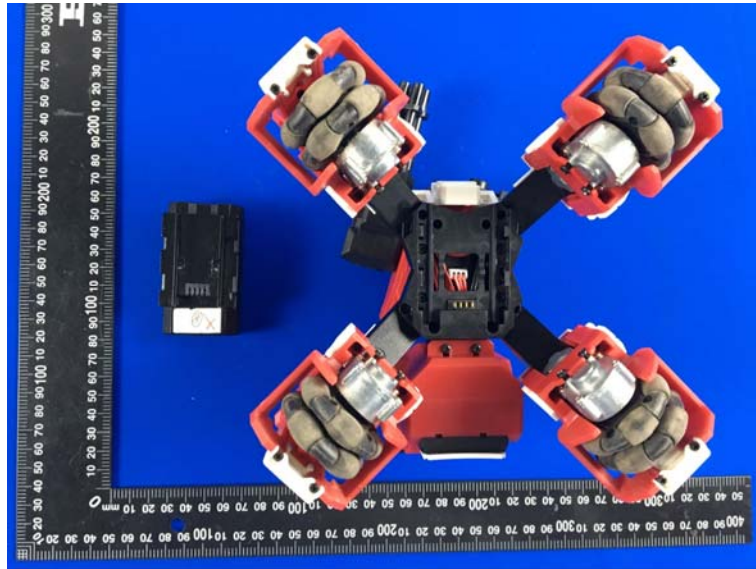
## 5. Photos of the EUT

### External Photos of EUT

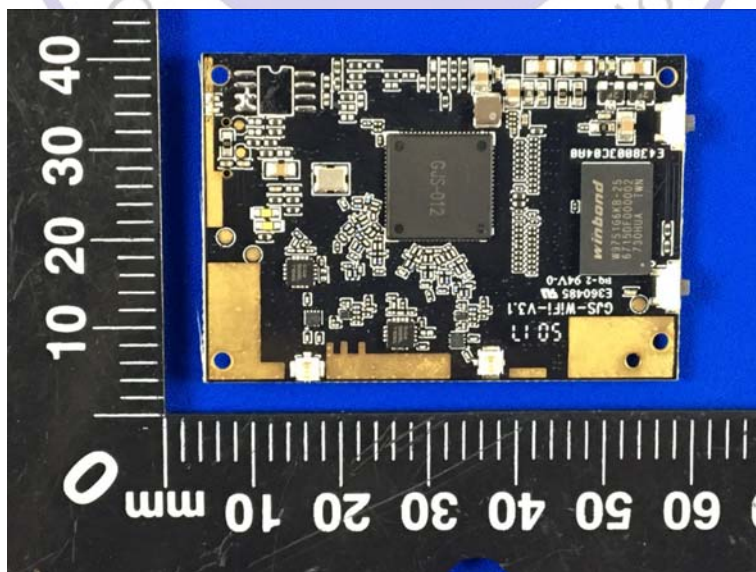
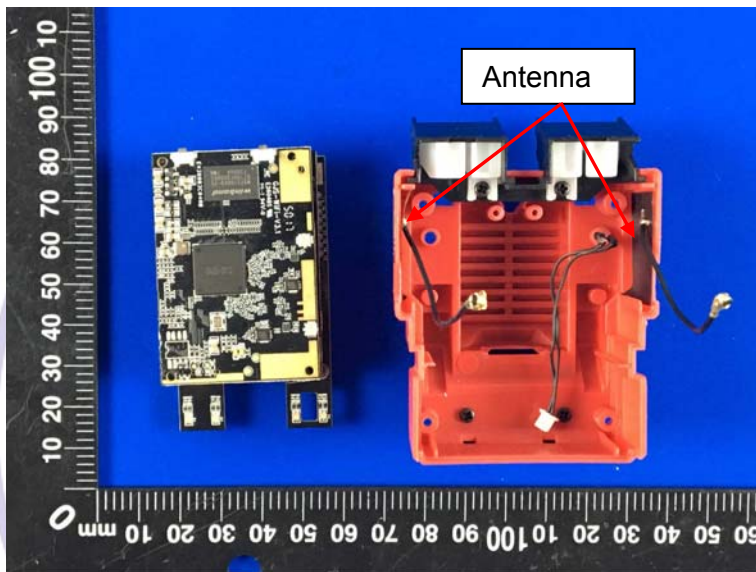
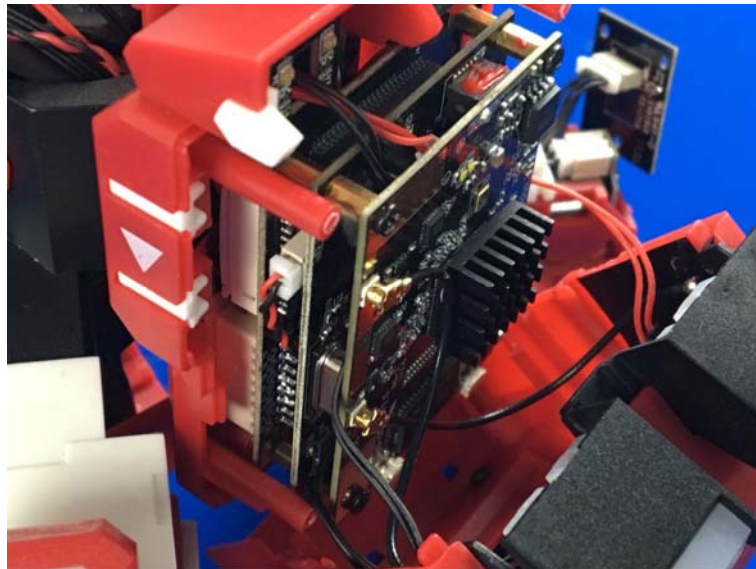


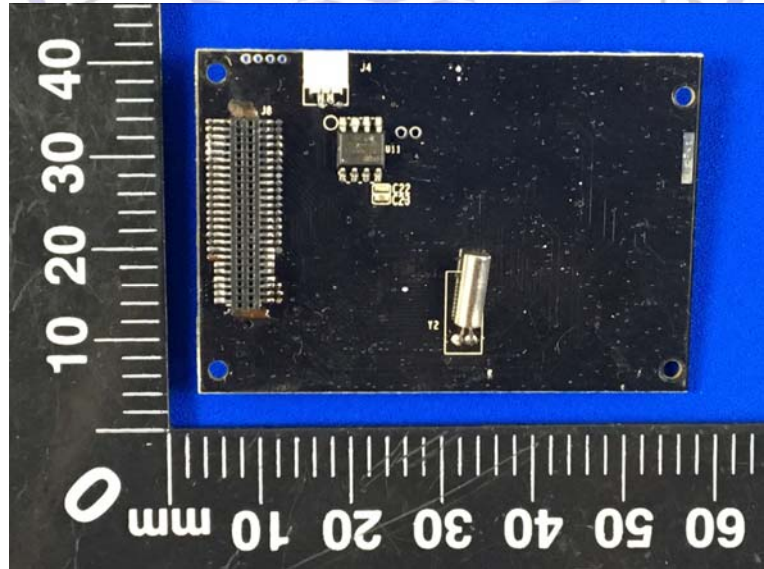
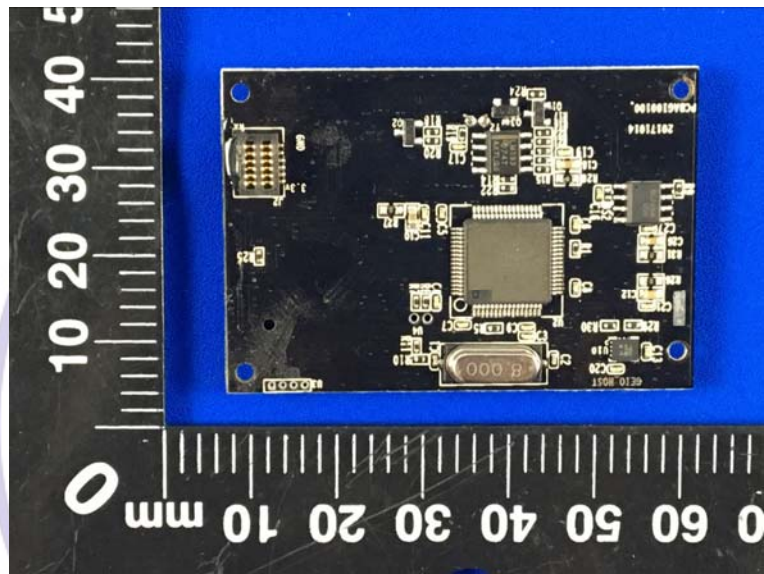
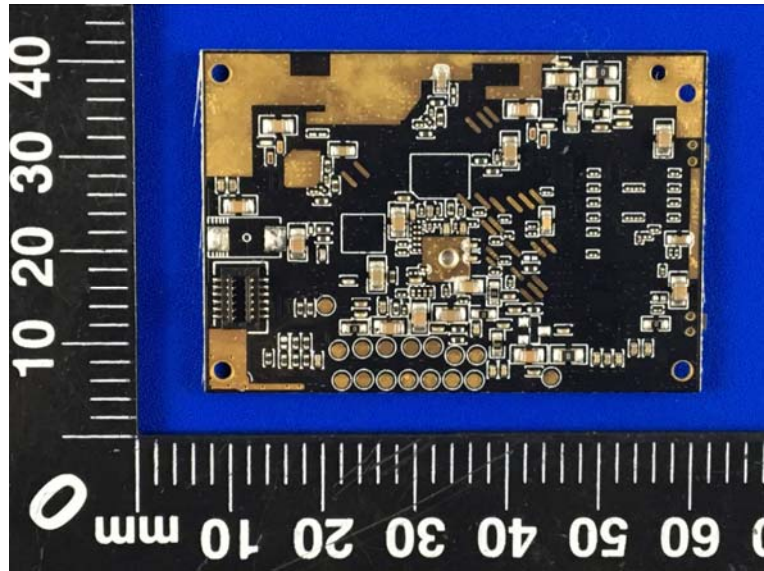


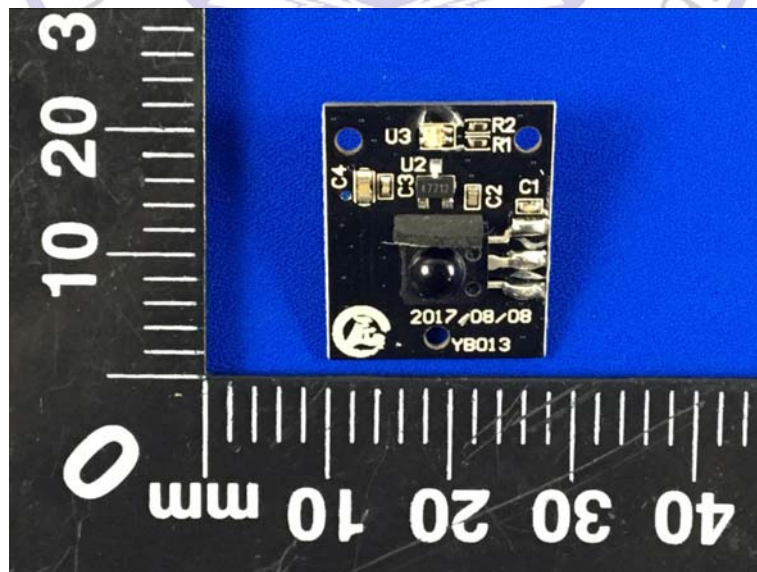
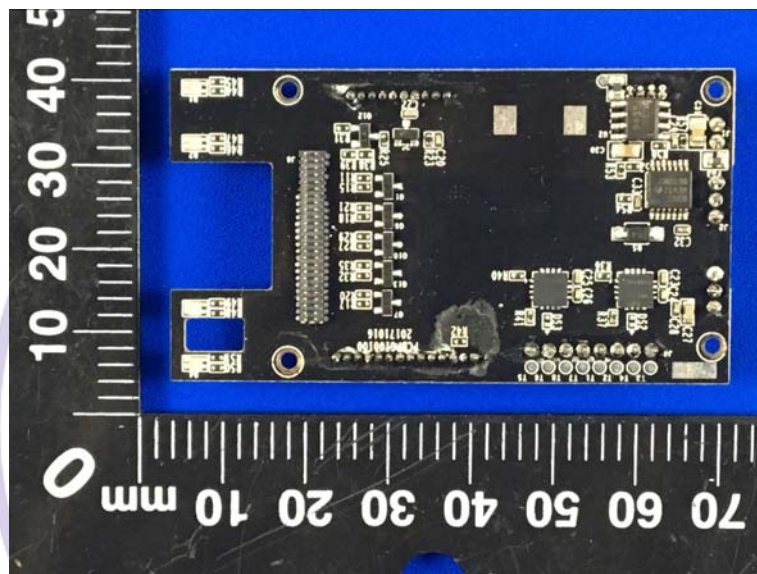
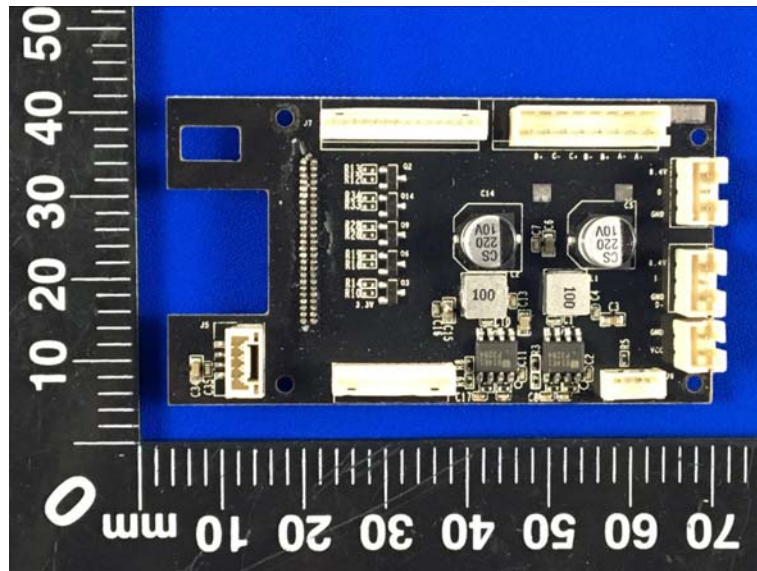
Internal Photos of EUT

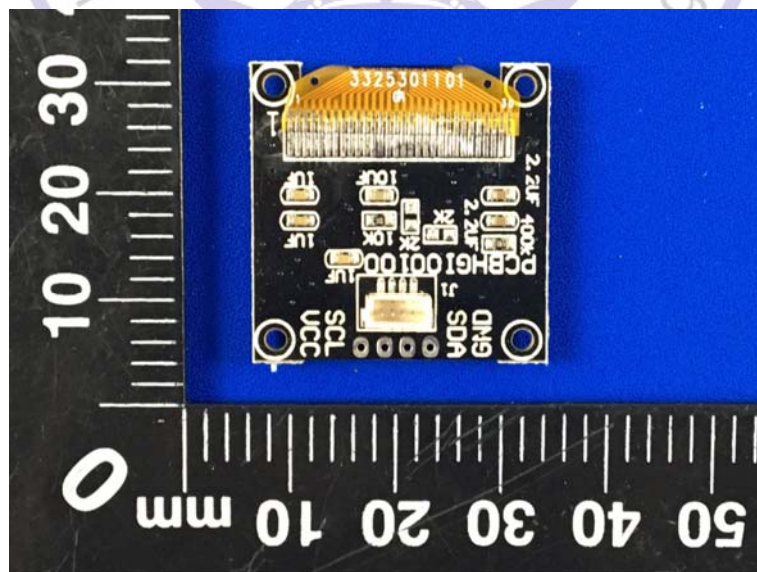
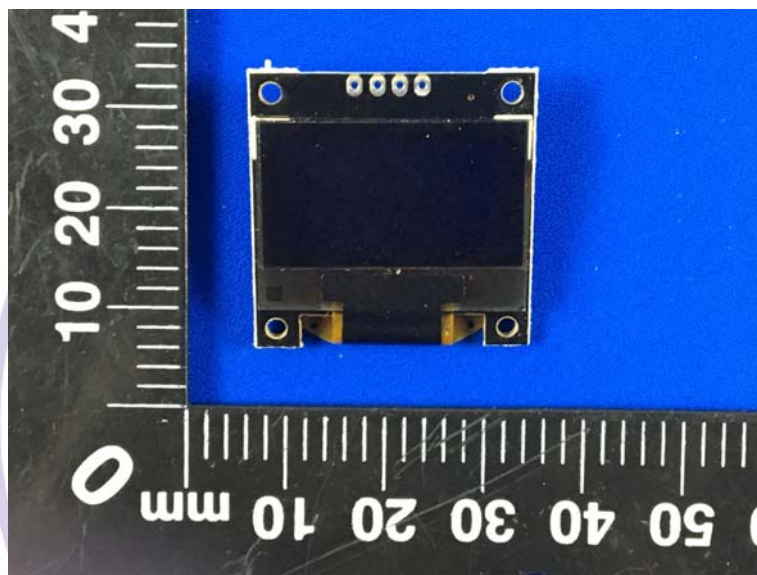
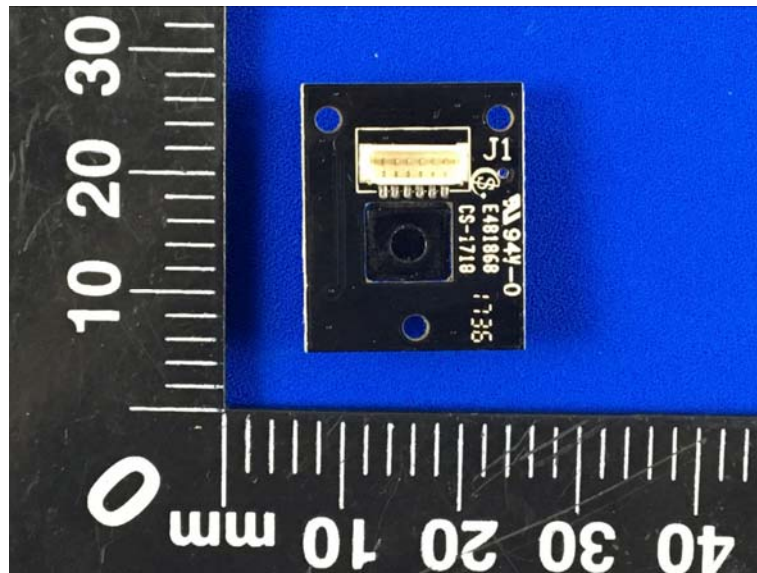














\*\*\*\*\* End of Report \*\*\*\*\*

