



**FCC TEST REPORT** 

Report No.: HK1812031776-E

Test report
On Behalf of

Dongguan E-Chief Electronic Technologies Co., Ltd.

For

**Smart Outdoor Outlet** 

Model No.: ECF-SOP02, ECF-SOP04, IC-BS06, HA109US, PS102BKUS, SS30, SS31, SS32, SS33, SS34, SS35, JE-ODP-02, JE-ODP-03, SOP02, SOP03, SOP04, SOP02-US, SOP03-US, SOP04-US, SOPXX, SOPXX-US

FCC ID: 2AP9Z-ECF-SOP02

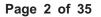
Prepared for: Dongguan E-Chief Electronic Technologies Co., Ltd.

F5,NO.687,Fumin Road,Dalang Town,Dongguan City,Guangdong Province,PRC

Prepared By: Shenzhen HUAK Testing Technology Co., Ltd.

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**TEST REPORT** 

Report No.: HK1812031776-E

Applicant's name	Dongguan E-Chief Electronic Technologies Co., Ltd.
Address	F5,NO.687,Fumin Road,Dalang Town,Dongguan City,Guangdong Province,PRC
Manufacture's Name	Dongguan E-Chief Electronic Technologies Co., Ltd.
Address	F5,NO.687,Fumin Road,Dalang Town,Dongguan City,Guangdong Province,PRC
Product description	
Trade Mark:	iclever,amir,poweradd,Teckin,Jeeo
Product name	Smart Outdoor Outlet
	ECF-SOP02, ECF-SOP04, IC-BS06, HA109US, PS102BKUS,
	SS30,SS31,SS32,SS33,SS34,SS35,JE-ODP-02,JE-ODP-03, SOP02,SOP03,SOP04,SOP02-US,SOP03-US,SOP04-US,SOPXX, SOPXX-US
Standards	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013
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Date of Test	
Date (s) of performance of tes	stsNov.17,2018 ~ Dec.02,2018
Date of Issue	Dec.02,2018
Test Result	Pass

Testing Engineer

(Gary Qian)

Technical Manager

(Eden Hu)

Authorized Signatory:

(Jason Zhou)



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# 1. SUMMARY

# 1.1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

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ANSI C63.10: 2013: American National Standard for Testing Unlicensed Wireless Devices

ANSI C63.4: 2014: –American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40GHz Range of 9 kHz to 40GHz

KDB558074 D01 V05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

# 1.2. Test Description

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(2)	6dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Conducted Output Power	PASS
FCC Part 15.247(e)	Power Spectral Density	PASS
FCC Part 15.109/ 15.205/ 15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge	PASS
FCC Part 15.203/15.247 (b)	Antenna Requirement	PASS





1.3. Test Facility

## 1.3.1 Address of the test laboratory

Shenzhen HUAK Testing Technology Co., Ltd.

1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China

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The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

# 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 HUAK 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.

Measurement Uncertainty

Conducted Emission Expanded Uncertainty = 2.23dB, k=2 Radiated emission expanded uncertainty(9kHz-30MHz) = 3.08dB, k=2 Radiated emission expanded uncertainty(30MHz-1000MHz) = 4.42dB, k=2 Radiated emission expanded uncertainty(Above 1GHz) = 4.06dB, k=2



2. GENERAL INFORMATION

# 2.1. Environmental conditions

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

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

# 2.2. General Description of EUT

Product Name:	Smart Outdoor Outlet
	ECF-SOP02, ECF-SOP04, IC-BS06, HA109US, PS102BKUS, SS30,
Model/Type reference:	SS31,SS32,SS33,SS34,SS35,JE-ODP-02,JE-ODP-03, SOP02,SOP03,
	SOP04,SOP02-US,SOP03-US,SOP04-US,SOPXX,SOPXX-US
Power supply:	AC 120V/60Hz
WIFI:	
Supported type:	802.11b/802.11g/802.11n(H20)
Modulation:	802.11b: DSSS
	802.11g/802.11n(H20): OFDM
Operation frequency:	802.11b/802.11g/802.11n(H20): 2412MHz~2462MHz
Channel number:	802.11b/802.11g/802.11n(H20): 11
Channel separation:	5MHz
Antenna type:	PCB antenna
Antenna gain:	3.23dBi

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

# 2.3. Description of Test Modes and Test Frequency

The Applicant provides software SSCOM 5.13.1 to control the EUT staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

There are 11 channels provided to the EUT and Channel 01/06/11 were selected for WIFI test.

# **Operation Frequency WIFI:**

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

Note: The line display in grey were the channel selected for testing



**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.

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Test Items	Mode	Data Rate	Channel
Maximum Conducted Output Power Power Spectral Density	11b/DSSS	1 Mbps	1/6/11
6dB Bandwidth Spurious RF conducted emission	11g/OFDM	6 Mbps	1/6/11
Radiated Emission 9kHz~1GHz& Radiated Emission 1GHz~10th Harmonic	11n(20MHz)/OFDM	6.5Mbps	1/6/11
	11b/DSSS	1 Mbps	1/11
Band Edge	11g/OFDM	6 Mbps	1/11
	11n(20MHz)/OFDM	6.5Mbps	1/11

# 2.4. Equipments Used during the Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	R&S	ENV216	HKE-002	Dec. 28, 2017	1 Year
2.	Receiver	R&S	ESCI 7	HKE-010	Dec. 28, 2017	1 Year
3.	RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2017	1 Year
4.	Spectrum analyzer	R&S	FSP40	HKE-025	Dec. 28, 2017	1 Year
5.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2017	1 Year
6.	Preamplifier	Schwarzbeck	BBV 9743	HKE-006	Dec. 28, 2017	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESCI 7	HKE-010	Dec. 28, 2017	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	HKE-012	Dec. 28, 2017	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 28, 2017	1 Year
10.	Horn Antenna	Schewarzbeck	9120D	HKE-013	Dec. 28, 2017	1 Year
11.	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	HKE-017	Dec. 28, 2017	1 Year
12.	Pre-amplifier	EMCI	EMC051845SE	HKE-015	Dec. 28, 2017	1 Year
13.	Pre-amplifier	Agilent	83051A	HKE-016	Dec. 28, 2017	1 Year
14.	EMI Test Software EZ-EMC	Tonscend	JS1120-B Version	HKE-083	Dec. 28, 2017	N/A
15.	Power Sensor	Agilent	E9300A	HKE-086	Dec. 28, 2017	1 Year
16.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2017	1 Year
17.	Signal generator	Agilent	N5182A	HKE-029	Dec. 28, 2017	1 Year
18.	Signal Generator	Agilent	83630A	HKE-028	Dec. 28, 2017	1 Year
19.	Shielded room	Shiel Hong	4*3*3	HKE-039	Dec. 28, 2017	3 Year
20.	RF Cable(below 1GHz)	HUBER+SUHNER	RG214	HKE-055	Dec. 28, 2017	1 Year



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21.	RF Cable(above 1GHz)	HUBER+SUHNER	RG214	HKE-056	Dec. 28, 2017	1 Year
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The calibration interval was one year

# 2.5. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
/	/	/	/	1
/	/	/	/	1

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

This submittal(s) (test report) is intended to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

# 2.7. Modifications

No modifications were implemented to meet testing criteria.



# 3. TEST CONDITIONS AND RESULTS

### 3.1. Conducted Emissions Test

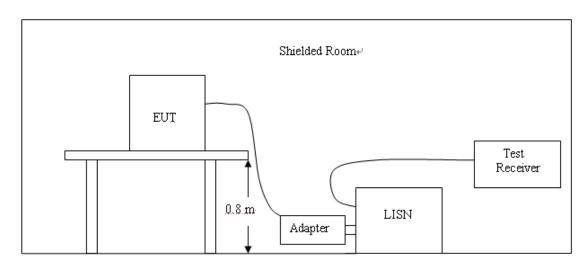
# **LIMIT**

FCC CFR Title 47 Part 15 Subpart C Section 15.207

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

<sup>\*</sup> 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 adapter received AC 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.

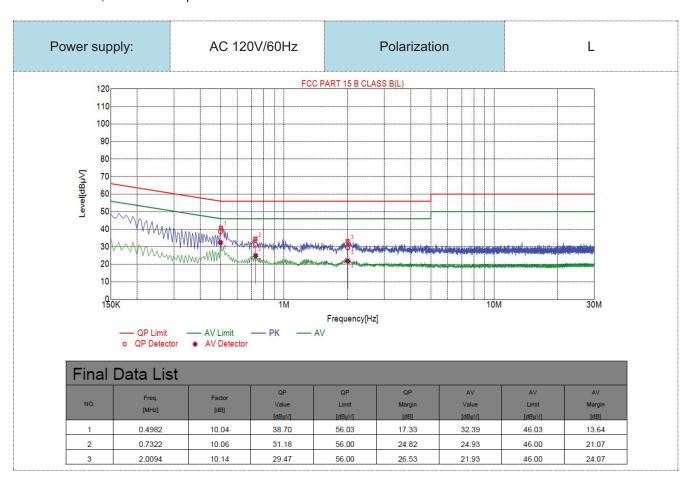


### Remark:

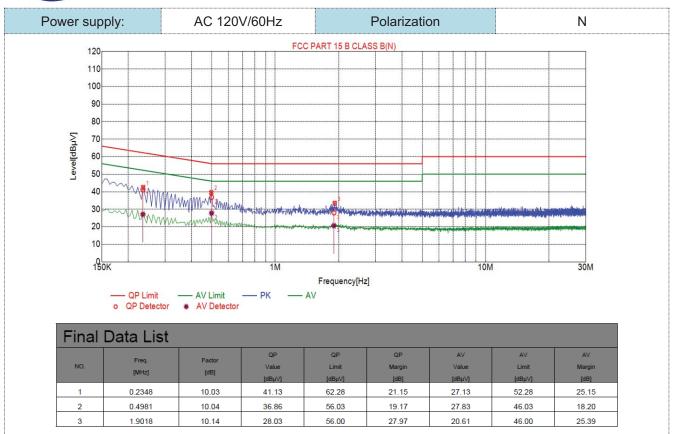
1. All modes of 802.11b/g/n were tested at Low, Middle, and High channel; only the worst result of 802.11b CH11 was reported as below:

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2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:



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# 3.2. Radiated Emissions and Band Edge

### **Limit**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

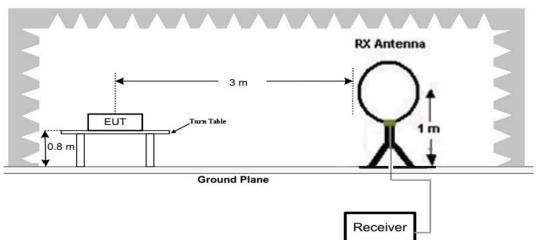
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

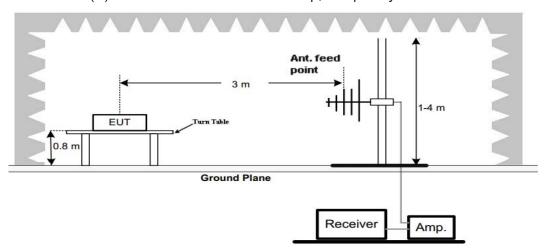
Transfer of the second						
Frequency (MHz) Distance (Meters)		Radiated (dBµV/m)	Radiated (µV/m)			
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)			
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)			
1.705-30	3	20log(30)+ 40log(30/3)	30			
30-88	3	40.0	100			
88-216	3	43.5	150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

### **TEST CONFIGURATION**

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

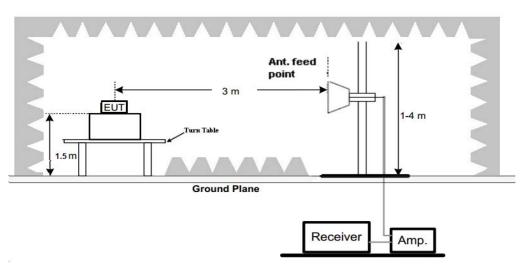


(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(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. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from  $0^{\circ}$  to  $360^{\circ}$  to acquire the highest emissions from EUT
- 3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4. Repeat above procedures until all frequency measurements have been completed.
- 5. Radiated emission test frequency band from 9KHz to 25GHz.
- 6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

Setting test receiver/spectrum as following table states:

Test Frequency	Test Receiver/Spectrum Setting	Detector
range		
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep	QP
SUIVITZ-TGTZ	time=Auto	QF
	Peak Value: RBW=1MHz/VBW=3MHz,	
1GHz-40GHz	Sweep time=Auto	Peak
TGHZ <del>-4</del> 0GHZ	Average Value: RBW=1MHz/VBW=10Hz,	
	Sweep time=Auto	

### **TEST RESULTS**

#### Remark:

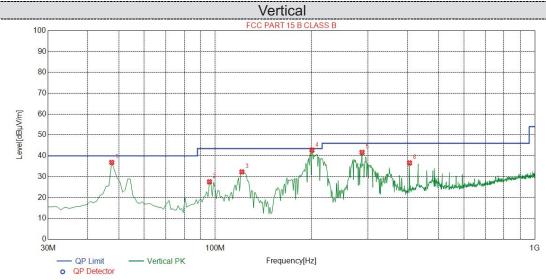
- 1. All three channels (lowest/middle/highest) of each mode were measured below 1GHz and recorded worst case at 802.11b low channel.
- 2. All three channels (lowest/middle/highest) of each mode were measured above1GHz and recorded worst case at 802.11b mode.
- 3. Radiated emission test from 9 KHz to 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



Susp	Suspected List									
NO.	Freq.	Level	Factor	Limit	Margin	Height	Angle	Polarity		
NO.	[MHz]	[dBµV/m]	[dB]	[dBµV/m]	[dB]	[cm]	[°]			
1	47.4600	20.55	-13.65	40.00	19.45	100	277	Horizontal		
2	120.210	17.70	-17.13	43.50	25.80	100	87	Horizontal		
3	221.090	29.22	-14.53	46.00	16.78	100	234	Horizontal		
4	309.360	35.52	-12.62	46.00	10.48	100	72	Horizontal		
5	344.280	42.61	-11.66	46.00	3.39	100	87	Horizontal		
6	768.170	33.01	-3.29	46.00	12.99	100	290	Horizontal		



Susp	Suspected List									
NO.	Freq.	Level	Factor	Limit	Margin	Height	Angle	Dolority		
NO.	[MHz]	[dBµV/m]	[dB]	[dBµV/m]	[dB]	[cm]	[°]	Polarity		
1	47.4600	36.83	-13.65	40.00	3.17	100	298	Vertical		
2	95.9600	27.55	-16.07	43.50	15.95	100	10	Vertical		
3	121.180	32.29	-17.27	43.50	11.21	100	10	Vertical		
4	200.720	42.75	-15.04	43.50	0.75	100	349	Vertical		
5	288.020	41.66	-12.92	46.00	4.34	100	270	Vertical		
6	405.390	36.60	-10.31	46.00	9.40	100	174	Vertical		



802.11b Mode (above 1GHz)

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Note: 802.11b/802.11g/802.11n (H20) all have been tested, only worse case 802.11b is reported

Horizontal: LOW CH1 (802.11b Mode)/2412

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
4824	61.89	-3.64	58.25	74	-15.75	peak
4824	45.79	-3.64	42.15	54	-11.85	AVG
7236	56.65	-0.95	55.7	74	-18.3	peak
7236	42.57	-0.95	41.62	54	-12.38	AVG
Remark: Factor	= Antenna Factor	+ Cable Loss –	Pre-amplifier.			-

Vertical: LOW CH1 (802 11b Mode)/2412

Vertical. LOVV C		ue)/2412				
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Type
4824	62.92	-3.64	59.28	74	-14.72	peak
4824	46.82	-3.64	43.18	54	-10.82	AVG
7236	56.67	-0.95	55.72	74	-18.28	peak
7236	41.95	-0.95	41	54	-13	AVG
1	· · · · · · · · · · · · · · · · · · ·	·	· · · · · · · · · · · · · · · · · · ·	·		

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



Horizontal: MID CH6 (802.11b Mode)/2437

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Type
4874	61.72	-3.51	58.21	74	-15.79	peak
4874	45.96	-3.51	42.45	54	-11.55	AVG
7311	56.51	-0.82	55.69	74	-18.31	peak
7311	42.63	-0.82	41.81	54	-12.19	AVG
Domark: Factor	- Antonna Factor	ı Cabla Lasa	Dra amplifier			-

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical: MID CH6 (802.11b Mode)/2437

7311	42.68	-0.82	41.86	54	-12.14	AVG
7311	57.72	-0.82	56.9	74	-17.1	peak
4874	46.19	-3.51	42.68	54	-11.32	AVG
4874	61.36	-3.51	57.85	74	-16.15	peak
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



Horizontal: HIGH CH11 (802.11b Mode)/2462

Meter Reading	Factor	Emission Level	Limits	Margin	Detector
(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Type
62.48	-3.43	59.05	74	-14.95	peak
45.86	-3.43	42.43	54	-11.57	AVG
56.6	-0.75	55.85	74	-18.15	peak
41.16	-0.75	40.41	54	-13.59	AVG
	(dBµV) 62.48 45.86 56.6 41.16	(dBµV) (dB) 62.48 -3.43 45.86 -3.43 56.6 -0.75 41.16 -0.75	(dBμV)     (dB)     (dBμV/m)       62.48     -3.43     59.05       45.86     -3.43     42.43       56.6     -0.75     55.85       41.16     -0.75     40.41	(dBμV)     (dB)     (dBμV/m)     (dBμV/m)       62.48     -3.43     59.05     74       45.86     -3.43     42.43     54       56.6     -0.75     55.85     74       41.16     -0.75     40.41     54	(dBμV)     (dB)     (dBμV/m)     (dBμV/m)     (dBμV/m)       62.48     -3.43     59.05     74     -14.95       45.86     -3.43     42.43     54     -11.57       56.6     -0.75     55.85     74     -18.15       41.16     -0.75     40.41     54     -13.59

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical: HIGH CH11 (802.11b Mode)/2462

	31111 (002:116 1		ı			
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Type
4924	62.96	-3.43	59.53	74	-14.47	peak
4924	46.3	-3.43	42.87	54	-11.13	AVG
7386	57.62	-0.75	56.87	74	-17.13	peak
7386	42.49	-0.75	41.74	54	-12.26	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

### Remark:

- (1) Data of measurement within this frequency range shown "--- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (2) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed.



Note: 802.11b/802.11g/802.11n (H20) all have been tested, only worse case 802.11b is reported

Horizontal: 802.11b Mode TX CH Low (2412MHz)

Results of Band Edges Test (Radiated)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Detector Type
2390	61.36	-5.81	55.55	74	-18.45	peak
2390	42.62	-5.81	36.81	54	-17.19	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical: 802.11b Mode TX CH Low (2412MHz)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Dotoctor Typo
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Detector Type
2390	62.72	-5.81	56.91	74	-17.09	peak
2390	43.19	-5.81	37.38	54	-16.62	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Horizontal: 802.11b Mode TX CH HIGH (2462MHz)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Detector Type
2483.5	58.65	-5.65	53	74	-21	peak
2483.5	42.53	-5.65	36.88	54	-17.12	AVG
			5 110	·	·	

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical: 802.11b Mode TX CH HIGH (2462MHz)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Detector Type
2483.5	61.26	-5.65	55.61	74	-18.39	peak
2483.5	43.42	-5.65	37.77	54	-16.23	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.





3.3. Maximum Conducted Output Power

# Limit

The Maximum Peak Output Power Measurement is 30dBm.

# **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**

#### WIFI

Туре	Channel	Output power PK (dBm)	Limit (dBm)	Result
	01	13.91		
802.11b	06	13.64	30.00	Pass
	11	13.76		
	01	13.57		
802.11g	06	13.57	30.00	Pass
	11	13.54		
	01	13.98		
802.11n(HT20)	06	14.39	30.00	Pass
	11	13.78		

## Note:

- 1) Measured output power at difference data rate for each mode and recorded worst case for each mode
- 2) Test results including cable loss;
- 3) Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20.



# 3.4. Power Spectral Density

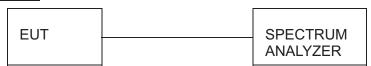
#### **Limit**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

## **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 ≥ 3 kHz.
- 3. Set the VBW  $\geq$  3× RBW.
- 4. Set the span to 1.5 times the DTS channel bandwidth.
- 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.
- 10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
- 11. The resulting peak PSD level must be 8dBm.

# **Test Configuration**



### **Test Results**

#### WIFI

Туре	Channel	Power Spectral Density (dBm/30KHz)	Limit (dBm/3KHz)	Result
	01	-17.718		
802.11b	06	-17.866	8.00	Pass
	11	-18.294		
	01	-22.898		
802.11g	06	-22.815	8.00	Pass
	11	-22.839		
	01	-21.444		
802.11n(HT20)	06	-21.056	8.00	Pass
	11	-21.617		

Test plot as follows:

CH11



802.11b 802.11g #Avg Type: Pwr(I Avg|Hold: 7/100 #Avg Type: Pwr( Avg|Hold: 4/100 Trig: Free Run Trig: Free Run #Atten: 20 dB Ref Offset 1 dB Ref 10.00 dBm Ref Offset 1 dB Ref 10.00 dBm Stop Fred 2.419300000 GH: CF Step 1.460000 MH Center 2.412000 GHz #Res BW 3.0 kHz Span 14.60 MHz Sweep 1.54 s (10000 pts) Span 26.53 MHz Sweep 2.80 s (10000 pts) #VBW 10 kHz #VBW 10 kHz CH01 CH01 Mkr1 2.436 064 8 GH -22.815 dBr 2.437 733 9 GH -17.866 dBi Ref Offset 1 dB Ref 10.00 dBm Ref Offset 1 dB Ref 10.00 dBm Center Free 2.437000000 GH: Center Free 2.423736000 GH Freq Offse Freq Offse Span 14.60 MHz Sweep 1.54 s (10000 pts) Span 26.53 MHz Sweep 2.80 s (10000 pts #VBW 10 kHz #VBW 10 kHz **CH06 CH06** nter Freq 2.462000000 GHz #Avg Type: Pwr(RMS) Avg|Hold: 3/100 #Avg Type: Pwr(RMS) Avg|Hold: 7/100 Auto Tur Mkr1 2.461 064 8 GH -22.839 dBr Mkr1 2.462 717 5 GH: -18.294 dBn Ref Offset 1 dB Ref 10.00 dBm Ref Offset 1 dB Ref 10.00 dBm 2.652800 MH: Mar CF Step 1.534560 MH Freq Offse Freq Offse Center 2.462000 GHz #Res BW 3.0 kHz Span 15.35 MHz Sweep 1.62 s (10000 pts) Center 2.46200 GHz #Res BW 3.0 kHz #VBW 10 kHz #VBW 10 kHz

CH11



802.11n(HT20) Trig: Free Run #Avg Type: Pwr(RM Avg|Hold: 2/100 Mkr1 2.405 416 2 GH -21.444 dBi Ref Offset 1 dB Ref 10.00 dBm Center Free 2.412000000 GH: #VBW 10 kHz CH01 #Avg Type: Pwr(RMS) Avg|Hold: 4/100 Auto Tur Mkr1 2.443 585 5 GH -21.056 dBn Ref Offset 1 dB Ref 10.00 dBm 2.851200 MH: Mar #VBW 10 kHz CH06 #Avg Type: Pwr(RMS) Avg|Hold: 4/100 2.468 577 5 GH: -21.617 dBn Ref Offset 1 dB Ref 10.00 dBm Span 28.42 MHz Sweep 3.00 s (10000 pts) #VBW 10 kHz

CH11



# 3.5. 6dB Bandwidth

### <u>Limit</u>

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

### **Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

### **Test Configuration**



#### **Test Results**

#### WIFI

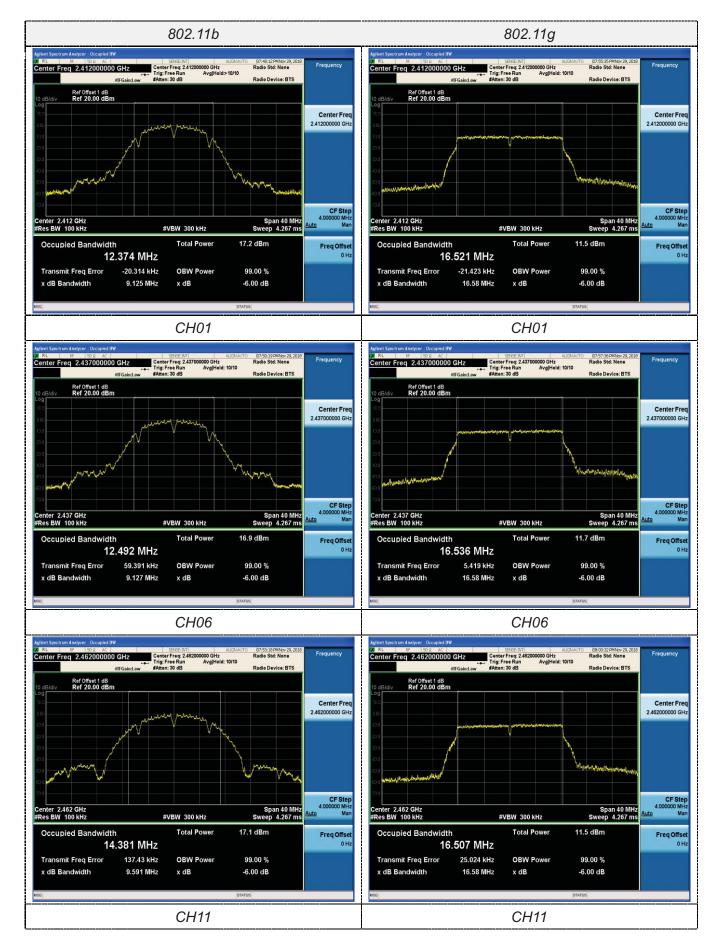
		VVII I		
Туре	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
	01	9.125		
802.11b	06	9.127	≥500	Pass
	11	9.591		
	01	16.58		
802.11g	06	16.58	≥500	Pass
	11	16.58		
	01	17.80		
802.11n(HT20)	06	17.82	≥500	Pass
	11	17.76		

#### Note:

- 1) Measured peak power spectrum density at difference data rate for each mode and recorded worst case for each mode.
- 2) Test results including cable loss;
- 3) Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20.
- 4) Please refer to following plots;



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802.11n(HT20) Center Freq 2.412000000 GHz Center Freq: 2.412000000 GHz
Trig: Free Run Avg|Hold: 10/10 Ref Offset 1 dB Ref 20.00 dBm Center Free #VBW 300 kHz Total Power 11.9 dBm Occupied Bandwidth Freq Offse 17.654 MHz Transmit Freq Error **OBW Power** 99.00 % 17.80 MHz x dB Bandwidth x dB -6.00 dB CH01 Ref Offset 1 dB Ref 20.00 dBm Center Free 2.437000000 GH: CF Step 4.000000 MHz Center 2.437 GHz #Res BW 100 kHz #VBW 300 kHz Total Power 12.2 dBm Occupied Bandwidth 17.679 MHz Transmit Freq Error 35.742 kHz **OBW Power** 99.00 % 17.82 MHz x dB -6.00 dB CH06 08:06:26 PMNov 29, 201 Radio Std: None Center Freq 2.462000000 GHz Ref Offset 1 dB Ref 20.00 dBm Center Free 2.462000000 GH: CF Step 4.000000 MH Span 40 MHz Sweep 4.267 ms #VBW 300 kHz 11.6 dBm **Total Power** Freq Offse 17.653 MHz Transmit Freq Error 39.775 kHz OBW Power 99.00 % x dB Bandwidth 17.76 MHz -6.00 dB x dB CH11



### 3.6. Out-of-band Emissions

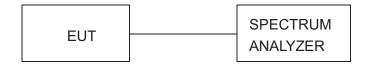
## **Limit**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

#### **Test Procedure**

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

### **Test Configuration**



#### **Test Results**

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data. And record the worst data in the report.

Test plot as follows:

3GHz-25GHz



802.11b CH01 802.11b CH06 Center Freq 2.412000000 GHz #Avg Type: Pwr(RMS) AvgiHold: 100/100 #Avg Type: Pwr(RMS) AvaiHold: 100/100 Trig: Free Run 411 495 GH: 0.833 dBn 437 510 GH: 0.510 dBn Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Free 2.412000000 GH Center Free 2.437000000 GH Stop Free 2.457000000 GH CF Step 4.000000 MH Ma CF Ste Freq Offse Span 40.00 MHz Sweep 4.27 ms (8001 pts) Span 40.00 MHz Sweep 4.27 ms (8001 pts) #VBW 300 kHz Reference nter Freq 1.515000000 GHz #Avg Type: Pwr(RMS) Avg|Hold: 13/100 #Avg Type: Pwr(R Avg|Hold: 13/100 Trig: Free Run Trig: Free Run Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre 1.515000000 GH Center Fred 1.515000000 GH: Stop Free Freq Offse Stop 3.000 GHz Sweep 284 ms (8001 pts) #VBW 300 kHz #VBW 300 kHz 30MHz-3GHz 30MHz-3GHz RL RF 50.2 AC

enter Freq 14.000000000 GHz

PNO: Fast → Trig: Free Run

#Galest ow #Atten: 30 dB Trig: Free Run #Avg Type: Pwr(RMS) AvgiHold: 2/100 #Avg Type: Pwr(RMS) AvailHold: 2/100 Auto Tun Auto Tun Mkr1 24.895 50 GH: -45.987 dBm Vlkr1 24.342 75 GHz -47.101 dBm Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre Center Fre Stop Free 25.000000000 GH Stop Free 25,000000000 GH CF Step 2.200000000 GH: CF Step 00000 GH Ma Stop 25.00 GHz Sweep 2.10 s (8001 pts) Start 3.00 GHz #Res BW 100 kHz Stop 25.00 GHz Sweep 2.10 s (8001 pts) #VBW 300 kHz #VBW 300 kHz

3GHz-25GHz

3GHz-25GHz



802.11g CH01 802.11b CH11 Center Freq 2.462000000 GHz #Avg Type: Pwr(RMS) AvgiHold: 100/100 #Avg Type: Pwr(RMS) AvalHold: 100/100 Trig: Free Run 463 505 GH: 0.321 dBn Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Free 2.462000000 GH Center Free 2.412000000 GH Stop Free 2.432000000 GH CF Step 4.000000 MH: Mar CF Step \* A harden Ministry Line Harve Freq Offse Span 40.00 MHz Sweep 4.27 ms (8001 pts) Span 40.00 MHz Sweep 4.27 ms (8001 pts) #VBW 300 kHz Reference Reference #Avg Type: Pwr(RMS) Avg|Hold: 13/100 #Avg Type: Pwr(F Avg|Hold: 13/100 Trig: Free Run Trig: Free Run Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre 1.515000000 GH Center Fred 1.515000000 GH: Stop Fre Freq Offse Stop 3.000 GHz Sweep 284 ms (8001 pts) #VBW 300 kHz #VBW 300 kHz 30MHz-3GHz 30MHz-3GHz RL RF 50.0 AC

PROF Freq 14.000000000 GHz

PRO: Fast → Trig: Free Run

Fream-Low #Atten: 30 dB Trig: Free Run #Avg Type: Pwr(RMS) AvgiHold: 2/100 #Avg Type: Pwr(RMS) AvailHold: 2/100 Auto Tun Auto Tun Mkr1 24.906 50 GH: -47.035 dBm Mkr1 23.680 00 GHz -46.673 dBm Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre Center Fre Stop Free 25.000000000 GH Stop Free 25.000000000 GH CF Step 2.200000000 GH Auto Ma CF Step 00000 GH: Mar Stop 25.00 GHz Sweep 2.10 s (8001 pts) Start 3.00 GHz #Res BW 100 kHz Stop 25.00 GHz Sweep 2.10 s (8001 pts) #VBW 300 kHz #VBW 300 kHz

3GHz-25GHz

3GHz-25GHz



802.11g CH11 802.11g CH06 Center Freq 2.437000000 GHz #Avg Type: Pwr(RMS) AvalHold: 100/100 #Avg Type: Pwr(RMS) Avg|Hold: 100/100 Trig: Free Run 441 150 GH: -8.371 dBm 468 890 GH: -8.574 dBn Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Free 2.437000000 GH Center Free 2.462000000 GH Stop Free 2.482000000 GH CF Step 4.000000 MH: Mar CF Step HANNAMAN MANAMAN Manuallagraphy Freq Offse Freq Offse Span 40.00 MHz Sweep 4.27 ms (8001 pts) Span 40.00 MHz Sweep 4.27 ms (8001 pts) Reference Reference #Avg Type: Pwr(RMS) Avg|Hold: 13/100 #Avg Type: Pwr(F Avg|Hold: 13/100 GHZ
PNO: Fast → Trig: Free Run
FGain: Low #Atten: 30 dB Trig: Free Run Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre 1.515000000 GH Center Fre 1.515000000 GH Stop Fre Freq Offse Stop 3.000 GHz Sweep 284 ms (8001 pts) #VBW 300 kHz #VBW 300 kHz 30MHz-3GHz 30MHz-3GHz RL RF 902 AC

enter Freq 14.0000000000 GHz

PN0: Fast ---
PN0: Fast ---
RGaind aw #Atten: 30 dB Trig: Free Run #Avg Type: Pwr(RMS) AvgiHold: 2/100 #Avg Type: Pwr(RMS) AvailHold: 2/100 Auto Tun Auto Tun 23.542 50 GH: -46.613 dBm Vlkr1 24.983 50 GHz -47.481 dBm Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre Center Fre Stop Free 25.000000000 GH CF Step 2.200000000 GHz Auto Man Stop 25.00 GHz Sweep 2.10 s (8001 pts) Start 3.00 GHz #Res BW 100 kHz Stop 25.00 GHz Sweep 2.10 s (8001 pts) #VBW 300 kHz #VBW 300 kHz

3GHz-25GHz

Auto Tun

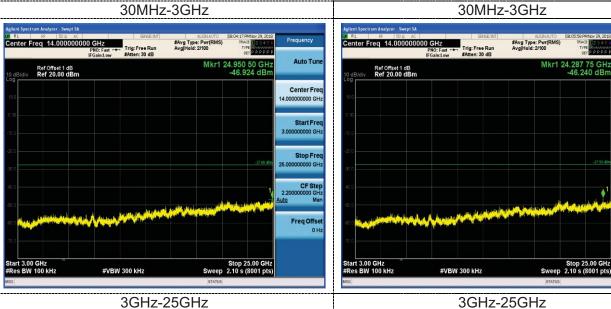
Center Fre

Stop Free 25,000000000 GH

CF Step 2.200000000 GH:

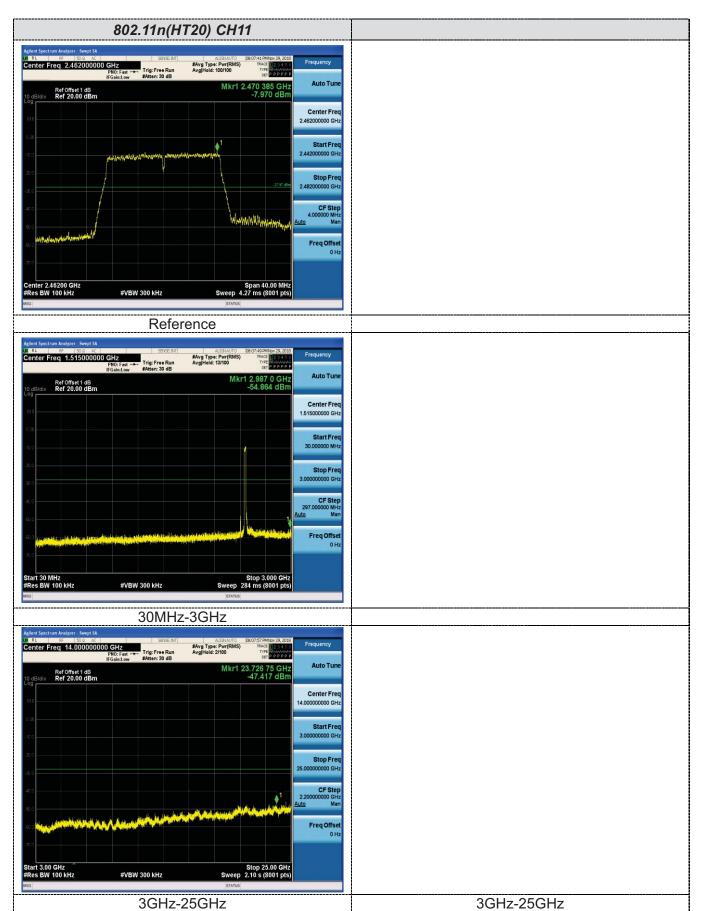


802.11n(HT20) CH06 802.11n(HT20) CH01 #Avg Type: Pwr(RMS) AvgiHold: 100/100 #Avg Type: Pwr(RMS) AvaiHold: 100/100 Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Free 2.412000000 GH Center Free 2.437000000 GH  $\phi^1$ Stop Free 2.457000000 GH CF Step 4.000000 MH: Mar CF Step Freq Offse Freq Offse Span 40.00 MHz Sweep 4.27 ms (8001 pts) Span 40.00 MHz Sweep 4.27 ms (8001 pts) #VBW 300 kHz Reference enter Freq 1.515000000 GHz #Avg Type: Pwr(RMS) Avg|Hold: 13/100 #Avg Type: Pwr(R Avg|Hold: 13/100 GHZ
PNO: Fast → Trig: Free Run
FGain: Low #Atten: 30 dB Trig: Free Run Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fre 1.515000000 GH Center Fre 1.515000000 GH Stop Fre Freq Offse Stop 3.000 GHz Sweep 284 ms (8001 pts) #VBW 300 kHz #VBW 300 kHz 30MHz-3GHz 30MHz-3GHz





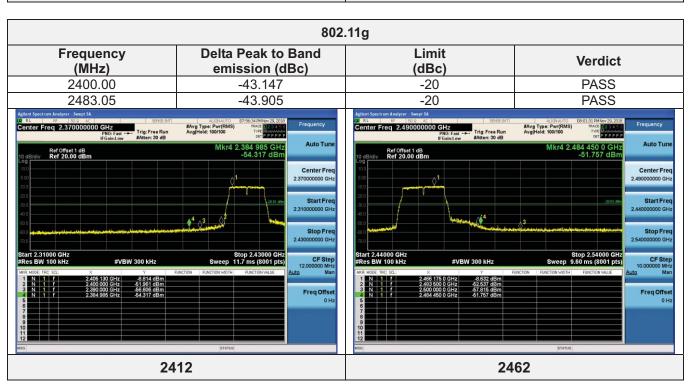
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**Band-edge Measurements for RF Conducted Emissions:** 

Frequency (MHz) Delta Peak to E emission (dE 2400.00 -49.573 2483.50 -54.676 Asplint Spectrum Analyzer Specific	Bc)	Limit (dBc) -20 -20 ctrum Analyzer Swept State Freq 2.490000000 GHz PRO Fast Trigs Free Foundations Ref Offset 1 dB	#Avg Type: Pwr(RMS) TRACE 12 3 4 5 6 Run Avg Hold: 100/100 TYPE  ABOUT PPPPPP  BETTER	requency  Auto Tune
2483.50  Agism Spectrum Analyzer, Sweigh Sk. US RL 1987 2.370000000 GHz PRIO: Frait	Frequency Center F	-20    Cirium Analyzer - Swept SA   FF   S0 2 AC   GHz     Freq 2.490000000 GHz   PRiO: Fast	PASS  ENT	
Agiliant Spectrum Analyzer - Swept SA   200 RL   58 200 MC   200	Frequency Center F	Ctrum Analyzer - Swept SA  RF   \$3.00 M/C    Freq 2.4900000000 GHZ  PRO: Fast	#AUSTANTO 07:54:14 PMNov 29, 2018 #Avg Type: Pwr(RMS)	
Selectif	Frequency Center F	RF 50.2 AC SENS Freq 2.490000000 GHz PRO: Fast → IFG Gint.tow #Atten: 30 d	#Avg Type: Pwr(RMS) TRACE 123456 Run Avg Hold: 100/100 Type Det PPPPPPP	
Start 2.31000 GHz Stop 2.43000 GHz #VBW 300 kHz Sweep 11.7 ms (8001 pts)	CF Step 12.000000 MHz Auto Man MRR MODE 1 1 N 2 N 3 N	44000 GHz W 100 kHz #VBW 300 kHz 1	-54.239 dBm  C 2.490  2.440  Sweep 9.60 ms (8001 pts)  Function   Punction value   Punction	Center Freq 0000000 GHz Start Freq 0000000 GHz Stop Freq 0000000 GHz CF Step 0.00000 MHz Man Freq Offset 0 Hz





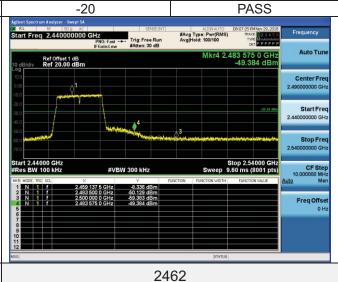
 802.11n HT20

 Frequency (MHz)
 Delta Peak to Band emission (dBc)
 Limit (dBc)
 Verdict

 2400.00
 -45.070
 -20
 PASS

 2483.50
 -41.793
 -20
 PASS





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# 3.7. Antenna Requirement

# **Standard Applicable**

### For intentional device, according to FCC 47 CFR Section 15.203:

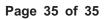
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

### FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### **Test Result:**

The maximum gain of antenna was 3.23dBi for 2.4GHz WIFI.





4. Test Setup Photos of the EUT

