



Shenzhen CTL Testing Technology Co., Ltd.
Tel: +86-755-89486194 E-mail: ctl@ctl-lab.com

TEST REPORT

FCC PART 15 SUBPART E 15.407

Report Reference No.: CTL1805044053-WF02

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.....: Ultra Stream Encoder

Model/Type reference: Ultra Stream HDMI

List Model(s).....: Ultra Stream HDMI Pro, Ultra Stream HDMI 4K Pro, Ultra Stream SDI Pro, Ultra Stream SDI 4K Pro, Ultra Stream AIO Pro

Trade Mark.....: MAGEWELL

FCC ID.....: 2AP6W-ENCODER

Applicant's name: Nanjing Magewell Electronics Co., Ltd.

Address of applicant: 14th Floor, Building 3, No. 89 Shengli Road, Jiangning Economic and Technological Development Zone, Nanjing, China

Test Firm.....: Shenzhen CTL Testing Technology Co., Ltd.

Address of Test Firm.....: Floor 1-A, Baisha Technology Park, No.3011, Shahehexi Road, Nanshan District, Shenzhen, China 518055

Test specification.....:

Standard.....: 47 CFR FCC Part 15 Subpart E 15.407

TRF Originator.....: Shenzhen CTL Testing Technology Co., Ltd.

Master TRF.....: Dated 2011-01

Date of Receipt.....: May 08, 2018

Date of Test Date.....: May 09, 2018–Jun. 18, 2018

Data of Issue.....: Jun. 19, 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

Test Report No. : CTL1805044053-WF02	Jun. 19, 2018 Date of issue
---	--------------------------------

Equipment under Test : Ultra Stream Encoder

Model /Type : Ultra Stream HDMI

Listed Models : Ultra Stream HDMI Pro, Ultra Stream HDMI 4K Pro,
Ultra Stream SDI Pro, Ultra Stream SDI 4K Pro, Ultra
Stream AIO Pro

Applicant : Nanjing Magewell Electronics Co., Ltd.

Address : 14th Floor, Building 3, No. 89 Shengli Road,
Jiangning Economic and Technological Development
Zone, Nanjing, China

Manufacturer : Nanjing Magewell Electronics Co., Ltd.

Address : 14th Floor, Building 3, No. 89 Shengli Road,
Jiangning Economic and Technological Development
Zone, Nanjing, China

Test result	Pass *
--------------------	---------------

* 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 ****

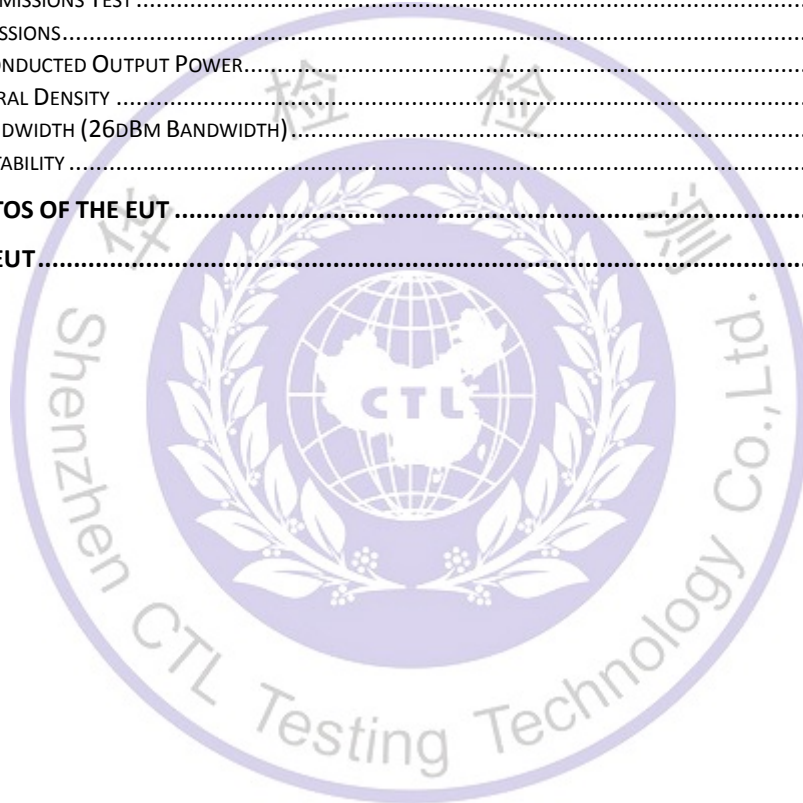
Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2018-06-19	CTL1805044053-WF02	Tracy Qi



Table of Contents

Page

1. SUMMARY.....	5
1.1. TEST STANDARDS.....	5
1.2. TEST DESCRIPTION.....	5
1.3. TEST FACILITY	6
1.4. STATEMENT OF THE MEASUREMENT UNCERTAINTY.....	6
2. GENERAL INFORMATION.....	7
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
3. TEST CONDITIONS AND RESULTS	10
3.1. CONDUCTED EMISSIONS TEST	10
3.2. RADIATED EMISSIONS.....	13
3.3. MAXIMUM CONDUCTED OUTPUT POWER.....	18
3.4. POWER SPECTRAL DENSITY	20
3.5. EMISSION BANDWIDTH (26dBm BANDWIDTH).....	25
3.6. FREQUENCY STABILITY	29
4. TEST SETUP PHOTOS OF THE EUT	31
5. PHOTOS OF THE EUT.....	32



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

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

[KDB789033 D02](#): General UNII Test Procedures New Rules v01r02

1.2. Test Description

FCC Requirement		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.407(a)	Emission Bandwidth(26dBm Bandwidth)	PASS
FCC Part 15.407(e)	Minimum Emission Bandwidth(6dBm Bandwidth)	N/A _{Note1}
FCC Part 15.407(a)	Maximum Conducted Output Power	PASS
FCC Part 15.407(a)	Peak Power Spectral Density	PASS
FCC Part 15.407(g)	Frequency Stability	PASS
FCC Part 15.407(b)	Undesirable emission	PASS
FCC Part 15.407(b)/15.205/15.209	Radiated Emissions	PASS
FCC Part 15.407(h)	Dynamic Frequency Selection	N/A _{Note 2}
FCC Part 15.203/15.247(b)	Antenna Requirement	PASS

Note 1: Apply to U-NII 3 band only.

Note 2: The device cannot operating at DFS band.

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	± 0.01 ppm	(1)
Radiated Emission 30~1000MHz	± 4.10 dB	(1)
Radiated Emission Above 1GHz	± 4.32 dB	(1)
Conducted Disturbance 0.15~30MHz	± 3.20 dB	(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:	Ultra Stream Encoder			
Model/Type reference:	Ultra Stream HDMI			
Power supply:	DC 5V from adapter			
Adapter information:	Model: PS10J050K2100UU Input: 100-240V~, 50/60Hz, 0.35A Output: 5.0V---2100mA			
WIFI				
Supported type:	20MHz system	40MHz system	80MHz system	160MHz system
	802.11a 802.11n 802.11ac	802.11n 802.11ac	N/A	N/A
Operation frequency:	5180-5240MHz	5190-5230MHz	N/A z	N/A
Modulation:	OFDM	OFDM	N/A	N/A
Channel number:	4	2	N/A	N/A
Channel separation:	20MHz	40MHz	N/A	N/A
Antenna type/gain:	FPC Antenna: 2.5dBi on 5GHz			

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 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	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII 1 (5150MHz-5250MHz)	36	5180	38	5190
	40	5200		5190
	44	5220	46	5230
	48	5240		5230

The line display in grey is those Channels/Frequencies select to test in 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) Undesirable emission Frequency Stability	11a/OFDM	6 Mbps
	11n(20MHz), 11ac(20MHz)/OFDM	7.2 Mbps
	11n(40MHz), 11ac(40MHz)/OFDM	15.0Mbps

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date last time	Calibration Date recent	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2017/06/02	2018/06/01	2019/05/31
LISN	R&S	ESH2-Z5	860014/010	2017/06/02	2018/06/01	2019/05/31
Power Meter	Agilent	U2531A	TW53323507	2017/06/02	2018/06/01	2019/05/31
Power Sensor	Agilent	U2021XA	MY5365004	2017/05/21	2018/05/20	2019/05/19
EMI Test Receiver	R&S	ESCI	103710	2017/06/02	2018/06/01	2019/05/31
Spectrum Analyzer	Agilent	E4407B	MY41440676	2017/05/21	2018/05/20	2019/05/19
Spectrum Analyzer	Agilent	N9020	US46220290	2017/01/17	2018/01/16	2019/01/15
Controller	EM Electronics	Controller EM 1000	N/A	2017/05/21	2018/05/20	2019/05/19
Active Loop Antenna	Daze	ZN30900A	N/A	2017/05/19	2018/05/18	2019/05/17
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2017/06/02	2018/06/01	2019/05/31
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2017/05/19	2018/05/18	2019/05/17
Horn Antenna	SCHWARZBACK	BBHA 9170	BBHA9170184	2017/05/19	2018/05/18	2019/05/17
Amplifier	Agilent	8349B	3008A02306	2017/05/19	2018/05/18	2019/05/17
Amplifier	Agilent	8447D	2944A10176	2017/05/19	2018/05/18	2019/05/17
Temperature/Humidity Meter	Gangxing	CTH-608	02	2017/05/20	2018/05/19	2019/05/18
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2017/05/20	2018/05/19	2019/05/18
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2017/05/20	2018/05/19	2019/05/18
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2017/06/02	2018/06/01	2019/05/31
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01	2019/05/31
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01	2019/05/31
RF Cable	Megalon	RF-A303	N/A	2017/06/02	2018/06/01	2019/05/31

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

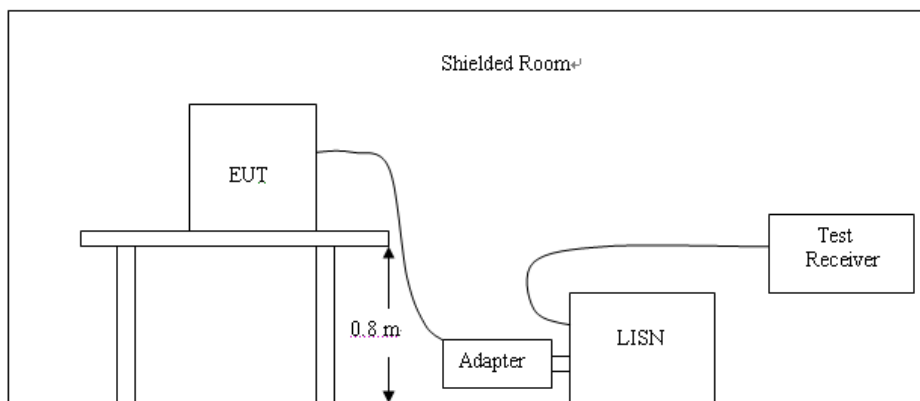
LIMIT

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

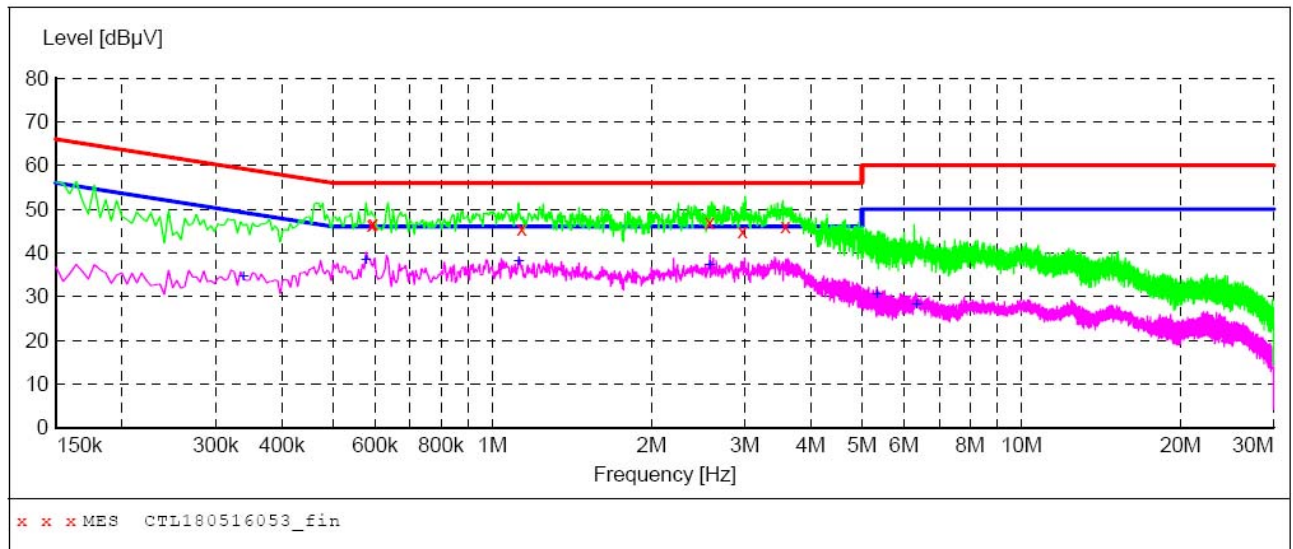
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as 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 adapter 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: 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) mode all have been tested, only worse case is reported

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

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL180516053_fin"**

16/05/2018 15:49

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.591000	46.40	10.2	56	9.6	QP	L1	GND
0.595500	46.70	10.2	56	9.3	QP	L1	GND
1.135500	45.60	10.3	56	10.4	QP	L1	GND
2.575500	47.10	10.4	56	8.9	QP	L1	GND
2.967000	44.90	10.4	56	11.1	QP	L1	GND
3.579000	46.20	10.4	56	9.8	QP	L1	GND

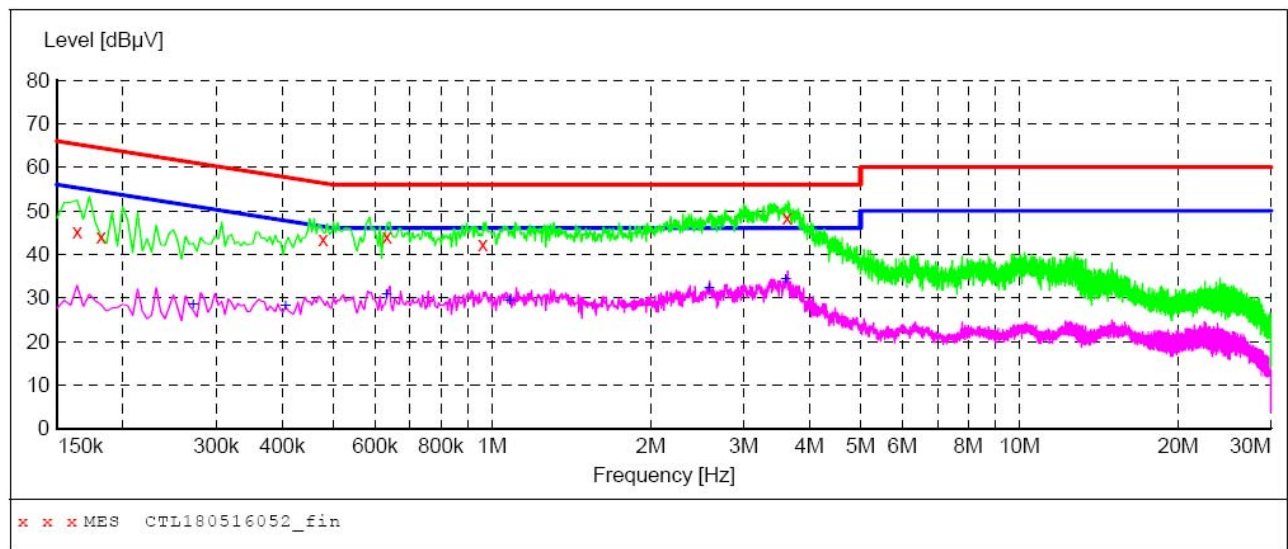
MEASUREMENT RESULT: "CTL180516053_fin2"

16/05/2018 15:49

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.339000	34.50	10.2	49	14.7	AV	L1	GND
0.577500	38.20	10.2	46	7.8	AV	L1	GND
1.122000	37.80	10.3	46	8.2	AV	L1	GND
2.580000	37.00	10.4	46	9.0	AV	L1	GND
5.338500	30.30	10.4	50	19.7	AV	L1	GND
6.346500	28.00	10.4	50	22.0	AV	L1	GND

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

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL180516052_fin"**

16/05/2018 15:45

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.163500	45.30	10.2	65	20.0	QP	N	GND
0.181500	44.00	10.2	64	20.4	QP	N	GND
0.478500	43.60	10.2	56	12.8	QP	N	GND
0.631500	44.10	10.2	56	11.9	QP	N	GND
0.960000	42.40	10.3	56	13.6	QP	N	GND
3.624000	48.30	10.4	56	7.7	QP	N	GND

MEASUREMENT RESULT: "CTL180516052_fin2"

16/05/2018 15:45

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.271500	28.30	10.2	51	22.8	AV	N	GND
0.406500	27.90	10.2	48	19.8	AV	N	GND
0.631500	30.60	10.2	46	15.4	AV	N	GND
1.081500	29.20	10.3	46	16.8	AV	N	GND
2.584500	32.00	10.4	46	14.0	AV	N	GND
3.610500	34.30	10.4	46	11.7	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) Note1
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:

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

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

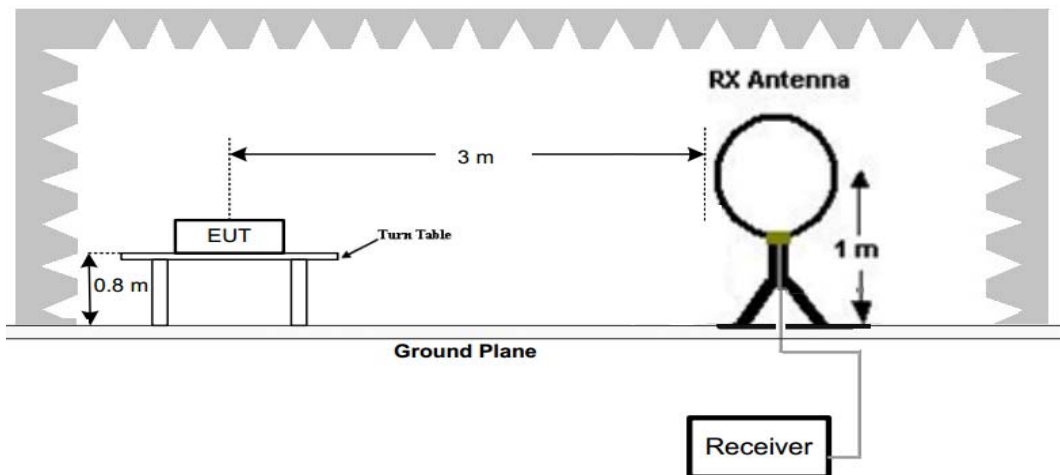
(6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

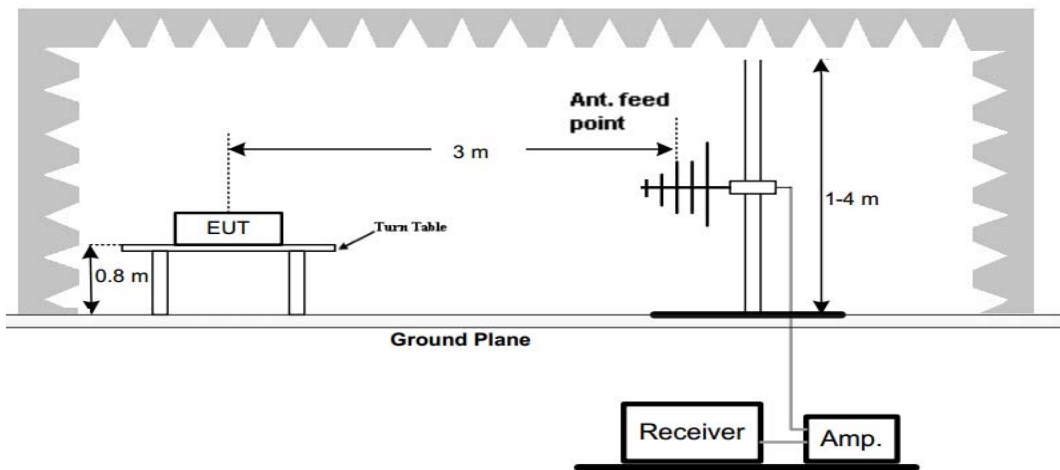
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960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

TEST CONFIGURATION

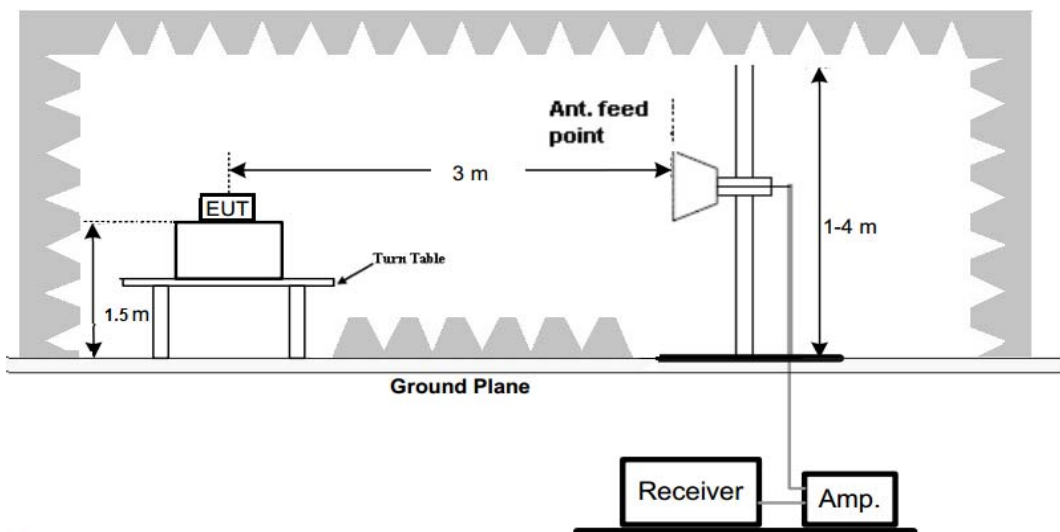
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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:

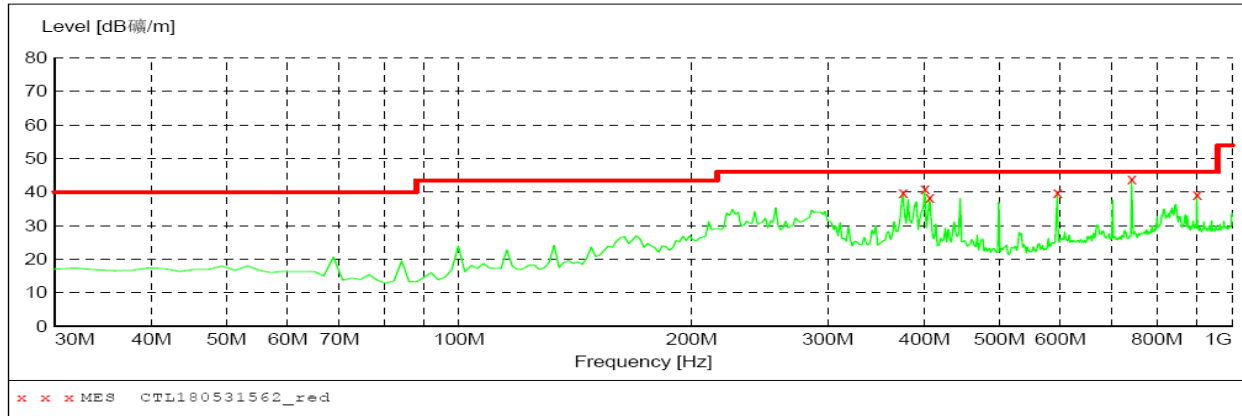
1. All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) modes have been tested for below 1GHz test, only the worst case 802.11ac (HT20) low channel of U-NII 1 band was recorded.
2. All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) modes have been tested for above 1GHz test, only the worst case 802.11ac (HT20) 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
Frequency	Frequency				
30.0 MHz	1.0 GHz	MaxPeak	200.0 ms	120 kHz	VULB 9168

**MEASUREMENT RESULT: "CTL180531562_red"**

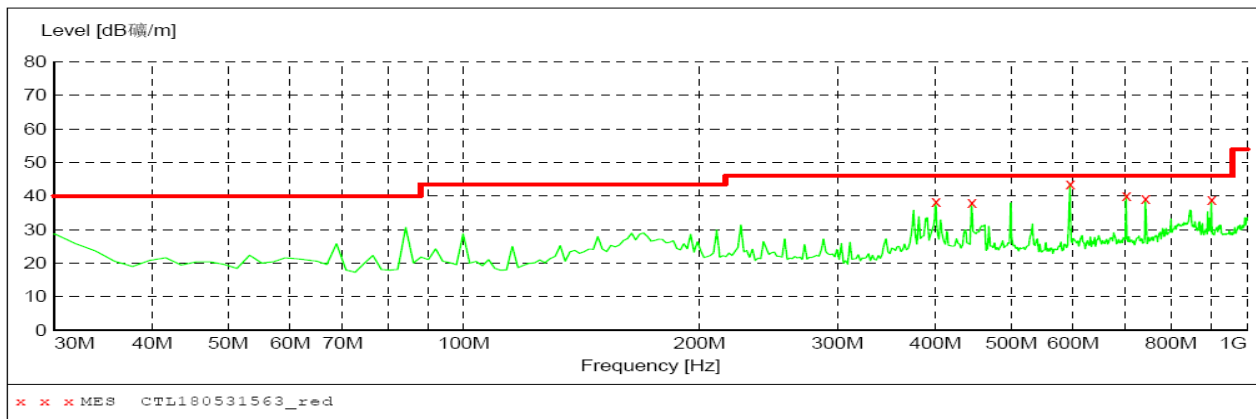
2018-6-5 17:09

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
375.320000	39.80	16.4	46.0	6.2	---	0.0	0.00	HORIZONTAL
400.540000	41.00	16.9	46.0	5.0	---	0.0	0.00	HORIZONTAL
406.360000	38.40	17.1	46.0	7.6	---	0.0	0.00	HORIZONTAL
594.540000	39.80	21.0	46.0	6.2	---	0.0	0.00	HORIZONTAL
741.980000	43.80	23.4	46.0	2.2	---	0.0	0.00	HORIZONTAL
901.060000	39.30	25.2	46.0	6.7	---	0.0	0.00	HORIZONTAL

Vertical

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

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency				
30.0 MHz	1.0 GHz	MaxPeak	200.0 ms	120 kHz	VULB 9168

**MEASUREMENT RESULT: "CTL180531563_red"**

2018-6-5 17:11

Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
400.540000	38.50	16.9	46.0	7.5	---	0.0	0.00	VERTICAL
445.160000	38.10	18.1	46.0	7.9	---	0.0	0.00	VERTICAL
594.540000	43.70	21.0	46.0	2.3	---	0.0	0.00	VERTICAL
701.240000	40.20	22.8	46.0	5.8	---	0.0	0.00	VERTICAL
741.980000	39.20	23.4	46.0	6.8	---	0.0	0.00	VERTICAL
901.060000	38.80	25.2	46.0	7.2	---	0.0	0.00	VERTICAL

For 1GHz to 25GHz

Note: All 802.11a / 802.11n (HT20) / 802.11ac (HT20) / 802.11n (HT40) / 802.11ac (HT40) modes have been tested for above 1GHz test, only the worst case 802.11ac (HT20) was recorded.

U-NII 1 & 802.11ac (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	47.56	PK	H	68.20	20.64	36.20	37.64	9.28	35.56	11.36
	10360.00	51.26	PK	H	68.20	16.94	35.53	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	50.69	PK	H	68.20	17.51	34.88	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	45.23	PK	H	68.20	22.97	33.82	37.64	9.28	35.51	11.41
	10480.00	51.35	PK	H	68.20	16.85	35.36	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

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	48.56	PK	V	68.20	19.64	37.20	37.64	9.28	35.56	11.36
	10360.00	54.25	PK	V	68.20	13.95	38.52	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	52.68	PK	V	68.20	15.52	36.87	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	49.23	PK	V	68.20	18.97	37.82	37.64	9.28	35.51	11.41
	10480.00	55.10	PK	V	68.20	13.10	39.11	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

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; RBW 1MHz VBW10Hz Peak detector is for AV value.

3.3. Maximum Conducted Output Power

Limit

FCC requirement:

For the band 5.15-5.25 GHz.

(i) For an outdoor 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.

(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.

(iii) For fixed point-to-point access points 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.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W

IC requirement:

Frequency band 5150-5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less.

For other devices, 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.

Frequency band 5250-5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;

b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Frequency bands 5470-5600 MHz and 5650-5725 MHz

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less.

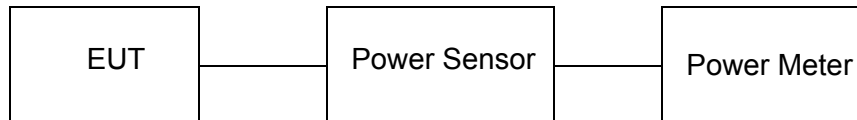
The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz.

Frequency band 5725-5850 MHz

The maximum conducted output power shall not exceed 1 W.

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)	EIRP (dBm)	Limit (dBm)	Result
802.11a	36	10.25	2.50	12.75	23.98	Pass
	40	10.52	2.50	13.02		
	48	10.45	2.50	12.95		
802.11n(HT20)	36	11.22	2.50	13.72	23.98	Pass
	40	10.36	2.50	12.86		
	48	10.54	2.50	13.04		
802.11n(HT40)	38	11.02	2.50	13.52	23.98	Pass
	46	10.25	2.50	12.75		
802.11ac(HT20)	36	11.12	2.50	13.62	23.98	Pass
	40	10.29	2.50	12.79		
	48	10.48	2.50	12.98		
802.11ac(HT40)	38	11.09	2.50	13.59	23.98	Pass
	46	10.65	2.50	13.15		

3.4. Power Spectral Density

Limit

FCC requirement:

For the band 5.15-5.25 GHz.

- (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.^{note1}
- (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.^{note1}
- (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.^{note1}

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands

The maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

IC requirement:

For the band 5.15-5.25 GHz.

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

Frequency band 5250-5350 MHz

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band

Frequency bands 5470-5600 MHz and 5650-5725 MHz

The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

For the band 5.725 - 5.85 GHz

The maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.^{note1, note2}

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***

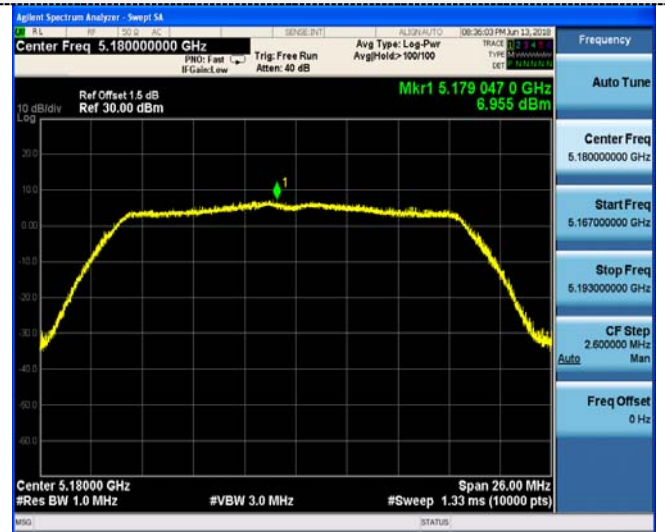
Type	Channel	P.S.D (dBm/MHz)	Antenna Gain (dBi)	EIRP P.S.D (dBm/ MHz)	Limit (dBm/ MHz)	Result
802.11a	36	7.598	2.50	10.098	11.00	Pass
	40	7.248	2.50	9.748		
	48	6.963	2.50	9.463		
802.11n(HT20)	36	6.955	2.50	9.455		Pass
	40	6.622	2.50	9.122		
	48	6.427	2.50	8.927		
802.11n(HT40)	38	7.436	2.50	9.936		Pass
	46	7.197	2.50	9.697		
802.11ac(HT20)	36	6.452	2.50	8.952		Pass
	40	7.220	2.50	9.720		
	48	6.618	2.50	9.118		
802.11ac(HT40)	38	6.960	2.50	9.460		Pass
	46	7.366	2.50	9.866		

Test plot as follows:

802.11a



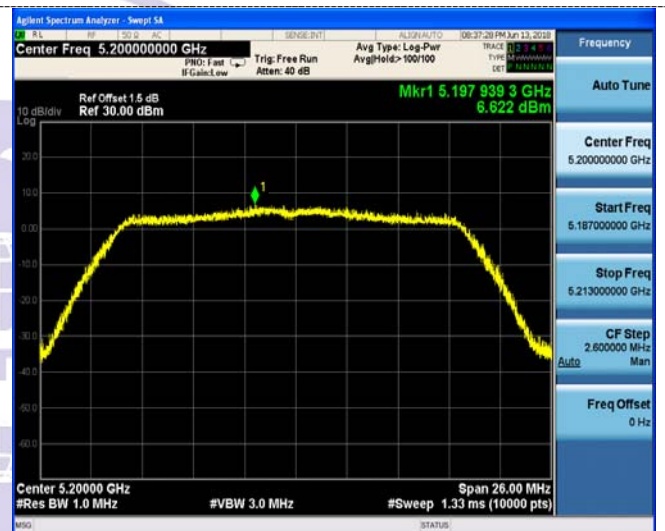
802.11n(HT20)



CH36



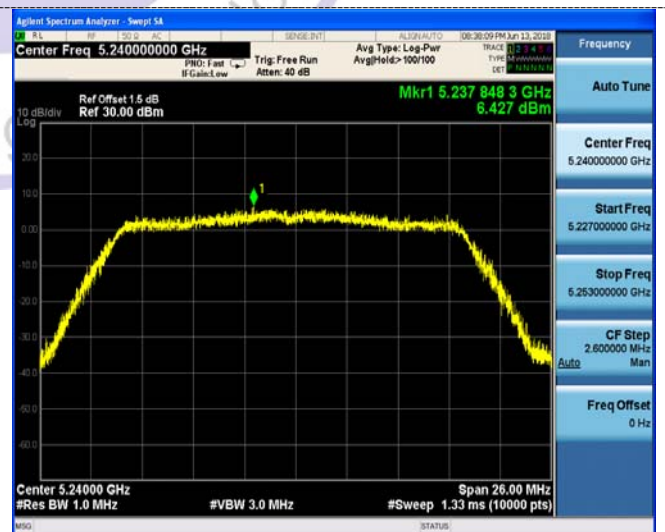
CH36



CH40



CH40



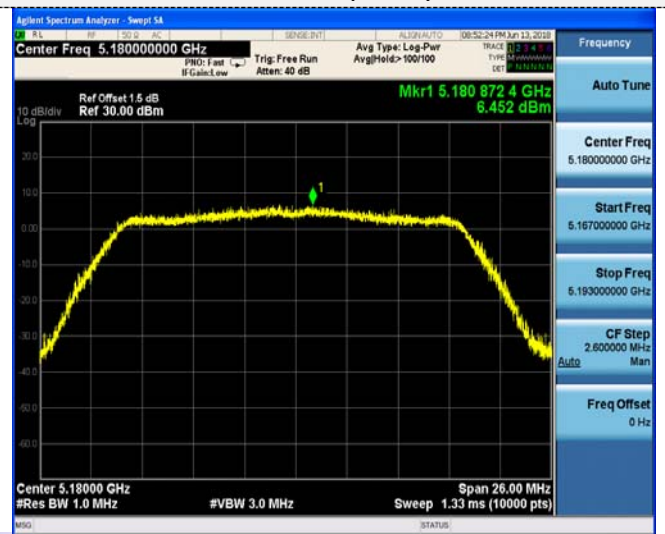
CH48

CH48

802.11n(HT40)



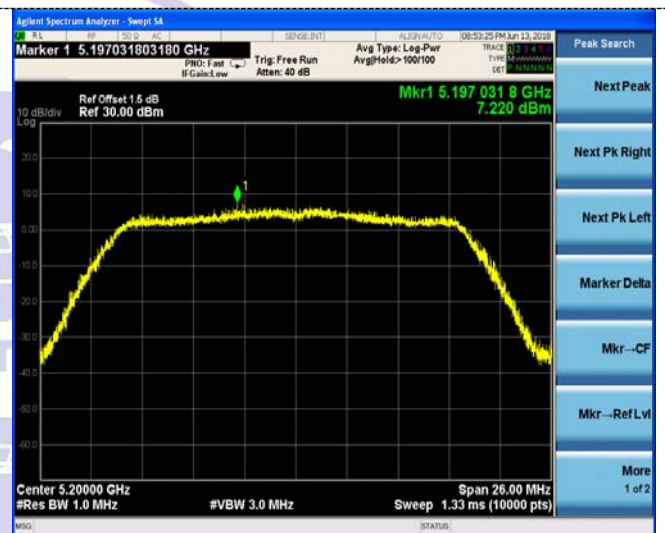
802.11ac(HT20)



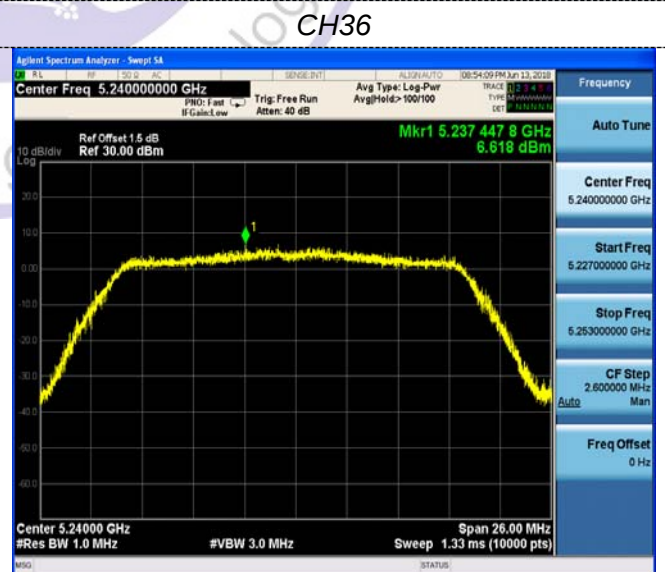
CH38



CH36

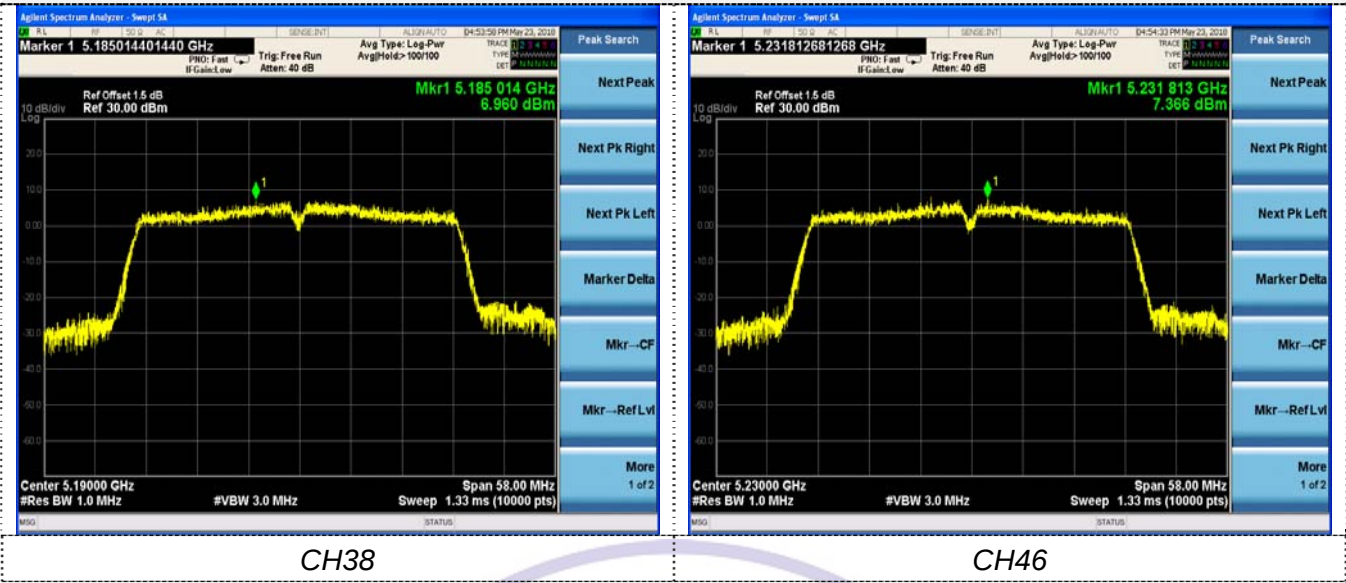


CH46



CH48

802.11ac(HT40)



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

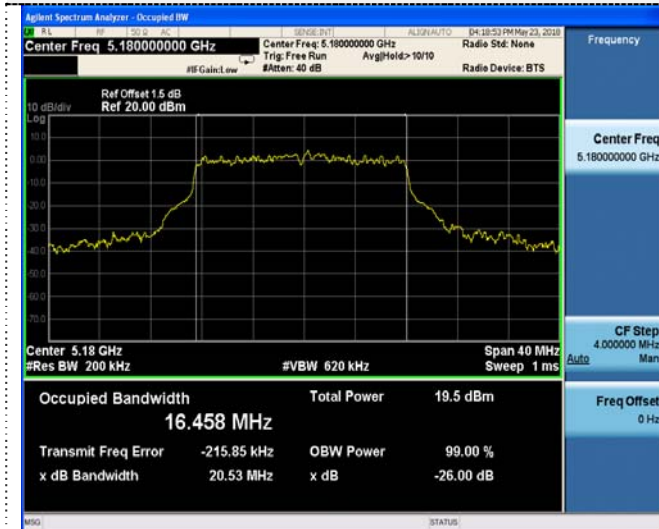


Test Results

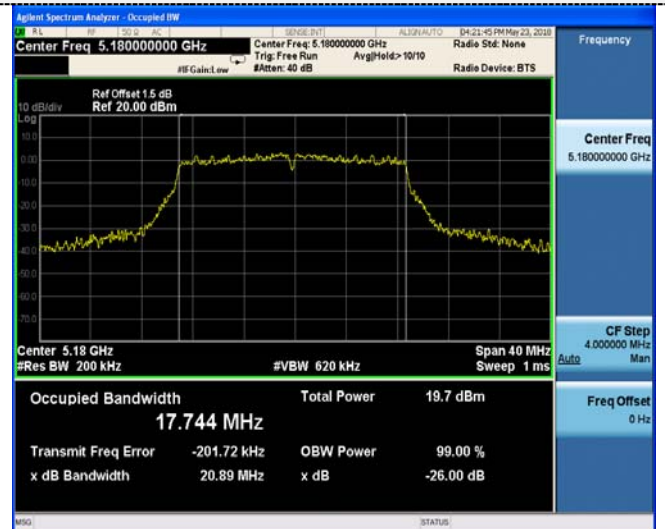
Type	Bands	Channel	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	20.53	16.458	N/A	Pass
		40	20.34	16.437		
		48	20.54	16.456		
802.11n(HT20)	U-NII 1	36	20.89	17.744		
		40	21.07	17.701		
		48	20.92	17.697		
802.11n(HT40)	U-NII 1	38	39.27	36.257		
		46	39.02	36.239		
802.11ac(HT20)	U-NII 1	36	21.21	17.739	N/A	Pass
		40	20.96	17.687		
		48	21.16	17.704		
802.11ac(HT40)	U-NII 1	38	39.67	36.280		
		46	39.52	36.268		

Test plot as follows:

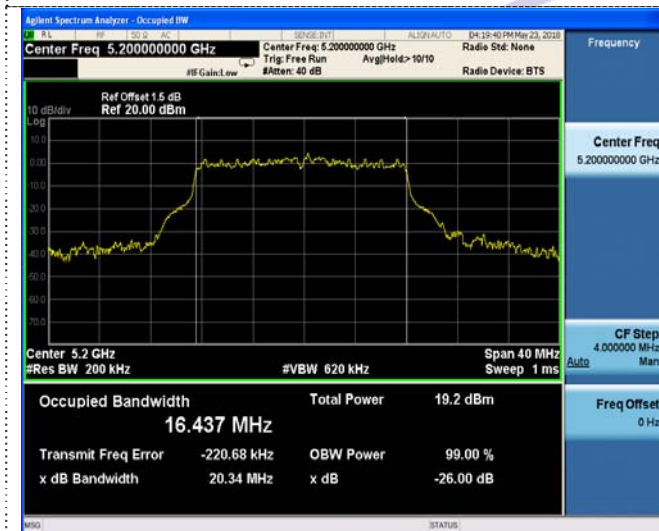
802.11a



802.11n(HT20)



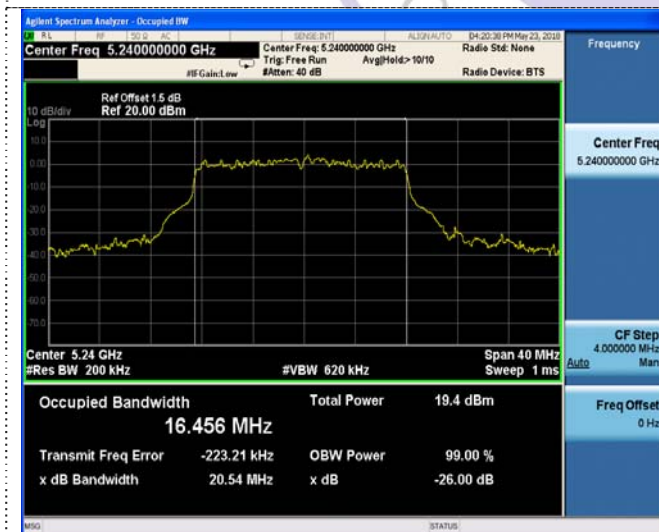
CH36



CH36



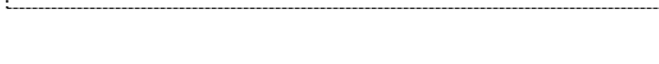
CH40



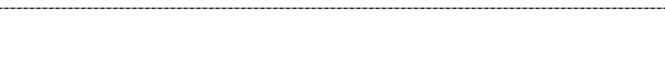
CH40



CH48



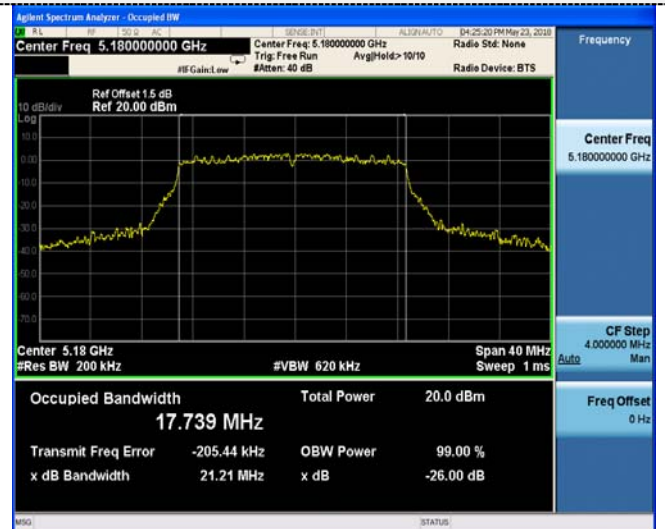
CH48



802.11n(HT40)



802.11ac(HT20)



CH38



CH36



CH46

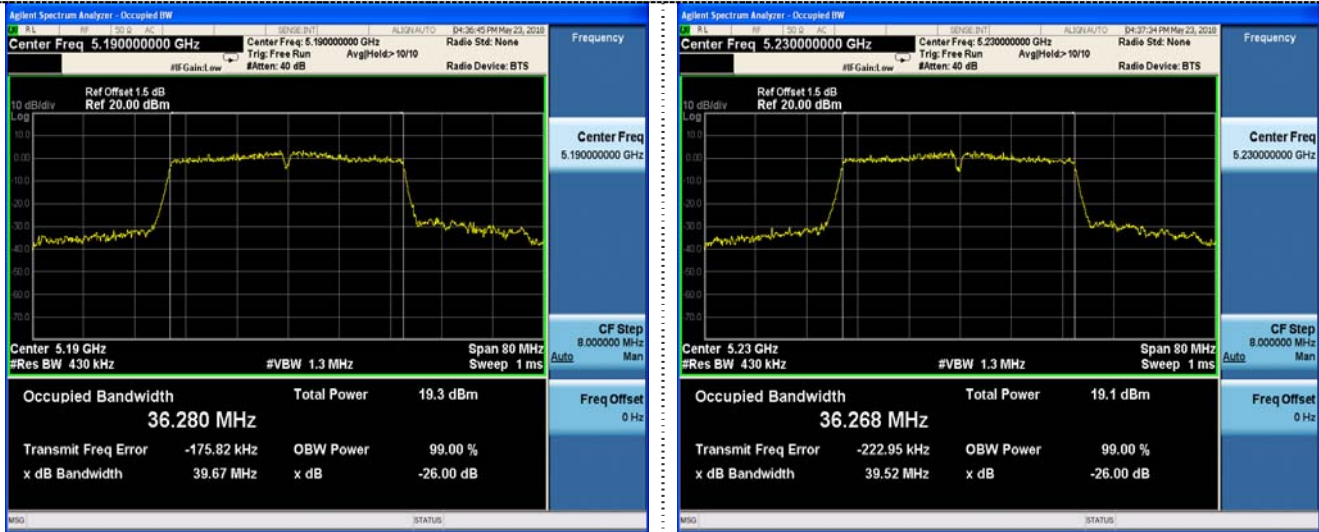


CH40



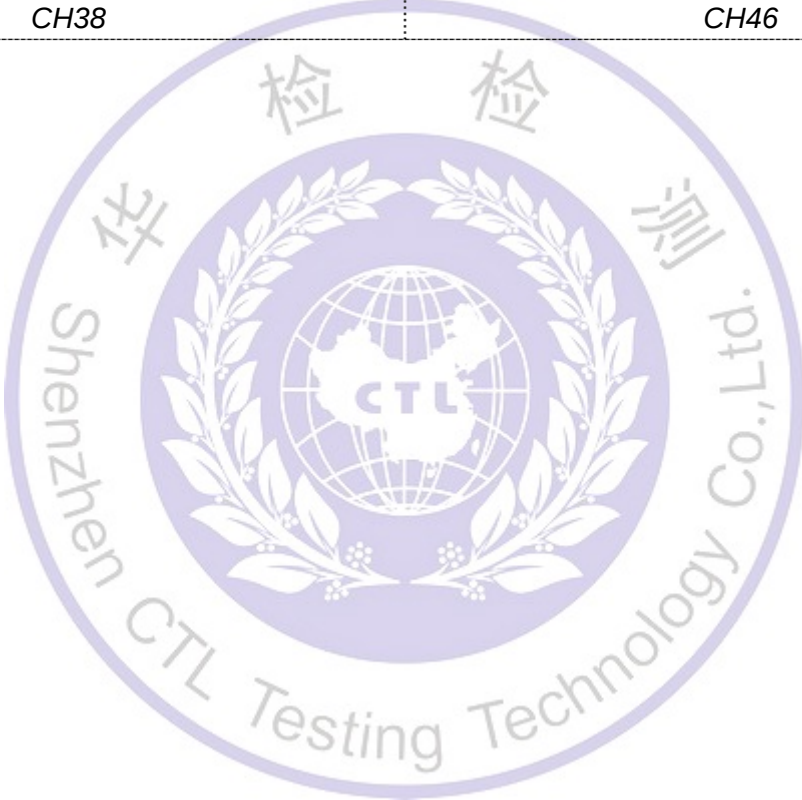
CH48

802.11ac(HT40)



CH38

CH46

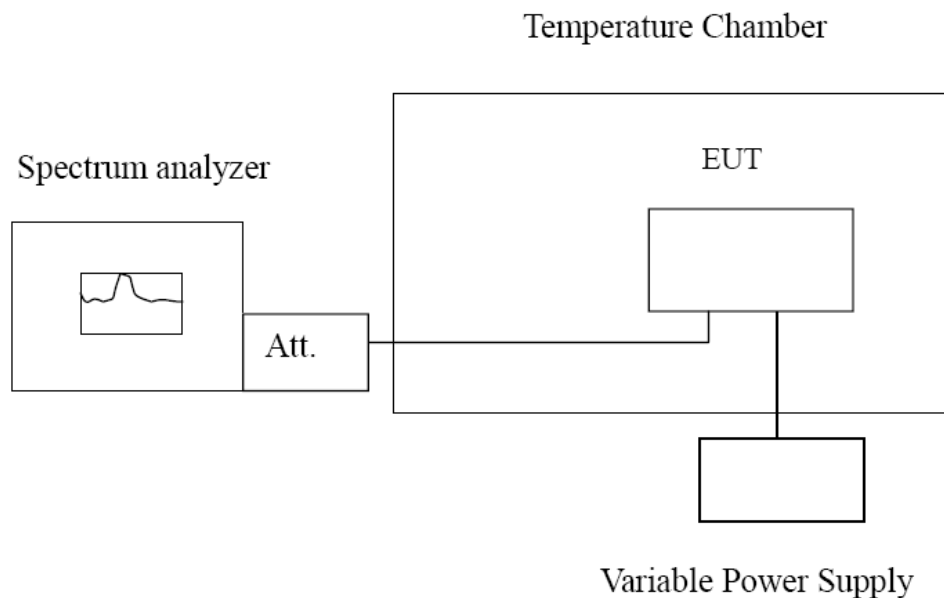


3.6. Frequency Stability

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: 802.11ac channel=36 frequency=5180MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
120V	-30	669	0.13	Within the band of operation	Pass
	-20	745	0.14		
	-10	852	0.16		
	0	732	0.14		
	10	769	0.15		
	20	835	0.16		
	30	841	0.16		
	40	725	0.14		
	50	755	0.15		
138V	25	769	0.15	Within the band of operation	Pass
102 V	25	861	0.17		



4. Test Setup Photos of the EUT



5. Photos of the EUT

Reference to the test report No. CTL1805044053-WF01

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

