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toll-free: (866) 311-3268
fax: (480) 926-3598
http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Ubiquiti Networks, Inc

Model: PBE-5AC

Description: PowerBeam 5AC

FCC ID: SWX-PBE5AC

To

FCC Part 15.407

Date of Issue: April 14, 2015

On the behalf of the applicant:	**Ubiquiti Networks, Inc** **91 E. Tasman Drive** **San Jose, CA 95134**
Attention of:	**Michael Taylor, Compliance Manager** **Ph: (408) 942-3085** **E-mail: compliance@ubnt.com**

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p14a0019

Greg Corbin

Greg Corbin
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 6, 2015	Greg Corbin	Original Document
2.0	April 9, 2015	Greg Corbin	Added test data for the following channels, 20 MHz BW added 5165 MHz, 30 MHz BW added 5170 and 5175 MHz, 40 MHz BW added 5175 and 5180 MHz, 50 MHz BW added5180, 5185, 5190 MHz
3.0	April 13, 2015	Greg Corbin	Corrected FCC ID on page 7, added test note to page 1 of Annex C. Revised the Output Power Limits in Annex A for 25, 27, 29 dBi Output Power tables
4.0	April 14, 2015	Amanda Reed	Corrected Antenna Peak Gain for PBE-AC-500 & PBE-AC-620

Table of Contents

ILAC / A2LA

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

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Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
24.0 – 26.4	27.9 – 31.3	960.7 – 970.6

EUT Operation during Tests

EUT Description
Model: PBE-5AC
Description: PowerBeam 5AC
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information:
The EUT was tested conducted mode with RF connectors mounted on the EUT at the antenna input.
When the test cable is plugged into the RF connector mounted to the EUT it disables the antenna connection.
The EUT is powered by POE (Power Over Ethernet).
The different data rates were evaluated and the worst case data rate was chosen for all the testing.

EUT Specifications

EUT Specifications	15.407
Equipment Code	NII
FCC ID	SWX-PBE5AC
Model(s)Tested	PBE-5AC-
Model(s) Covered	PBE-5AC-300, PBE-5AC-400, PBE-5AC-500, PBE-5AC-620, PBE-5AC-OMNI
Maximum Conducted Output Power	22.4 dBm
Frequency Ranges covered	5150 – 5250 MHz
EUT temperature range	-40C to 70C
Bandwidths	10/20/30/40/50/60/80 MHz
Data Rates	6, 9, 12, 18, 24, 36, 48, 54, MCS0, MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7, MCS8, MCS9
Modulations	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM

Antenna List

Model No.	Manufacturer	Antenna Type	Peak Gain
PBE-AC Omni	Ubiquiti	OMNI	6
PBE-AC-300	Ubiquiti	Dish	22
PBE-AC-400	Ubiquiti	Dish	25
PBE-AC-500	Ubiquiti	Dish	27
PBE-AC-620	Ubiquiti	Dish	29

15.203: Antenna Requirement:

	The antenna is permanently attached to the EUT
	The antenna uses a unique coupling
X	The EUT must be professionally installed
	The antenna requirement does not apply

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Switching Gigabit Power Supply/POE	Ubiquiti	GP-A240-050G	N/A

Cables: None

Modifications: None

Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
§15.203	Antenna Requirements	Pass	
§15.207 §15.407(b)(6)	Line Conducted Emissions	Pass	
§15.407(a)(1)	Conducted Output Power	Pass	
§15.407(a)(1),(5)	Power Spectral Density	Pass	
§15.403(i) 15.407(a)(5)	26dB Occupied Bandwidth	Pass	
	99% Occupied Bandwidth		
§15.407(b)(1)	Undesirable Emissions	Pass	
§15.205 §15.407(b)(1),(5),(6)(7)	General Field Strength Limits (Restricted Bands and Radiated Emission limits)	Pass	
§15.407(g)	Frequency Stability	Pass	
§15.407(f)	RF Exposure	Pass	

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
CFR47, Part 15, Subpart E	Unlicensed Nation Information Infrastructure Devices (U-NII)
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 644545 D03	Guidance for IEEE 802 11ac New Rules
KDB 789033 D02	General U-NII Test Procedures New Rules V01
KDB 926956 D01	U-NII Transition Plan

Peak Output Power
Engineer: Greg Corbin
Test Date: 4/2/2015

Test Requirements

(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. If transmitting antennas of directional gain greater than 6 dBi are used the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(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. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

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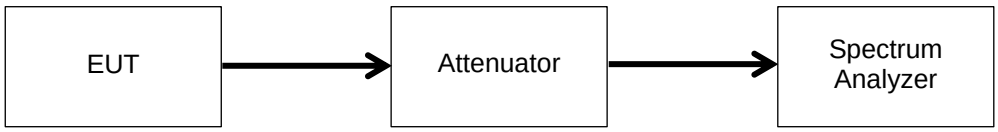
Test Procedure

The RF power was calculated using the spectrum analyzers' band power function per Method SA-1 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid, and high channels of the band.

The Spectrum Analyzer was set to the following:

a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Sweep time = auto
d. Detector = RMS
e. 100 traces in power averaging mode

Test Setup



NOTE: For all antenna gains greater than 6dBi the output power must be reduced per the tables in Annex A.

Test Results for 6 dBi OMNI Antenna

Bandwidth	Test Frequency	Data Rate	TP	J7 Level	J13 Level	J7 Level	J8 Level	Combined output power	Limit	Margin
MHz	MHz			dBm	dBm	mW	mW	dBm	dBm	dB
10	5165	vt0	18	16.9	19.3	49.0	85.1	21.3	30	-8.7
10	5200	vt0	18	17	19.4	50.1	87.1	21.4	30	-8.6
10	5245	vt0	18	16.8	18.7	47.9	74.1	20.9	30	-9.1
20	5165	vt0	1	1.1	2.1	1.3	1.6	4.6	30	-25.4
20	5170	vt0	10	9.7	10.1	9.3	10.2	12.9	30	-17.1
20	5175	vt0	17	16.4	18.4	43.7	69.2	20.5	30	-9.5
20	5180	vt0	19	19.7	20.9	93.3	123.0	23.4	30	-6.6
20	5200	vt0	19	19.6	20.1	91.2	102.3	22.9	30	-7.1
20	5240	vt0	19	19.2	19.6	83.2	91.2	22.4	30	-7.6
30	5170	vt0	-7	-2	-1.1	0.6	0.8	1.5	30	-28.5
30	5175	vt0	6	6.7	7.3	4.7	5.4	10.0	30	-20.0
30	5180	vt0	11	10.5	11.9	11.2	15.5	14.3	30	-15.7
30	5185	vt0	14	14	14.7	25.1	29.5	17.4	30	-12.6
30	5190	vt0	18	17.3	19.4	53.7	87.1	21.5	30	-8.5
30	5200	vt0	18	17.1	19.5	51.3	89.1	21.5	30	-8.5
30	5235	vt0	18	17	18.9	50.1	77.6	21.1	30	-8.9
40	5175	vf0	-6	-2.2	-0.8	0.6	0.8	1.6	30	-28.4
40	5180	vf0	5	5.2	5.2	3.3	3.3	8.2	30	-21.8
40	5185	vf0	9	8.3	8.9	6.8	7.8	11.6	30	-18.4
40	5190	vf0	11	9.7	10.6	9.3	11.5	13.2	30	-16.8
40	5195	vf0	13	12	12.4	15.8	17.4	15.2	30	-14.8
40	5200	vf0	15	13.7	14.8	23.4	30.2	17.3	30	-12.7
40	5230	vf0	15	13.6	14.1	22.9	25.7	16.9	30	-13.1
50	5180	vf0	-7	-2.5	-1.5	0.6	0.7	1.0	30	-29.0
50	5185	vf0	3	3.1	4	2.0	2.5	6.6	30	-23.4
50	5190	vf0	8	7.3	8.1	5.4	6.5	10.7	30	-19.3
50	5195	vf0	10	9.1	9.6	8.1	9.1	12.4	30	-17.6
50	5200	vf0	12	11	11.6	12.6	14.5	14.3	30	-15.7
50	5205	vf0	13	11.8	12.4	15.1	17.4	15.1	30	-14.9
50	5225	vf0	13	11.7	12.1	14.8	16.2	14.9	30	-15.1
60	5185	vf0	-7	-2.5	-1.7	0.6	0.7	0.9	30	-29.1
60	5190	vf0	-4	0.1	1.6	1.0	1.4	3.9	30	-26.1
60	5195	vf0	7	6.3	6.9	4.3	4.9	9.6	30	-20.4
60	5200	vf0	9	8.3	8.8	6.8	7.6	11.6	30	-18.4
60	5220	vf0	9	8.1	8.6	6.5	7.2	11.4	30	-18.6
80	5190	ve00	-10	-5.8	-5.2	0.3	0.3	-2.5	30	-32.5
80	5195	ve00	-6	-2.2	-1.3	0.6	0.7	1.3	30	-28.7
80	5200	ve00	2	1.7	2.5	1.5	1.8	5.1	30	-24.9
80	5210	ve00	9	7.8	8.4	6.0	6.9	11.1	30	-18.9

Transmitter Power Spectral Density
Engineer: Greg Corbin
Test Date: 4/2/2015

Test Requirements

(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 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in the maximum conducted power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

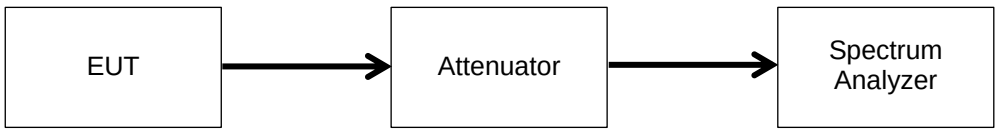
Test Procedure

The Power Spectral Density was measured using the method per SA-1 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid, and high channels of the band. The maximum PSD was determine by finding the peak value across the carrier bandwidth.

The Spectrum Analyzer was set to the following:

a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Span 1.5 * BW
d. Sweep time = auto
e. Detector = RMS
f. 100 traces in power averaging mode

Test Setup



Test Results for 6 dBi Antenna

Bandwidth	Frequency	Data Rate	TP setting	J7 Level	J13 Level	J7 Level	J13 Level	Combined Spectral Density	Limit/ 1 MHz	Margin
MHz	MHz			dBm	dBm	mW	mW	dBm	dBm	dB
10	5160	vt0	7	-2.8	-2.5	0.52	0.56	0.4	17	-16.6
10	5165	vt0	18	7.8	9.1	6.03	8.13	11.5	17	-5.5
10	5200	vt0	18	7.8	9.2	6.03	8.32	11.6	17	-5.4
10	5245	vt0	18	6.8	8.5	4.79	7.08	10.7	17	-6.3
20	5165	vt0	1	-10.9	-10.4	0.08	0.09	-7.6	17	-24.6
20	5170	vt0	10	-3	-2.6	0.50	0.55	0.2	17	-16.8
20	5175	vt0	17	4.2	5.6	2.63	3.63	8.0	17	-9.0
20	5200	vt0	19	7.2	7.1	5.25	5.13	10.2	17	-6.8
20	5240	vt0	19	6.5	6.6	4.47	4.57	9.6	17	-7.4
30	5170	vt0	-7	-15.6	-14.8	0.03	0.03	-12.2	17	-29.2
30	5175	vt0	6	-7.1	-6.5	0.19	0.22	-3.8	17	-20.8
30	5180	vt0	11	-3.3	-3.2	0.47	0.48	-0.2	17	-17.2
30	5185	vt0	14	-0.1	-0.2	0.98	0.95	2.9	17	-14.1
30	5200	vt0	18	3.3	4.4	2.14	2.75	6.9	17	-10.1
30	5235	vt0	18	3.1	4.2	2.04	2.63	6.7	17	-10.3
40	5175	vt0	-6	-16.7	-15.7	0.02	0.03	-13.2	17	-30.2
40	5180	vt0	5	-9.5	-9.5	0.11	0.11	-6.5	17	-23.5
40	5185	vf0	9	-7.2	-7.2	0.19	0.19	-4.2	17	-21.2
40	5190	vf0	11	-4.9	-5	0.32	0.32	-1.9	17	-18.9
40	5195	vf0	13	-3.6	-3.1	0.44	0.49	-0.3	17	-17.3
40	5200	vf0	15	-1.2	-0.6	0.76	0.87	2.1	17	-14.9
40	5230	vf0	15	-1.4	-1.8	0.72	0.66	1.4	17	-15.6
50	5180	vt0	-7	-18.6	-17.3	0.01	0.02	-14.9	17	-31.9
50	5185	vt0	3	-12.6	-11.6	0.05	0.07	-9.1	17	-26.1
50	5190	vt0	8	-8.1	-7.7	0.15	0.17	-4.9	17	-21.9
50	5195	vf0	10	-7.8	-7.1	0.17	0.19	-4.4	17	-21.4
50	5200	vf0	12	-5.6	-5.2	0.28	0.30	-2.4	17	-19.4
50	5225	vf0	13	-5	-4.5	0.32	0.35	-1.7	17	-18.7
60	5185	vf0	-7	-20.3	-19.2	0.01	0.01	-16.7	17	-33.7
60	5190	vf0	-4	-17.5	-16.3	0.02	0.02	-13.8	17	-30.8
60	5195	vf0	7	-11.4	-10.7	0.07	0.09	-8.0	17	-25.0
60	5200	vf0	9	-9.9	-8.8	0.10	0.13	-6.3	17	-23.3
60	5220	vf0	9	-10	-9.2	0.10	0.12	-6.6	17	-23.6
80	5190	ve00	-10	-24.1	-24.2	0.00	0.00	-21.1	17	-38.1
80	5195	ve00	-6	-22.2	-20	0.01	0.01	-18.0	17	-35.0
80	5200	ve00	2	-17.5	-16.6	0.02	0.02	-14.0	17	-31.0
80	5205	ve00	6	-13.2	-13.9	0.05	0.04	-10.5	17	-27.5
80	5210	ve00	9	-11.3	-10.7	0.07	0.09	-8.0	17	-25.0

EIRP Higher than 30°
Engineer: Greg Corbin
Test Date: 4/2/2015

Test Requirements

In addition to the emission limits specified in § 15.407(a)(1)(i), if the access point is an outdoor Point-to-Multipoint device operating in the band 5.15-5.25 GHz, the rules require that the maximum EIRP at any elevation angle above 30° not exceed 125 mW (21 dBm) as measured from the horizon. This restriction leads to a general requirement for the antenna pattern: if the EIRP within 3-dB elevation beam width of any radiation lobe is higher than 125 mW, this lobe must be controlled, either mechanically or electrically, so that the 3-dB elevation beam width of this lobe is below 30° elevation angle relative to horizon.
For the purposes of compliance, information for all the antenna types must be included in the filing. In order for antennas to be considered of similar type, the antenna patterns must also be similar as well as other characteristics of the antenna.

Test procedure

a) The 0 degree reference angle was determined
b) From the provided radiation pattern the highest gain between 30° and 90° was determined
c) The EIRP was calculated based on the highest gain and conducted output power
d) The results were compared with the 125mW limit.

Antenna Model	Highest in Band Gain ≥30° (dBi)	Maximum Conducted Power (dBm)	Maximum EIRP (mW)	Limit (mW)	Margin (mW)
PBE-5AC Omni	-7	23.4	43.7	125	81.3

Note: The maximum power on either port J7 or J13 was matched up with the highest gain ≥ 30° for a worst case configuration.

Undesirable Emissions Conducted
Engineer: Greg Corbin
Test Date: 4/3/2015

Test Requirements

Unwanted Emissions that fall Outside Restricted Bands

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. As specified in § 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a maximum emission limit of -27 dBm/MHz. However, an out-of-band emission that complies with both the peak and average limits of § 15.209 is not required to satisfy the -27 dBm/MHz maximum emission limit.

The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz

The provisions of §15.205 apply to intentional radiators operating under this section

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

For Conducted Unwanted Emissions in the Restricted Bands

For conducted measurements above 1000 MHz, EIRP was determined and then the field strength computed by the following:
E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3m
E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters.

Test Procedure

Per KDB 789033 D02 General U-NII Test Procedures New Rules v01 conducted RF port measurements were made in lieu of radiated. In addition, Cabinet Emissions measurements were performed in a semi-anechoic chamber with the antenna port terminated by a matching load. See additional section for Radiated Emissions.

The following criteria were addressed:

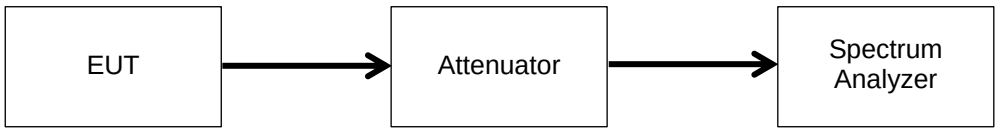
The Spectrum Analyzer was set to the following for emissions > 1000MHz:

a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak.
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10 Hz

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold

Test Setup



Test Results: **See Annex B: Undesirable Emissions Conducted**

Undesirable Emissions Radiated
Engineer: Mark Sechrist
Test Date: 12/19/14

Test Requirements

The provision of §15.209 were applied. In addition the requirements of §15.205 were also applied.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits

Frequency (MHz)	Frequency (microvolts/meter)	Frequency (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBµV/m) = 20 log E field strength (uV/m)

Test Procedure

The EUT was setup in accordance with ANSI C63.10 2013 and tested per KDB 789033. The antenna was replaced with non-radiating matched load. The EUT is placed on non-conductive platform at a height of 0.8 meters above the ground plane of the semi-anechoic chambers. The EUT was rotated 360 degrees and the receive antenna raised and lowered to find the maximum emissions from 30MHz to the 10th harmonic of the fundamental. The EUT was set to the maximum power level allowed and the low, mid, and high channels were investigated for emissions.

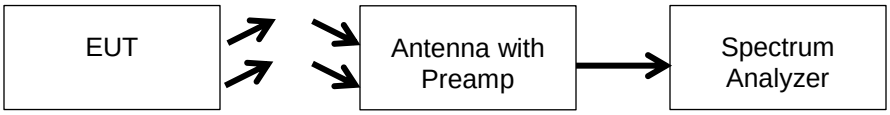
The Spectrum Analyzer was set to the following for emissions > 1000MHz:

a. (RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10Hz

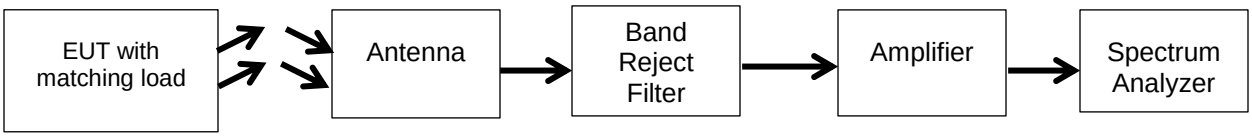
For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: A quasi peak detector was used for emissions where the peak exceeded that of the average 15.209 emission limits

Test Setup below 1000MHz



Test Setup above 1000MHz



Test Results: **See Annex C: Undesirable Emission Radiated**

Occupied Bandwidth
Engineer: Greg Corbin
Test Date: 4/2/2015

Test Requirement

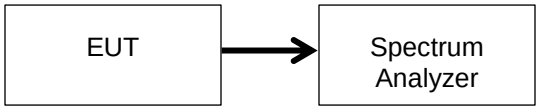
The emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement

Test Procedure

The Spectrum Analyzer was set to the following parameters:

a. RBW = approximately 1% of the emission bandwidth.
b. VBW > RBW.
c. Detector = Peak.
d. Trace mode = max hold.

Test Setup



Test Results: **See Annex D: Occupied Bandwidth**

Frequency Stability
Engineer: Mark Sechrist
Test Date: 12/11/14

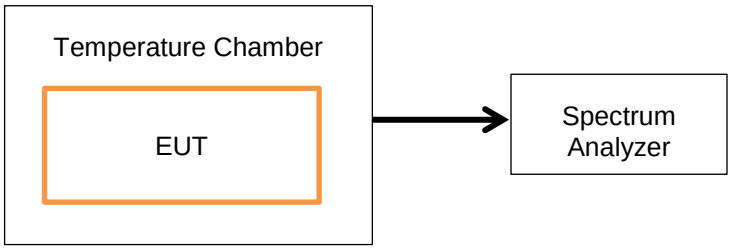
Test Requirement

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 user's manual.

Test Procedure

a. The EUT was placed into a temperature chamber and the temperature ranges were set to the manufacturers' specifications.
b. The RF output of the EUT was connected to a spectrum analyzer
c. The lowest and highest channels of the band were set to transmit
d. The carrier plots were measured to insure that the 26dB band width remained within the band over the prescribed temperature extremes.

Test Setup



Test Results: **See Annex E: Frequency Stability**

RF Exposure
Engineer: Greg Corbin
Test Date: 4/3/15

Requirements

U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. In addition, systems operating under the provisions of this section shall be operated in a manner that insures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

Exposure Limits

At operating frequencies less than or equal to 6 GHz, the limits for maximum permissible exposure (MPE) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b), except for portable devices as defined in §2.1093 as these evaluations shall be performed according to the SAR provisions in §2.1093 of this chapter.

MPE Limit Calculations

Exposure Limit 1mW/cm^2

Source Based Time Averaged Power Calculation

Average Power Calculations

Average Power = Peak Power * duty-cycle%

Tuned Frequency (MHz)	Conducted Peak Output Power (mW)	Duty Cycle %	Average Power (mW)
5180	219	100	219

MPE Evaluation

This is a **fixed/mobile** device used in uncontrolled /general population exposure environment.

Limits Uncontrolled Exposure	0.3-1.234 MHz	Limit [mW/cm²] = 100
47 CFR 1.1310	1.34-30 MHz	Limit [mW/cm²] = (180/f²)
Table 1, (B)	30-300 MHz	Limit [mW/cm²] = 0.2
	300-1500 MHz	Limit [mW/cm²] = f/1500
	1500-100,000 MHz	Limit [mW/cm²] = 1.0

Test Data

Test Frequency, MHz	5180
Power, Conducted, mW (P)	219
Antenna Gain Isotropic	6 dBi
Antenna Gain Numeric (G)	3.98
Antenna Type	Omni
Distance (R)	20 cm

$$S = \frac{P * G}{4\pi r^2}$$

Power Density (S) mw/cm^2	Power mW (P)	Numeric Gain (G)	Distance (r^2) cm
0.173	219	3.98	20

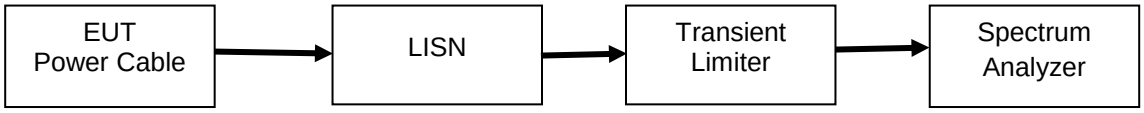
Power Density (S) =	0.173
Limit =(from above table) =	1.0

A/C Powerline Conducted Emission
Engineer: Mark Sechrist
Test Date: 11/3/2014

Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup



Test Results: **See Annex F: A/C Powerline Conducted Emission**

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	NCR	NCR
Temperature Chamber	Tenney	Tenney II Benchmaster	i00287	NCR	NCR
EMI Receiver	HP	8546A	i00033	2/26/15	2/26/16
Preamplifier	HP	8447D	i00055	NCR	NCR
Horn Antenna	EMCO	3116	i00085	NCR	NCR
Bi-Log Antenna	Schaffner	CBL611C	i00267	2/24/14	2/24/15
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/9/12	4/9/2015
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	4/1/15	4/1/16
Spectrum Analyzer	Agilent	E4407B	i00331	6/13/14	6/13/15
Data Logger	Fluke	Hydra Data Bucket	i00343	3/24/15	3/24/16
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/8/13	10/8/15
EMI Analyzer	Agilent	E7405A	i00379	2/5/15	2/5/16
Standard Gain Horn Kit	Pacific Millimeter Products	Mixer Mdl: MD1A 60 – 90 GHz Horn Mdl: EM 90 – 140 GHz Horn Mdl: FM	i00394	NCR	NCR
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	11/26/13	3/12/16
Spectrum Analyzer	Agilent	E4448A	S/N:MY46180566	12/1/2014	12/1/2016

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT