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Test Report

Prepared for: Ubiquiti Networks, Inc

Model: R5AC-PRISM

Description: Rocket 5AC Prism

Serial Number: N/A

FCC ID: SWX-R5ACPRISM

To

FCC Part 15.247

Date of Issue: September 10, 2015

On the behalf of the applicant:	**Ubiquiti Networks, Inc** **2580 Orchard Parkway** **San Jose, CA 95131**
Attention of:	**Michael Taylor, Compliance Manager** **Ph: (408) 942-3085** **E-mail: compliance@ubnt.com**

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Project No: p1580024

Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	August 28, 2015	Alex Macon	Original Document

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ILAC / A2LA

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

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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 C63.10-2009 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)**
20.6 – 21.7	36.7 – 41.2	968.7 – 972.4

EUT Operation during Tests

The EUT was configured to run in a continuous data stream using ART software through a POE adaptor and Ethernet connection.

EUT Description
Model: R5AC-PRISM
Description: Rocket 5AC Prism
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information: The EUT is a 2x2 MIMO 802.11ac radio

EUT Specifications	15.247
Equipment Code	DTS
FCC ID	SWX-R5ACPRISM
Model(s)Tested	R5AC-PRISM
Model(s) Covered	R5AC-PRISM
Maximum Output Power	25.3dBm
Frequency Ranges covered	5725-5850MHz
EUT temperature range	-40C to 80C
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

Model No.	Manufacturer	Antenna Type	Peak Gain
AM-5G-16-120	Ubiquiti	Sector	16
AM-5G-17-90	Ubiquiti	Sector	17
AM-M-V5G-Ti	Ubiquiti	Sector	17
AM-5G19-120	Ubiquiti	Sector	19
AM-5G20-90	Ubiquiti	Sector	20
AM5AC21-60	Ubiquiti	Sector	21
AM-V6G-Ti	Ubiquiti	Sector	21
AM-5AC22-45	Ubiquiti	Sector	22
RD-5G30	Ubiquiti	Dish	30
RD-5G31-AC	Ubiquiti	Dish	31
AMO-5G13	Ubiquiti	Omni	13
AMO-5G10	Ubiquiti	Omni	10

Accessories: None

Cables: None

Modifications: None

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

Test Reports Summary

FCC 15.247 Specification	Test Name	Pass, Fail, N/A	Comments
15.203	Antenna Requirements	Pass	
15.247(b)	Peak Output Power	Pass	
15.247(b)	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Radiated Spurious Emissions	Pass	
15.247(a)(2)	Occupied Bandwidth	Pass	
15.247(e)	Transmitter Power Spectral Density	Pass	
15.207	A/C Power line Conducted Emissions	Pass	
2.1093	RF Exposure	Pass	

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2009	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2009	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 558074 D01 v03r03	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Conducted Output Power
Engineer: Alex Macon
Test Date: 8/31/15

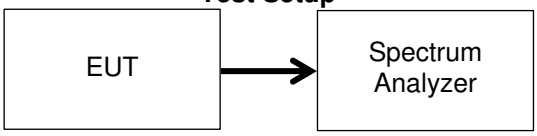
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 1-5% of the OBW, not to exceed 1MHz
VBW ≥ 3 x RBW
RMS Detector
Number of points in sweep ≥ 2 x span / RBW
Trace average at least 100 traces in power averaging mode
Sweep = auto
Span = 1.5 x EBW

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The RF output power was measured using the spectrum analyzer's channel power function

Test Setup



Bandwidth	Frequency	Data Rate	TP	J7 Level	J8 Level	J7 Level	J8 Level	Total Summed power	Limit	Margin
MHz	MHz			dBm	dBm	mW	mW	dBm	dBm	dB
10	5735	vt0	20	21.5	21.5	141.6	141.6	24.5	26	-1.5
10	5800	vt0	20	22.9	20.5	196.8	110.9	24.9	26	-1.1
10	5840	vt0	20	22.9	20.8	194.1	119.7	25.0	26	-1.0
20	5740	vt0	20	21.6	21.0	143.2	125.6	24.3	26	-1.7
20	5800	vt0	20	23.0	20.5	200.0	113.2	25.0	26	-1.0
20	5835	vt0	20	23.1	20.8	205.1	120.5	25.1	26	-0.9
30	5745	vt0	20	22.0	20.9	158.9	121.6	24.5	26	-1.5
30	5800	vt0	20	23.0	20.6	197.2	114.0	24.9	26	-1.1
30	5830	vt0	20	23.4	20.8	218.8	119.1	25.3	26	-0.7
40	5750	vf0	20	22.4	21.4	173.8	138.0	24.9	26	-1.1
40	5800	vf0	20	21.9	21.2	154.9	132.4	24.6	26	-1.4
40	5825	vf0	20	21.8	21.4	150.0	139.3	24.6	26	-1.4
50	5755	vf0	20	22.3	21.3	169.4	134.0	24.8	26	-1.2
50	5800	vf0	20	21.7	21.1	149.3	129.7	24.5	26	-1.5
50	5820	vf0	20	21.9	21.3	153.5	136.1	24.6	26	-1.4
60	5760	vf0	20	22.5	21.3	176.2	135.5	24.9	26	-1.1
60	5800	vf0	20	23.0	21.3	198.6	133.4	25.2	26	-0.8
60	5815	vf0	20	22.1	21.5	162.2	139.6	24.8	26	-1.2
80	5775	ve00	19	21.0	21.2	125.9	133.0	24.1	26	-1.9
80	5800	ve00	19	20.8	20.2	119.1	105.4	23.5	26	-2.5

See Annex A for output power tables

Conducted RF Measurements (15.209)
Engineer: Alex Macon
Test Date: 8/28/15

Test Procedure

Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands for 15.209.

The following offsets were added to the measurements:
The maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level
A maximum ground reflection factor to the EIRP level, 6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000MHz.

The following equations were used to determine the field strength from the conducted values.
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.

The Spectrum Analyzer was set to the following:

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

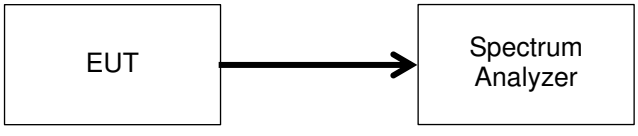
a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak.
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10 Hz

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

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was investigated.

Test Setup



See Annex B for test data

Radiated Spurious Emissions
Engineer: Mark Sechrist
Test Date: 12/18/14

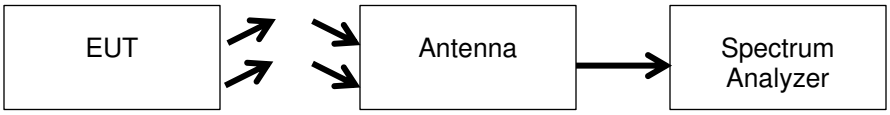
Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined.
Measured Level includes antenna and receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording "Measured Level".

RBW = 100 KHz
VBW = 300 KHz
Detector – Quasi Peak

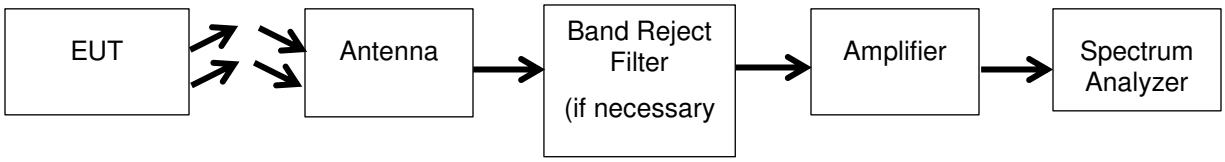
Test Setup



Test Procedure for
Radiated Spurious Emissions above 1 GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

Test Setup



See Annex C for Test Data

Conducted Spurious Emissions 15.247(d)
Engineer: Alex Macon
Test Date: 8/28/15

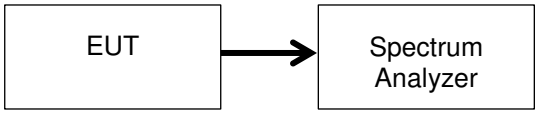
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Frequency Range = 30MHz – 10th Harmonic of the fundamental

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The trace was allowed to stabilize. All emissions were investigated to insure they were attenuated from the peak fundamental by at least 20dB. If the average power levels were measured then the out-of-band emissions needed to be attenuated by 30dB. In addition emissions were investigated at the band edges to insure all out-of-band emissions were attenuated 20 or 30dB as necessary.

Test Setup



See Annex D for Test Data

DTS Bandwidth
Engineer: Alex Macon
Test Date: 8/28/15

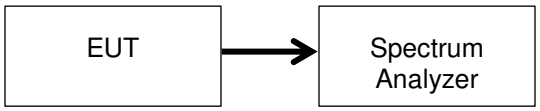
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. The maximum width of the emission that was determined by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that were attenuated by 6db and this value was used to determine the width of the carrier. Alternatively the spectrum analyzer's automatic bandwidth capability was used.

Test Setup



See Annex E for Test Data

Transmitter Power Spectral Density (PSD)
Engineer: Alex Macon
Test Date: 8/31/15

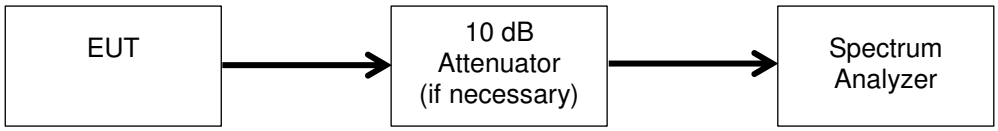
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

DTS channel center frequency
Span 1.5 x DTS bandwidth
RBW =3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Sweep time = auto couple
Trace mode = max hold

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. Once the trace has stabilize the peak marker was used to determine the peak power spectral density.

Test Setup



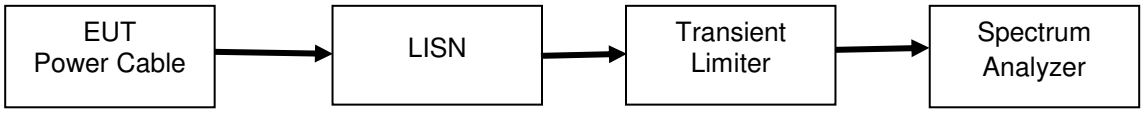
Bandwidth	Frequency	Data Rate	TP	J7 Level	J8 Level	J7 Level	J8 Level	Total Summed SD	Limit/3KHz	Margin
MHz	MHz			dBm	dBm	W	W	dBm	dBm	dB
10	5735	vt0	20	0.1	0.2	1.0	1.0	3.2	4	-0.8
10	5800	vt0	20	-0.6	-1.2	0.9	0.8	2.1	4	-1.9
10	5840	vt0	20	-0.2	-0.6	1.0	0.9	2.6	4	-1.4
20	5740	vt0	20	-3.2	-4.5	0.5	0.4	-0.8	4	-4.8
20	5800	vt0	20	-3.0	-3.6	0.5	0.4	-0.3	4	-4.3
20	5835	vt0	20	-2.6	-3.1	0.5	0.5	0.2	4	-3.8
30	5745	vt0	20	-4.9	-4.2	0.3	0.4	-1.5	4	-5.5
30	5800	vt0	20	-5.3	-6.6	0.3	0.2	-2.9	4	-6.9
30	5830	vt0	20	-5.1	-6.0	0.3	0.3	-2.5	4	-6.5
40	5750	vf0	20	-6.6	-7.1	0.2	0.2	-3.8	4	-7.8
40	5800	vf0	20	-6.9	-7.3	0.2	0.2	-4.1	4	-8.1
40	5825	vf0	20	-7.0	-8.0	0.2	0.2	-4.5	4	-8.5
50	5755	vf0	20	-8.2	-7.9	0.2	0.2	-5.0	4	-9.0
50	5800	vf0	20	-7.9	-8.3	0.2	0.1	-5.1	4	-9.1
50	5820	vf0	20	-8.0	-8.2	0.2	0.2	-5.1	4	-9.1
60	5760	vf0	20	-6.6	-7.0	0.2	0.2	-3.8	4	-7.8
60	5800	vf0	20	-6.7	-6.7	0.2	0.2	-3.7	4	-7.7
60	5815	vf0	20	-5.9	-6.3	0.3	0.2	-3.1	4	-7.1
80	5775	ve00	19	-11.1	-12.0	0.1	0.1	-8.5	4	-12.5
80	5800	ve00	19	-10.2	-10.3	0.1	0.1	-7.3	4	-11.3

A/C Powerline Conducted Emission
Engineer: Mark Sechrist
Test Date: 6/30/15

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



See Annex F

MPE Evaluation
Engineer: Alex Macon
Test Date: 9/2/15

Minimum Safe Distance Evaluation

This is a Fixed/mobile device used in Uncontrolled/General Population Exposure environment.

Limits Uncontrolled Exposure 47 CFR 1.1310 Table 1, (B)		
	0.3-1.234 MHz:	Limit [mW/cm²] = 100
	1.34-30 MHz:	Limit [mW/cm²] = (180/f²)
	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	5830
Power, Conducted, mW (P)	339
Antenna Gain Isotropic	31dBi
Antenna Gain Numeric (G)	1259
Antenna Type	Dish
Limit (L)	

R=√(PG/4πL)			
Distance (R) cm	Power mW (P)	Numeric Gain (G)	Limit (L)
9.2m	339	1259	1.0

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	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
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	4/9/2016
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	4/1/15	4/1/16
Spectrum Analyzer	Agilent	E4407B	i00331	6/13/14	6/13/16
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	11/26/15
Spectrum Analyzer	Agilent	E4440A	S/N:MY46180566	3/20/15	12/1/16

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