RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

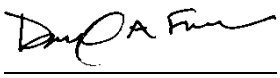
FCC Part 15.225 & Industry Canada RSS-210
Certification Application Report

Test Lab	Applicant
Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com Tel: 703-689-0368 Fax: 703-689-2056 www.rheintech.com	Outsite Networks, Inc. 2551 Eltham Avenue, Suite N Norfolk, VA 23513 Tel: 757-853-3000

FCC/IC ID	U2C-APT-2014/ 6944A-APT	**Test Report Date**	July 1, 2014
Platform	N/A	**RTL Work Order #**	2014053
Model	APT	**RTL Quote #**	QRTL14-053B
American National Standard Institute	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
FCC Classification	DXX – Part 15 Low Power Communication Device Transmitter		
FCC Rule Part(s)/Guidance	FCC Rules Part 15.225: Operation within the band 13.110-14.010 MHz (10-01-13)		
Industry Canada	RSS-210 Issue 8: Low Power License-Exempt Communications Devices RSS-Gen: Issue 3: 2010 General Requirements and Information for the Certification of Radio Apparatus		
Digital Interface Information	Digital Interface was found to be compliant		

Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
13.56	N/A	N/A	2M61A1D

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, RSS-210, and ANSI C63.4.

Signature:  Date: July 1, 2014

Typed/Printed Name: Desmond A. Fraser Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This is an original certification application request for the Outsite Networks, Inc. Model APT.

Applicable Standards:

- FCC Part 15.225: Operation within the band 13.110-14.010 MHz
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices

1.2 Description of EUT

Equipment Under Test	Point of Sale Coupon Printer
Model	APT
Power Supply	24 VDC from AC adapter
Modulation Type	ASK
Frequency Range	13.56 MHz
Antenna Connector Type	N/A
Antenna Type	Internal

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4-2003).

1.4 Related Submittal(s)/Grant(s)

This is an original certification application for Model APT, FCC ID: U2C-APT-2014, IC: 6944A-APT.

1.5 Modifications

No modifications were made to the equipment during testing in order to achieve compliance with these standards.

2 Test Information

2.1 Description of Test Modes

Table 2-1: Channels Tested

Frequency (MHz)
13.56

2.2 Exercising the EUT

The EUT was supplied with test firmware programmed with the used modulation type and rate. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.225)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	Pass
FCC 15.209	Radiated Emissions	Pass
FCC 15.225(a),(d)	Field Strength of Fundamental and Harmonics	Pass
RSS-Gen	99% Bandwidth	Pass

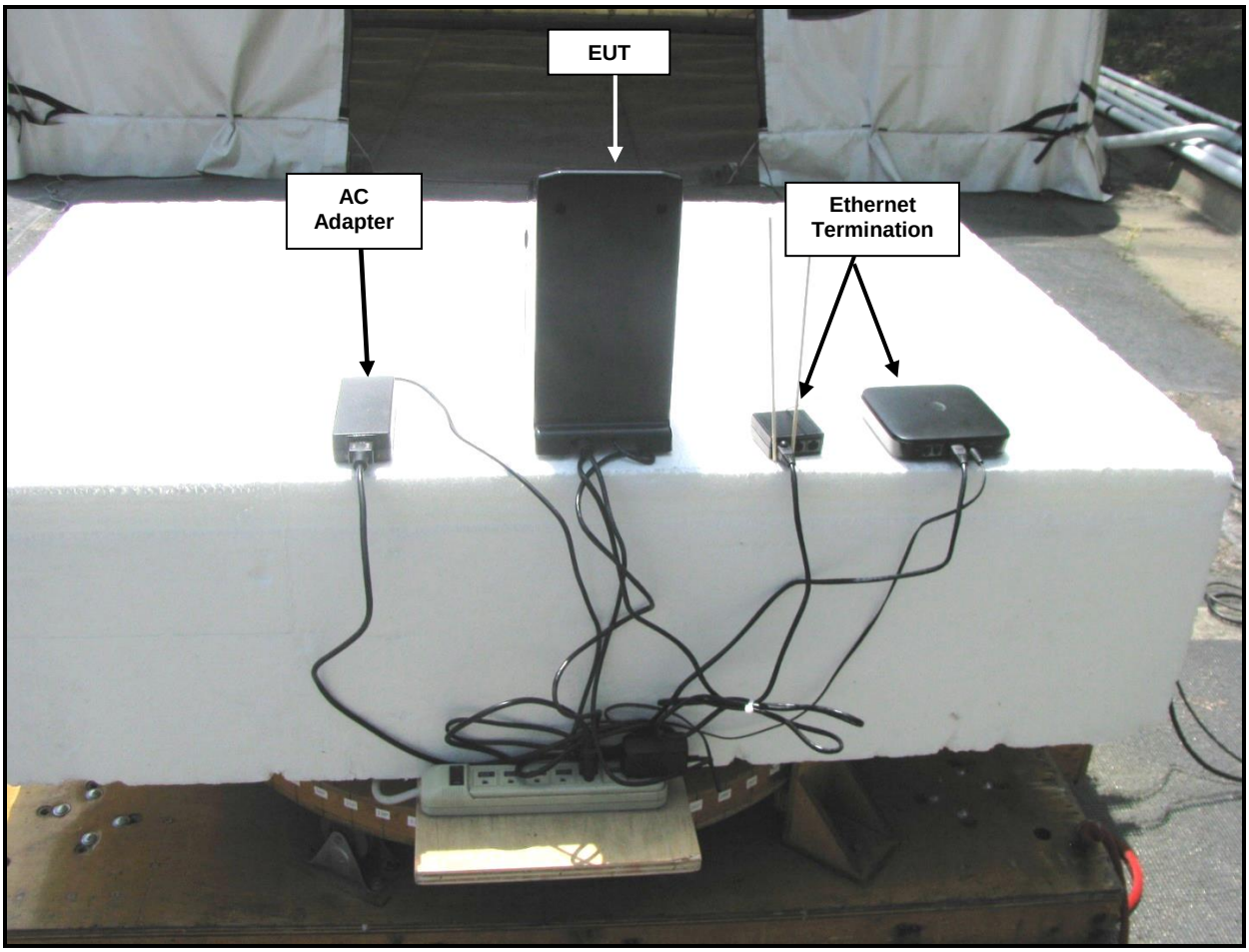
2.4 Test System Details

The test samples were received on February 21, 2014. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
APT	Outsite Networks, Inc.	APT	2349012010600064	U2C-APT-2014	Shielded Power, Unshielded IO	21143
AC Adapter	Star Micronics Co. Ltd.	PS60A-24B 1	369000872	N/A	Shielded Power	21144

2.5 Configuration of Tested System



Photograph 1: Configuration of System Under Test

3 Radiated Emissions – FCC 15.209, 15.225(a) & (d); IC RSS-210 A2.6; RSS-Gen

3.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector however, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any circumstances of modulation.

15.225(a) states "The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters."

20log(15,848)=84 dBuV/m at 30 m and 40*log(30/3)=40, 84+40=124 dBuV/m at 3 m.

3.2 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (135.6 MHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 3-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	Rhein Tech Laboratories, Inc.	PR-1040	Amplifier (20 MHz-2 GHz)	900905	8/20/14
900724	ARA	LPB-2520	Bilog Periodic Antenna (25 MHz-2 GHz)	1037	4/19/15
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz-6.5 GHz)	3325A00159	9/20/14
900914	Hewlett Packard	85460A	RF Filter Section (100 kHz-6.5 GHz)	3330A00107	9/20/14
901364	Rhein Tech Laboratories, Inc.	PR-1042	Amplifier (1 GHz–26.0 GHz)	N/A	9/4/14
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9 kHz–30 MHz)	827525/019	3/4/17
N/A	Rhein Tech Laboratories, Inc.	Automated Emissions Tester	Emissions Testing Software	Rev. 14.0.2	N/A

3.3 Radiated Emissions Test Data

Table 3-2: Radiated Emissions Test Data (Fundamental)

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV/m)	Site Correction Factor (dB/m)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
13.560	39.4	29.4	68.8	124.0	-55.2

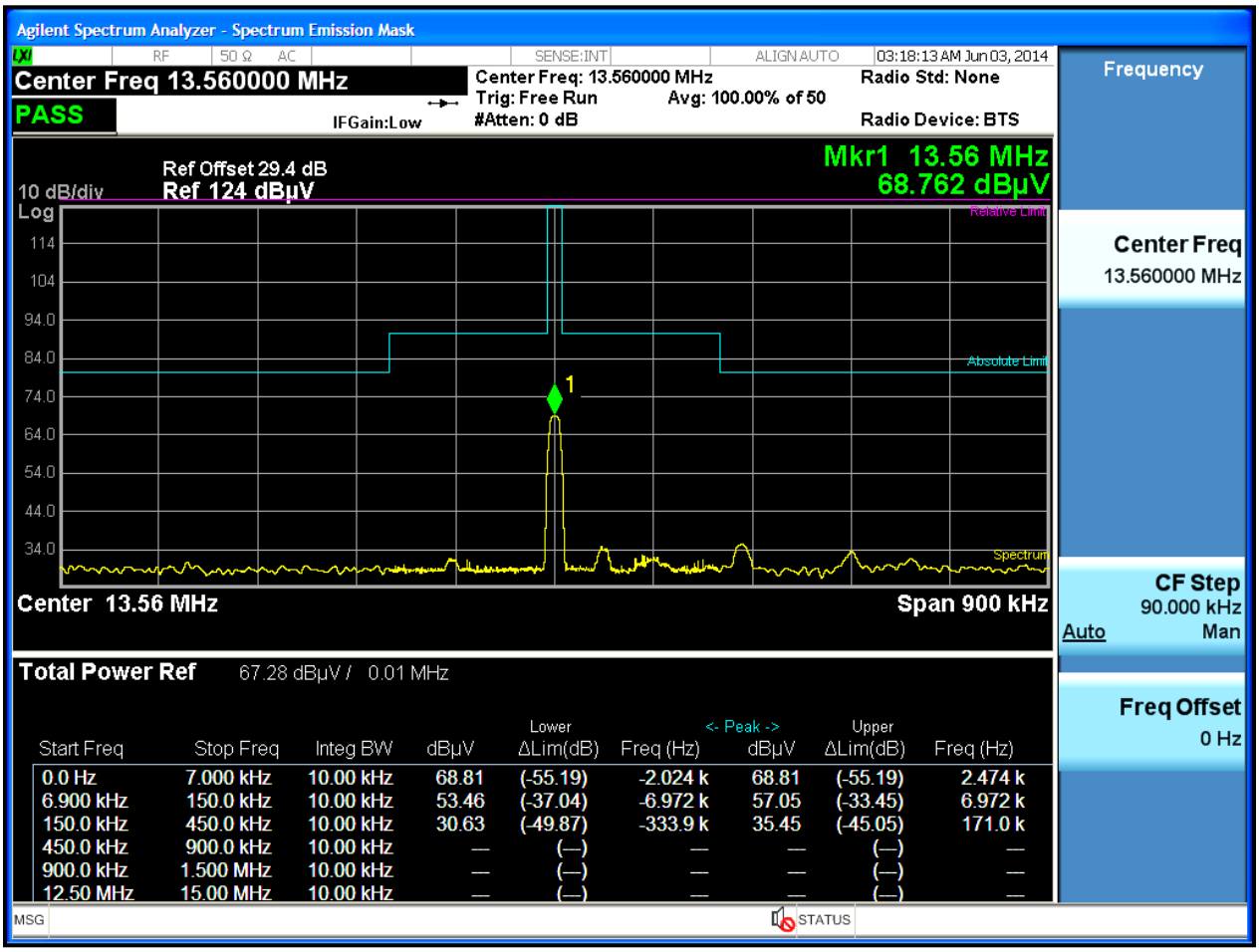
Part 15.225(a), (b), and (c) state:

> The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
>
> Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
>
> Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

The 30 meter limits were interpolated to 3 meters by adding 40 log (30m/3m) to 20 log (E), where E is the limit in microvolts/meter at 30 meters.

The corrected measured fundamental level in Table 3-2 was used as a reference for the fundamental in the following plot in dBuV/m at 3 meters as a means to show compliance with Part 15.225(b) and (c).

Plot 3-1: Part 15.225(b), (c) Mask



3.4 Radiated Emissions Harmonics/Spurious Test Data

Table 3-3: Radiated Emissions Harmonics/Spurious Test Data

Temperature: 70.3°F Humidity: 51%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
27.121	Qp	H	180	1.0	16.1	31.0	47.1	69.5	-22.4	Pass
40.680	Qp	H	165	1.2	44.3	-16.6	27.7	40.0	-12.3	Pass
54.240	Qp	V	10	1.5	36.0	-20.0	16.0	40.0	-24.0	Pass
67.800	Qp	V	320	1.0	38.5	-22.9	15.6	40.0	-24.4	Pass
81.360	Qp	V	180	1.0	37.9	-25.0	12.9	40.0	-27.1	Pass
94.920	Qp	V	190	1.0	35.9	-23.3	12.6	43.5	-30.9	Pass
108.482	Qp	H	250	2.0	43.8	-21.5	22.3	43.5	-21.2	Pass
122.042	Qp	V	210	1.2	50.5	-20.0	30.5	43.5	-13.0	Pass
126.545	Qp	V	310	1.0	57.9	-20.5	37.4	43.5	-6.1	Pass

3.5 Radiated Emissions Digital Test Data

Table 3-4: Digital Radiated Emissions Test Data

Temperature: 70.3°F Humidity: 51%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
116.640	Qp	V	220	1.0	54.5	-20.3	34.2	43.5	-9.3	Pass
122.042	Qp	V	210	1.2	50.5	-20.0	30.5	43.5	-13.0	Pass
126.545	Qp	V	310	1.0	57.9	-20.5	37.4	43.5	-6.1	Pass
230.545	Qp	H	250	1.3	58.4	-18.7	39.7	46.0	-6.3	Pass
257.647	Qp	H	165	1.2	61.1	-17.6	43.5	46.0	-2.5	Pass
271.215	Qp	H	180	1.5	59.3	-17.5	41.8	46.0	-4.2	Pass
284.775	Qp	H	185	1.0	58.9	-17.3	41.6	46.0	-4.4	Pass
288.010	Qp	H	190	1.1	52.0	-17.1	34.9	46.0	-11.1	Pass
336.000	Qp	H	100	1.0	52.1	-15.4	36.7	46.0	-9.3	Pass
375.270	Qp	H	85	1.5	46.0	-14.5	31.5	46.0	-14.5	Pass

Test Personnel

Jon Wilson		June 3-5, 2014
Test Engineer	Signature	Dates of Test

4 AC Conducted Emissions - FCC 15.207; IC RSS-Gen 7.2.4: Conducted Limits

4.1 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50-ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable).

The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

4.2 Test Limits

Line-Conducted Emissions		
Limit (dBµV)		
Frequency (MHz)	**Quasi-Peak**	**Average**
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

Table 4-1: Conducted Line Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	8/27/14
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz-1.5 GHz)	2602A00160	2/17/15
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	2/17/16
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A11239	2/17/15

4.3 Test Justification

Two sets of conducted data are shown in this report. Plots 4-1 and 4-2 show AC conducted emissions with the normal/original EUT antenna in place. These two plots show compliance with 15.207 limits outside the transmitter's fundamental emission band. Plots 4-3 and 4-4 show AC conducted emissions with the EUT antenna replaced by a 500 ohm resistive dummy load. These two plots show compliance with 15.207 limits within the transmitter's fundamental emission band. Per the FCC OET Knowledge Database, the rationale is as follows:

Publication Number: 174176 **Rule Parts:** 15C **Publication Date:** 07/02/2008

Keyword: Section 15.207, C63.10, Suitable Dummy Load, AC Power Line Conducted Measurement

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First Category: Administrative Requirements

Second Category: Measurement Procedures

Question: Under what conditions may a dummy load be connected in place of an antenna when calculating AC power line conducted measurements for a Part 15 device?

Answer: The method used for AC power line conducted measurement with suitable dummy loads will differ for detachable and non-detachable antennas, depending on whether the operating frequency is above or below 30 MHz.

A suitable dummy load is a radio frequency termination used in place of the antenna, which has the same electrical properties as the intended antenna without radiated emissions. A device with a suitable dummy load must supply identical signals to the dummy load, as it would if an antenna were connected. In the test report, results obtained using a suitable dummy antenna shall be so noted.

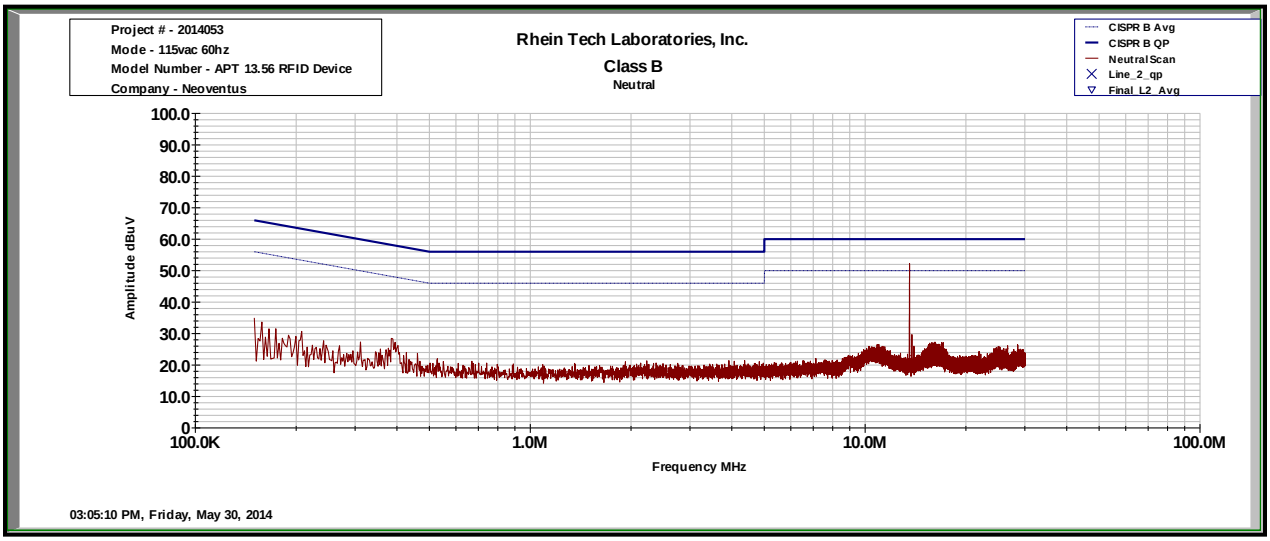
Device with a Permanent Non-Detachable Antenna:

For a device with a permanent antenna operating above 30 MHz, measurements must be done with the permanent antenna connected as specified in Annex H, Paragraph H1 of ANSI C63.4- 2003.

For a device with a permanent antenna operating at or below 30 MHz, the FCC will accept measurements done with a suitable dummy load, in lieu of the permanent antenna under the following conditions: (1) perform the AC line conducted tests with the permanent antenna to determine compliance with the Section 15.207 limits outside the transmitter's fundamental emission band; (2) retest with a dummy load in lieu of the permanent antenna to determine compliance with the Section 15.207 limits within the transmitter's fundamental emission band.

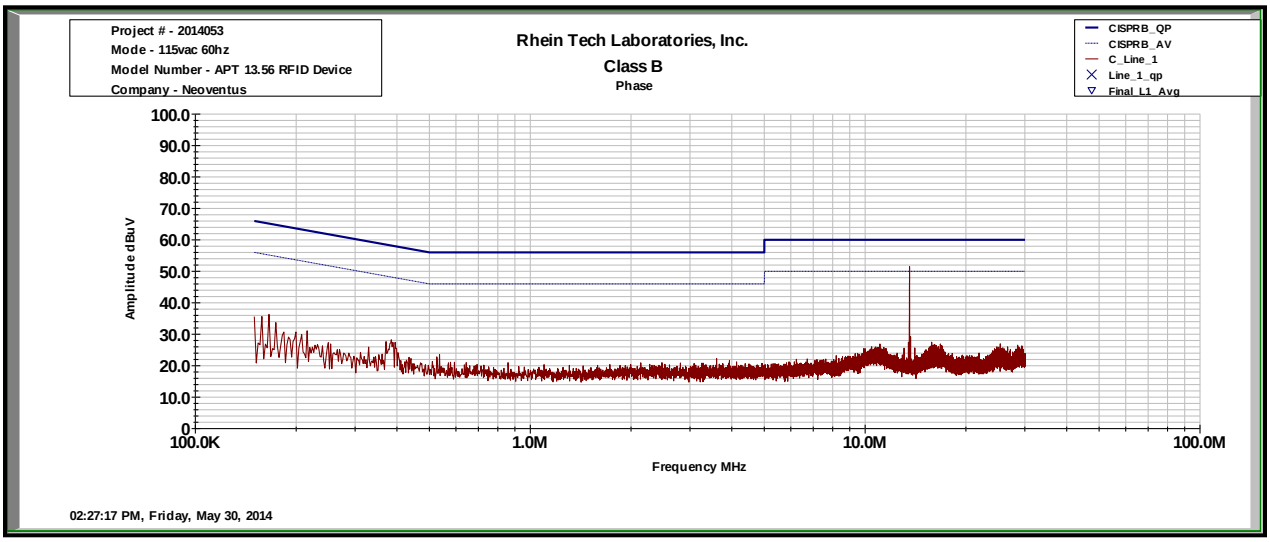
4.4 Conducted Emissions Test Data

Plot 4-1: Conducted Emissions - Neutral Side, Original Antenna



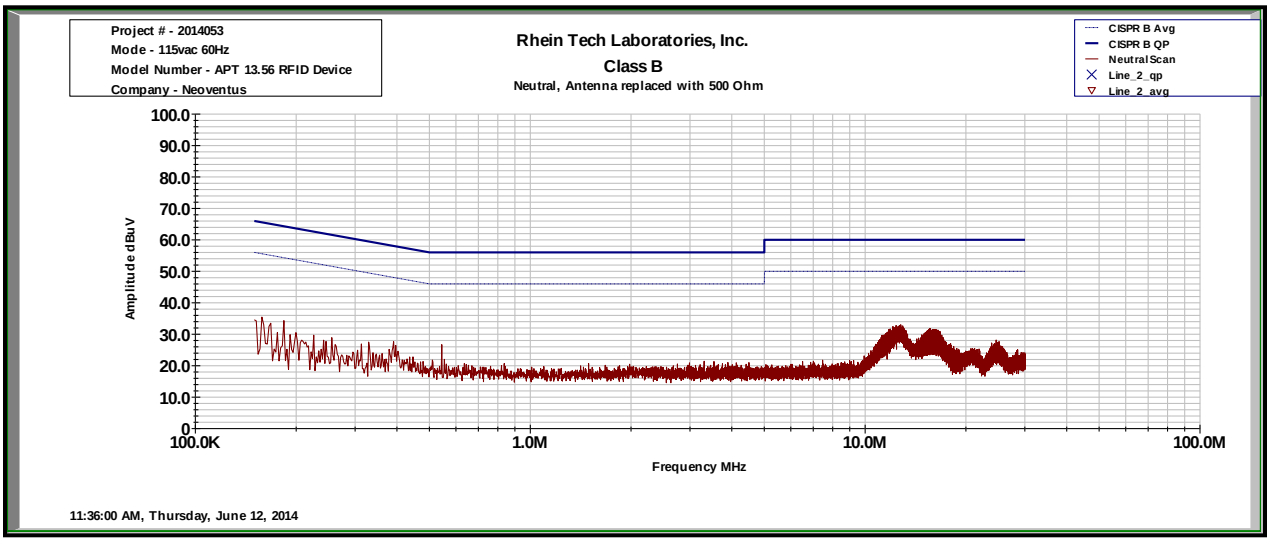
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
13.560	QP	50.2	2.1	52.3	60.0	-7.7	Pass
13.560	Av	50.8	2.1	52.9	50.0	+2.9	Fail

Plot 4-2: Conducted Emissions - Hot Side, Original Antenna

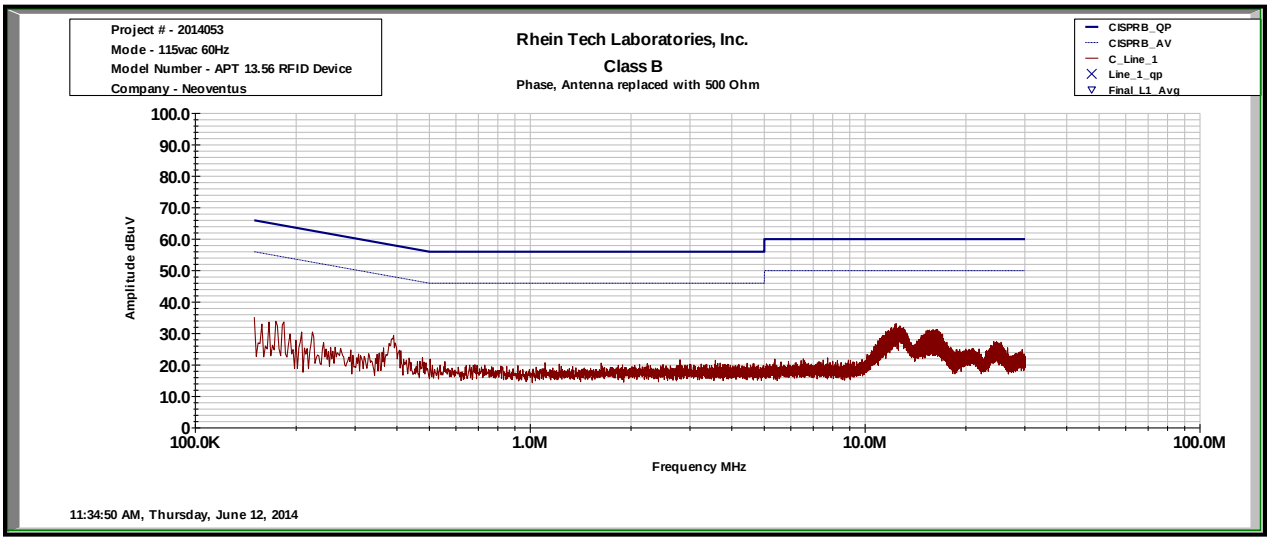


Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
13.560	QP	49.3	2.2	51.5	60.0	-8.5	Pass
13.560	Av	50.1	2.2	52.3	50.0	+2.3	Fail

Plot 4-3: Conducted Emissions - Neutral Side, Antenna Replaced with 500Ω



Plot 4-4: Conducted Emissions - Hot Side, Antenna Replaced with 500Ω



Test Personnel

Jon Wilson		May 30 & June 12, 2014
Test Engineer	Signature	Dates of Test

5 99% Bandwidth – IC RSS-Gen 4.6.1

5.1 99% Bandwidth Test Procedure

The 99% bandwidths per RSS-Gen 4.6.1 were measured using a 50-ohm spectrum analyzer. The modulated carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was auto and allowed through several sweeps with the max hold function used in peak detector mode.

Table 5-1: 99% Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	4/16/15

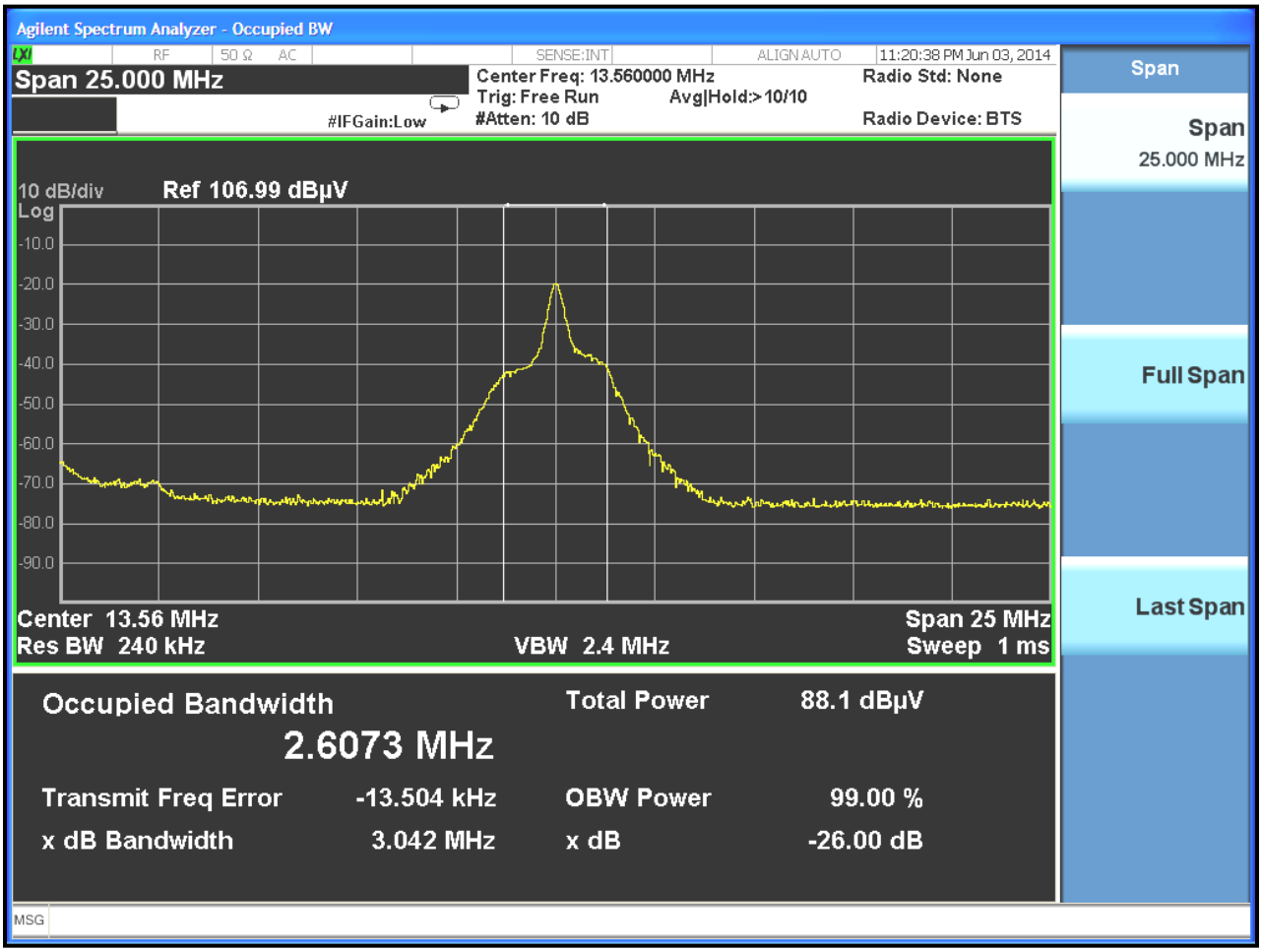
5.2 99% Bandwidth Test Data

Table 5-2: 99% Bandwidth Test Data

99% Bandwidth (kHz)
2607.3

5.3 99% Bandwidth Plots

Plot 5-1: 99% Bandwidth - 106 kbps



Test Personnel

Jon Wilson		June 3, 2014
Test Engineer	Signature	Date of Test

6 Frequency Stability – FCC 2.1055, 15.225(e): Frequency Stability; IC RSS-119 5.3 Transmitter Frequency Stability

6.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

15.255(e): The frequency tolerance of the carrier signal shall be maintained within ± .01% of the operating frequency over a temperature variation of -20°C to +50°C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C. For battery-operated equipment, the equipment tests shall be performed using a new battery.

The EUT was evaluated over the temperature range -20°C to +50°C.

The temperature was initially set to -20°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

The worst-case deviation was found to be 0.0037 % of operating frequency.

Table 6-1: Frequency Stability Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	1/13/15
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	4/16/15
N/A	Kikusui	PCR4000L	Power Supply	BD001921	9/16/14

6.2 Test Data

Table 6-2: Temperature Frequency Stability

Temperature (°C)	Measured Frequency (Hz)	Percent of Operating Frequency
-20	13.560300	+0.0022
-10	13.560300	+0.0022
0	13.560500	+0.0037
10	13.560500	+0.0037
20	13.560400	+0.0029
30	13.560200	+0.0015
40	13.560200	+0.0015
50	13.560400	+0.0029

Table 6-3: Voltage Frequency Stability at 20°C (85-115% at 20C)

Voltage (115vac)	Measured Frequency (Hz)	Percent of Operating Frequency
97.8	13.560400	+0.0029
115.0	13.560400	+0.0029
128.3	13.560400	+0.0029

Results: The EUT is compliant

Test Personnel

Jon Wilson		June 5-6, 2014
Test Engineer	Signature	Dates of Tests

7 Conclusion

The data in this measurement report shows that the EUT as tested, Outsite Networks, Inc. Model APT, FCC ID: U2C-APT-2014, IC: 6944A-APT, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and IC RSS-210 and RSS-Gen.