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FCC & Industry Canada Certification Test Report

For the

Evolv

Edge

FCC ID: 2ALLJ-EDGE01

WLL JOB# 15064-01 Rev 4
November 10, 2017

Prepared for:

Evolv
200 West St.
Waltham, MA 02453

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
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ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

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Prepared by:

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Test Engineer

Reviewed by:

Steve Koster
President

Abstract

This report has been prepared on behalf of Evolv to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.209(10/2014) of the FCC Rules and Regulations This Certification Test Report documents the test configuration and test results for the Evolv Edge.

Testing was performed on an at the Chomerics test facility by Washington Laboratories personnel. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

The Evolv Edge complies with the limits for an Intentional Radiator device under FCC Part 15.209.

Revision History	Description of Change	Date
Rev 0	Initial Release	August 29, 2017
Rev 1	Modify duty cycle using 20 dB	October 2, 2017
Rev 2	Re-measure fundamental	November 8, 2017
Rev 3	Corrected the DCCF	November 10, 2017

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1 Introduction

1.1 Compliance Statement

The Evolv Edge complies with the limits for an Intentional Radiator device under FCC Part 15.209 (10/2014).

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance 2013 version of ANSI C63.10. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Chomerics 77 Dragon Ct. Woburn, MA 01888
On Behalf of:	Evolv 200 West St. Waltham, MA 02453
Purchase Order Number:	CHO14991-1
Quotation Number:	70003

1.4 Test Dates

Testing was performed on the following date(s): 3/28/2017 and 4/7/2017 and 11/8/2017

1.5 Test and Support Personnel

Washington Laboratories, LTD	Mike Violette
Customer Representative	Patty Terilli

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga – prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo – prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega – prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro – prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The Evolv Edge™ is a mass-casualty screening system designed for use in temporary or traditional security checkpoints. It combines flat-panel, millimeter wave technology with HF sensors to screen visitors for concealed metallic and non-metallic weapons, contraband and other items.

Depending on the application, the visitor may be required to remove items, such as laptop bags, large backpacks and handbags for inspection. When instructed, the visitor proceeds through the Evolv Edge.

The Evolv Edge scans the visitor during the entry zone, threshold, and exit zone. After the visitor has passed through all three areas, the Evolv Edge displays the scan results to the operator via LED indicators on the rear side of each tower. Alternatively, the tablet may be configured to display the results and photos from the scan.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Evolv
FCC ID:	2ALLJ-EDGE01
Model:	Edge
FCC Rule Parts:	§15.209
Frequency Range:	24.00 to 28.80 GHz
Maximum Average Field Strength:	79.4 uV/m @24.1 GHz
Modulation:	Stepped Frequency Modulated Continuous Wave (SFMCW)
Occupied Bandwidth:	CW
Keying:	Automatic
Type of Information:	None
Number of Channels:	121
Power Output Level	Fixed
Antenna Connector	Internal, SMA
Antenna Type	PCBA
Power Source & Voltage:	120 VAC

2.2 Test Configuration

The Edge was configured to continuously transmit on the fundamental frequencies.

2.3 Testing Algorithm

The Edge set to continuously transmit on a given frequency for testing.

Worst case emission levels are provided in the test results data.

2.4 Test Location

Measurements herein were performed at Chomerics test facility by Washington Laboratories personnel. Further re-testing was performed at Evolv facility in Waltham, MA. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

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

DA 17-1073 FCC Waiver

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned. A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date:	**3/28/2017; 4/7/2017**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	8/10/2017
865	Storm	High Frequency Cable	5/22/2017
55	AGILENT - 11970W	MIXER HARMONIC 75- 110GHZ	CNR
83	AGILENT - 11970U	MIXER HARMONIC 40 - 60GHZ	CNR
54	AGILENT - 11970V	MIXER HARMONIC 50-75GHZ	CNR
210	NARDA - V638	HORN STANDARD GAIN	CNR
209	NARDA - V637	HORN STANDARD GAIN	CNR
103	OLESON MICROWAVE LABS - M06HW	D-BAND HARMONICS MIXER	CNR
104	OLESON MICROWAVE LABS - M05HW	MIXER G-BAND HARMONICS	CNR

4 Test Summary

The unit was scanned to 100 GHz as required in Part 15.33(a)(2). No other emissions aside from the fundamental were found. Testing was performed in the worst-case mode.

5 Test Results

5.1 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for pulsed licensed and unlicensed devices.

For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements are compared to a 100 millisecond period duty cycle = on time/100 milliseconds.

The waiver allows the average measurements to be performed with the sweep active. This makes it difficult to measure average. Therefore the peak is measured and the average is calculated by applying a correction for duty cycle.

Specifically, Part15.209 limit is 500uV/meter at 3 meters.

Per the Operational description, in any mode the maximum on time will be 6.993 mSec per Second.

Using that information, the duty cycle would be calculated by using the formula:

The duty cycle correction factor is calculated by:

20 x LOG (dwell time/100 ms)

20 x LOG(.7mSec/100mSec)

20 X -2.1549

DCCF = -43.1 dB

Note: This calculation was used because with the unit in sweep mode as the waiver states, the sweep was too fast to allow for an average reading. Also note that this is the maximum on time and the unit can be used with on times as low as 0.577 mSec/Sec so the DCCF is a conservative calculation.

Evolv suggests that it is reasonable to apply the Duty Cycle Correction factor to this Peak "ON" field strength to determine an appropriate Average when the device is operating in its normal sweeping fashion for purposes of rule 15.209 results in a correction factor of 43.1 dB.

5.2 Occupied Bandwidth (FCC Part §2.1049 and RSS-Gen [4.6.1]):

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. The transmitted signal is a CW and therefore the bandwidth will be a direct result of the bandwidth used to plot the signal.

No Limits are provided for this measurement

5.3 Radiated Emissions: (FCC Part §15.209)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.3.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2009. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 4: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Radiated measurements were collected at 3 meters distance. The spectrum analyzer reading was corrected for the Antenna Factor (AF) and Cable Loss (CL). To determine the average level, the Duty Cycle Correction Factor (DCCF) of 43.1dB was applied to the measured level.

For the peak measurement, the limit was corrected by 42.3 dB above the average limit per the waiver for this system. The peak emission data was compared against the waiver level (96.3 dBuV/m).

The signal was strongly vertically polarized. Horizontal emissions were typically 15dB below the vertical components and only vertical measurements are reported.

Table 5: Radiated Emission Test Data - Fundamental

Frequency (MHz)	Polarity H/V	SA dBuV	DCCF dB	AF dB	CL dB	E-Field dBuV/m	E-Field uV/m	Limit dBuV/m	Margin dB	Comment
24100	V	51.7	43.1	41	1.8	51.4	371.5	54.0	-2.6	AVE
24100	V	51.7	0	41	1.8	94.5	53088.4	96.3	-1.8	PK
26400	V	52.3	43.1	40.6	2	51.8	389.0	54.0	-2.2	AVE
26400	V	52.3	0	40.6	2	94.9	55590.4	96.3	-1.4	PK
28600	V	51.2	43.1	41	3	52.1	402.7	54.0	-1.9	AVE
28600	V	51.2	0	41	3	95.2	57544.0	96.3	-1.1	PK

For spurious emissions, correction factors were then applied and the resulting value was compared to the limit. Testing at the fundamental frequencies was accomplished at the 3 meter distance. There were no other emissions detected from the EUT during the transmitter spurious testing. The rest of the points recorded were the detection system noise. Scans were performed within 0.5m of the device with no emissions detected. The limit was normalized to the 0.5m distance to compare to the limit.

Table 6: Radiated Emission Test Data – Spurious

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Duty Cycle (dB)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
45000.0	V	0.00	0.00	12.60	0.00	48.0	1071.5	3000.0	-8.9	NSD
50000.0	V	0.00	0.00	12.80	0.00	48.4	1148.2	3000.0	-8.3	
55000.0	V	0.00	0.00	13.20	0.00	48.8	1258.9	3000.0	-7.5	
60000.0	V	0.00	0.00	12.90	0.00	49.3	1288.2	3000.0	-7.3	
65000.0	V	0.00	0.00	13.20	0.00	49.7	1396.4	3000.0	-6.6	
70000.0	V	0.00	0.00	13.70	0.00	50.1	1548.8	3000.0	-5.7	
90000.0	V	0.00	0.00	12.40	0.00	47.7	1011.6	3000.0	-9.4	
95000.0	V	0.00	0.00	12.60	0.00	47.7	1035.1	3000.0	-9.2	
100000.0	V	0.00	0.00	13.30	0.00	48.2	1188.5	3000.0	-8.0	