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Test Report

Certification

FCC ID	2ANAC-EP001
Equipment Under Test	EssexProx
Test Report Serial No	V042098_02
Date of Test	August 7, 2017 and October 24, 2017
Report Issue Date	October 24, 2017

Test Specifications:	Applicant:
FCC Part 15, Subpart C	Essex Electronics 1130 Mark Ave Carpinteria, CA 93013 U.S.A.



Certification of Engineering Report

This report has been prepared by VPI Laboratories, Inc. to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

Applicant	Essex Electronics
Manufacturer	Essex Electronics
Brand Name	Essex Electronics
Model Number	EssexProx
FCC ID	2ANAC-EP001

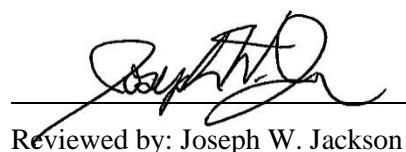
On this 24th day of October 2017, I, individually and for VPI Laboratories, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the VPI Laboratories, Inc. EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

VPI Laboratories, Inc.



Tested by: Norman P. Hansen



Reviewed by: Joseph W. Jackson

Revision History		
Revision	Description	Date
01	Original Report Release	September 7, 2017
02	Include additional test configurations to cover mounting options not previously addressed and update photos of section 8. Update section 4.2 to list the vertical configuration as the EUT was wall mounted as worst-case. Update section 3.3 to update NVLAP accreditation.	October 24, 2017

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1 Client Information

1.1 Applicant

Company Name	Essex Electronics 1130 Mark Ave Carpinteria, CA 93013 U.S.A.
Contact Name	Steven Petree
Title	Engineering Technician

1.2 Manufacturer

Company Name	Essex Electronics 1130 Mark Ave Carpinteria, CA 93013 U.S.A.
Contact Name	Steven Petree
Title	Engineering Technician

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	Essex Electronics
Model Number	EssexProx
Serial Number	None
Dimensions (cm)	11.5 x 7.0 x 3.2

2.2 Description of EUT

The EssexProx is an RFID device operating at 125 kHz used in security, tracking, and access systems. It is powered by 5 Vdc or 12 Vdc and has a Wiegand interface. Power was provided for testing using an Iomega UP01842010 power supply that supplied 5 Vdc or 12 Vdc. A Northern Computers Inc. Proximity tag was used in testing.

This report covers the transmitter circuitry of the devices subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Subpart B was found to be compliant and is covered in VPI Laboratories, Inc. report V041916.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name	Description	Name of Interface Ports / Interface Cables
BN: Essex Electronics MN: EssexProx (Note 1) SN: None	RFID device	See Section 2.4

Notes: (1) EUT

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

Name of Ports	No. of Ports Fitted to EUT	Cable Description/Length
Interface	1	8 conductors/ 1 to 3 meters

2.5 Modification Incorporated/Special Accessories on EUT

There were no modifications or special accessories required to comply with the specification.

2.6 Deviation from Test Standard

There were no deviations from the test specification.

3 Test Specification, Methods and Procedures

3.1 Test Specification

Title	FCC PART 15, Subpart C (47 CFR 15) 15.203, 15.207, and 15.209
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 §15.203 Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.207 Conducted Limits

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	Limit (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50*	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

Table 1: Limits for conducted emissions at mains ports of Class B ITE.

3.2.3 §15.209 Radiated Emission Limits; General Requirements

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

**Except as provided in paragraph (g), fundamental emission from intentional radiators operating under this section shall not be located in the frequency bands 54 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operating within these frequency bands is permitted under other section this part, e.g., §15.231 and §15.241.

- b) In the emission table above, the tighter limit applies at the band edges.
- c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
- d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
- e) The provisions in §15.31, §15.33, and §15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.
- f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.
- g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

3.3 Test Procedure

The conducted disturbance at mains ports and radiated disturbance testing was performed according to the procedures in ANSI C63.10:2013. Testing was performed at VPI Laboratories, Inc. Wanship Upper Open Area Test Site, located at 29145 Old Lincoln Highway, Wanship, UT. VPI Laboratories, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2018.

4 Operation of EUT During Testing

4.1 Operating Environment

Power Supply	120 VAC/60 Hz to AC/DC Power Supply 5 VDC or 12 VDC to the EUT from the Supply
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4.2 Operating Modes

The EUT was tested at both 5 VDC and 12 VDC with no change seen in transmitter characteristics. The EUT was tested on 3 orthogonal axes. The EUT was emitting constantly and was tested with and without a tag in the field. The worst-case emissions were seen with the EUT mounted vertical as on a wall. See photographs 1 – 3.

4.3 EUT Exercise Software

Internal firmware was used to exercise the EUT.

5 Summary of Test Results

5.1 FCC Part 15, Subpart C

5.1.1 Summary of Tests

Part 15, Subpart C Reference	Test Performed	Frequency Range (MHz)	Result
15.203	Antenna Requirement	N/A	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.209	Field Strength	0.009 – 1000	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

6 Measurements, Examinations and Derived Results

6.1 General Comments

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Section 7 of this report.

6.2 Test Results

6.2.1 §15.203 Antenna Requirements

The antenna is a wound wire coil that is soldered to the PCD and is not user accessible or replaceable.

Result

The EUT complied with the specification

6.2.2 §15.207 Conducted Emissions at the AC Mains

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dB μ V)	Limit (dB μ V)	Margin (dB)
0.15	Hot Lead	Peak (Note 1)	49.1	56.0	-6.9
0.19	Hot Lead	Peak (Note 1)	44.4	54.1	-9.7
0.27	Hot Lead	Peak (Note 1)	41.4	51.2	-9.8
0.31	Hot Lead	Peak (Note 1)	32.3	50.1	-17.8
0.69	Hot Lead	Peak (Note 1)	29.4	46.0	-16.6
0.16	Neutral Lead	Peak (Note 1)	47.7	55.7	-8.0
0.19	Neutral Lead	Peak (Note 1)	46.5	53.9	-7.4
0.27	Neutral Lead	Peak (Note 1)	44.7	51.1	-6.4
0.31	Neutral Lead	Peak (Note 1)	32.6	50.0	-17.4
0.69	Neutral Lead	Peak (Note 1)	28.6	46.0	-17.4

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.
Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Result

The EUT complied with the specification limit by a margin of 6.4 dB.

6.2.3 §15.209 Radiated Disturbance Data (0.009 – 30 MHz)

The transmitter was tested for spurious emissions from 0.009 – 30 MHz using the limits of §15.209. The worst-case emission test data is shown in the table below.

Frequency (MHz)	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Field Strength (dB μ V/m)	Limit (dB μ V/m) (Note 3)	Margin (dB)
0.125 (Note 1)	Peak (Note 2 & 3)	71.9	10.3	82.2	105.5	-23.3
0.250	Peak (Note 2 & 3)	46.5	10.2	56.7	99.5	-42.8
0.375	Peak (Note 2 & 3)	40.9	10.1	51.0	95.9	-44.9
0.500	Peak (Note 2 & 3)	41.1	10.3	51.4	73.4	-22.0
0.625	Peak (Note 2 & 3)	38.9	10.3	49.2	71.5	-22.3
0.750	Peak (Note 2 & 3)	34.8	10.4	45.2	69.9	-24.7
0.875	Peak (Note 2 & 3)	32.6	10.5	43.1	68.6	-25.5
1.000	Peak (Note 2 & 3)	32.1	10.6	42.7	67.4	-24.7
1.125	Peak (Note 2 & 3)	34.4	10.6	45.0	66.4	-21.4
1.250	Peak (Note 2 & 3)	38.1	10.6	48.7	65.5	-16.8
22.986	Peak (Note 2 & 3)	14.5	10.3	24.8	69.5	-44.7
27.386	Peak (Note 2 & 3)	15.2	9.7	24.9	69.5	-44.6
27.711	Peak (Note 2 & 3)	13.3	9.7	23.0	69.5	-46.5

Note 1: Fundamental emission.

Note 2: The reference detector used for the measurements was peak and the data was compared to the quasi-peak or average limit, as applicable.

Note 3: Active Loop antenna was used for these measurements

Note 4: At frequencies below 30 MHz, measurements were made at 30 meters, 20 meters, 10 meters, and 3 meters. The fundamental emission was not visible at 30 meters or 20 meters. At 10 meters the fundamental emission became visible. The fundamental was visible and out of the noise floor at 3 meters and the result of this measurement is reported. Spurious emissions and harmonic emissions were not visible until a 3 meter measurement distance was used. The limits were adjusted accordingly using an inverse proportionality factor of 40 dB per decade. At frequencies above 30 MHz, the measurement distance was 3 meters.

Result

The EUT complied with the specification by 16.8 dB.

6.2.4 §15.209 Radiated Disturbance Data (30 MHz – 1000 MHz) Vertical Polarity

Frequency (MHz)	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Field Strength (dB μ V/m)	Class B 3 m Limit (dB μ V/m)	Margin (dB)
39.7	Peak (Note 1)	7.3	17.4	24.7	40.0	-15.3
51.9	Peak (Note 1)	8.8	13.7	22.5	40.0	-17.5
181.0	Peak (Note 1)	8.7	18.1	26.8	43.5	-16.7
196.3	Peak (Note 1)	4.7	18.2	22.9	43.5	-20.6
376.0	Peak (Note 1)	0.5	25.9	26.4	46.0	-19.6
486.4	Peak (Note 1)	-1.1	28.3	27.2	46.0	-18.8

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.

Result

The EUT complied with the specification limit by a margin of 15.3 dB.

6.2.5 §15.209 Radiated Disturbance Data (30 MHz – 1000 MHz) Horizontal Polarity

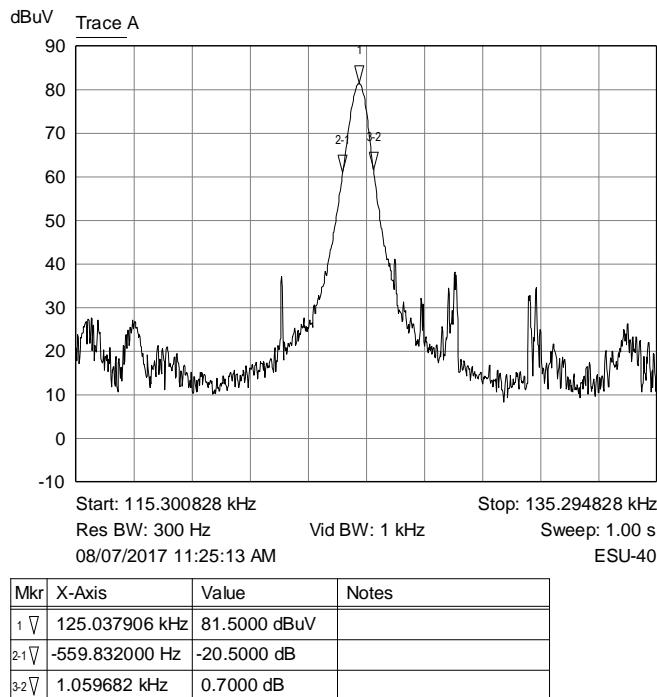
Frequency (MHz)	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Field Strength (dB μ V/m)	Class B 3 m Limit (dB μ V/m)	Margin (dB)
31.2	Peak (Note 1)	-0.8	22.0	21.2	40.0	-18.8
37.8	Peak (Note 1)	-0.7	18.4	17.7	40.0	-22.3
61.8	Peak (Note 1)	4.3	13.5	17.8	40.0	-22.2
369.6	Peak (Note 1)	-0.5	25.6	25.1	46.0	-20.9
400.0	Peak (Note 1)	-1.7	27.4	25.7	46.0	-20.3
491.2	Peak (Note 1)	1.5	28.4	29.9	46.0	-16.1

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.

Result

The EUT complied with the specification limit by a margin of 16.1 dB.

6.2.6 Emission Bandwidth Plot



6.3 Sample Field Strength Calculation

The field strength is calculated by adding the *Correction Factor* (*Antenna Factor* + *Cable Factor*), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. The basic equation with a sample calculation is shown below:

$$\text{Receiver Amplitude Reading} = \text{Receiver Reading} - \text{Amplifier Gain}$$

$$\text{Correction Factor} = \text{Antenna Factor} + \text{Cable Factor}$$

$$\begin{aligned}\text{Field Strength} \\ = \text{Receiver Amplitude Reading} + \text{Correction Factor} + \text{Averaging Factor}\end{aligned}$$

Example

Assuming a *Receiver Reading* of 42.5 dB μ V is obtained from the receiver, the *Amplifier Gain* is 26.5 dB, the *Antenna Factor* is 4.5 dB, the *Cable Factor* is 4.0 dB, and the *Averaging Factor* is -6.0. The *Field Strength* is calculated by subtracting the *Amplifier Gain* and adding the *Correction Factor* and *Averaging Factor*, giving a *Field Strength* of 18.5 dB μ V/m.

$$\text{Receiver Amplitude Reading} = 42.5 - 26.5 = 16.0 \text{ dB}\mu\text{V/m}$$

$$\text{Correction Factor} = 4.5 + 4.0 = 8.5 \text{ dB}$$

$$\text{Averaging Factor} = -6.0$$

$$\text{Field Strength} = 16.0 + 8.5 + (-6.0) = 18.5 \text{ dB}\mu\text{V/m}$$

7 Test Procedures and Test Equipment

7.1 Conducted Emissions at Mains Ports

The conducted emissions at mains and telecommunications ports from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted emissions at mains ports measurements are performed in a screen room using a (50 Ω/50 μH) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of devices with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

- Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
- Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

For testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	Hewlett Packard	8566B	V034141	02/15/2017	02/15/2018
Quasi-Peak Detector	Hewlett Packard	85650A	V039474	03/16/2017	03/16/2018
LISN	VPI Labs	LISN-COMM-50	V034042	02/24/2017	02/24/2018
Conductance Cable Wanship Upper Site	VPI Labs	Cable J	V034832	01/09/2017	01/09/2018
Transient Limiter	Hewlett Packard	11947A	V033591	01/09/2017	01/09/2018
Test Software (AC)	VPI Labs	Revision 01	V035674	N/A	N/A

Table 2: List of equipment used for conducted emissions testing at mains ports.

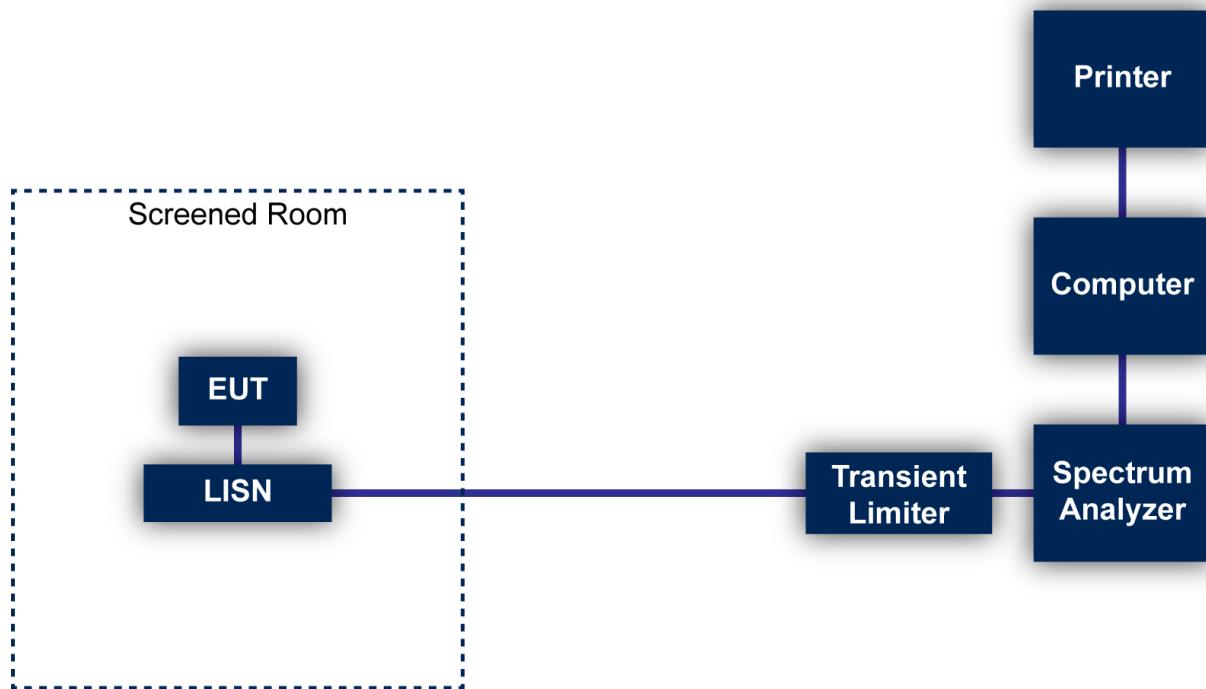


Figure 1: Conducted Emissions Test

7.2 Radiated Emissions

The radiated emissions from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For frequencies below 30 MHz, a 9 kHz resolution bandwidth was used.

A loop antenna was used to measure frequencies below 30 MHz. A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 10 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors. A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a distance of 3 and/or 1 meter from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated emissions. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. For frequencies above 1000 MHz, the EUT is placed on a table 1.5 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emissions testing that is performed at distances closer than the specified distance; an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	06/06/2017	06/06/2018
Spectrum Analyzer	Hewlett Packard	8566B	V034141	02/15/2017	02/15/2018
Quasi-Peak Detector	Hewlett Packard	85650A	V039474	03/16/2017	03/16/2018
Loop Antenna	EMCO	6502	V034216	01/25/2017	01/25/2019
Biconilog Antenna	EMCO	3142E-PA	V035736	06/24/2016	06/24/2018
6' High Frequency Cable	Microcoax	UFB197C-0-0720-000000	V033638	01/09/2017	01/09/2018
3 Meter Radiated Emissions Cable Wanship Upper Site	Microcoax	UFB205A-0-4700-000000	V033639	01/09/2017	01/09/2018
10 Meter Radiated Emissions Cable Wanship Upper Site	VPI Labs	Cable L	V033649	01/09/2017	01/09/2018
Test Software (FCC)	VPI Labs	Revision 01	V035673	N/A	N/A

Table 3: List of equipment used for radiated emissions testing.

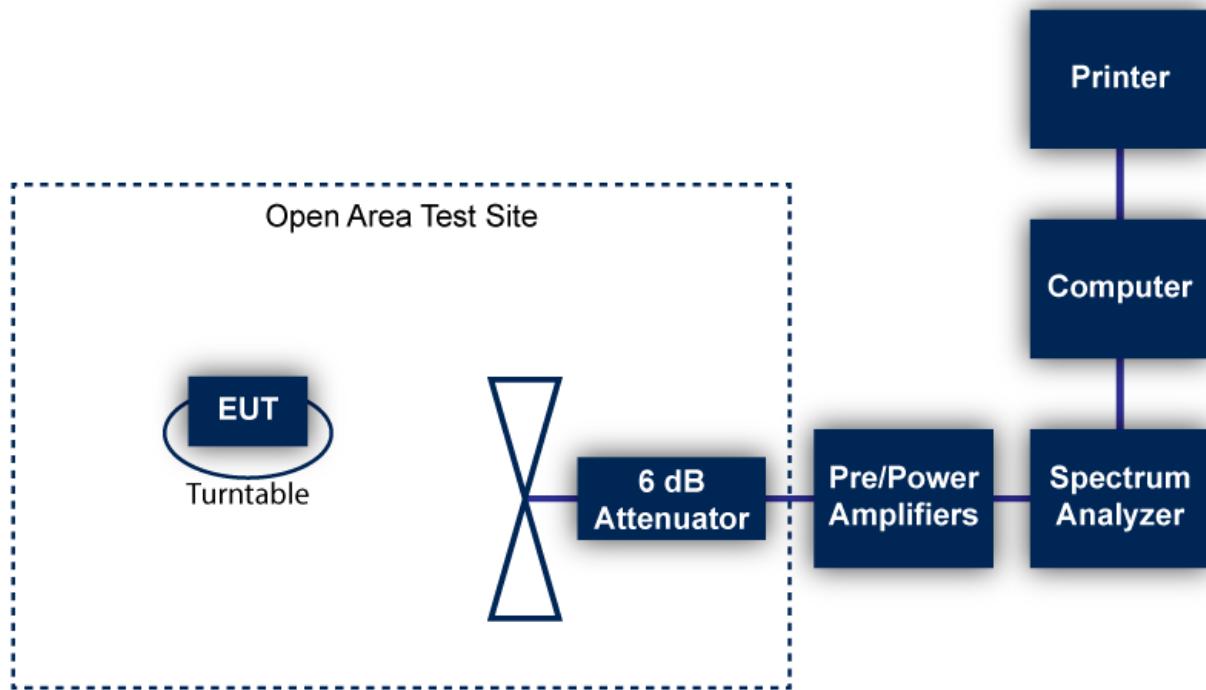


Figure 2: Radiated Emissions Test

7.3 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or VPI Laboratories, Inc. personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

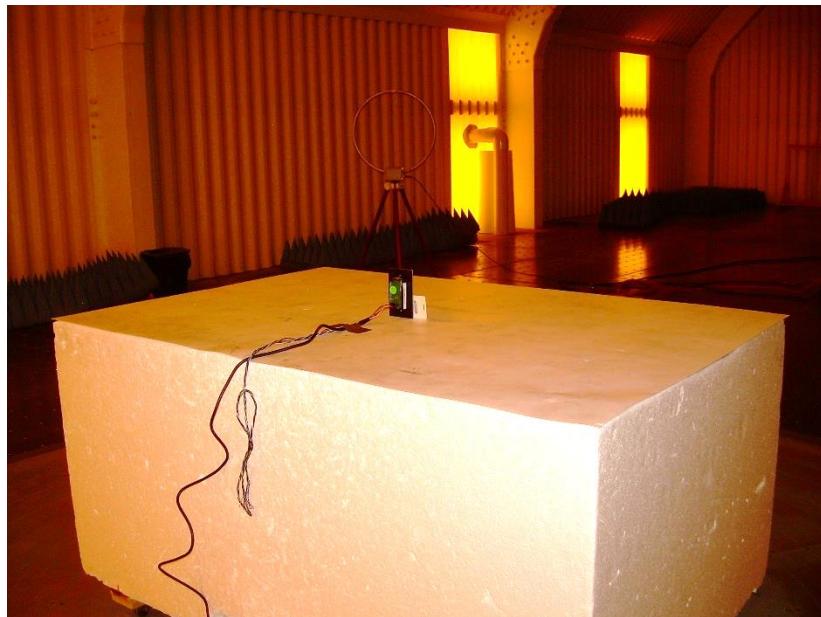
7.4 Measurement Uncertainty

Test	Uncertainty (\pm dB)	Confidence (%)
Conducted Emissions	2.8	95
Radiated Emission (9 kHz to 30 MHz)	3.3	95
Radiated Emissions (30 MHz to 1 GHz)	3.4	95

8 Photographs



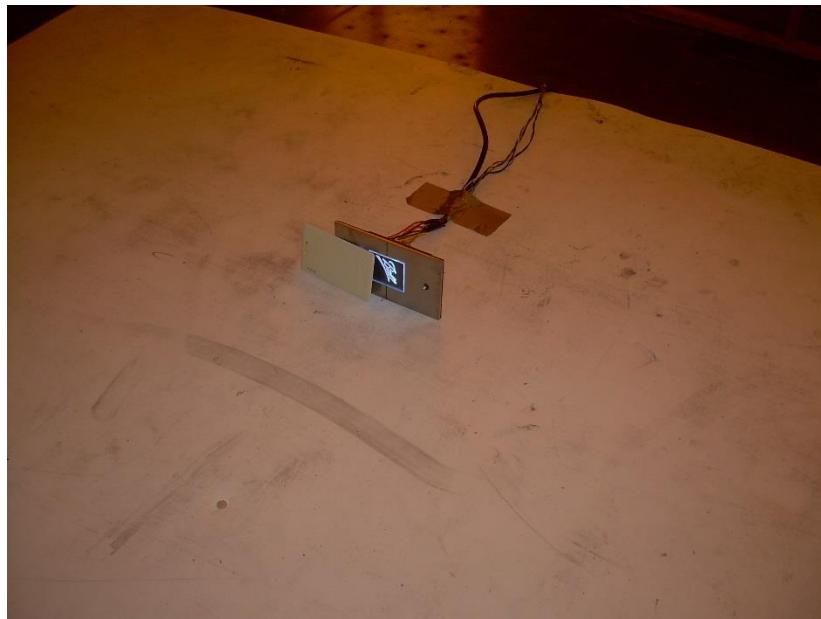
Photograph 1 – Front View Radiated Emissions Worst-Case Configuration – Vertical Placement



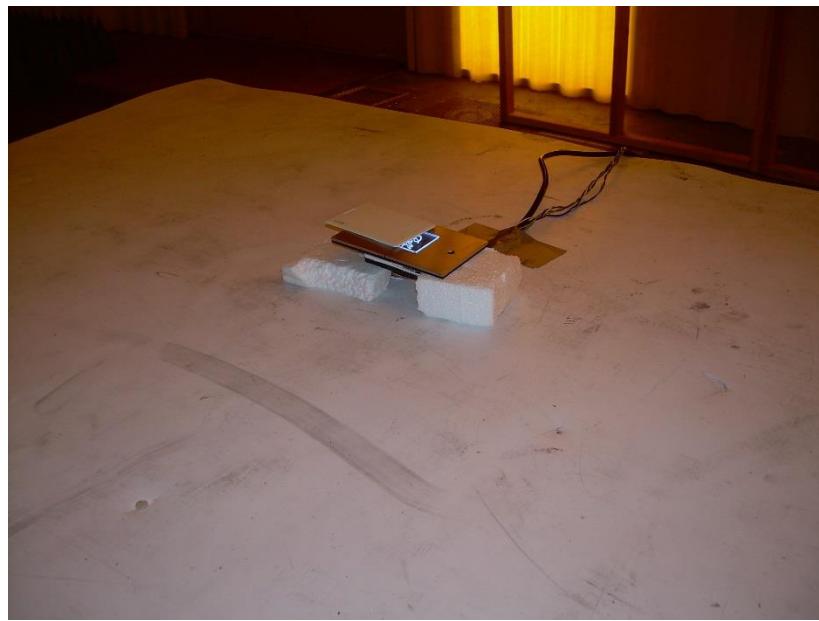
Photograph 2 – Back View Radiated Emissions (0.009 – 30 MHz)



Photograph 3 – Back View Radiated Emissions (30 – 1000 MHz)



Photograph 4 – Radiated Emissions – On Edge Configuration



Photograph 5 – Radiated Emissions – Horizontal Placement



Photograph 6 – Front View Conducted Emissions Worst-Case Configuration



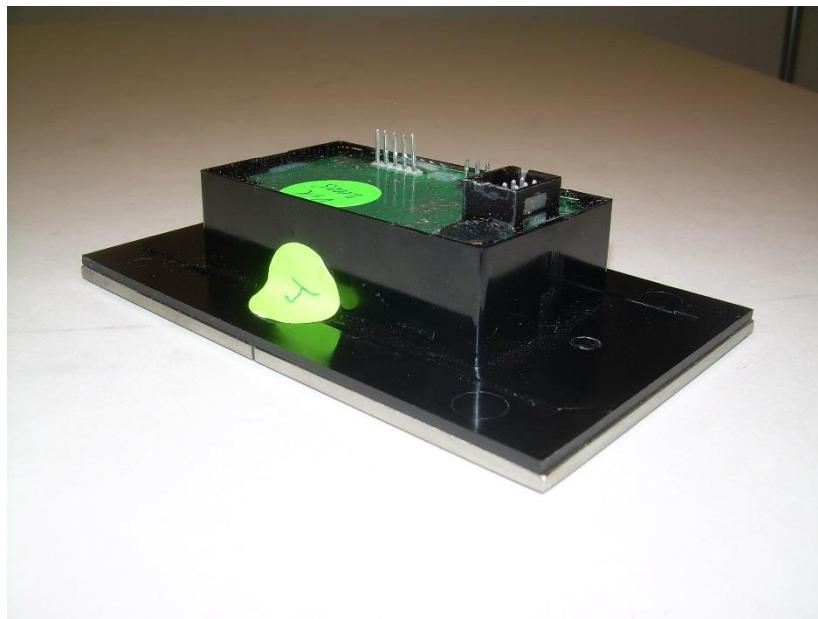
Photograph 7 – Back View Conducted Emissions Worst-Case Configuration



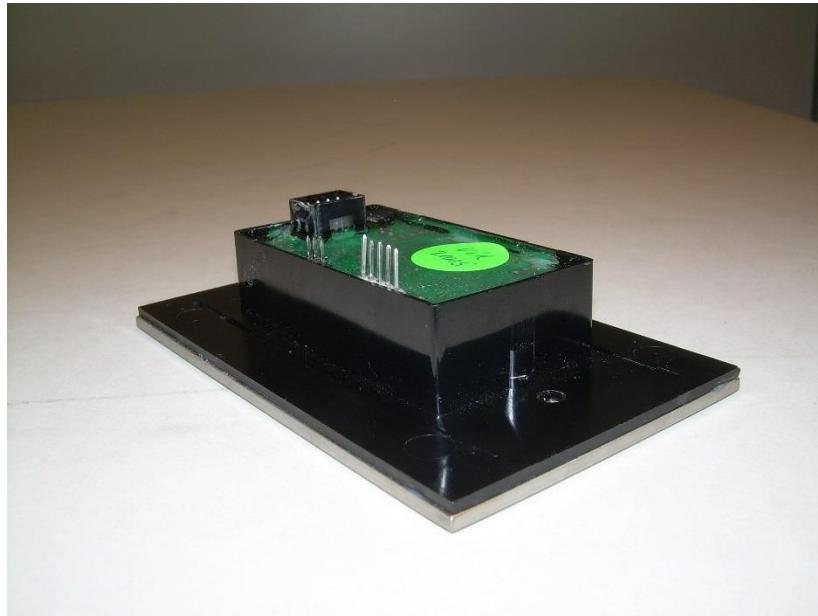
Photograph 8 - Front View of the EUT



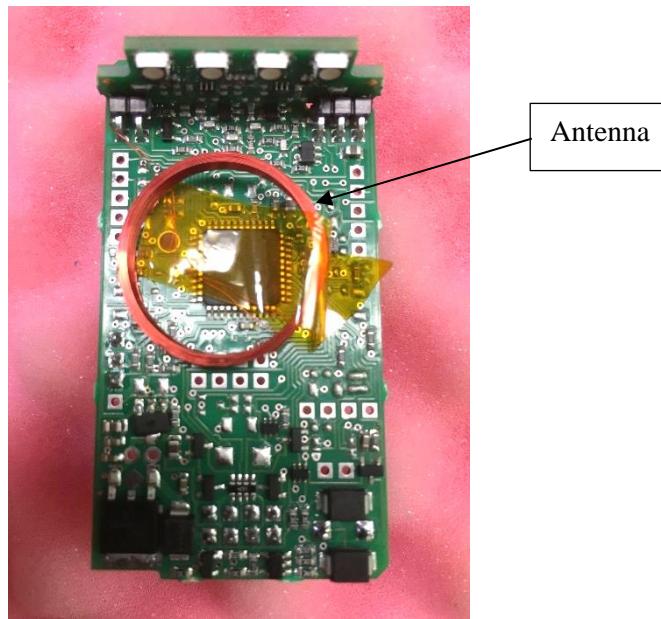
Photograph 9 - Back View of the EUT



Photograph 10 – Right Side View of the EUT



Photograph 11 – Left Side View of the EUT



Photograph 12 – View of the Front Side of the EUT PCB



Photograph 13 – View of the Back Side of the EUT PCB

--- End of Report ---