Nemko-CCL, Inc.

1940 West Alexander Street
Salt Lake City, UT 84119
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Test Report

Certification

Test Of: RP01

Test Specifications:

FCC Part 15, Subpart C

FCC ID: 2AAAS-RP01

Test Report Serial No: 285938-4.1

Applicant:
Vivint, Inc.
4931 N 300 W
Provo, UT 84604
U.S.A

Dates of Test: May 4 and 14, 2015

Report Issue Date: May 21, 2015

Accredited Testing Laboratory By:

NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Nemko-CCL, Inc. to document compliance of the device described below with the certification requirements of 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: Vivint, Inc.
- Manufacturer: Flextronics
- Manufacturer: Hourui Linear Electronics Manufactory
- Brand Name: Vivint
- Model Number: RP01
- FCC ID: 2AAAS-RP01

On this 21st day of May 2015, I, individually and for Nemko-CCL, 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 Nemko-CCL, 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.

Nemko-CCL, Inc.

Tested by: Norman P. Hansen
Test Technician

Reviewed by: Thomas C. Jackson
Certification Manager

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SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

1.1 Applicant:

Company Name:	Vivint, Inc. 4931 N 300 W Provo, UT 84604 U.S.A
Contact Name:	Greg Hansen
Title:	Regulatory Compliance Manager

1.2 Manufacturer:

Company Name:	Flextronics 89 Yong Fu Road Tong Fu Yu Industrial Park Fu Yong Town, Bao An District Shenzhen 518103 P.R. China
Contact Name:	Feng Zhou
Title:	QA Engineer

1.3 Manufacturer:

Company Name:	Hourui Linear Electronics Manufactory Hourui Second Industrial Zone Hourui Village Xixang, Bao An District, Shenzhen P.R. China
Contact Name:	Henry Luk
Title:	Senior Electronic Engineering Supervisor

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Brand Name:	Vivint
Model Number:	RP01
Serial Number:	None
Dimensions:	16.0 cm x 10.0 cm x 2.5 cm

2.2 Description of EUT:

The RP01 is a 345 MHz repeater used in Vivint systems. The RP01 is used to extend communication range from sensors and devices in the system to the controller. The RP01 receives transmissions from other devices in the system at 345 MHz and retransmits the data at 345 MHz. The antenna is a trace on the PCB. The RP01 has a 3.6 V, 2200 mAH battery for powering the device during power outages. The RP01 is powered by either a Huizhou Zhongang Electronics Co., Ltd ZB-A050010A-L power supply or a Phihong PSAC05R-050 power supply. Both supplies provide 5 Vdc at 1 amp.

This report covers the transmitter circuitry of the device subject to FCC Part 15, Subpart C. The circuitry of the device, subject to FCC Part 15, Subpart B is covered in Nemko-CCL, Inc. report 285938-7.

2.3 EUT and Support Equipment:

Brand Name Model Number Serial Number	FCC ID Number or Compliance	Description	Name of Interface Ports / Interface Cables
BN: Vivint MN: RP01 SN: None	2AAAS-RP01	345 MHz Repeater	See Section 2.4

2.4 Interface Ports on EUT:

There are no interface ports on the EUT.

2.5 Modification Incorporated/Special Accessories on EUT:

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

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15)
Section 15.203, Section 15.207, and Section 15.231

Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

Purpose of Test: The tests were performed to demonstrate initial compliance.

3.2 Methods & Procedures:

3.2.1 §15.203

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 for Class A digital devices, for equipment 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 μH/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 band edges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5*	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	60	50

*Decreases with the logarithm of the frequency.

3.2.3 §15.231

(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as Shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmission to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(b) In addition to the provisions of §15.205, the field strength of emission from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 –130	1,250	125
130 – 174	1,250 to 3,750 **	125 to 375 **
174 – 260	3,750	375
260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 – 174 MHz, µV/m at 3 meters = 56.81818(F) – 6136.3636; for the band 260 – 470 MHz, µV/m at 3 meters = 41.6667(F) – 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provision in §15.35 for averaging pulsed emission and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emission in the above table are based on the fundamental frequency of the intentional radiator. Spurious emission shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

(d) For devices operation within the frequency band 40.66-40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be ±0.01%. This frequency tolerance shall be maintained for a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation on the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided that intentional radiator complies with the provisions of paragraphs (b) through (d) of this section except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66 - 40.70	1,000	100
70 –130	500	50
130 – 174	500 to 1,500 **	50 to 150 **
174 – 260	1,500	150
260 – 470	1,500 to 5,000 **	150 to 500 **
Above 470	5,000	500

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 – 174 MHz, µV/m at 3 meters = 22.72727(F) – 2454.545; for the band 260 – 470 MHz, µV/m at 3 meters = 16.6667(F) – 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent periods between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

3.3 Test Procedure

The conducted disturbance at mains ports and radiated disturbance testing was performed according to the procedures in ANSI C63.4: 2003 and 47 CFR Part 15. Testing was performed at Nemko-CCL, Inc. Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been registered with the FCC, and was renewed January 22, 2015 (90504). This registration is valid for three years.

Nemko-CCL, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2015.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 120 VAC/60 Hz

4.2 Operating Modes:

The EUT was operated in normal mode, triggering the transmissions with other devices to capture plots of the timing. An EUT with test firmware was used to put the EUT into a constant transmit mode for radiated emissions testing. The AC mains voltage was varied from 85% to 115% of nominal with no change seen in the power supply output voltage or transmitter characteristics.

4.3 EUT Exercise Software:

Internal test firmware or production ready code was used to exercise the EUT.

SECTION 5.0 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	Emissions at the AC Mains	0.15 - 30	Complied
15.231 (a)	Periodic Operation	345	Complied
15.231 (b)	Radiated Emissions	0.009 - 3450	Complied
15.231 (c)	Bandwidth	345	Complied
15.231 (d)	Frequency Stability	40.66 – 40.70	Not Applicable
15.231 (e)	Radiated Emissions	0.009 - 3450	Not Applicable

5.2 Result

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

SECTION 6.0 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 Appendix 1 of this report.

6.2 Test Results:

6.2.1 §15.203 Antenna Requirements

The antenna is an etched portion of the PCB and cannot be replaced by the user.

RESULT

The EUT complied with the requirements of this section.

6.2.2 §15.207 Emissions at the AC Mains

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.16	Hot Lead	Peak (Note 1)	48.9	55.7	-6.8
0.22	Hot Lead	Peak (Note 1)	45.2	52.7	-7.5
0.48	Hot Lead	Quasi-Peak (Note 2)	45.1	56.3	-11.2
0.48	Hot Lead	Average (Note 2)	32.4	46.3	-13.9
0.65	Hot Lead	Peak (Note 1)	38.1	46.0	-7.9
1.02	Hot Lead	Peak (Note 1)	38.2	46.0	-7.8
1.50	Hot Lead	Peak (Note 1)	38.4	46.0	-7.6
2.29	Hot Lead	Peak (Note 1)	38.8	46.0	-7.2
3.58	Hot Lead	Peak (Note 1)	38.2	46.0	-7.8
0.16	Neutral Lead	Peak (Note 1)	52.0	55.7	-3.7
0.23	Neutral Lead	Peak (Note 1)	46.6	52.5	-5.9
0.49	Neutral Lead	Peak (Note 1)	41.0	46.3	-5.3
1.12	Neutral Lead	Peak (Note 1)	38.3	46.0	-7.7
1.46	Neutral Lead	Peak (Note 1)	38.6	46.0	-7.4

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
1.89	Neutral Lead	Peak (Note 1)	37.9	46.0	-8.1

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.

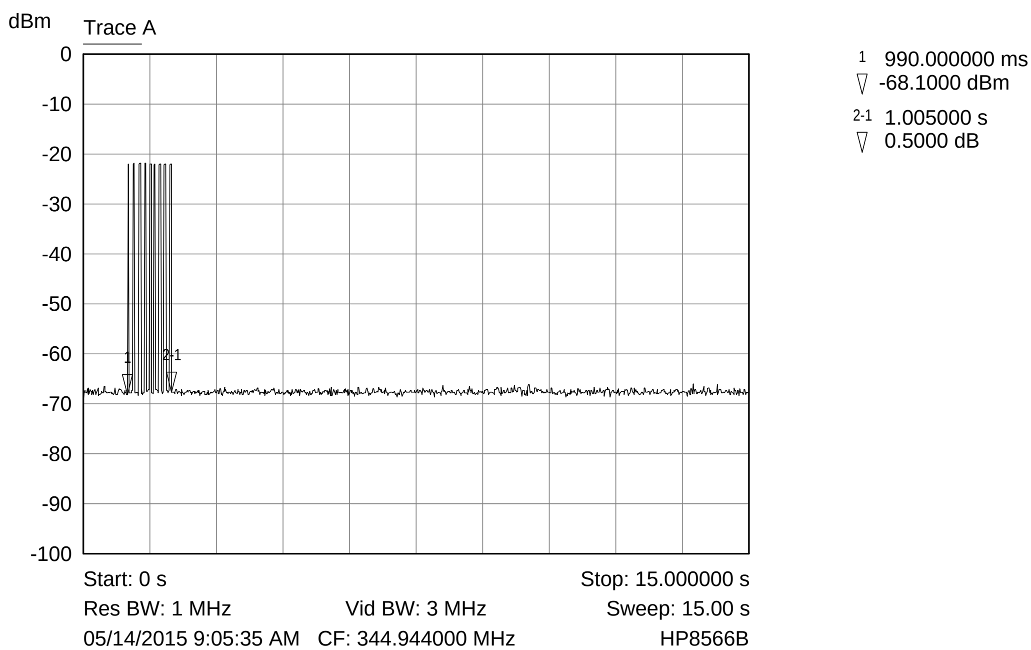
RESULT

The EUT complied with the specification limit by a margin of 3.7 dB.

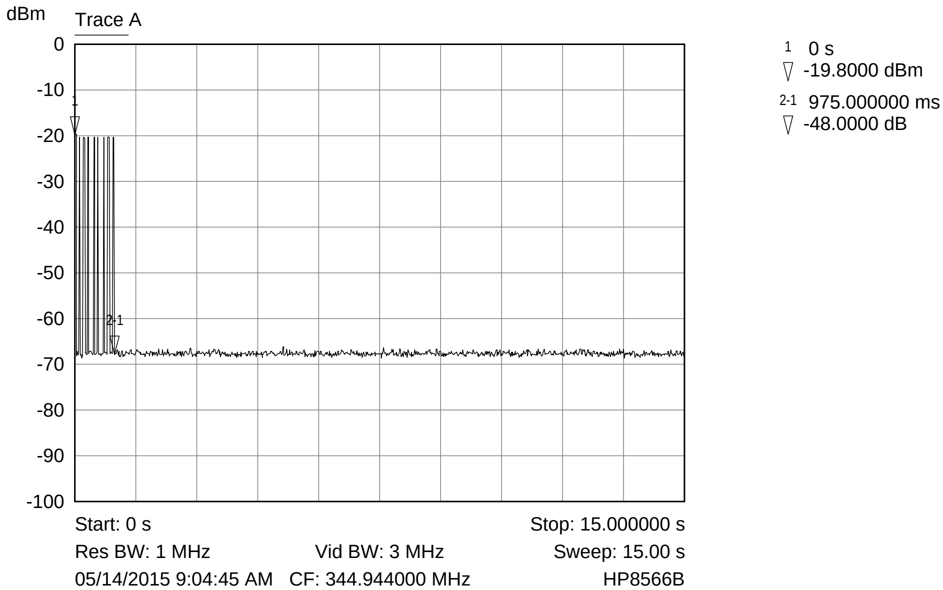
6.2.3 §15.231 (a)

1. The EUT is not manually activated.

2. The EUT is automatically activated when a transmission is received from a sensor or device in the Vivint system. This transmission must cease within 5 seconds of activation. The plot below shows the emissions ceasing within 5 seconds of activation.



3. The RP01 does transmit 9 power management/supervisory packets once every 70 minutes. These transmissions must not exceed 2 seconds per hour. The 9 packets are transmitted over 975 ms and occur once in 70 minutes.



4. The EUT may be used during an emergency that involves fire and safety of life.

5. The EUT does not require set up information transmissions by a professional installer.

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

6.2.4 §15.231 (b) Radiated Emissions

The RP01 operates at 345 MHz, therefore; the field strength of the fundamental must be less than 7291.7 µV/m (77.3 dBµV/m) at 3 meters. The maximum permitted field strength of any unwanted emission must be 20 dB below the maximum allowable fundamental field strength (57.3 dBµV/m).

Emissions in the restricted bands of §15.205 must meet the limits specified in §15.209.

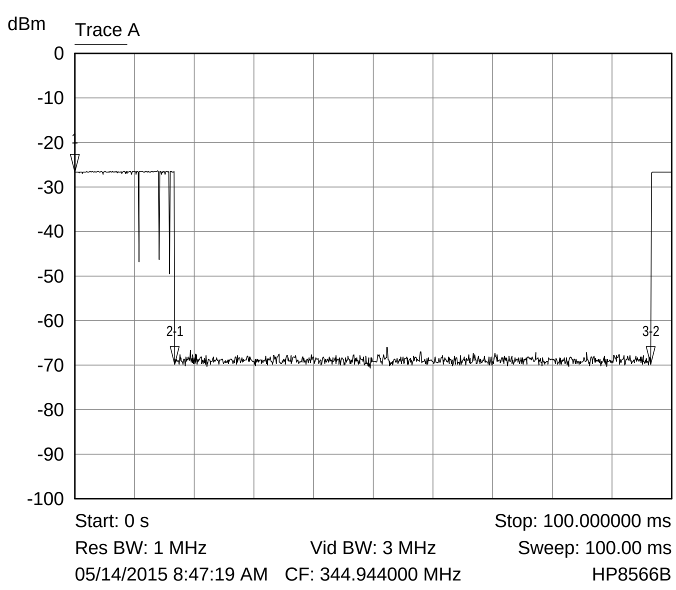
Measurement Data Fundamental and Harmonic Emissions:

The frequency range from the lowest frequency to the tenth harmonic of the highest fundamental frequency was investigated to measure any radiated emissions.

Pulsed Emission Averaging Factor

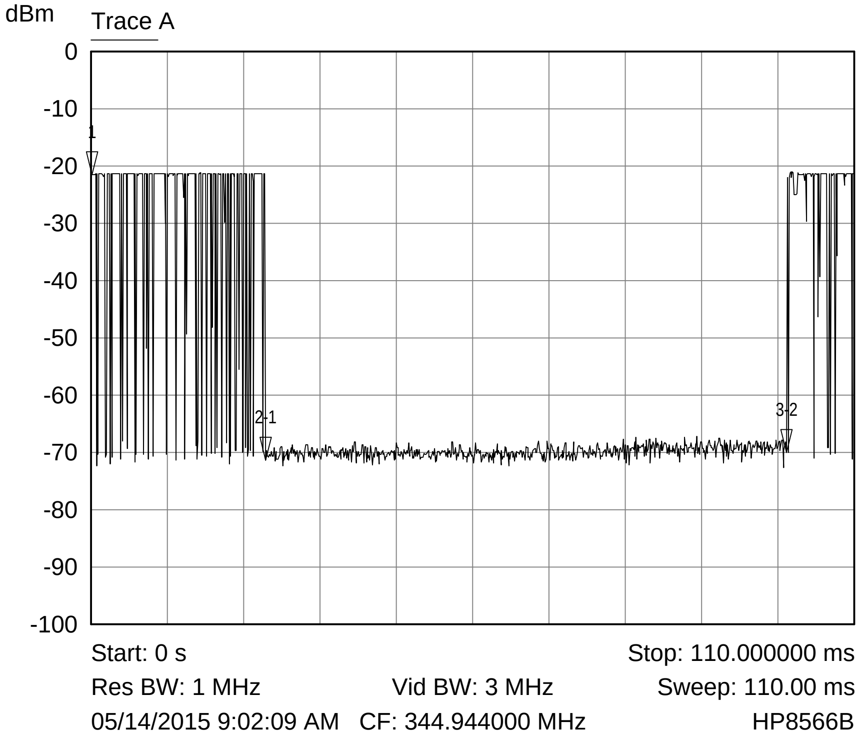
The RP01 transmitter is a pulsed emission device using Manchester encoding with a 50% duty cycle; therefore, the method of §15.35 for averaging a pulsed emission may be used. Two lengths of pulse trains are used in the system depending on the device emission being received and repeated. Either a 17 ms or a 25 ms pulse train may be transmitted. The time between pulse trains varies from a minimum of 75 ms to a maximum of 130 ms. Based on this, the worst-case duty cycle occurs with a 25 ms pulse train and a 75 ms off time until the next pulse train is sent. A timing diagram of the pulsed transmission, plots of the pulse train, and the average factor calculations are shown below:

16.7 ms pulse train and 79.8 ms off time



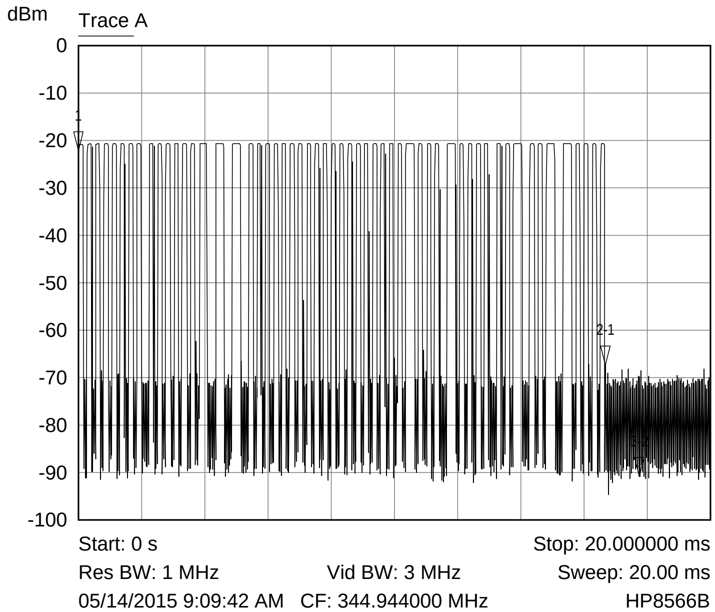
Mkr	X-Axis	Value	Notes
1 ∇	0 s	-26.7000 dBm	
2-1 ∇	16.700000 ms	-43.2000 dB	
3-2 ∇	79.800000 ms	0.1000 dB	

25.2 ms pulse train and 75.02 ms off time



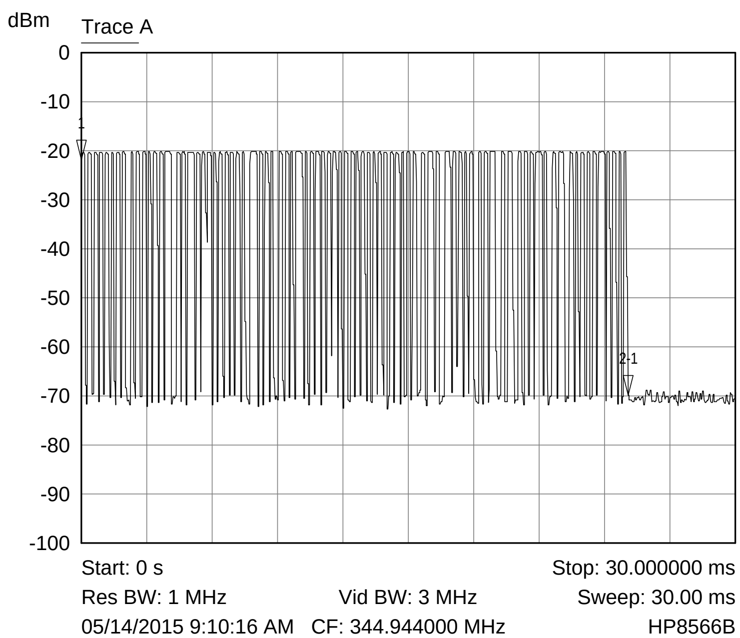
Mkr	X-Axis	Value	Notes
1 ▽	110.000000 us	-21.5000 dBm	
2-1 ▽	25.080000 ms	-49.9000 dB	
3-2 ▽	75.020000 ms	1.4000 dB	

16.7 ms Pulse Train



Mkr	X-Axis	Value	Notes
1 ▽	0 s	-22.1000 dBm	
2-1 ▽	16.680000 ms	-45.2000 dB	
3-2 ▽	1.060000 ms	-23.6000 dB	

25.1 ms Pulse Train



Mkr	X-Axis	Value	Notes
1 ▽	0 s	-21.8000 dBm	
2-1 ▽	25.080000 ms	-48.0000 dB	

Average factor calculation

The worst- case duty cycle occurs with a 25.1 ms pulse train followed by the minimum off time of 75 ms. The Average Factor will be calculated using 100 ms as specified in FCC §15.35(c). The pulsed transmission is 25.1 ms and has a duty cycle of 50%.

The Average Factor is calculated by the equation:

Average Factor = 20 log (on time/pulse train time)

Pulse train time = 100 ms

On time = 25.1 ms x 50% = 12.55 ms

Average Factor = 20 log (12.55 / 100)
= -18.0 dB

6.2.4.1 Radiated Interference Measurements – (Vertical Polarity)

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
345	Peak	74.4	-18.0	19.4	75.8	77.3	-1.5
690	Peak	30.3	-18.0	27.6	39.9	57.3	-17.4
1035*	Peak	24.7	-18.0	26.9	33.6	54.0	-20.4
1380*	Peak	11.0	-18.0	28.2	21.2	54.0	-32.8
1725	Peak	8.5	-18.0	29.5	20.0	57.3	-37.3
2070	Peak	4.1	-18.0	30.9	17.0	57.3	-40.3
2415	Peak	3.8	-18.0	31.8	17.6	57.3	-39.7
2760*	Peak	3.9	-18.0	33.1	19.0	54.0	-35.0
3105	Peak	3.3	-18.0	34.3	19.6	57.3	-37.7
2450	Peak	4.6	-18.0	35.3	21.9	57.3	-35.4
*** Emissions within restricted bands**							

6.2.4.2 Radiated Interference Measurements - (Horizontal Polarity)

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
345	Peak	64.2	-18.0	19.4	65.6	77.3	-11.7
690	Peak	22.4	-18.0	27.6	32.0	57.3	-25.3
1035*	Peak	23.4	-18.0	26.9	32.3	54.0	-21.7

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
1380*	Peak	9.3	-18.0	28.2	19.5	54.0	-34.5
1725	Peak	6.7	-18.0	29.5	18.2	57.3	-39.1
2070	Peak	5.5	-18.0	30.9	18.4	57.3	-38.9
2415	Peak	3.6	-18.0	31.8	17.4	57.3	-39.9
2760*	Peak	5.1	-18.0	33.1	20.2	54.0	-33.8
3105	Peak	3.9	-18.0	34.3	20.2	57.3	-37.1
2450	Peak	4.4	-18.0	35.3	21.7	57.3	-35.6
*** Emissions within restricted bands**							

6.2.4.3 Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor) and the Average Factor to the measured level of the receiver. The receiver amplitude reading is compensated for any amplifier gain.

The basic equation with a sample calculation is shown below:

FS = RA + CF + AV Where

FS = Field Strength
RA = Receiver Amplitude Reading
CF = Correction Factor (Antenna Factor + Cable Factor)
AV = Averaging Factor

Assume a receiver reading of 44.2 dBμV is obtained from the receiver, with an average factor of –8.6 dB and a correction factor of 17.5 dB. The field strength is calculated by adding the correction factor and the average factor, giving a field strength of 53.1 dBμV/m, FS = 44.2 + 17.5 + (-8.6) = 53.1 dBμV/m

RESULT

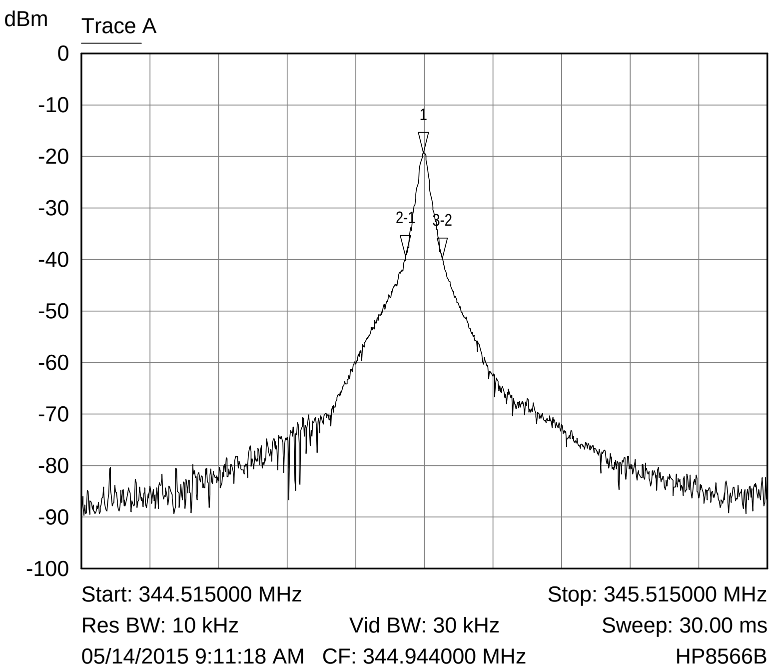
In the configuration tested, the EUT complied with the requirements of this section.

6.2.5 §15.231 (c) Bandwidth

Demonstration of Compliance:

The bandwidth of the emission must not be wider than 0.25% of the center frequency. The center frequency is 345 MHz, therefore the bandwidth must not be wider than 862.5 kHz. The RP01 bandwidth was 53 kHz. See spectrum analyzer plot below.

Bandwidth Plot



Mkr	X-Axis	Value	Notes
1 ▽	345.014000 MHz	-19.3000 dBm	
2-1 ▽	-26.000000 kHz	-20.1000 dB	
3-2 ▽	53.000000 kHz	-0.4000 dB	

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A1.1 Conducted Disturbance at Mains Ports:

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

Where the mains flexible power cords are longer than 1m, 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:

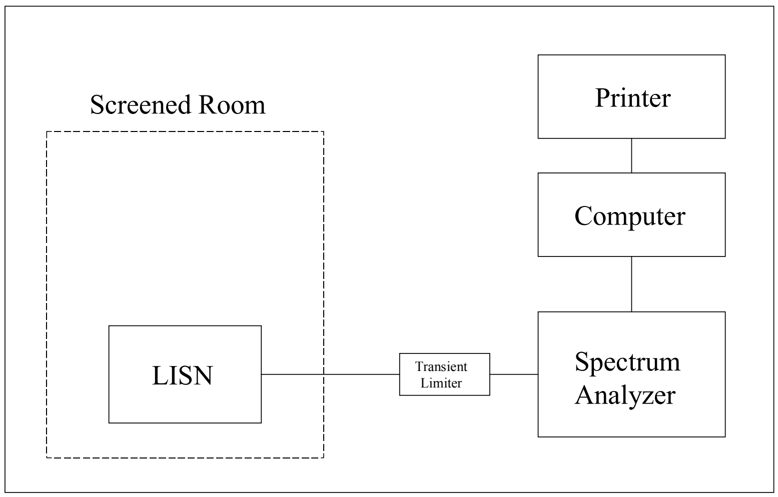
(a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.
(b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
(c) Power cords which are specified by the manufacturer to be connected via a host unit 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.
(d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
(e) 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 AC mains port 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	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	Hewlett Packard	8566B	1407	06/27/2014	06/27/2015
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
LISN	Nemko	LISN-COMM-50	1424	02/25/2015	02/25/2016
Conductance Cable Wanship Site #2	Nemko	Cable J	840	12/23/2014	12/23/2015
Transient Limiter	Hewlett Packard	11947A	768	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards Technology (NIST). Supporting documentation relative to traceability is on file and available for examination upon request.

Conducted Emissions Test Setup



A1.2 Radiated Disturbance:

The radiated disturbance from the EUT was 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 was 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. A 31 dB preamp was used for measurements above 1000 MHz with the spectrum analyzer RBW set to 1 MHz and VBW at 3 MHz..

A loop antenna was used to measure emissions below 30 MHz. Emission readings more than 20 dB below the limit at any frequency may not be listed in the reported data. For frequencies between 9 kHz and 30 MHz, or the lowest frequency generated or used in the device greater than 9 kHz, and less than 30 MHz, the spectrum analyzer resolution bandwidth was set to 9 kHz and the video bandwidth was set to 30 kHz. For average measurements, the spectrum analyzer average detector was used.

For frequencies above 30 MHz, an amplifier and preamplifier 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 peak emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average measurements above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the average detector of the analyzer was used.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 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 meters 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 disturbance. 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.

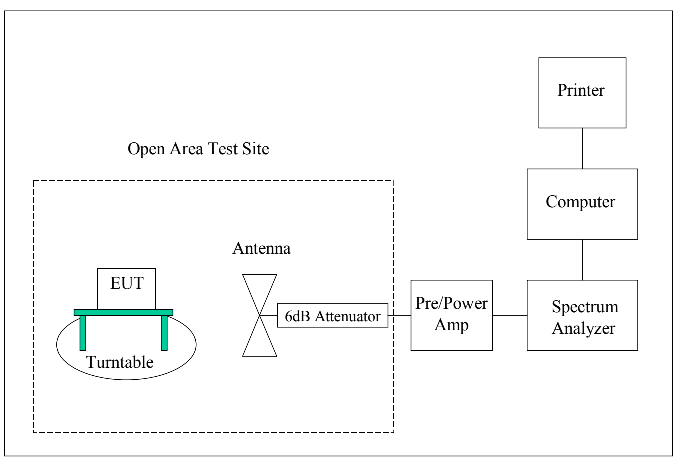
Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emission testing at 30 MHz or above 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	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	FSU26	1557	01/26/2015	01/26/2016
Spectrum Analyzer	Hewlett Packard	8566B	1407	06/27/2014	06/27/2015
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
Loop Antenna	EMCO	6502	560	10/01/2014	10/01/2016
Biconilog Antenna	EMCO	3142	713	10/22/2014	10/22/2016
Double Ridged Guide Antenna	EMCO	3115	735	03/17/2015	03/17/2017
High Frequency Amplifier	Miteq	AFS4-00102650-35-10P-4	1299	12/23/2014	12/23/2015
3 Meter Radiated Emissions Cable Wanship Site #2	Microcoax	UFB205A-0-4700-000000	1295	12/23/2014	12/23/2015
Pre/Power-Amplifier	Hewlett Packard	8447F	762	09/05/2014	09/05/2015
6 dB Attenuator	Hewlett Packard	8491A	1103	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 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.

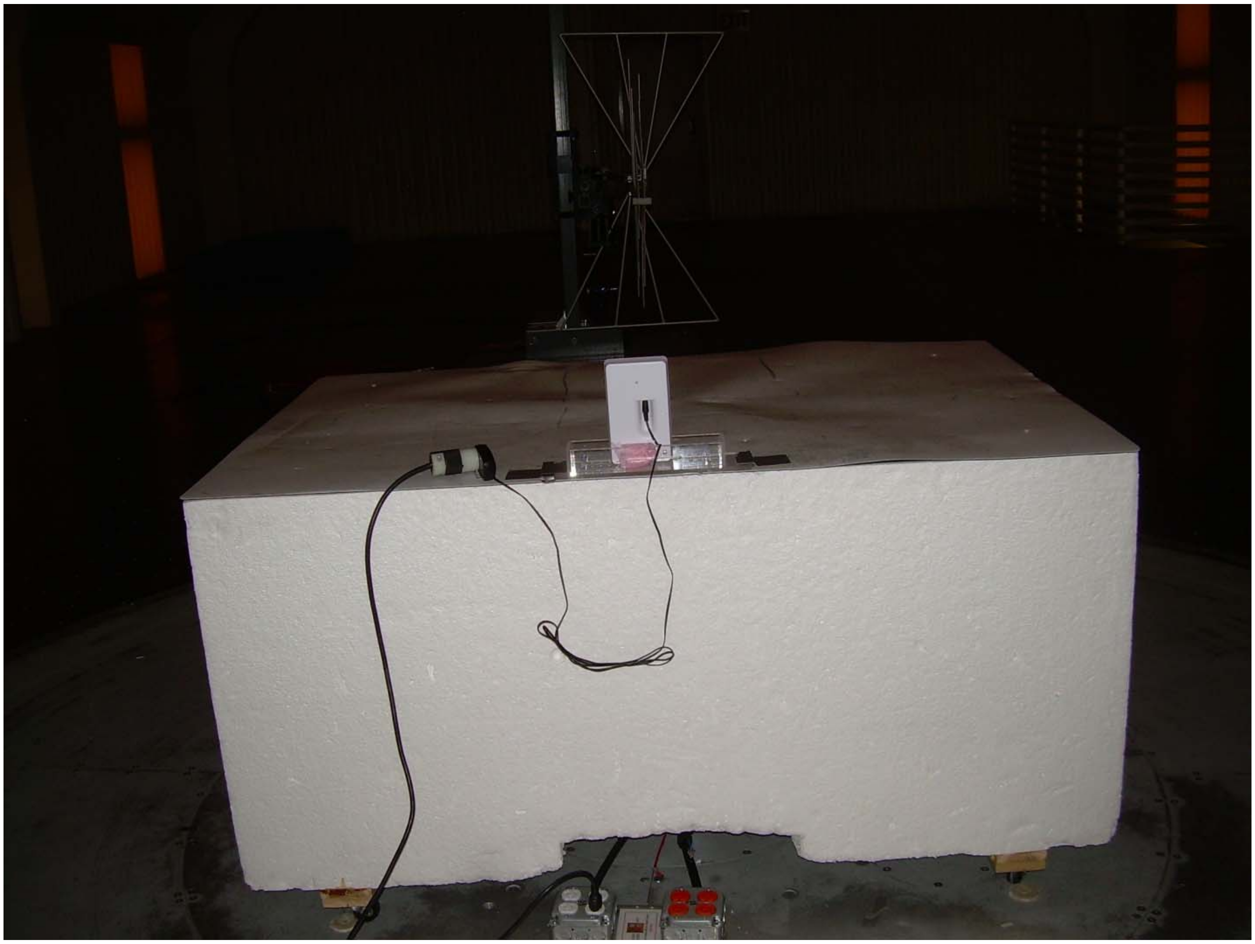
Radiated Emissions Test Setup



APPENDIX 2 PHOTOGRAPHS

Photograph 1 – Front View Radiated Disturbance Worst Case Configuration

Photograph 2 – Back View Radiated Disturbance Worst Case Configuration



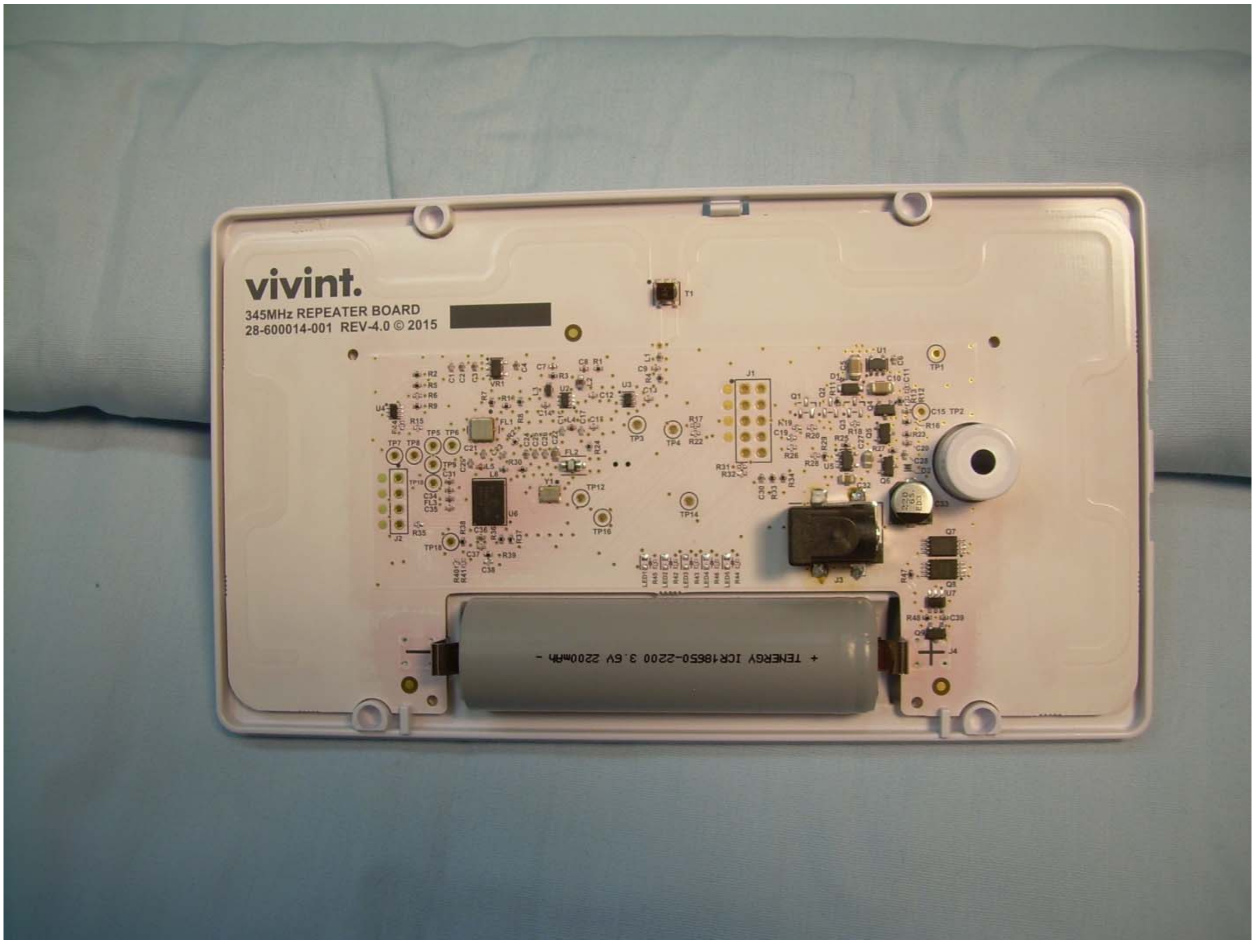
Photograph 3 – Front View Conducted Disturbance Worst Case Configuration

Photograph 4 – Back View Conducted Disturbance Worst Case Configuration

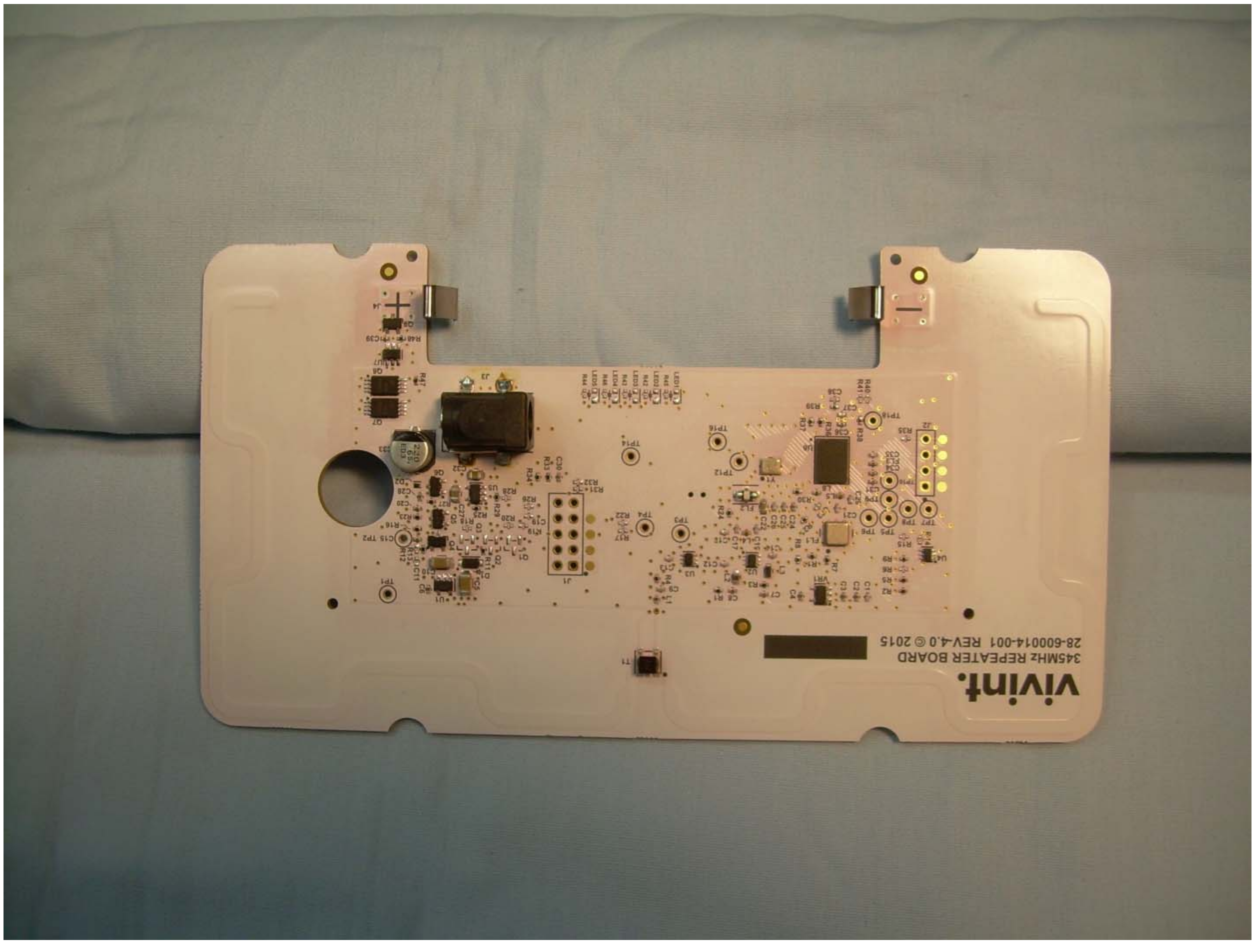
Photograph 5 – Front View of the EUT

Photograph 6 – View with the Cover Removed

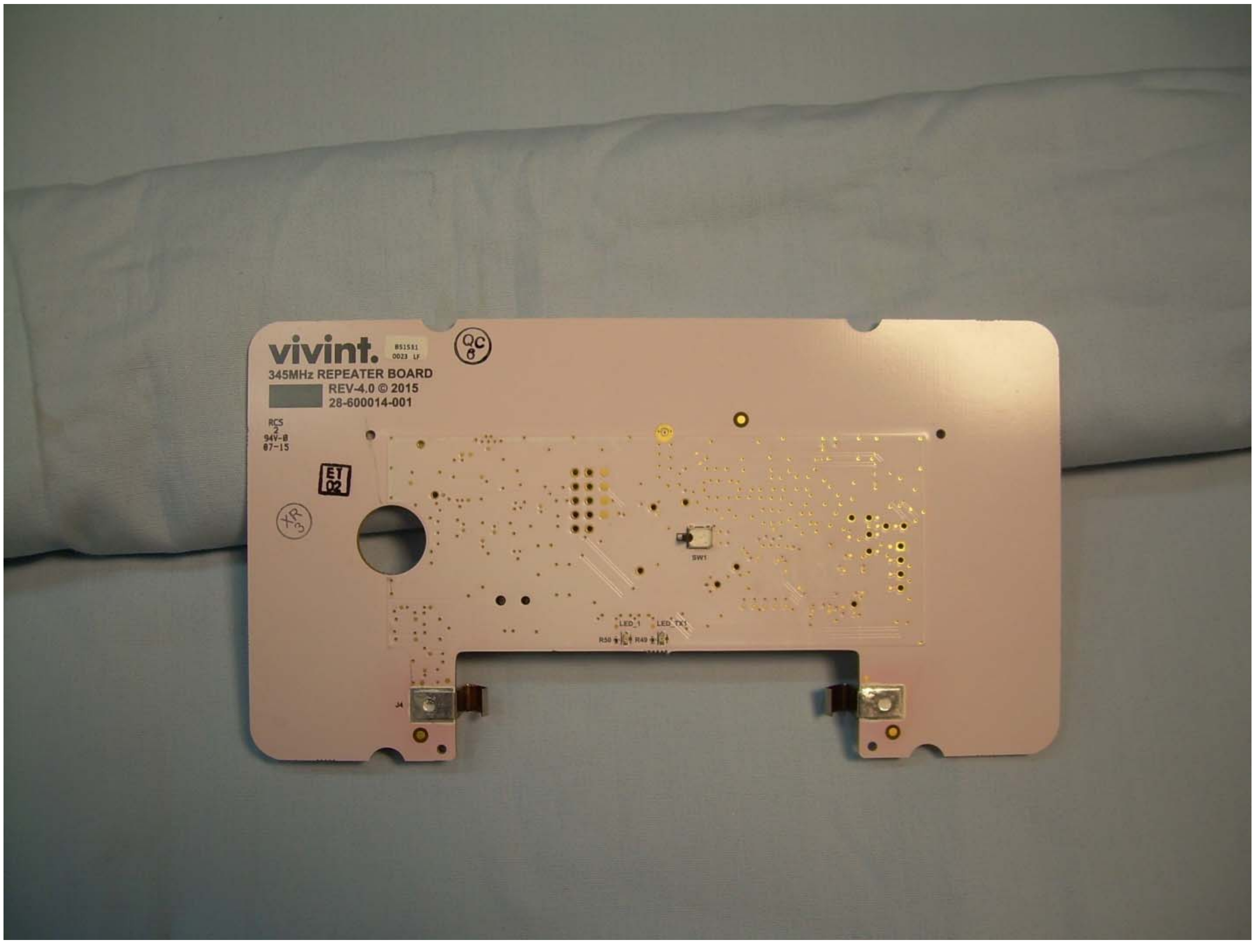
Photograph 7 – View of the PCB Mounted in the Housing



Photograph 8 – View of the Front Side of the PCB



Photograph 9 – View of the Back Side of the PCB



Photograph 10 – View of the ZB-A050010A-L Supply

Photograph 11 – View of the PSAC05R-050 Supply