



Engineering Solutions & Electromagnetic Compatibility Services

**FCC Part 15.231 Test Data**

**EUT: 433.92 MHz Panel 56-0053-00 Rev G01**

**for**

**Resolution Engineering, Inc.  
1402 Heggen Street  
Hudson, WI 54016  
Contact: Jake Peterson**

**Testing Conducted By  
Rhein Tech Laboratories, Inc.  
360 Herndon Parkway, Suite 1400  
Herndon, VA 20170**

**RTL Test Engineer: Jon Wilson**

**RTL Project/Report Number: 2014154DXT**

**August 20, 2014**

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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.

## Testing Represented in Report

### 15.231

The data and limits presented in this report are for radiated emissions per 15.231(b)(2) which references 15.35(b), and peak limiting for restricted bands per 15.209(e), which again references 15.35(b)(2), as procured by Resolution Engineering. No average data is presented in this report. Data is also presented for spurious, non-harmonic radiated emissions per 15.209.

### 15.207

Unintentional digital emissions, mains conducted.

The Equipment Under Test (EUT) was the **433.92 MHz Panel 56-0053-00 Rev G01 (RTL Bar Code 21477) with AC Adapter (RTL Bar Code 21476)**.

### 15.231 Radiated Emissions Test Data – FCC Limits/ 3m Distance

#### Top Antenna

| Emission Frequency (MHz) | Test Detector | Antenna Polarity (H/V) | Analyzer Reading (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pass/Fail |
|--------------------------|---------------|------------------------|-------------------------|-------------------------------|-------------------------|----------------|-------------|-----------|
| 433.92                   | Peak          | V                      | 79.3                    | 18.0                          | 97.3                    | 100.8          | -3.5        | Pass      |
| 867.84                   | Peak          | H                      | 55.0                    | -2.9                          | 52.1                    | 80.8           | -28.7       | Pass      |
| 1301.76                  | Peak          | H                      | 39.9                    | 2.9                           | 42.8                    | 74.0           | -31.2       | Pass      |
| 1735.69                  | Peak          | H                      | 45.2                    | 5.3                           | 50.5                    | 80.8           | -30.3       | Pass      |
| 2169.59                  | Peak          | H                      | 49.0                    | -10.7                         | 38.3                    | 80.8           | -42.5       | Pass      |
| 2603.51                  | Peak          | V                      | 53.0                    | -8.7                          | 44.3                    | 80.8           | -36.5       | Pass      |
| 3037.43                  | Peak          | V                      | 60.3                    | -8.7                          | 51.6                    | 80.8           | -29.2       | Pass      |
| 3471.35                  | Peak          | H                      | 48.2                    | -7.4                          | 40.8                    | 80.8           | -40.0       | Pass      |
| 3905.27                  | Peak          | H                      | 53.8                    | -6.0                          | 47.8                    | 74.0           | -26.2       | Pass      |
| 4339.19                  | Peak          | V                      | 42.9                    | -0.4                          | 42.5                    | 74.0           | -31.5       | Pass      |

#### Side Antenna

| Emission Frequency (MHz) | Test Detector | Antenna Polarity (H/V) | Analyzer Reading (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pass/Fail |
|--------------------------|---------------|------------------------|-------------------------|-------------------------------|-------------------------|----------------|-------------|-----------|
| 433.92                   | Peak          | H                      | 80.2                    | 18.0                          | 98.2                    | 100.8          | -2.6        | Pass      |
| 867.84                   | Peak          | V                      | 50.6                    | -2.9                          | 47.7                    | 80.8           | -33.1       | Pass      |
| 1301.76                  | Peak          | H                      | 38.8                    | 2.9                           | 41.7                    | 74.0           | -32.3       | Pass      |
| 1735.69                  | Peak          | H                      | 42.8                    | 5.3                           | 48.1                    | 80.8           | -32.7       | Pass      |
| 2169.59                  | Peak          | V                      | 50.3                    | -10.7                         | 39.6                    | 80.8           | -41.2       | Pass      |
| 2603.51                  | Peak          | H                      | 54.3                    | -8.7                          | 45.6                    | 80.8           | -35.2       | Pass      |
| 3037.43                  | Peak          | H                      | 60.1                    | -8.7                          | 51.4                    | 80.8           | -29.4       | Pass      |
| 3471.35                  | Peak          | V                      | 48.0                    | -7.4                          | 40.6                    | 80.8           | -40.2       | Pass      |
| 3905.27                  | Peak          | H                      | 53.3                    | -6.0                          | 47.3                    | 74.0           | -26.7       | Pass      |
| 4339.19                  | Peak          | H                      | 44.9                    | -0.4                          | 44.5                    | 74.0           | -29.5       | Pass      |

### Non-Harmonic Spurious Emissions

| Emission Frequency (MHz) | Test Detector | Antenna Polarity (H/V) | Analyzer Reading (dBuV) | Site Correction Factor (dB/m) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pass/Fail |
|--------------------------|---------------|------------------------|-------------------------|-------------------------------|-------------------------|----------------|-------------|-----------|
| 78.55                    | QP            | V                      | 54.7                    | -20.1                         | 34.6                    | 40.0           | -5.4        | Pass      |
| 88.80                    | QP            | H                      | 43.4                    | -18.9                         | 24.5                    | 43.5           | -19.0       | Pass      |
| 108.00                   | QP            | V                      | 42.6                    | -16.6                         | 26.0                    | 43.5           | -17.5       | Pass      |
| 153.52                   | QP            | V                      | 50.7                    | -18.2                         | 32.5                    | 43.5           | -11.0       | Pass      |
| 216.97                   | QP            | H                      | 56.4                    | -14.5                         | 41.9                    | 60.8           | -18.9       | Pass      |
| 277.11                   | QP            | H                      | 36.2                    | -13.0                         | 23.2                    | 46.0           | -22.8       | Pass      |
| 325.44                   | QP            | H                      | 47.0                    | -11.9                         | 35.1                    | 46.0           | -10.9       | Pass      |

### Test Procedure

Radiated fundamental and spurious emissions were tested at three meters. The EUT was tested in the three orthogonal planes with the receive antenna in both polarities. The emissions were maximized per ANSI C63.4:2003 8.3.1.2; that is, the measurement antenna height was varied between 1 and 4 m, and the EUT was rotated through 360° on a rotating turntable until the maximum emissions were found. Both horizontal and vertical measurement antenna polarizations were used. A resolution bandwidth of 100 kHz was used for frequencies less than 1000 MHz, and a resolution bandwidth of 1 MHz was used for frequencies greater than or equal to 1000 MHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth.

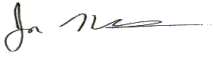
### EUT Disposition

The EUT was adapted to continuously transmit for testing purposes.

### Radiated Emissions Test Equipment

| Part                                     | Manufacturer                  | Model                     | Serial Number | RTL Bar Code | Calibration Due Date |
|------------------------------------------|-------------------------------|---------------------------|---------------|--------------|----------------------|
| Amplifier (20 MHz-2 GHz)                 | Rhein Tech Laboratories, Inc. | PR-1040                   | 900905        | 900905       | 9/4/14               |
| Spectrum Analyzer (10 Hz-26.5 GHz)       | Agilent                       | EXA N9010                 | MY51250846    | 901583       | 4/16/15              |
| Bilog Periodic Antenna (25 MHz-2000 MHz) | ARA                           | LPB-2520                  | 1037          | 900724       | 4/19/15              |
| Amplifier (1 GHz-26.5 GHz)               | Hewlett Packard               | 8449B OPT H02             | 3008A00505    | 900932       | 8/27/2014            |
| Horn Antenna (2.0-4.0 GHz)               | EMCO                          | 3161-02                   | 9804-1044     | 900772       | 4/20/15              |
| Horn Antenna (4.0-8.0 GHz)               | EMCO                          | 3161-03                   | 9508-1020     | 900321       | 4/20/17              |
| Emissions Testing Software               | Rhein Tech Laboratories, Inc. | Automated Emission Tester | Rev. 14.0.2   | N/A          | N/A                  |

### Test Personnel:

|               |                                                                                     |                 |
|---------------|-------------------------------------------------------------------------------------|-----------------|
| Jon Wilson    |  | August 18, 2014 |
| Test Engineer | Signature                                                                           | Date of Test    |

Rhein Tech Laboratories, Inc.  
360 Herndon Parkway, Suite 1400  
Herndon, VA 20170  
<http://www.rheintech.com>

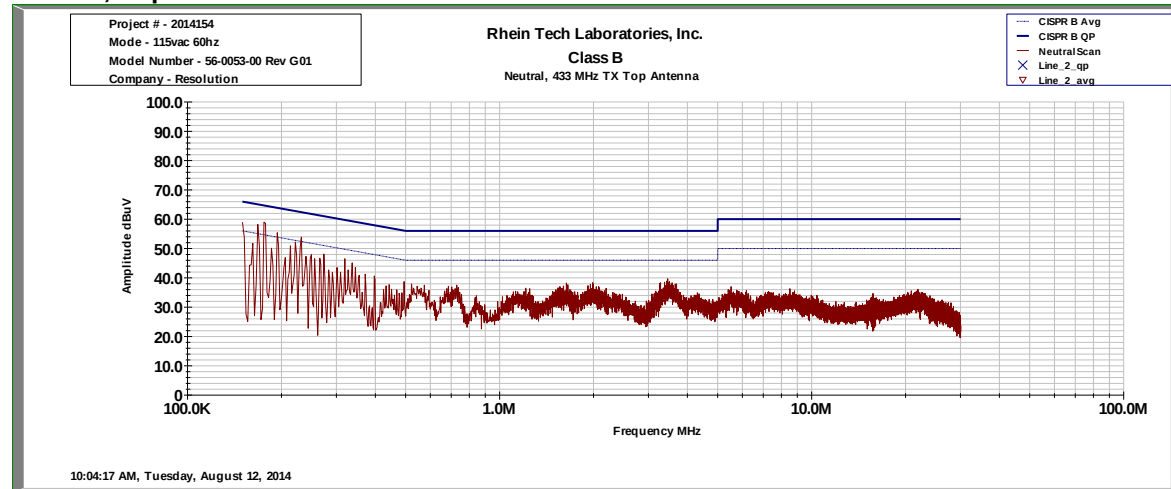
Client: Resolution Engineering  
EUT: 433.92 MHz Panel 56-0053-00 Rev G01  
Standards: FCC Parts 2, 15  
Report #: 2014154DXT

#### **FCC/IC Cross Reference**

|                  |                       |
|------------------|-----------------------|
| FCC 15.231(b)(2) | RSS-210 Issue 8 A1.1  |
| FCC 15.35(b)     | RSS-Gen Issue 3 7.2.3 |
| FCC 15.205       | RSS-Gen Issue 3 7.2.2 |
| FCC 15.209       | RSS-Gen Issue 3 7.2.5 |

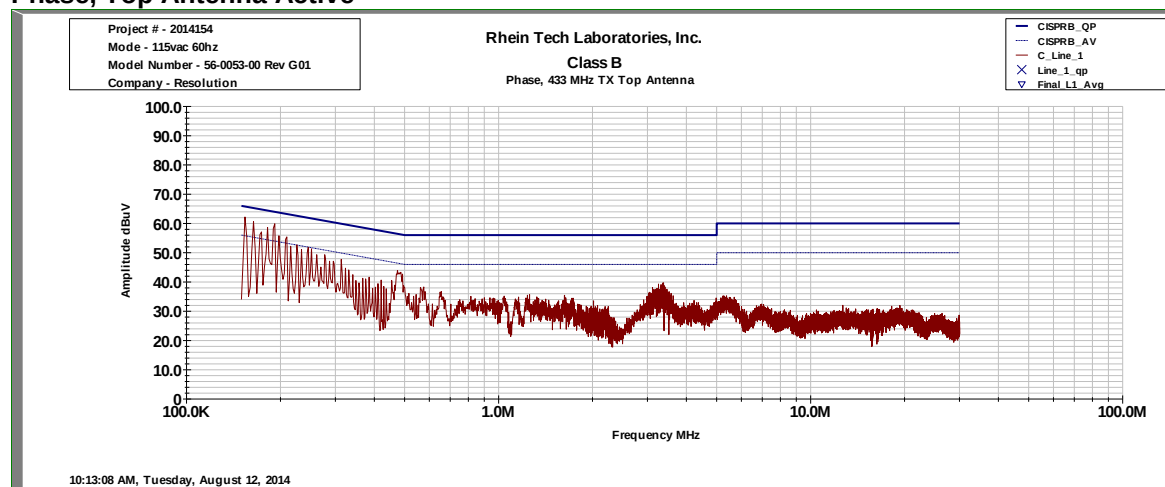
## 15.207 Conducted Line Emissions Test Data – FCC Limits

### Neutral, Top Antenna Active



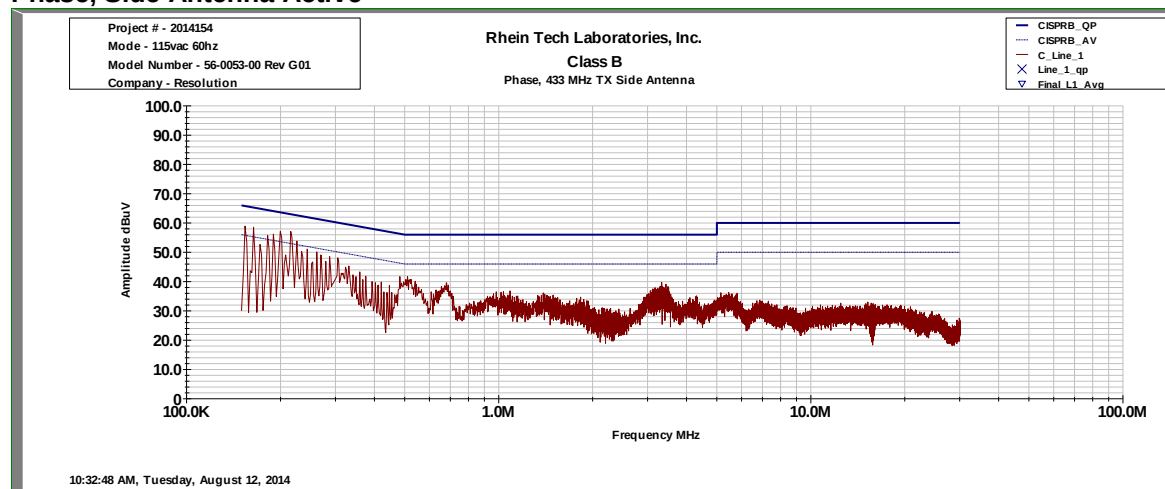
| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.151           | QP       | 49.0         | 0.4                         | 49.4                   | 65.9         | -16.5       | Pass      |
| 0.151           | Av       | 32.5         | 0.4                         | 32.9                   | 55.9         | -23.0       | Pass      |
| 0.176           | QP       | 49.8         | 0.4                         | 50.2                   | 64.7         | -14.5       | Pass      |
| 0.176           | Av       | 35.9         | 0.4                         | 36.3                   | 54.7         | -18.4       | Pass      |
| 0.232           | QP       | 49.2         | 0.4                         | 49.6                   | 62.4         | -12.8       | Pass      |
| 0.232           | Av       | 34.5         | 0.4                         | 34.9                   | 52.4         | -17.5       | Pass      |

### Phase, Top Antenna Active



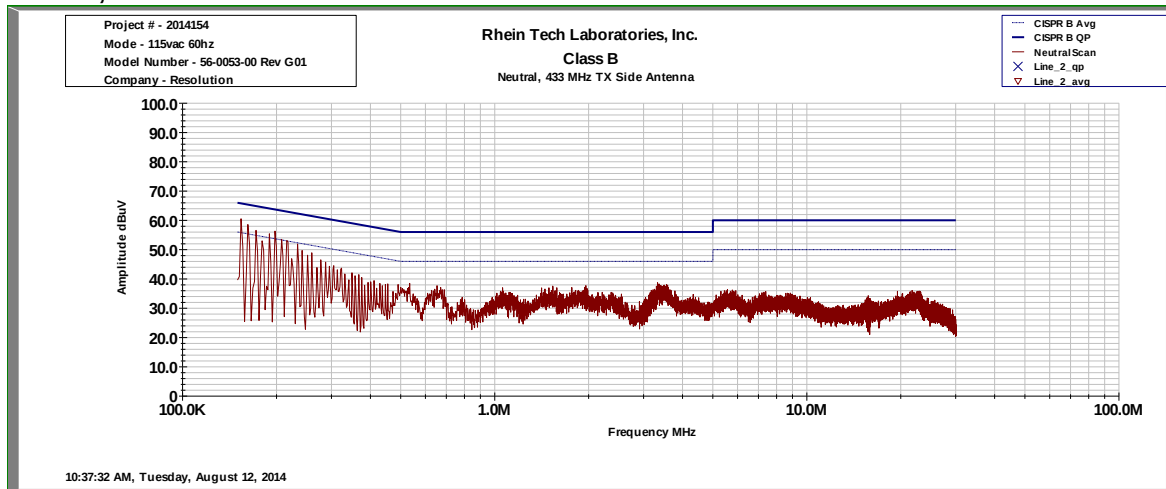
| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.223           | QP       | 52.5         | 0.4                         | 52.9                   | 62.7         | -9.8        | Pass      |
| 0.223           | Av       | 42.6         | 0.4                         | 43.0                   | 52.7         | -9.7        | Pass      |
| 0.154           | QP       | 50.7         | 0.4                         | 51.1                   | 65.8         | -14.7       | Pass      |
| 0.154           | Av       | 34.6         | 0.4                         | 35.0                   | 55.8         | -20.8       | Pass      |
| 0.243           | QP       | 44.5         | 0.4                         | 44.9                   | 62.0         | -17.1       | Pass      |
| 0.243           | Av       | 32.6         | 0.4                         | 33.0                   | 52.0         | -19.0       | Pass      |

### Phase, Side Antenna Active



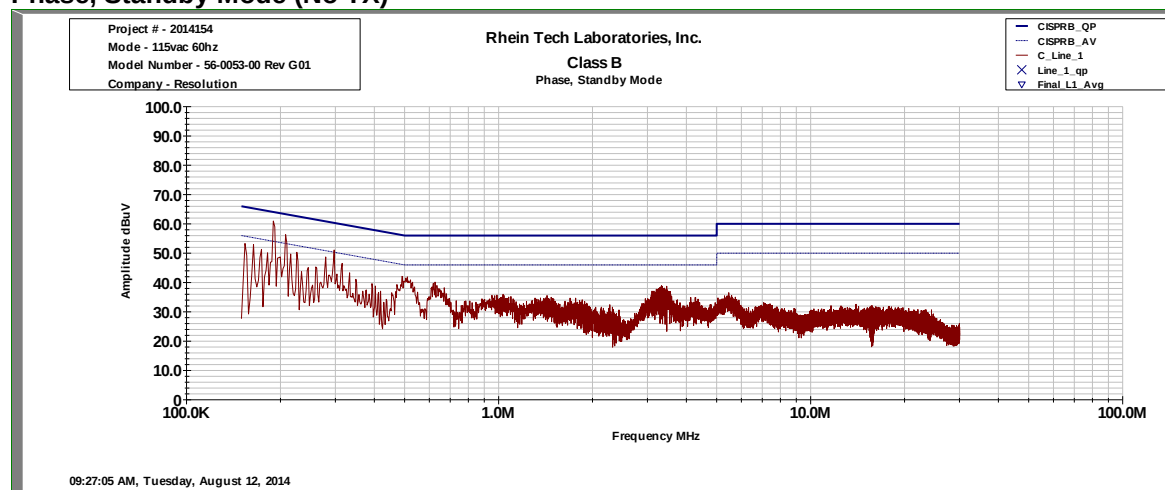
| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.154           | QP       | 51.2         | 0.4                         | 51.6                   | 65.8         | -14.2       | Pass      |
| 0.154           | Av       | 34.8         | 0.4                         | 35.2                   | 55.8         | -20.6       | Pass      |
| 0.227           | QP       | 49.9         | 0.4                         | 50.3                   | 62.6         | -12.3       | Pass      |
| 0.227           | Av       | 42.4         | 0.4                         | 42.8                   | 52.6         | -9.8        | Pass      |

## Neutral, Side Antenna Active



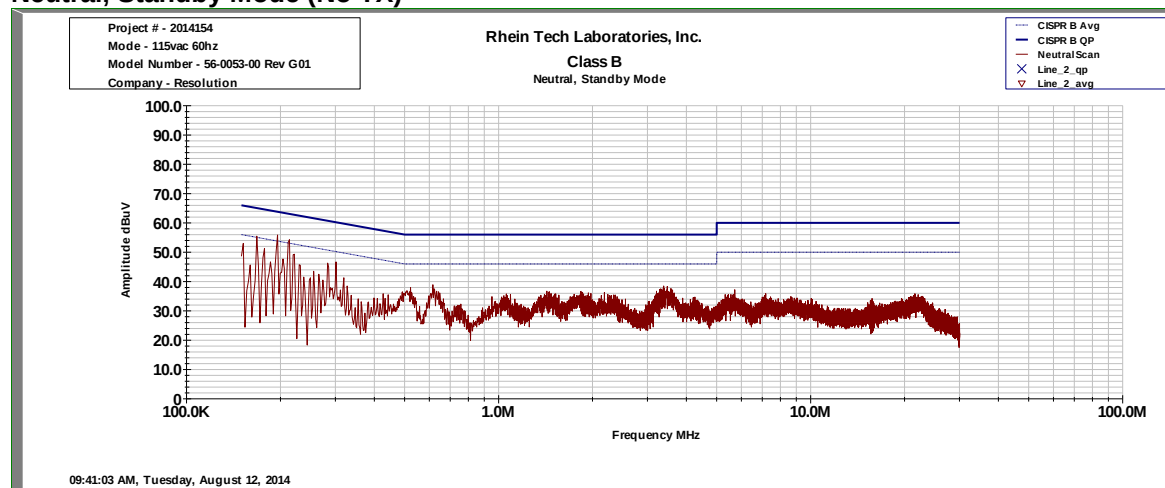
| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.154           | QP       | 49.0         | 0.4                         | 49.4                   | 65.8         | -16.4       | Pass      |
| 0.154           | Av       | 33.2         | 0.4                         | 33.6                   | 55.8         | -22.2       | Pass      |
| 0.227           | QP       | 44.1         | 0.4                         | 44.5                   | 62.6         | -18.1       | Pass      |
| 0.227           | Av       | 37.4         | 0.4                         | 37.8                   | 52.6         | -14.8       | Pass      |

### Phase, Standby Mode (No TX)



| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.202           | QP       | 52.6         | 0.4                         | 53.0                   | 63.5         | -10.5       | Pass      |
| 0.202           | Av       | 44.2         | 0.4                         | 44.6                   | 53.5         | -8.9        | Pass      |
| 0.311           | QP       | 43.4         | 0.4                         | 43.8                   | 59.9         | -16.1       | Pass      |
| 0.311           | Av       | 37.5         | 0.4                         | 37.9                   | 49.9         | -12.0       | Pass      |

### Neutral, Standby Mode (No TX)



| Frequency (MHz) | Detector | Level (dBμV) | Site Correction Factor (dB) | Corrected Level (dBμV) | Limit (dBμV) | Margin (dB) | Pass/Fail |
|-----------------|----------|--------------|-----------------------------|------------------------|--------------|-------------|-----------|
| 0.204           | QP       | 52.0         | 0.4                         | 52.4                   | 63.4         | -11.0       | Pass      |
| 0.204           | Av       | 38.3         | 0.4                         | 38.7                   | 53.4         | -14.7       | Pass      |
| 0.168           | QP       | 45.6         | 0.4                         | 46.0                   | 65.1         | -19.1       | Pass      |
| 0.168           | Av       | 30.0         | 0.4                         | 30.4                   | 55.1         | -24.7       | Pass      |

**Result: Pass**

### **Test Procedure**

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was placed on a wooden table. Power was fed to the EUT through a 50-ohm/50 microhenry LISN. 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 resolution bandwidth was set to 9 kHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth. Average measurements are performed in linear mode using a 9 kHz resolution bandwidth and a 1 Hz video bandwidth. The frequency spectrum was scanned from 150 kHz to 30 MHz.

### **EUT Disposition**

The EUT was adapted to continuously transmit for testing purposes.

### **Conducted Line Emissions Test Equipment**

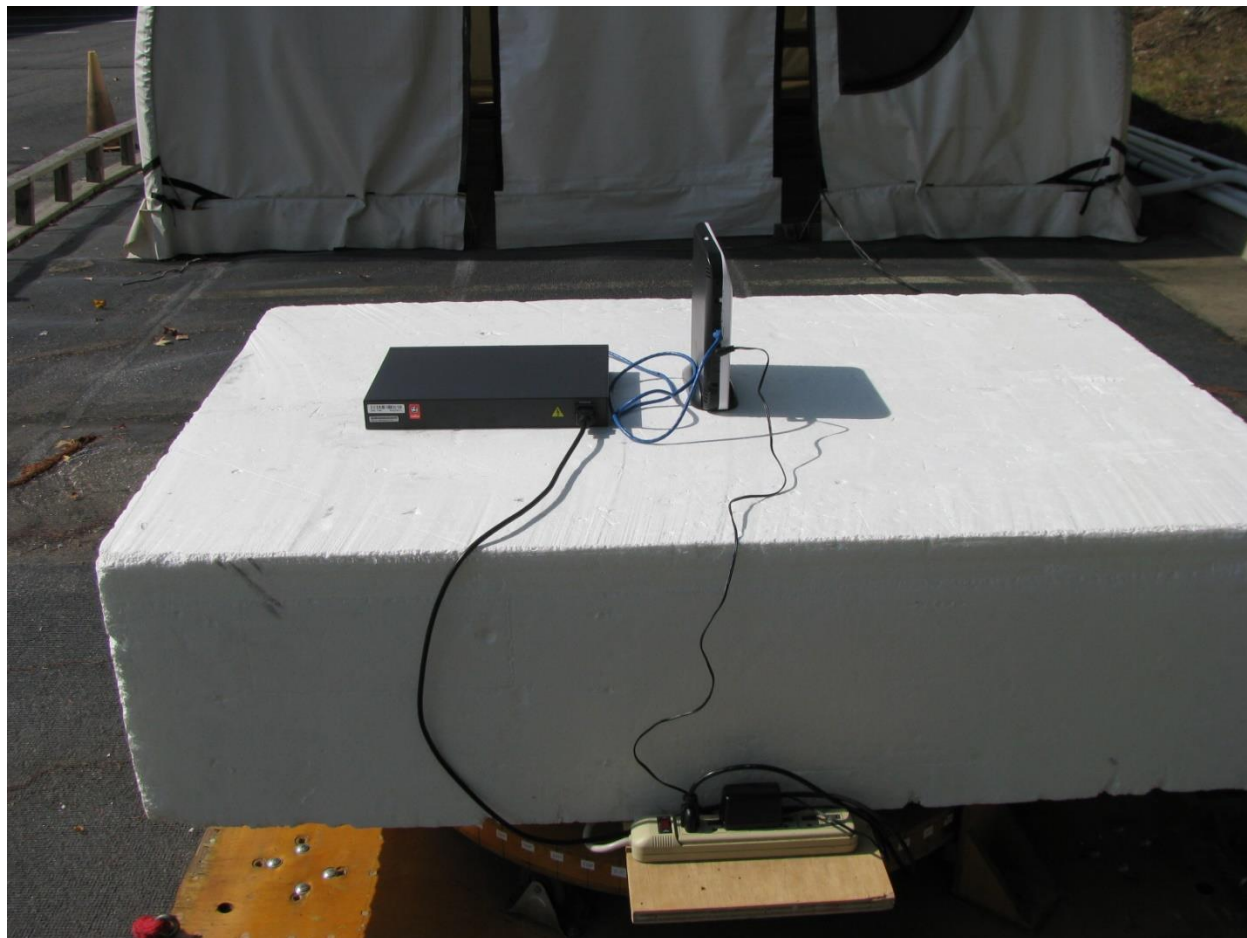
| Part Type                           | Manufacturer      | Model       | Serial Number | Barcode | Cal Due Date |
|-------------------------------------|-------------------|-------------|---------------|---------|--------------|
| <b>Conducted Emissions</b>          |                   |             |               |         |              |
| Spectrum Analyzer (100 Hz – 22 GHz) | Hewlett Packard   | 8566B       | 3138A07771    | 900930  | 4/21/2016    |
| Spectrum Analyzer Display Section   | Hewlett Packard   | 85662A      | 3144A20839    | 900931  | 4/21/2016    |
| Quasi-Peak Adapter                  | Hewlett Packard   | 85650A      | 2412A00414    | 900969  | 4/21/2016    |
| Filter                              | Solar             | 8130        | 947306        | 900729  | 3/26/2015    |
| 16A LISN                            | AFJ International | LS16/110VAC | 16010020080   | 901083  | 8/27/2014    |
| Test software                       | Quantum Change    | Tile!       | 4.0.A.8       | N/A     | N/A          |

### **Test Personnel:**

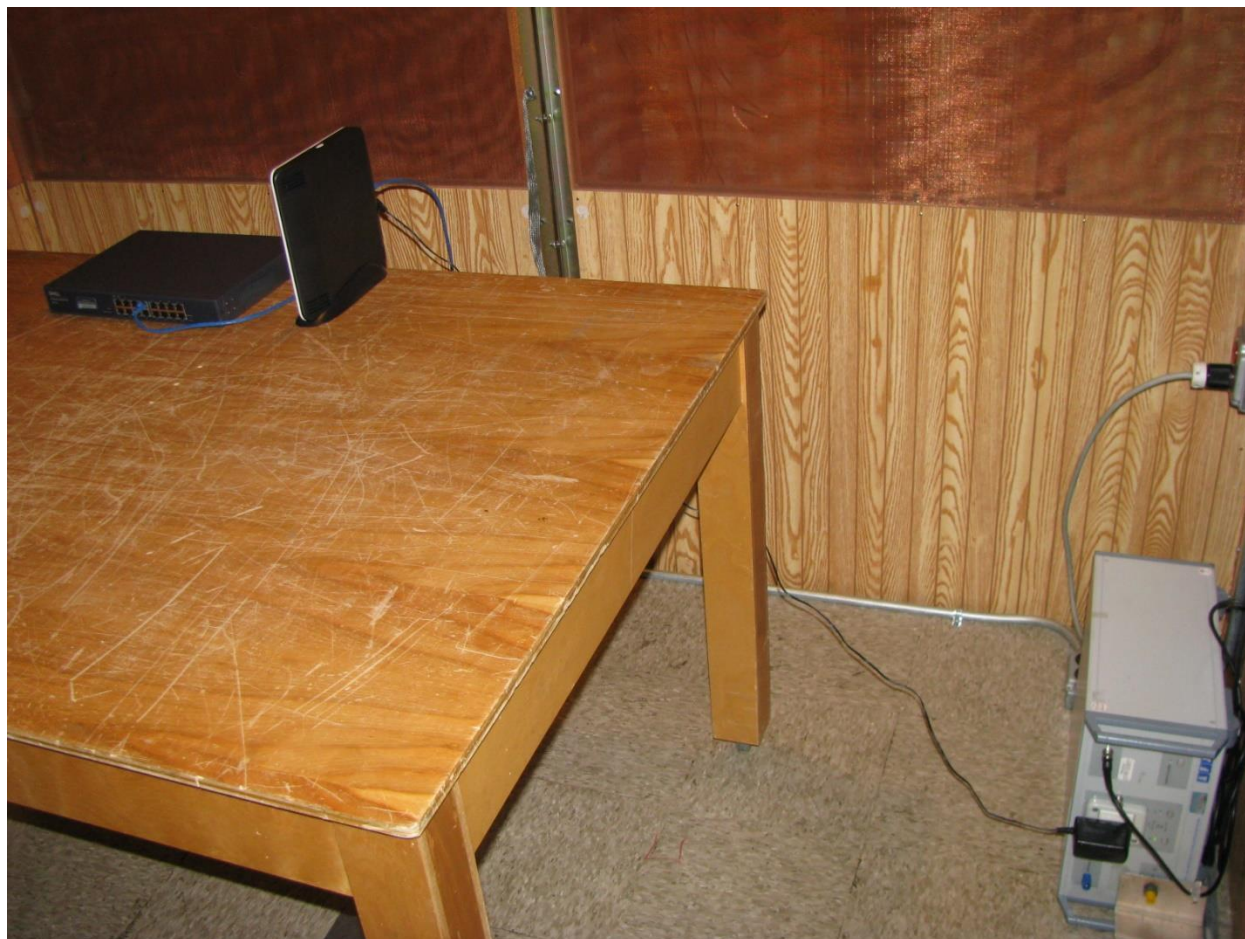
|               |                                                                                     |                 |
|---------------|-------------------------------------------------------------------------------------|-----------------|
| Jon Wilson    |  | August 12, 2014 |
| Test Engineer | Signature                                                                           | Date Of Test    |

## Test Configuration Photographs

### Radiated Emissions



### Conducted Emissions



### EUT Photograph

