# Nemko-CCL, Inc.

**1940 West Alexander Street**
**Salt Lake City, UT 84119**
**801-972-6146**


## Test Report

Certification

Test Of: WSG15-0DZ and WSG15-TDZ

FCC ID: QGH-WSG15

Test Specifications:

FCC Part 15, Subpart C

Test Report Serial No: 233247-3.2

Applicant:
Leviton Manufacturing Co., Inc.
201 North Service Road
Melville, NY 11747

Date of Test: March 19, 2013

Issue Date: March 20, 2013

Accredited Testing Laboratory By:

NVLAP

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.

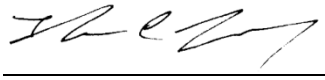
- Applicant: Leviton Manufacturing Co., Inc.
- Manufacturer: Leviton Manufacturing Co., Inc.
- Brand Name: Leviton
- Model Number: WSG15-0DZ and WSG15-TDZ
- FCC ID Number: QGH-WSG15

On this 20th day of March 2013, 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
General Manager

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## SECTION 1.0 CLIENT INFORMATION

### 1.1 Applicant:

Company Name: Leviton Manufacturing Co., Inc.
201 North Service Road
Melville, NY 11747

Contact Name: Frank Tse
Title: Manager

### 1.2 Manufacturer:

Company Name: Leviton Manufacturing Co., Inc.
20497 SW Teton Avenue
Tualatin, OR 97062

Contact Name: Ken Vannice
Title: Manager of Codes, Standards, and Compliance

## SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

### 2.1 Identification of EUT:

Brand Name: Leviton
Model Number: WSG15-0DZ and WSG15-TDZ
Serial Number: None

### 2.2 Description of EUT:

The WSG15-0DZ and WSG15-TDZ are AC outlets that have a 315 MHz transceiver that controls the outlet. WSG15-0DZ and WSG15-TDZ are installed in metal wall boxes. The WSG15-0DZ controls one of the two AC outlets where the WSG15-TDZ controls both outlets. The only difference in the devices is whether 2 outlets are connected to the control circuitry or only one. The 315 MHz transceiver uses a 6 ¼" metal wire as an antenna, routed in a slot in the plastic front case of the device.

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 233247-2.

### 2.3 EUT and Support Equipment:

| Brand Name<br>Model Number<br>Serial No. | FCC ID Number | Description | Name of Interface Ports / Interface Cables |
|---|---|---|---|
| BN: Leviton<br>MN: WSG15-0DZ<br>(Note 1)<br>SN: None | QGH-WSG15 | Wireless Controlled Outlet | See Section 2.4 |
| BN: Leviton<br>MN: WSG15-TDZ<br>(Note 1)<br>SN: None | QGH-WSG15 | Wireless Controlled Outlet | See Section 2.4 |
| BN: Wavetek<br>MN: Model 30<br>SN: 2269 | None | Device used as Load | AC In/3 conductor cord<br>(Note 2) |

Note: (1) EUT
(2) Interface port connected to EUT (See Section 2.4)

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 Descriptions/Length |
|---|---|---|
| AC In | 1 | 3 conductor power cord/1 meter |
| AC Out | 1 | 3 conductor extension cord/>3 meters |

## 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

(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 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 boundary between the frequency ranges.

| 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.

### 3.2.3 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 February 15, 2012 (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, 2013.

## SECTION 4.0 OPERATION OF EUT DURING TESTING

### 4.1 Operating Environment:

Power Supply: 120 VAC/60 Hz

### 4.2 Operating Mode:

The EUT was tested while constantly transmitting a signal at 315 MHz. The voltage to the transmitter was varied as required by §15.31(e) with no change seen in the transmitter characteristics.

### 4.3 EUT Exercise Software:

Internal test firmware 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 | 315.0 | Complied |
| 15.231 (b) | Radiated Emissions | 0.009 to 3150 | Complied |
| 15.231 (c) | Bandwidth | 315 | Complied |
| 15.231 (d) | Frequency Stability | 40.66 to 40.70 | Not Applicable |
| 15.231 (e) | Radiated Emissions | 30 to 3150 | 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

The antenna is a solid wire routed in the plastic housing and soldered to the PCB. It is not user replaceable.

**RESULT**

The EUT complied with the requirements of this section.

### 6.2.2 §15.207

| Frequency (MHz) | AC Mains Lead | Detector | Measured Level (dBμV) | Limit (dBμV) | Margin (dB) |
|---|---|---|---|---|---|
| 0.33 | Hot Lead | Quasi-Peak (Note 2) | 44.3 | 59.6 | -15.3 |
| 0.33 | Hot Lead | Average (Note 2) | 36.6 | 49.6 | -13.0 |
| 0.46 | Hot Lead | Quasi-Peak (Note 2) | 44.3 | 56.7 | -12.4 |
| 0.46 | Hot Lead | Average (Note 2) | 33.8 | 46.7 | -12.9 |
| 0.57 | Hot Lead | Quasi-Peak (Note 2) | 43.8 | 56.0 | -12.2 |
| 0.57 | Hot Lead | Average (Note 2) | 34.4 | 46.0 | -11.6 |
| 0.64 | Hot Lead | Quasi-Peak (Note 2) | 44.2 | 56.0 | -11.8 |
| 0.64 | Hot Lead | Average (Note 2) | 33.8 | 46.0 | -12.2 |
| 0.85 | Hot Lead | Quasi-Peak (Note 1) | 40.5 | 46.0 | -5.5 |
| 4.56 | Hot Lead | Quasi-Peak (Note 1) | 41.6 | 46.0 | -4.4 |
| 0.17 | Neutral Lead | Peak (Note 1) | 49.1 | 55.0 | -5.9 |
| 0.40 | Neutral Lead | Quasi-Peak (Note 1) | 41.4 | 47.8 | -6.4 |
| 0.60 | Neutral Lead | Quasi-Peak (Note 1) | 40.9 | 46.0 | -5.1 |
| 0.68 | Neutral Lead | Quasi-Peak (Note 1) | 40.7 | 46.0 | -5.3 |

| Frequency (MHz) | AC Mains Lead | Detector | Measured Level (dBµV) | Limit (dBµV) | Margin (dB) |
|---|---|---|---|---|---|
| 0.80 | Neutral Lead | Quasi-Peak (Note 1) | 39.7 | 46.0 | -6.3 |
| 1.89 | Neutral Lead | Peak (Note 1) | 40.0 | 46.0 | -6.0 |
| 2.97 | Neutral Lead | Peak (Note 1) | 41.9 | 46.0 | -4.1 |
| 4.56 | Neutral Lead | Quasi-Peak (Note 2) | 42.8 | 56.0 | -13.2 |
| 4.56 | Neutral Lead | Average (Note 2) | 41.2 | 46.0 | -4.8 |

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 by 4.1 dB.

## 6.2.3 §15.231 (a)

1. The EUT is manually activated.

2. The EUT is automatically activated when a 315 MHz signal is received. The EUT, when activated, transmits 3 pulsed emissions, each 1.24 ms in duration, in a 24.1 ms period. The EUT will wait for the rest of a 1 second period, and then transmit the 3 pulsed emissions again. The EUT will then wait to be retriggered before transmitting again.

3. The EUT does not transmit at regular predetermined intervals.

4. The EUT is not 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 EUT operates at 315 MHz, therefore; the field strength of the fundamental must be less than 6041.68 µV/m (75.6 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 (55.6 dBµV/m).

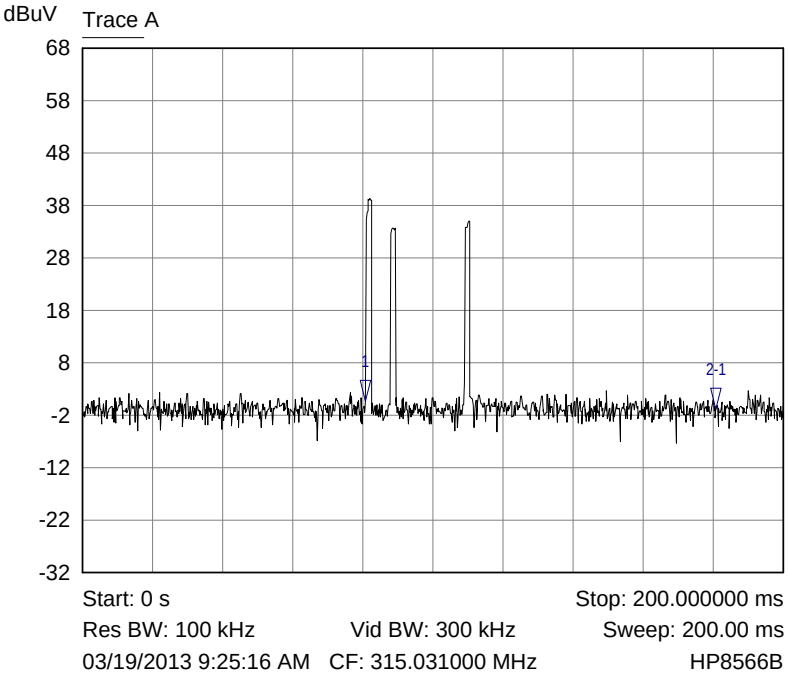
Emissions in the restricted bands of §15.205 must meet the limits specified in §15.209.

**Measurement Data Fundamental and Harmonic Emissions:**

The frequency range from the lowest frequency used in the device above 9 kHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any radiated emissions.

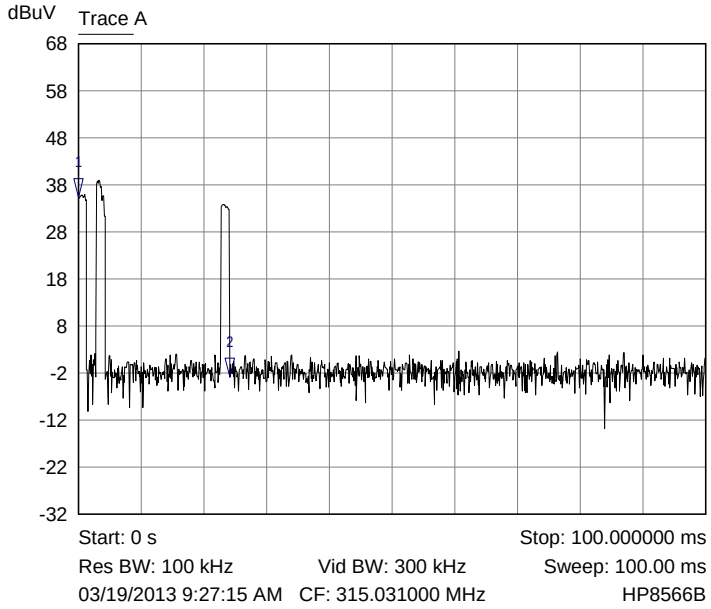
**Pulsed Emission Averaging Factor**

The EUT transmitter is a pulsed emission device using ASK (OOK) modulation; therefore, the method of §15.35 for averaging a pulsed emission may be used. Plots of the pulse train, and the average factor calculations are shown below:



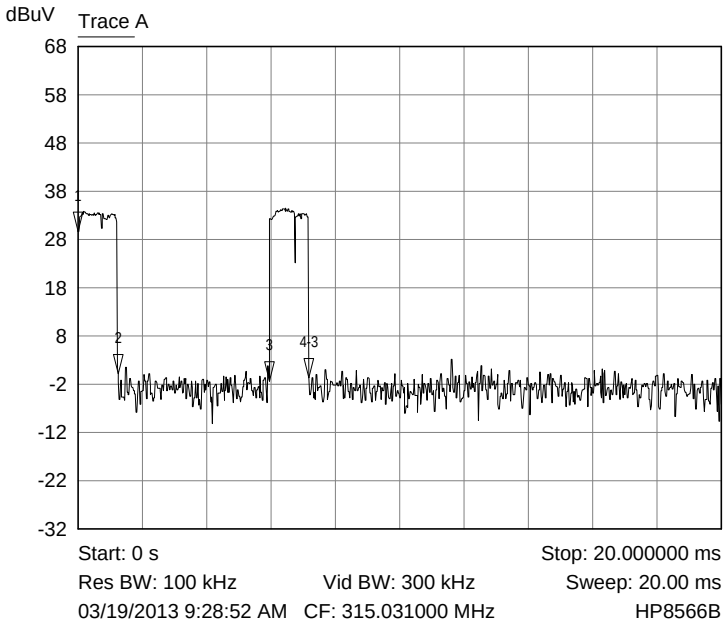

| Mkr | Trace | X-Axis | Value | Notes |
|---|---|---|---|---|
| 1 ▽ | Trace A | 80.800000 ms | 0.6000 dBuV | |
| 2-1 ▽ | Trace A | 100.000000 ms | -1.4000 dB | |

Trace A 200 ms plot




| Mkr | Trace | X-Axis | Value | Notes |
|---|---|---|---|---|
| 1 ▽ | Trace A | 0 s | 35.4000 dBuV | |
| 2 ▽ | Trace A | 24.100000 ms | -2.9000 dBuV | |

Trace A 100 ms




| Mkr | X-Axis | Value | Notes |
|---|---|---|---|
| 1 ▽ | 0 s | 29.7000 dBuV | |
| 2 ▽ | 1.240000 ms | 0.2000 dBuV | |
| 3 ▽ | 5.940000 ms | -1.3000 dBuV | |
| 4-3 ▽ | 1.240000 ms | 0.7000 dB | |

Trace A 20 ms

**Average factor calculation**

From the plots, the pulse train is greater than 100 ms in duration. The Average Factor will be calculated using 100 ms as specified in FCC §15.35(c). There are 3 pulsed emissions in the 100 ms time period.

The Average Factor is calculated by the equation:

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

Pulse train time = 100 ms per FCC §15.35(c)

On time = 3 pulses x 1.24 ms = 3.72 ms

Average Factor = 20 log (3.72 / 100)
= -28.6 dB

§15.35(b) specifies a 20 dB maximum between the peak and average measurements; therefore, a –20.0 dB averaging factor will be used.

**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) |
|---|---|---|---|---|---|---|---|
| 315 | Peak | 62.5 | -20.0 | 18.5 | 61.0 | 75.6 | -14.6 |
| 630 | Peak | 23.0 | -20.0 | 26.2 | 29.2 | 55.6 | -26.4 |
| 945 | Peak | 9.8 | -20.0 | 31.0 | 20.8 | 55.6 | -34.8 |
| 1260 | Peak | 19.5 | -20.0 | 27.2 | 26.7 | 55.6 | -28.9 |
| 1575* | Peak | 7.7 | -20.0 | 28.6 | 16.3 | 54.0 | -37.7 |
| 1890 | Peak | 16.3 | -20.0 | 30.2 | 26.5 | 55.6 | -29.1 |
| 2205* | Peak | 3.3 | -20.0 | 31.3 | 14.6 | 54.0 | -39.4 |
| 2520 | Peak | 8.0 | -20.0 | 32.1 | 20.1 | 55.6 | -35.5 |
| 2835* | Peak | 4.0 | -20.0 | 33.4 | 17.4 | 54.0 | -36.6 |
| 3150 | Peak | 7.2 | -20.0 | 34.4 | 21.6 | 55.6 | -34.0 |
| *** Emissions within restricted bands** | | | | | | | |

**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) |
|---|---|---|---|---|---|---|---|
| 315 | Peak | 67.3 | -20.0 | 18.5 | 65.8 | 75.6 | -9.8 |
| 630 | Peak | 22.3 | -20.0 | 26.2 | 28.5 | 55.6 | -27.1 |
| 945 | Peak | 11.4 | -20.0 | 31.0 | 22.4 | 55.6 | -33.2 |
| 1260 | Peak | 26.6 | -20.0 | 27.2 | 33.8 | 55.6 | -21.8 |
| 1575* | Peak | 12.8 | -20.0 | 28.6 | 21.4 | 54.0 | -32.6 |
| 1890 | Peak | 17.5 | -20.0 | 30.2 | 27.7 | 55.6 | -27.9 |
| 2205* | Peak | 5.2 | -20.0 | 31.3 | 16.5 | 54.0 | -37.5 |
| 2520 | Peak | 11.0 | -20.0 | 32.1 | 23.1 | 55.6 | -32.5 |
| 2835* | Peak | 7.5 | -20.0 | 33.4 | 20.9 | 54.0 | -33.1 |
| 3150 | Peak | 9.6 | -20.0 | 34.4 | 24.0 | 55.6 | -31.6 |
| *** Emissions within restricted bands** | | | | | | | |

**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

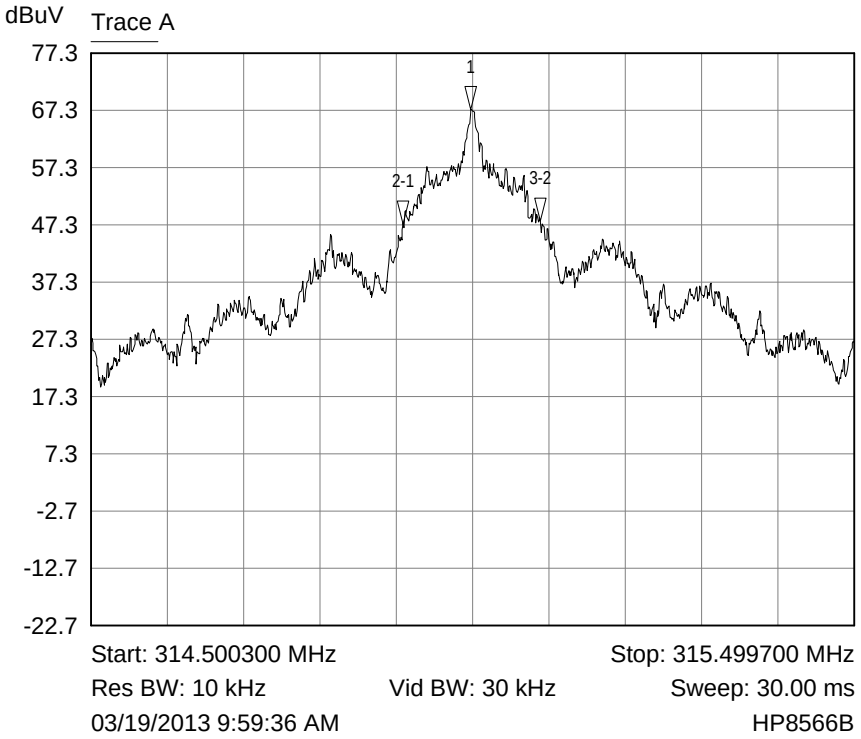
**RESULT**

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

## 6.2.5 §15.231 (c) Bandwidth

The bandwidth of the emission must not be wider than 0.25% of the center frequency. The center frequency is 315 MHz, therefore the bandwidth must not be wider than 787.5 kHz. The EUT bandwidth was 179.9 kHz. See spectrum analyzer plot below.

*Bandwidth Plot*




| Mkr | X-Axis | Value | Notes |
|---|---|---|---|
| 1 ▽ | 314.998001 MHz | 67.5000 dBuV | |
| 2-1 ▽ | -88.946600 kHz | -20.0000 dB | |
| 3-2 ▽ | 179.892000 kHz | 0.5000 dB | |

Trace A bandwidth

**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 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:

(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.

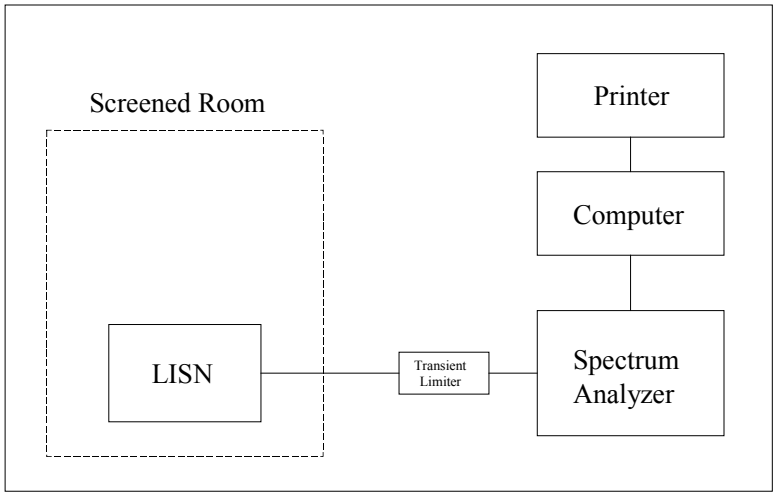
For AC mains port testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

| Type of Equipment | Manufacturer | Model Number | Serial Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| Wanship Open Area Test Site #2 | Nemko-CCL, Inc. | N/A | N/A | 12/07/2012 | 12/07/2013 |
| Test Software | Nemko-CCL, Inc. | Conducted Emissions | Revision 1.2 | N/A | N/A |
| Spectrum Analyzer | Hewlett Packard | 8566B | 2230A01711 | 02/06/2013 | 02/06/2014 |
| Quasi-Peak Detector | Hewlett Packard | 85650A | 2043A00137 | 02/06/2013 | 02/06/2014 |
| LISN | EMCO | 3825/2 | 9305-2099 | 03/12/2013 | 03/12/2014 |

| Type of Equipment | Manufacturer | Model Number | Serial Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| Conductance Cable Wanship Site #2 | Nemko-CCL, Inc. | Cable J | N/A | 12/21/2012 | 12/21/2013 |
| Transient Limiter | Hewlett Packard | 11947A | 3107A02266 | 12/21/2012 | 12/21/2013 |

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.

Conducted Emissions Test Setup



**A1.2 Radiated Disturbance:**

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

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 and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz, and a Pyramidal Horn antenna was used to measure the frequency range of 18 GHz to 25 GHz, at a distance of 3 meters and 1 meter from the EUT. The readings obtained by the antenna are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The intentional radiator was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cables were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there are 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 intentional radiators are measured on a non-conducting table 80 centimeters above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. 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. 40 dB per decade is used for frequencies below 30 MHz.

| Type of Equipment | Manufacturer | Model Number | Serial Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| Wanship Open Area Test Site #2 | Nemko-CCL, Inc. | N/A | N/A | 12/07/2012 | 12/07/2013 |
| Test Software | Nemko-CCL, Inc. | Radiated Emissions | Revision 1.3 | N/A | N/A |
| Spectrum Analyzer/Receiver | Rhode & Schwarz | ESU40 | 100064 | 07/28/2012 | 07/28/2013 |
| Spectrum Analyzer | Hewlett Packard | 8566B | 2230A01711 | 02/06/2013 | 02/06/2014 |
| Quasi-Peak Detector | Hewlett Packard | 85650A | 2043A00137 | 02/06/2013 | 02/06/2014 |
| Loop Antenna | EMCO | 6502 | 9111-2675 | 03/04/2013 | 03/04/2015 |
| Biconilog Antenna | EMCO | 3142 | 9601-1009 | 04/21/2011 | 04/21/2013 |
| Double Ridged Guide Antenna | EMCO | 3115 | 9409-4355 | 06/06/2012 | 06/06/2014 |
| Pyramidal Standard Gain Horn | EMC Test System | 3160-09 | 0003-1197 | 04/10/2009 | ICO |
| High Frequency Amplifier | Miteq | AFS4-01001800-43-10P-4 | 1096455 | 06/26/2012 | 06/26/2013 |
| 20’ High Frequency Cable | Microcoax | UFB197C-1-3120-000000 | 1297 | 05/14/2012 | 05/14/2013 |
| 3 Meter Radiated Emissions Cable Wanship Site #2 | Microcoax | UFB205A-0-4700-000000 | 1295 | 05/10/2011 | 05/10/2013 |
| Pre/Power-Amplifier | Hewlett Packard | 8447F | 3113A05161 | 08/27/2012 | 08/27/2013 |
| 6 dB Attenuator | Hewlett Packard | 8491A | 32835 | 12/21/2012 | 12/21/2013 |

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Radiated Emissions Test Setup