CURRENT Group, LLC
Report of Measurements
CURRENT Gateway-Bridge URD 6121

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1. General Information

Applicant: CURRENT Group, LLC

Applicant Address: 20420 Century Boulevard
Germantown, MD 20874
301-944-2700

Equipment: CURRENT Gateway-Bridge URD 6121

Equipment Description: The CURRENT Gateway-Bridge URD 6121 is part of an Access BPL system. It operates on underground public utility power lines over low-voltage and medium-voltage wires.

The CURRENT Gateway-Bridge URD 6121 is the device that routes and controls data traffic between the low- and medium-voltage lines. The CURRENT Gateway-Bridge serves as a gateway to all customers powered from the same distribution transformer as itself. It communicates over the medium-voltage lines via the CURRENT Coupler Assembly URD 6300 and over the low-voltage system by a standard 240V two-wire connection.

Test Operator: Robert Patrick

Dates of Testing: February 12, 2008 to February 29, 2008

Test Locations:
- 8608 Aqueduct Road – C-7053 (Potomac, Maryland),
- 12141 McDonald Chapel – A-9204 (Gaithersburg, Maryland)
- 12157 McDonald Chapel – A-7042 (Gaithersburg, Maryland)
- Washington Laboratories Open Area Test Site (Gaithersburg, Maryland)

Modes of Operation:
- LV: transmitting a high-density OFDM signal on the low voltage power line in the frequency range (4.4 MHz to 20.8 MHz) by galvanically connecting directly to it.
- MV: transmitting a high-density OFDM signal on the underground medium voltage cable using the CURRENT Coupler Assembly URD 6300 in the same frequency range as the LV above and also in the 31.4 to 47.9 MHz high band.

Applicable EMC Specification: FCC Part 15, Subpart G

Class of Service:
- Class A

2. Applicable Documents

Testing of emissions was performed in accordance with FCC requirements.

2.1 Federal Communication Commission (FCC), code of Federal Regulations 47, FCC docket 89-103, Part 15: Radio Frequency Devices, Subpart G, October 2005.

2.2 Federal Communication Commission (FCC), code of Federal Regulations 47, FCC docket 89-103, Part 15: Radio Frequency Devices, Section 15.109(b) and 15.209, October 2001.

2.3 FCC/OET, "FCC Procedure for Measuring Electromagnetic Emissions for Digital Devices", TP-5, March 1989.

2.4 Federal Communication Commission (FCC), Report and Order, FCC-04-245, Appendix C, Measurement Guidelines for Broadband Over Power Line (BPL) Devices or Carrier Current Systems (CCS) and Certification Requirements for Access BPL Devices, October 2004.

2.5 International Special committee on Radio Interference (CISPR) Publication 16, First Edition 1977, "CISPR Specification for Radio Interference Measuring, Apparatus and Measurement Methods".

2.6 American National Standard, "Interim Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz", ANSI C63.4, 2000.

3. Detailed Applicable EMC Requirements and Limits

The equipment was evaluated to Federal Communications Commission (FCC) requirements.

3.1 Conducted Limits

Conducted emissions limits do not apply to this Access BPL equipment.

3.2 Radiated Limits

The following radiated emissions limits apply:

Applicable Specification Reference	Frequency Range (MHz)	Class	Limit of Radiated Emissions		Measurement Distance (m)
			(µV/m)	(dBµV/m)	
FCC 15.107(c)(3), 15.109(c), 15.209	1.705 to 30	-	30	29.5	30
FCC 15.109	30 to 88	A	90	39.1	10
	88 to 216	A	150	43.5	10
	216 to 960	A	210	46.4	10
	960 and Above	A	300	49.5	10

Notes:

1. *The tighter limit shall apply at the edge between two frequency bands.*
2. *Distance refers to the distance in meters from measuring instrument antenna to the closest point of any part of the equipment under test.*

4. Procedures for Measuring RF Emissions

The following test procedures were used to measure RF emissions from the CURRENT Gateway-Bridge URD 6121.

4.1 AC Power Line Conducted Emissions Measurements

Conducted emissions limits do not apply to this Access BPL equipment.

4.2 Radiated Emissions Measurements

Measurements of radiated emissions were made using a spectrum analyzer and calibrated broadband antennas. Tests were performed in the following frequency ranges: 1.705 MHz to 30 MHZ, 30 MHz to 50 MHz, and 50 MHz to 1000 MHz. The CURRENT Gateway-Bridge URD 6121 was set and operated in a manner representative of actual use.

The CURRENT Gateway-Bridge URD 6121 and CURRENT Bridge URD 6111 are derivative products from a common set of circuit modules with identical layouts. The CURRENT Gateway-Bridge URD 6121 differs from the CURRENT Bridge URD 6111 only by the addition of a second OFDM modem and an upconverter circuit which generates the high band (31.4 to 47.9 MHz) signal set. Therefore, the data from the compliance testing of the CURRENT Bridge URD 6111 in the low band (4.4 to 20.8 MHz) and in the 50 to 1000 MHz range is directly applicable and is reproduced in this report for the CURRENT Gateway-Bridge 6121.

4.2.1 Radiated Emissions Measurement – 1.705 MHz to 30 MHz

In the frequency band 1.705 MHz to 30 MHz, the CURRENT Gateway-Bridge 6121 functions as an Access BPL device as described in FCC Rules, Sections 15.3(ff).

The CURRENT Bridge was installed in a residential neighborhood inside a utility transformer case. The CURRENT Bridge low voltage wires were connected to the power utility's low voltage power lines. The CURRENT Bridge medium voltage connector was connected to a CURRENT Coupler Assembly URD 6300 medium-voltage coupler, which was installed on the power utility's medium voltage power line.

The CURRENT Bridge was operated remotely using Access BPL services. The Access BPL control equipment is described in Section 5. Control equipment was connected to the CURRENT Bridge through public utility wiring. For measurements of radiated emissions in the 4.4 MHz to 20.8 MHz transmission band, the CURRENT Bridge was configured to continuously transmit simulated high-density data traffic over the low and medium voltage power lines at its maximum output power level.

The test antenna was placed on the ground at a distance of approximately 3 meters, measured horizontally, from the CURRENT Bridge and its associated transformer case. The antenna was kept at a fixed height of 1 meter. The antenna was moved to various locations around the CURRENT Bridge and transformer, with radial spacings of approximately 22.5°. The radiated emissions were measured at frequencies from 4.4 MHz to 20.8 MHz. All significant emissions were recorded.

At each test location during this initial sweep, the test antenna was rotated to find the orientation that resulted in maximum emissions. This antenna orientation was used for the remainder of emissions measurements at that antenna location. Small frequency ranges (typically 5 MHz) were spanned in order to increase resolution and to make it easier to identify emissions emanating from the CURRENT Bridge. The spectrum analyzer was set to peak detection mode with the resolution bandwidth set to 9 kHz.

Quasi-peak measurements were made at each significant emission recorded during the initial sweep. For the quasi-peak measurements, the spectrum analyzer was set to quasi-peak detection and tuned to the recorded emission frequency using a narrow frequency span.

The horizontal distance from the antenna to the transformer case was used as the measurement distance. Measurements were compared to the limits given in Section 3.2, after correcting them for distance using an extrapolation factor of 40 dB/decade.

All significant emissions are reported in Appendix A of this report.

4.2.2 Radiated Emissions Measurement – 30 MHz to 50 MHz

In the frequency band 30 MHz to 50 MHz, the CURRENT Gateway-Bridge URD 6121 functions as an Access BPL device as described in FCC Rules, Sections 15.3(ff). The radiated emissions were measured at three separate installation sites, as required under the rules. Measurements were made with the transmit power set to its maximum output power level.

The CURRENT Gateway-Bridge was installed in a residential neighborhood inside a utility transformer case. The CURRENT Gateway-Bridge low voltage wires were connected to the power utility's low-voltage power lines. The CURRENT Gateway-Bridge medium voltage connector was connected to a CURRENT Coupler Assembly URD 6300, which was installed on the power utility's medium voltage power line.

The CURRENT Gateway-Bridge was operated remotely using Access BPL services. The Access BPL control equipment is described in Section 5. Control equipment was connected to the CURRENT Gateway-Bridge through public utility wiring. For measurements of radiated emissions associated with the MV-signal (31.4 MHz to 47.9 MHz), the CURRENT Gateway-Bridge was configured to continuously transmit simulated high-density data traffic over the medium-voltage power-line at its maximum output power level.

The test antenna was placed on the ground at a distance of approximately 3 meters, measured horizontally, from the CURRENT Gateway-Bridge and its associated transformer case. The antenna height during this initial sweep was kept at a fixed height of 1 meter. The antenna was moved to various locations around the CURRENT Gateway-Bridge and transformer, with radial spacing of approximately 22.5°. The MV-signal radiated emissions were measured at frequencies from 31.4 MHz to 47.9 MHz. All significant emissions were recorded.

At each test location during this initial sweep, the test antenna polarity was changed to find the orientation that resulted in maximum emissions. This antenna orientation was used for the remainder of emissions measurements at that antenna location. Small frequency ranges (typically 5 MHz) were spanned in order to increase resolution and to make it easier to identify emissions emanating from the CURRENT Gateway-Bridge. The spectrum analyzer was set to peak detection mode with the resolution bandwidth set to 120 kHz.

Quasi-peak measurements were made at each significant emission recorded during the initial sweep. For the quasi-peak measurements, the spectrum analyzer was set to quasi-peak detection and tuned to the recorded emission frequency using a narrow frequency span.

The horizontal distance from the antenna to the transformer case was used as the measurement distance. Measurements were compared to the limits given in Section 3.2, after correcting them for distance using an extrapolation factor of 20 dB/decade.

All significant emissions are reported in Appendix A of this report.

4.2.3 Radiated Emissions Measurement – 50 MHz to 1000 MHz

Because of the nature of this equipment, radiated emissions above 50 MHz were measured in two stages. The first stage was to measure emissions at an Open Area Test Site using a simulated installation of the CURRENT Bridge. The controlled conditions in the laboratory environment allowed any and all frequencies, from 50 MHz to 1000 MHz, radiating from the CURRENT Bridge to be observed and measured. The second stage was to measure emissions from the CURRENT Bridge in actual installations. Since ambient conditions at the actual installation sites prevented being able to perform a complete frequency sweep, measurements were made only at the specific radiating frequencies discovered in stage one testing.

4.2.3.1 Radiated Emissions Measurement – 50 MHz to 1000 MHz – Stage One

The CURRENT Bridge was mounted on a wooden table or stand in the same position in which it would be mounted in an actual installation. The stand positions the device under test (DUT) at a height above the ground plane of 0.8 meter. The power leads from the device were connected to the laboratory power source through a LISN. The device's medium voltage connections were terminated with standard 4' coaxial cables and 75-ohm resistors.

The CURRENT Bridge was operated remotely using a controlling computer and a commercially available power line modem. The control equipment is described in Section 5. Control equipment was connected to the DUT through the LISN. For measurements of radiated emissions above 50 MHz, the CURRENT Bridge was configured to continuously transmit simulated high-density data traffic over both the low-voltage and medium-voltage connections at the maximum output power levels.

The DUT was placed on a turntable at the Open Area Test Site. The test antenna was placed at a distance of 3 meters from the DUT and the radiated emissions were measured. The DUT was rotated in a complete circle while the spectrum analyzer performed a maximum-hold of measured emissions. All significant emissions were recorded.

During this initial sweep, the test antenna was installed on the antenna mast in the horizontal polarity at a height of 1 meter. Small frequency ranges (typically 100 MHz) were spanned in order to increase resolution and aid in the identification of emissions emanating from the DUT. The spectrum analyzer was set to peak detection mode with the resolution bandwidth set to 120 kHz.

Quasi-peak measurements were made at each emission recorded in the initial sweep. For the quasi-peak measurements, the spectrum analyzer was set to quasi-peak detection and tuned to the recorded emission frequency using a large frequency span. The frequency span was then reduced while keeping the spectrum analyzer's center frequency tuned to the emission's peak. The DUT was then rotated in a full circle to determine the direction of maximum emission. Further maximization of the emission was done by changing the height of the antenna from 1 meter to 4 meters.

The initial sweep to identify frequencies with significant emissions and the subsequent quasi-peak measurement process was repeated with the antenna in the vertical polarity.

All significant emissions are reported in Appendix A of this report.

4.2.3.2 Radiated Emissions Measurement – 50 MHz to 1000 MHz – Stage Two

The CURRENT Bridge was installed in a residential neighborhood inside a utility transformer case. The CURRENT Bridge low voltage wires were connected to the power utility's low-voltage power lines. The CURRENT Bridge medium voltage connector was connected to a CURRENT Group URD medium voltage coupler, model number CURRENT Coupler Assembly URD 6300, which was installed on the power utility's medium-voltage power line.

The CURRENT Bridge was operated remotely using Access BPL services. The Access BPL control equipment is described in Section 5. Control equipment was connected to the CURRENT Bridge through public utility wiring. For measurements of radiated emissions above 50 MHz, the CURRENT Bridge was configured to continuously transmit simulated high-density data traffic over both the low voltage and medium voltage connections at the maximum output power levels.

The test antenna was placed on the ground at a distance of 3 meters, measured horizontally, from the CURRENT Bridge and its associated transformer case. The antenna height during this initial sweep was kept at a fixed height of one (1) meter. The antenna was moved to various locations around the DUT with radial spacing of approximately 22.5°. The radiated emissions were measured at the frequencies discovered in stage one testing. All significant emissions were recorded.

During this initial sweep, the test antenna was installed on the antenna mast in the horizontal polarity. The analyzer was tuned to the desired frequency with a small frequency span (typically 200 kHz or less). The spectrum analyzer was set to peak detection mode with the resolution bandwidth set to 120 kHz. The sweep was repeated with the antenna set to the vertical polarity.

Quasi-peak measurements were made at each significant emission recorded during the initial sweep. For the quasi-peak measurements, the spectrum analyzer was set to quasi-peak detection and tuned to the recorded emission frequency using a narrow frequency span. Maximization of the emission was done by changing the height of the antenna from 1 meter to 4 meters in 0.5 meter increments.

The horizontal distance from the antenna to the transformer case was used as the measurement distance. Measurements were compared to the limits given in Section 3.2, after correcting them for distance using an extrapolation factor of 20 dB/decade.

All significant emissions are reported in Appendix A of this report.

5. System Test Configuration

Figure 1 shows the system configuration that was used for testing. Using Access BPL services, a manufacturing command was sent from the controller to the CURRENT Gateway-Bridge URD 6121, configuring it to continuously transmit simulated high-density data traffic over the low-voltage and medium-voltage connections at maximum output power levels.

In the laboratory, where a medium-voltage power line was not available, the controller was connected to the test configuration through a LISN and through the low-voltage power connection. An appropriate amount of attenuation was used to ensure that the HomePlug BPL modem's signal did not affect the desired measurement. During field testing, attenuation of signals from control devices was naturally provided by distance.

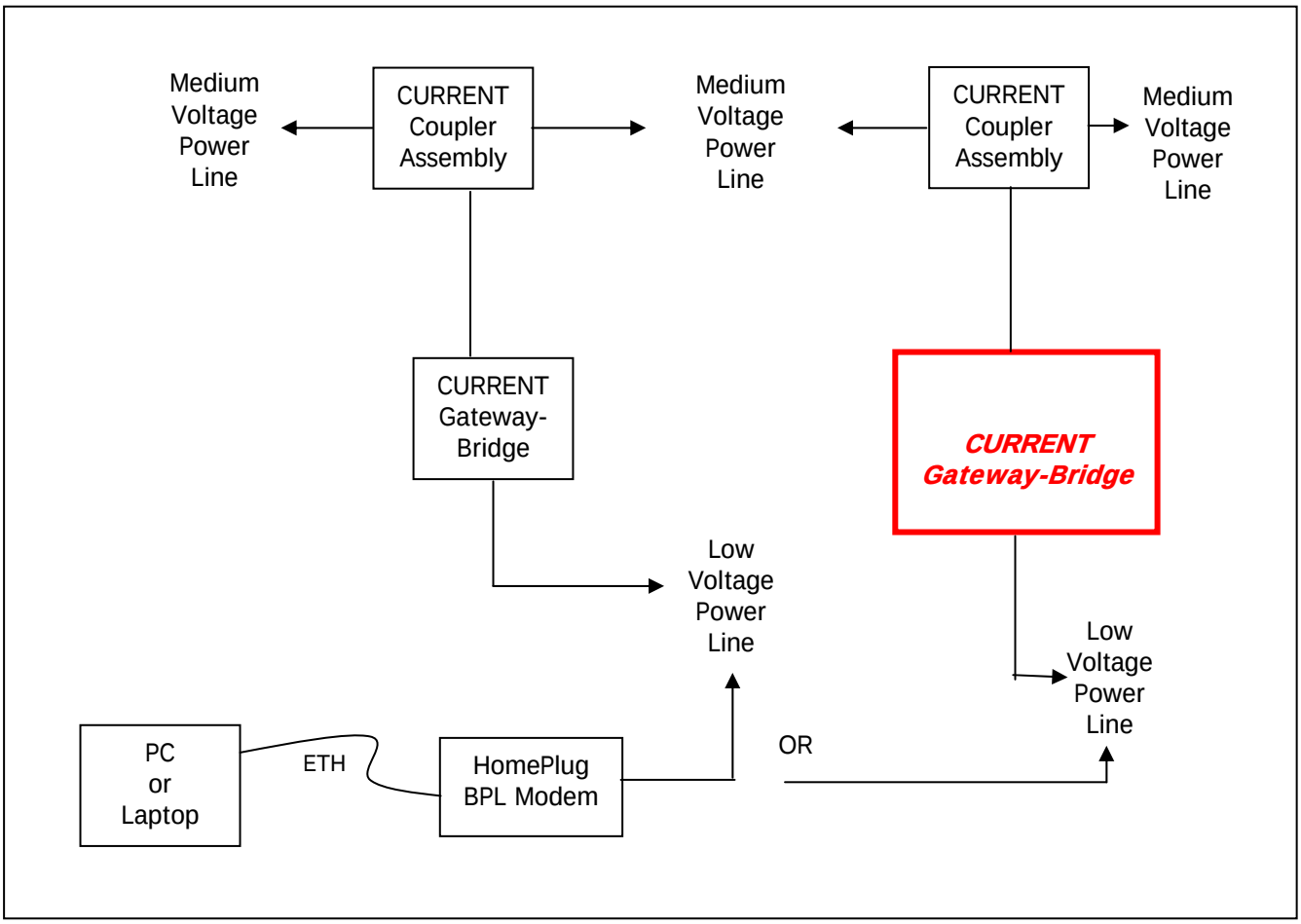

Figure 1: System Test Configuration

6. Equipment Modifications

The equipment tested was the latest version as of the date it was tested. There were no modifications necessary for compliance.

7. Description of the Test Sites

Radiated emissions tests were conducted at three different field locations and one third party lab location. A description of each location is given below. A list of the testing performed at each location is included in the descriptive information for that location

CURRENT Potomac Test Area – C-7053

Location:	8608 Aqueduct Road Potomac, MD
Site Description:	System installation inside a utility transformer case in a residential neighborhood. The transformer case is located next to a residential street and is equipped with a low-voltage wires and medium-voltage wires.
Site Diagrams:	See Figure 2, below. See Figure 3, below.
Site Photos:	See Photographs B-1 and B-2 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 1.705 MHz to 30 MHz, on February 7, 2008 ▪ Radiated Emissions, 50 MHz to 1000 MHz, on February 29, 2008

Figure 2: Test Site Diagram – CURRENT Potomac Test Area – C-7053

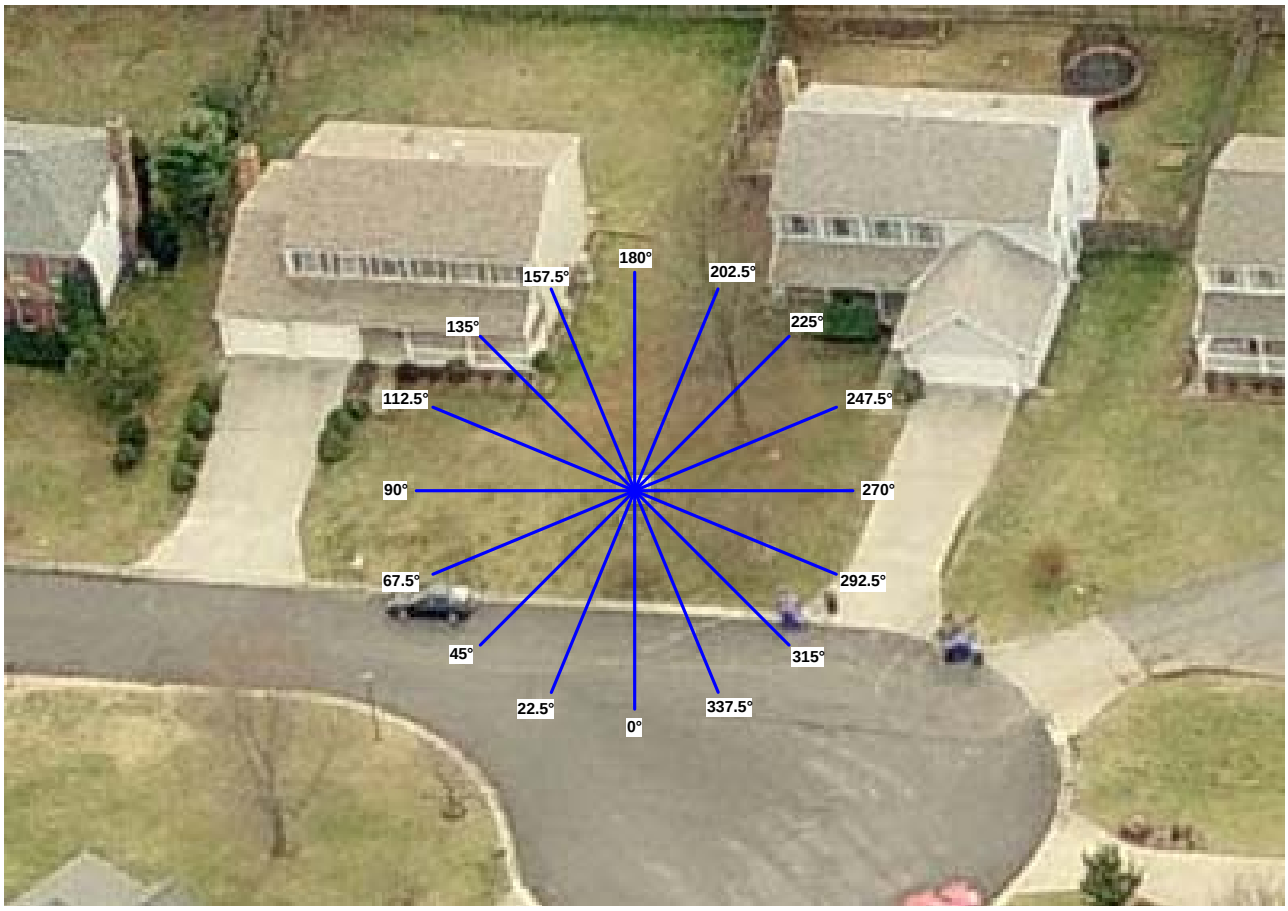

Figure 3: Test Site Orientation – CURRENT Potomac Test Area – C-7053

CURRENT Gaithersburg Test Area – A-9204

Location:	12141 McDonald Chapel Gaithersburg, MD
Site Description:	System installation inside a utility transformer case in a residential neighborhood. The transformer case is located next to a residential street and is equipped with low-voltage wires and medium-voltage wires.
Site Diagrams:	See Figure 4, below. See Figure 5, below.
Site Photos:	See Photographs B-3 and B-4 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 1.705 MHz to 30 MHz, on February 22, 2008 ▪ Radiated Emissions, 50 MHz to 1000 MHz, on February 27, 2008

Figure 4: Test Site Diagram – CURRENT Gaithersburg Test Area – A-9204

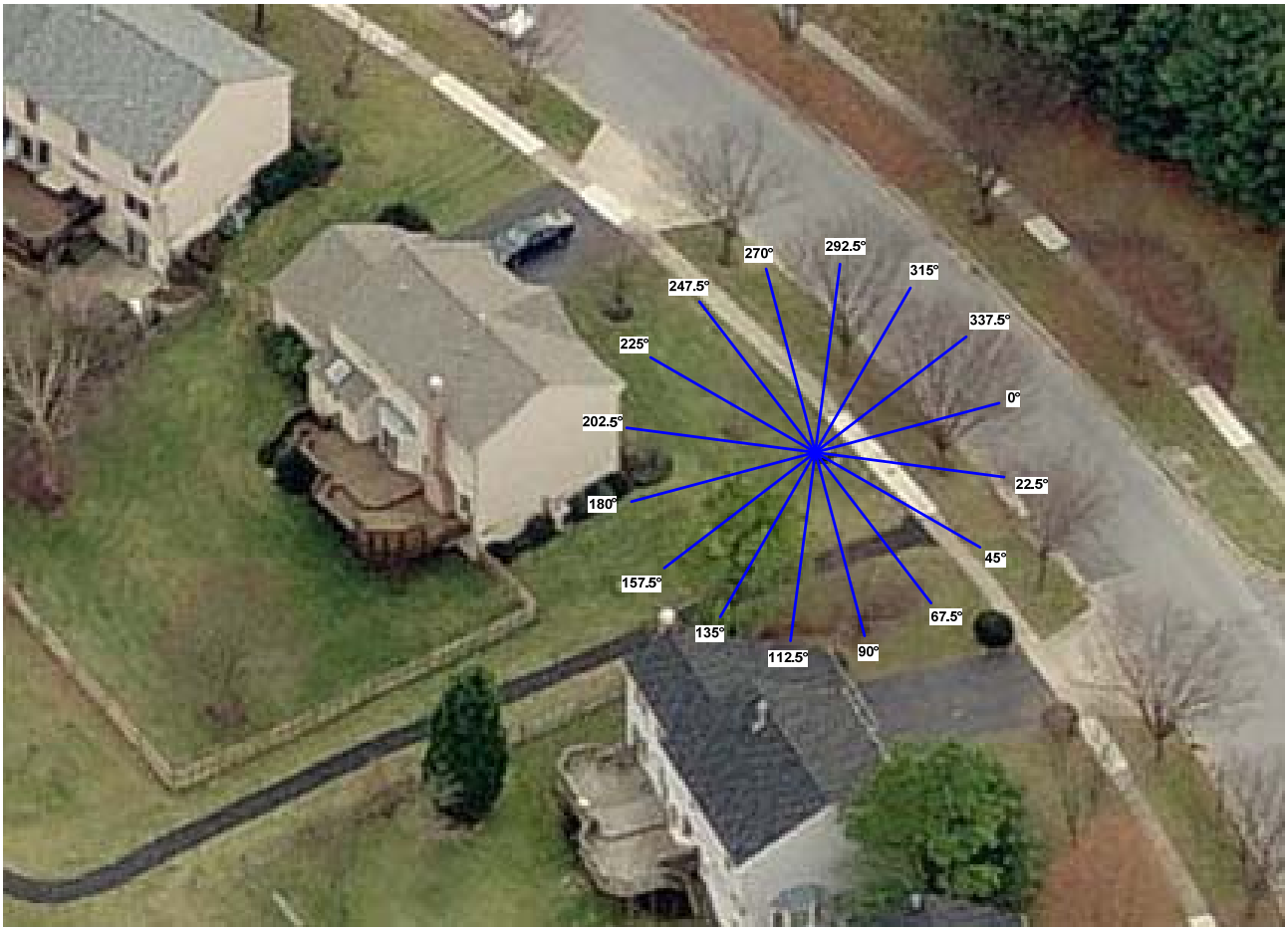

Figure 5: Test Site Orientation – CURRENT Gaithersburg Test Area – A-9204

CURRENT Gaithersburg Test Area – A-7042

Location:	12157 McDonald Chapel Gaithersburg, MD
Site Description:	System installation inside a utility transformer case in a field. The transformer case is located in the middle of the field and is equipped with medium-voltage wires.
Site Diagrams:	See Figure 6, below. See Figure 7, below.
Site Photos:	See Photographs B-5 and B-6 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 1.705 MHz to 30 MHz, on February 23, 2008

Figure 6: Test Site Diagram – CURRENT Gaithersburg Test Area – A-7042

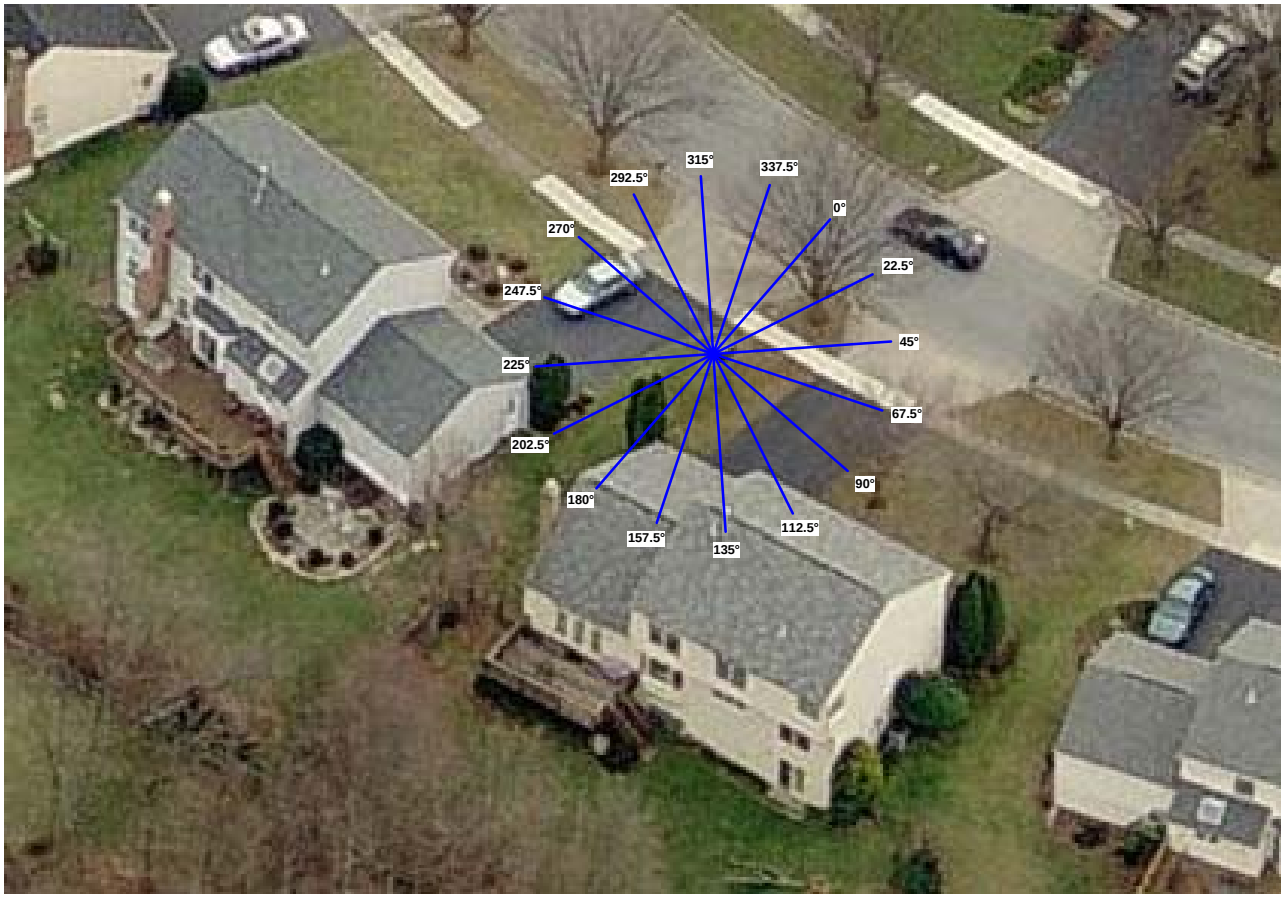

Figure 7: Test Site Orientation – CURRENT Gaithersburg Test Area – A-7042

Washington Laboratories Open Area Test Site

Location:	Washington Laboratories 7560 Lindbergh Drive Gaithersburg, MD
Site Description:	Simulated system installation at an Open Area Test Site. The CURRENT Gateway-Bridge URD 6121 was mounted on a wooden platform in approximately the same position in which it would be mounted in the field, at a height of approximately 0.8 meter above the floor. The medium-voltage connections were terminated with 4' coaxial cables and 50-ohm resistors. The cables were arranged in a way that was representative of the way they would be arranged in an actual installation.
Site Diagram:	See Figure 8, below.
Tests Performed at this Location:	▪ Radiated Emissions, 30 MHz to 1000 MHz, on February 12, 2008

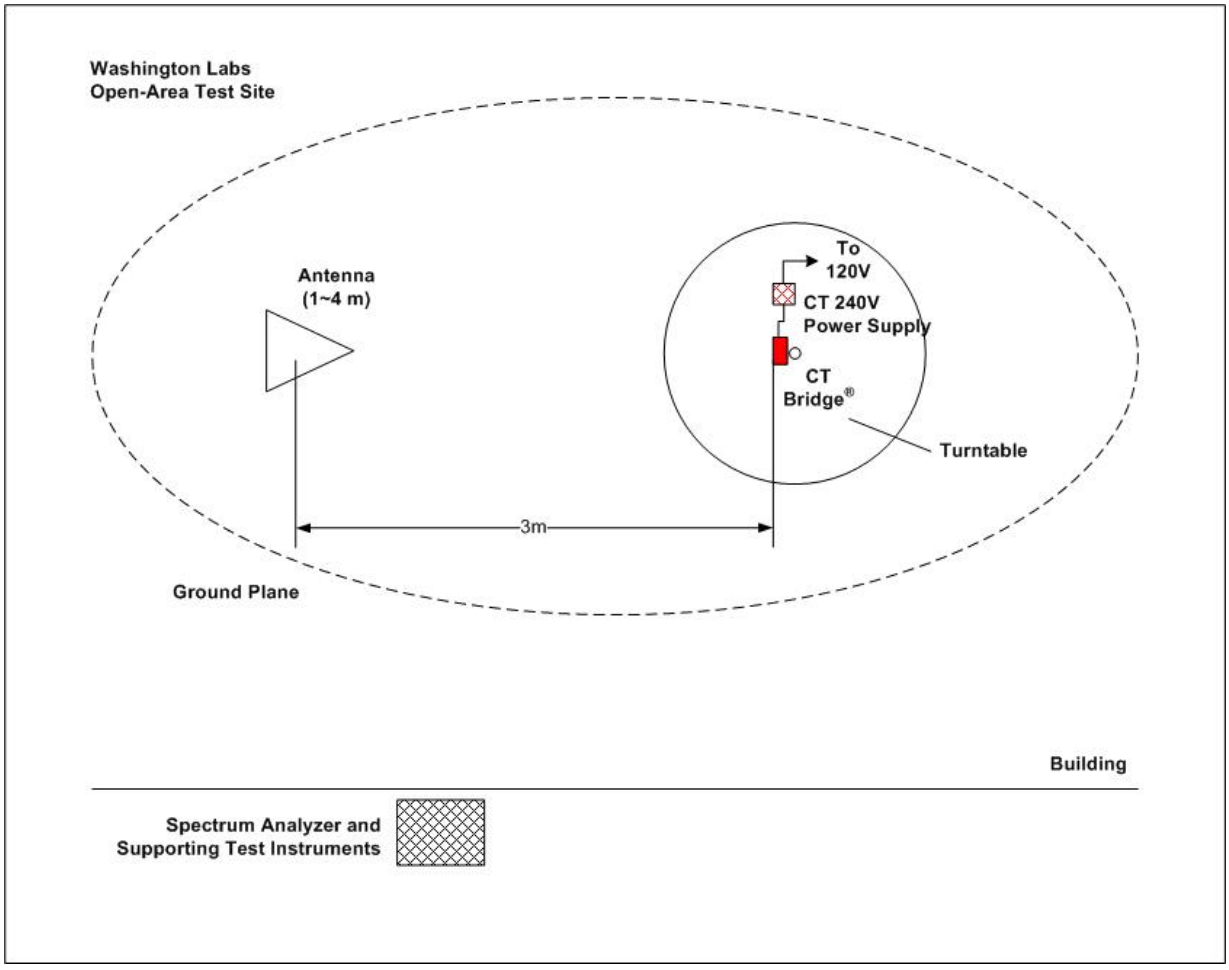

Figure 8: Test Site Diagram – Washington Laboratories Open Area Test Site

8. List of Test Equipment Used

The following is a list of test equipment used during testing.

Radiated Emissions Measurement – 1.705 MHz to 30 MHz

Description	Manufacturer and Model Number	Serial Number and Identification Number	Calibration Due Date
EMC Analyzer	HP E7402A	MY44212893	May 29, 2008
Antenna, Passive Loop (10 kHz to 30 MHz)	EMCO 6512	00051987	November 29, 2007
RF Cable, 125'	RG-58	CT #125	January 12, 2009

Radiated Emissions Measurement – 30 MHz to 1000 MHz – Stage One

Description	Manufacturer and Model Number	Serial Number and Identification Number	Calibration Due Date
Spectrum Analyzer	HP 8568B	WL #00073	July 7, 2008
Quasi-Peak Adapter	HP 85650A	WL #00069	July 7, 2008
RF Pre-Selector (w/ OPT 8ZE)	HP 85685A	WL #00071	July 7, 2008
Antenna, Biconlog	Sunol JB1	WL #00644	November 27, 2009

Radiated Emissions Measurement – 30 MHz to 1000 MHz – Stage Two

Description	Manufacturer and Model Number	Serial Number and Identification Number	Calibration Due Date
EMC Analyzer	HP E7402A	MY44212893	May 29, 2008
Antenna, Log-Periodic (290 MHz to 2000 MHz)	A.H. Systems SAS-200/510	784	November 7, 2007
Antenna, Biconical (20 MHz to 330 MHz)	A.H. Systems SAS-200/540	573	November 29, 2007
RF Cable, 100' RF Cable, 30'	RG-58 RG-58	CT #125 CT #30B	January 12, 2009 January 12, 2009

9. EMI Test Results

EMI test results for both conducted and radiated emissions measurements are summarized below.

9.1 Conducted Emission Data

Conducted emissions limits do not apply to this Access BPL equipment

9.2 Radiated Emission Data

The final level of the radiated emission, in dBµV/m, is calculated by taking the reading from the spectrum analyzer (in dBµV) and adding the appropriate correction factors (antenna, cable loss, external pre-amplifier, filter, etc.). A distance correction factor is then added to compensate for the actual measurement distance being different from the specified measurement distance. The difference between this result and the FCC limit is calculated, giving the margin of compliance, as shown in Appendix A.

The field strength was calculated using the formula:

$$E(dB\mu V/m) = Vrec(dB\mu V) + AF(dB/m) + CL(dB)$$

Where Vrec is the voltage detected voltage by the spectrum analyzer, AF is the antenna factor at the specified frequency, and CL is the insertion loss on the RF cable which is connected between the antenna and the spectrum analyzer.

Conclusion: The CURRENT Gateway-Bridge URD 6121 meets the FCC limits for radiated emissions from Access BPL devices in the frequency range 1.705 MHz to 30 MHz when actively transmitting LV signals (4.4 MHz to 20.8 MHz). In this operation mode, and over this frequency range, the minimum passing margin was 3.89 dB.

The CURRENT Bridge 6121 meets the FCC limits for radiated emissions from Access BPL devices in the frequency range 30 MHz to 50 MHz when actively transmitting MV signals (31.4 MHz to 47.9 MHz). In this operation mode, and over this frequency range, the minimum passing margin was 10.6 dB.

The CURRENT Gateway-Bridge URD 6121 meets the Part 15 Class A radiated emission requirements over the frequency range 50 MHz to 1000 MHz. Over this frequency range, the minimum passing margin was 17.1 dB.