CURRENT Technologies, LLC
Report of Measurements
CT Bridge® URD 5000r

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1. General Information

Applicant:	CURRENT Technologies, LLC
Applicant Address:	20420 Century Boulevard Germantown, MD 20874 301-944-2700
Equipment:	CT Bridge® URD 5000r
Equipment Description:	The CT Bridge URD 5000r is part of an Access BPL system. It operates on underground public utility power lines over low-voltage and medium-voltage wires. The CT Bridge URD 5000r is the device that routes and controls data traffic between the low- and medium-voltage lines. The CT 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 CT Coupler® and over the low-voltage system by a standard 240V two-wire connection.
Modification Description:	Small carrier-by-carrier amplitude adjustments were made to flatten the MV-side transmit spectrum across the operating band. Overall transmit power was also adjusted slightly to bring the resulting flat spectrum into compliance.
Test Operator:	Steve Seymour
Dates of Testing:	August 15, 2007 to August 16, 2007
Test Locations:	CURRENT Technologies Field Research and Test Area (Urbana, Maryland)
Modes of Operation:	MV Active: transmitting high-density OFDM signal on Medium-Voltage power line (31.4 MHz to 47.9 MHz)
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 CT Bridge URD 5000r.

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 a calibrated broadband antenna. Tests were performed in the frequency range 30 MHz to 50 MHz. Radiated emissions in the frequency range 1.705 MHz to 30 MHZ, and in the frequency range 50 MHz to 1000 MHz are unaffected by the changes being considered. The CT Bridge URD 5000r was set and operated in a manner representative of actual use.

4.2.1. Radiated Emissions Measurement – 1.705 MHz to 30 MHz

Radiated emissions in the frequency range 1.705 MHz to 30 MHz were unaffected by the changes being considered.

4.2.2. Radiated Emissions Measurement – 30 MHz to 50 MHz

In the frequency band 30 MHz to 50 MHz, the CT Bridge URD 5000r functions as an Access BPL device as described in FCC Rules, Sections 15.3(ff). The radiated emissions were measured at three separate, representative installation sites as required under the rules. Measurements were made with the transmit power set to its maximum output power level and at the highest possible duty cycle.

The CT Bridge was installed in a power-utility transformer case. The bridge's low-voltage wires were connected to the low-voltage power lines. The bridge's medium-voltage connectors were connected to a CURRENT Technologies URD medium-voltage coupler, model number CT Coupler® URD 5000r, which was installed on the power utility's medium-voltage power lines.

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

The test antenna was placed on the ground at a distance of 10 meters, measured horizontally, from the CT 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 CT Bridge and transformer, with radial spacings 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 CT 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 0-Hz 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.

4.2.3. Radiated Emissions Measurement – 50 MHz to 1000 MHz

Radiated emissions in the frequency range 50 MHz to 1000 MHz were unaffected by the changes being considered.

5. System Test Configuration

Figure 1 shows the system configuration that was used for testing. Using Access BPL services, a software command was sent from the controller to the CT Bridge, configuring it to continuously transmit simulated high-density data traffic over the medium-voltage connections at maximum output power levels and at the highest possible duty cycle.

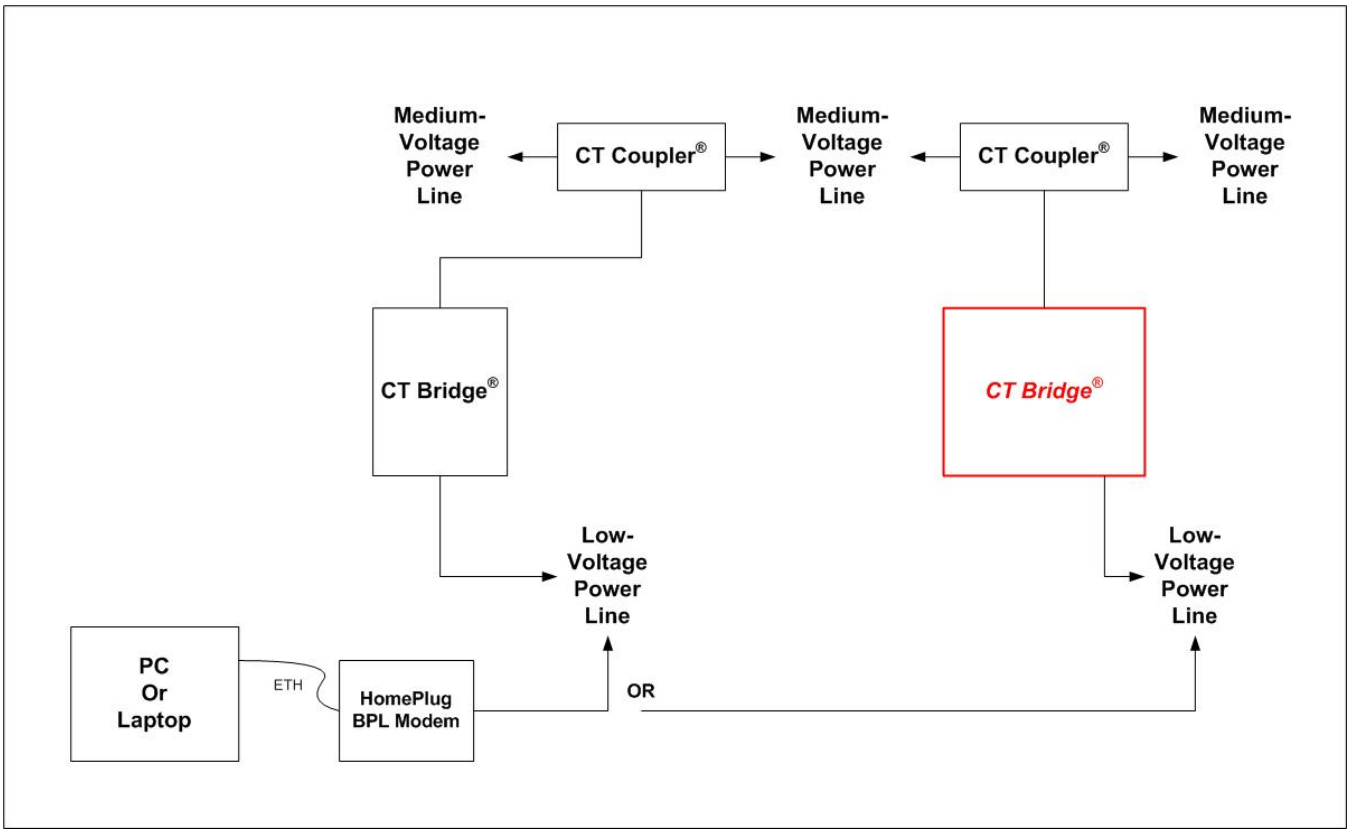

Figure 1: System Test Configuration

5.1. Description of Test Signal and Power Levels

Data traffic was generated using an embedded software application ('nuttcp') to ensure that transmit signals were consistently generated at the maximum possible duty factor. This application was originally designed for network performance measurement and is ideal for emissions testing since it generates a continuous stream of data from the unit under test to a receiving unit. The '-u' parameter was used to provide UDP traffic from the unit under test, since that eliminates the need for the receiving device to generate IP layer acknowledgement packets and thereby increases the duty factor to the absolute maximum.

For the purposes of this testing (i.e. establishing compliance), individual carrier amplitudes and the overall transmit power level on the medium-voltage output connectors was adjusted via embedded software using commands that are available ONLY during product development. These commands are NOT available during normal operation and power levels cannot be subsequently adjusted to levels other than those established during this testing in the field. All of the data shown in Appendix A was taken with the final values and all equipment will be shipped with these values immutably set in the embedded code.

6. Equipment Modifications

The equipment tested was the latest version as of the date it was tested. All equipment shipped under this authorization will have the software variables defining the carrier amplitudes and overall transmit level immutably set at the final values determined per the discussion in Section 5.1 above.

7. Description of the Test Sites

Radiated emissions testing was performed at three different representative installations. 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 Technologies Field Research and Test Area – XFMR DX-2

Location:	3280 Urbana Pike Urbana, MD
Site Description:	System installation inside a utility transformer case in a field research and test area. The transformer case is equipped with medium-voltage wires.
Site Diagrams:	See Figure 2, below.
Site Photos:	See Photographs B-1 and B-2 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 30 MHz to 50 MHz, on August 16, 2007

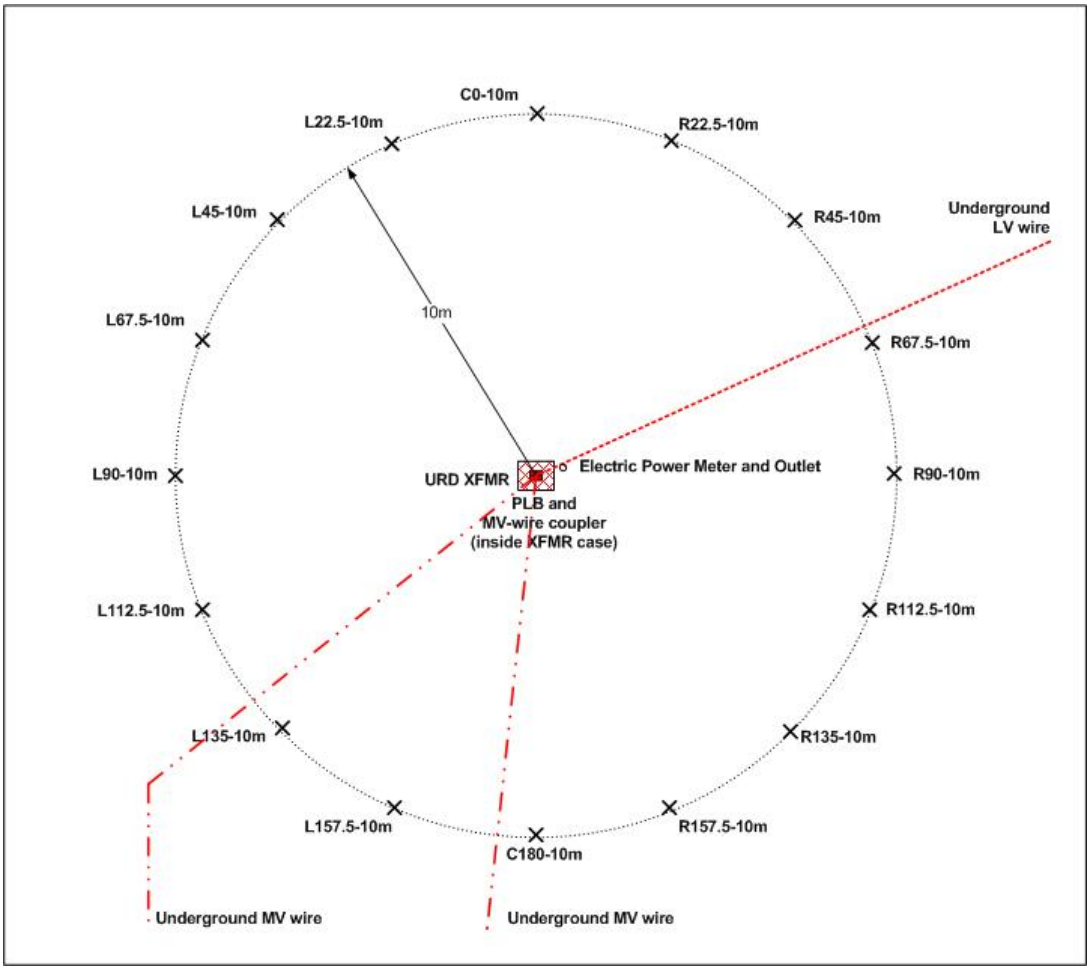

Figure 2: Test Site Diagram – CURRENT Technologies Field Research and Test Area – XFMR DX-2

CURRENT Technologies Field Research and Test Area – XFMR DX-4

Location:	3280 Urbana Pike Urbana, MD
Site Description:	System installation inside a utility transformer case in a field research and test area. The transformer case is equipped with medium-voltage wires.
Site Diagrams:	See Figure 3, below.
Site Photos:	See Photographs B-3 and B-4 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 30 MHz to 50 MHz, on August 15, 2007

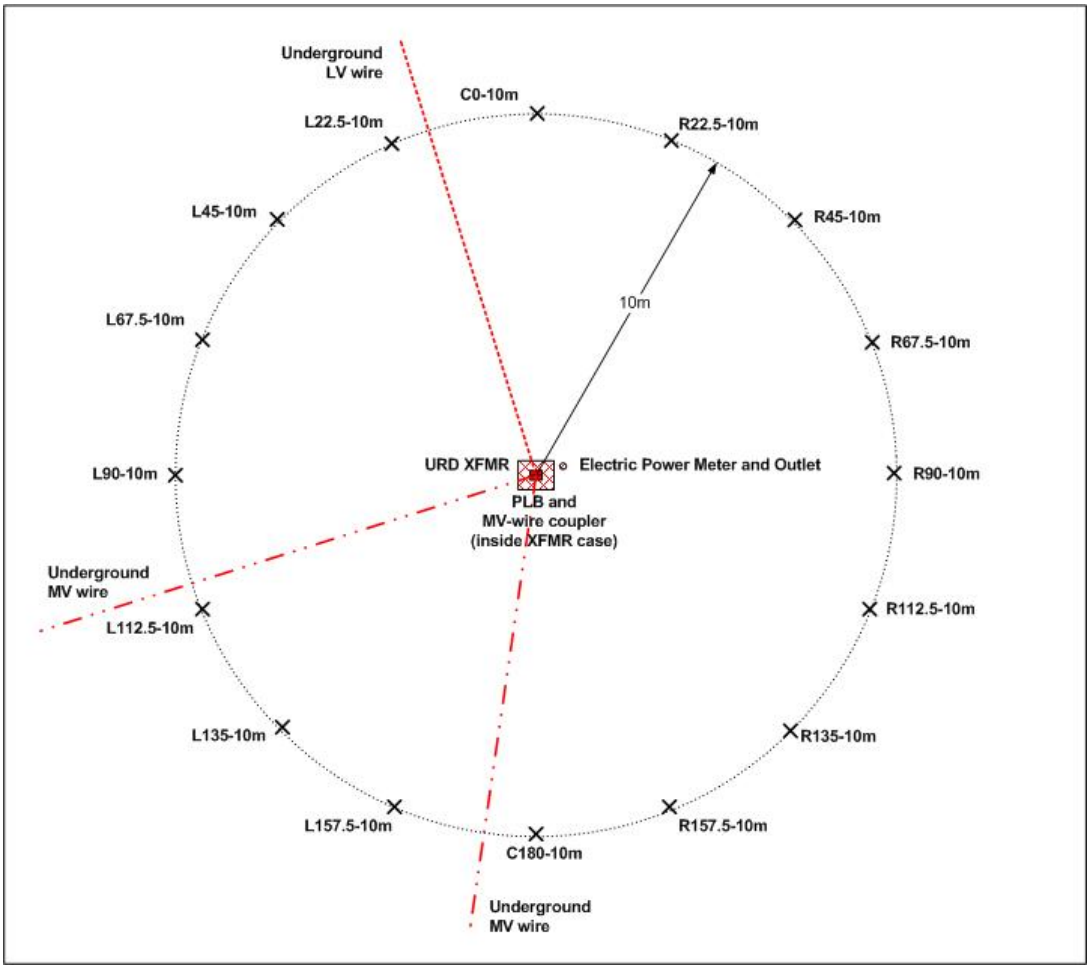

Figure 3: Test Site Diagram – CURRENT Technologies Field Research and Test Area – XFMR DX-4

CURRENT Technologies Field Research and Test Area – XFMR DX-5

Location:	3280 Urbana Pike Urbana, MD
Site Description:	System installation inside a utility transformer case in a field research and test area. The transformer case is equipped with medium-voltage wires.
Site Diagrams:	See Figure 4, below.
Site Photos:	See Photographs B-5 and B-6 in Appendix B.
Tests Performed at this Location:	▪ Radiated Emissions, 30 MHz to 50 MHz, on August 16, 2007

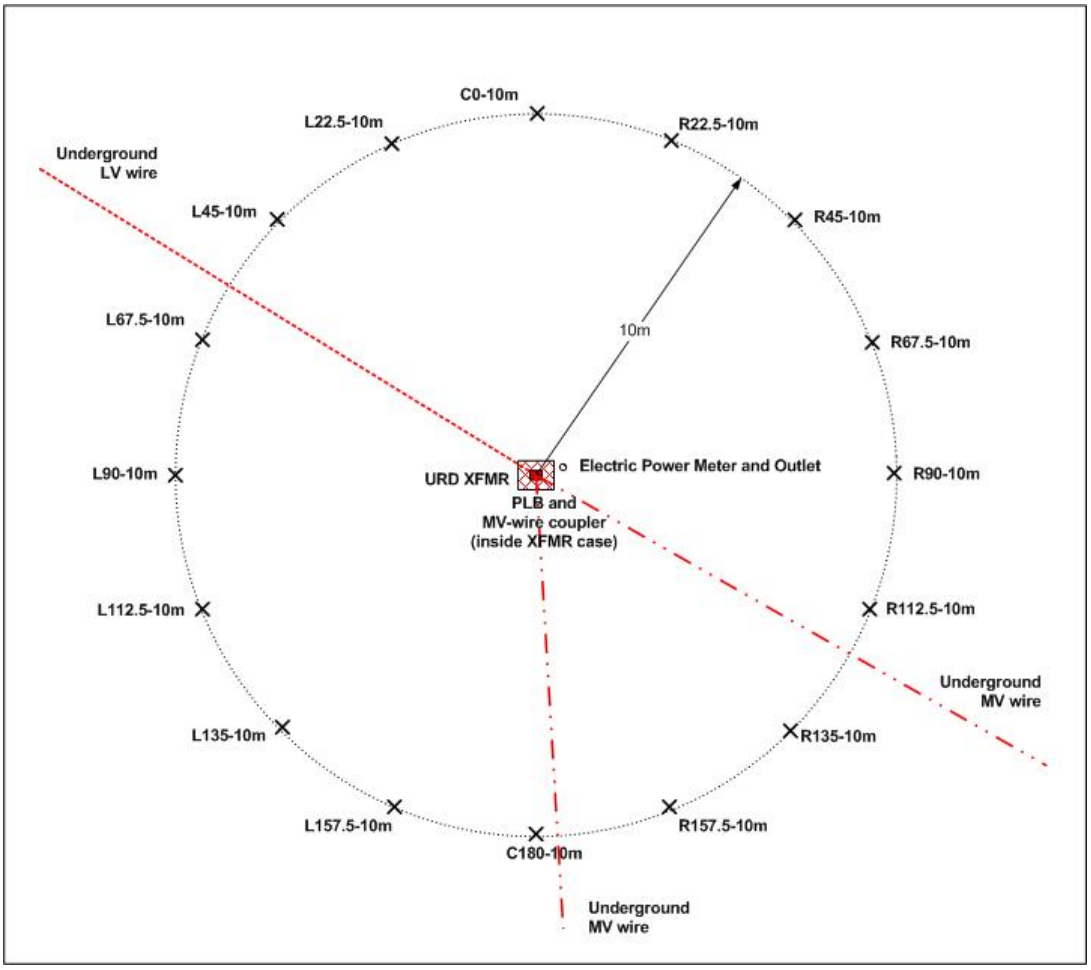

Figure 4: Test Site Diagram – CURRENT Technologies Field Research and Test Area – XFMR DX-5

8. List of Test Equipment Used

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

Radiated Emissions Measurement – 30 MHz to 50 MHz

Description	Manufacturer and Model Number	Serial Number and Identification Number	Calibration Due Date
EMC Analyzer	HP E7402A	MY44212893	May 29, 2008
Antenna, Biconical (20 MHz to 330 MHz)	A.H. Systems SAS-200/540	573	November 28, 2007
RF Cable, 125'	RG-58	CT #125A	January 3, 2008

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 adding the appropriate correction factors (antenna, cable loss, etc.) to a voltage reading made using a spectrum analyzer. The spectrum analyzer adds the correction factors automatically, producing a reading in dBµV/m. Since all measurements were made at the distance specified in the rules, an additional distance correction factor was not needed. The difference between the corrected 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 CT Bridge URD 5000r 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 0.5 dB.