

**TEST REPORT** 

**Equipment Tested:** 

**Electric ERT Reader** 

Itron Test Facility 2401 North State Street Waseca, Minnesota 56093



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#### 1. TEST SUMMARY

| Test Report No.:                        | W030117                                                                                                            |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Company:                                | Itron, Inc.                                                                                                        |
| Test Date(s):                           | Dec 5-9 & 12, 2002 & Jan 16, 2003                                                                                  |
| Equipment Under Test:                   | Utility Meter Transmitter                                                                                          |
| General Test Summary:                   | The ERT Reader transmitter was tested for compliance to FCC Part 15.247 requirements for an intentional radiator.  |
| Original Grant or<br>Pormissive Change: | Original Grant                                                                                                     |
| i et missive Change.                    | onginal oran                                                                                                       |
| Certification Status:                   | The ERT Reader has been verified as being compliant with FCC Part 15.247 requirements for an intentional radiator. |

#### Modifications Necessary for Compliance:

None. See Section 2. For EUT description.

Tested By: Jim Frost

Report Written By: Drew Rosenberg



#### 2. Product Description and Test Objective

The EUT consists of an electric ERT Reader that is designed to receive, decode, and retransmit standard consumption messages from a 15.249 compliant Itron ERT. The message is retransmitted in a 15.247 compliant format.

#### 3. Test Facility

The tests were performed at the test facility of Itron, Inc. located at 2401 North State Street, Waseca, Minnesota 56093. This site is fully described in a document submitted to the FCC accepted per letter dated June 4, 1999 (Ref.: Registration Number: 90716).

#### 4. EUT System Description:

The EUT was physically configured similar to a typical user configuration. The ERT Reader was powered by a non-metallic electric meter socket. The assembly was placed in the center of the test table 80 cm above the ground plane. There were no other associated components or accessories on the table during the radiated emissions tests.



#### 5. Operating Mode of EUT, Software/Firmware Etc.:

During testing, the EUT was configured with special test software that allowed rapid retransmit of ERT messages. In addition, a signal generator and special pulse generator were configured to simulate very frequent ERT transmissions. This special test mode causes the ERT Reader to transmit more messages consecutively, thus allowing peaks of transmitter radiation to be more easily found as antenna height and turntable azimuth are varied

See Attachment B for message detail.

See the test set-up diagram in Section 7 and the photo in Attachment F.

#### FCC ID: EO9-ERTRDR-E



#### 6. Test Set-Up Diagram:





#### 7. Test And Measurement Equipment Detail:

| Test Equipment         | Model       | Manufacturer      | Serial      | Cal Due |
|------------------------|-------------|-------------------|-------------|---------|
|                        |             |                   | Number      |         |
| Spectrum Analyzer      | 8593E       | Hewlett-Packard   | 3543A02032  | 08/03   |
| Synthesized Signal     | 8673D       | Hewlett-Packard   | 3123A01161  | 10/03   |
| Generator              |             |                   |             |         |
| Power Meter            | 437B        | Hewlett-Packard   | 3125U11553  | 10/03   |
| Power Meter Sensor     | 8481D       | Hewlett-Packard   | 3318A08626  | 10/03   |
| Amplifier < 5 GHz      | ZHL - 1042J | Mini-Circuits     | H110894-008 | N/A     |
| Amplifier > 5 GHz      | JCA010-415  | JCA               | 103         | N/A     |
| LISN                   | 3825-2      | EMCO              | 9508-2436   | 01/03   |
| Antenna - Dipole       | Roberts     | Compliance Design | 12261       | 08/03   |
| Antenna -              | 3115        | EMCO              | 9205-3878   | 04/04   |
| Double Ridged Guide    |             |                   |             |         |
| Antenna - Log periodic | 3148        | EMCO              | 9201-3358   | 01/03   |
| Antenna - Bi-conical   | 3108        | EMCO              | 9807-3129   | 01/03   |

#### 9. Ambient Conditions During Test:

| Date     | Temp (°F) | Humidity (% RH) |
|----------|-----------|-----------------|
| 12/05/02 | 57        | 27              |
| 12/6/02  | 62        | 22              |
| 12/7/02  | 55        | 16              |
| 12/12/02 | 57        | 21              |

10. Distribution List: Archive

11. References:

ANSI C63.4-1992



#### 12. Description of Test Procedure

#### 12.1 RADIATED EMISSIONS (TRANSMITTER)

These tests measure the transmitter radiated emissions using a spectrum analyzer and receiving antenna. During testing the EUT was placed on a non-conducting support, 80 cm above the ground plane. The RF spectrum was scanned from 30 MHz to 1000 MHz using the Bi-conical, Log Periodic and Dipole antennae. A Double Ridged Guide antenna was used from 1 GHz to the transmitter's  $10^{th}$  harmonic at 9170. Levels below 1 GHz were measured with the spectrum analyzer resolution bandwidth at 120 kHz and levels at or above 1 GHz were measured with the spectrum analyzer resolution bandwidth at 1 MHz. The emissions were measured in vertical and horizontal antenna polarizations. The antenna height was varied from 1-4 meters and the EUT was rotated from 0-360°. Maximum emissions were recorded. The antenna to EUT test distance was 3 meters horizontally. An analog spectrum analyzer was used as an aid in locating the maximum radiation emission as the EUT orientation and antenna position were varied. The level was determined on the HP8593E by means of signal substitution. Testing was performed according to the procedures in ANSI C63.4-1992. See Attachment F; Test Setup Photographs.

#### **12.2 CONDUCTED EMISSIONS**

This test determines the power line conducted emission using a LISN (Line Impedance Stabilization Network) and a spectrum analyzer. The EUT was placed on a non-conducting tabletop 80 cm above the conductive ground plane of the test site. The LISN was grounded to the conductive ground plane by means of a copper strap. A 9 kHz resolution bandwidth was used during the conducted emissions testing. The response due to the ambient electromagnetic conditions (without the EUT being energized) was plotted and the frequencies involved were determined. This was done in order to differentiate between the responses caused by ambient electromagnetic signals and the true EUT generated conducted emissions. The outputs of both ports of the LISN were plotted.

#### 13. Results

#### 13.1 RADIATED EMISSIONS (TRANSMITTER)

Final emission levels are expressed in  $dB\mu V/m$ . This level is determined by converting the reading from the spectrum analyzer or power meter to  $dB\mu V$  and adding the antenna correction factor (dB) and cable loss (dB) to it. The amplifier gain is accounted for when the spectrum analyzer display is calibrated. Antenna and cable loss factors are included in the tabular results contained in Attachment A. All levels below 1 GHz are peak. Transmitter harmonic final levels above 1 GHz are peak average with a 20 dB relaxation allowed for duty cycle.

Refer to Attachment B for duty cycle calculation.



#### 13.1.1 6 dB Bandwidth

**RULE:** 

**Part 15.247:** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz

#### STANDARD: Part 15.247(a)(2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

**TEST RESULTS:** 

The 6dB bandwidth was found to be approximately 566 kHz





#### 13.1.2 Peak Output Power

# Standard:Part 15.247(b)(3) The maximum peak output power of the intentional<br/>radiator shall not exceed the following: For systems using digital modulation<br/>in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt

**TEST RESULTS:** 

The peak output power of the ERT Reader is 10mW.



#### 13.1.3 RF Safety

#### **STANDARD:**

**Part 15.247(b)(5)** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

#### Part 1.1307(b)(1)

The appropriate exposure limits in §1.1310 and §2.1093 of this chapter are generally applicable to all facilities, operations and transmitters regulated by the Commission. However, a determination of compliance with the exposure limits in §1.1310 or §2.1093 of this chapter (routine environmental evaluation), and preparation of an EA if the limits are exceeded, is necessary only for facilities, operations and transmitters that fall into the categories listed in Table 1, or those specified in paragraph (b)(2) of this section. All other facilities, operations and transmitters are categorically excluded from making such studies or preparing an EA, except as indicated in paragraphs (c) and (d) of this section. For purposes of Table 1, "building-mounted antennas" means antennas mounted in or on a building structure that is occupied as a workplace or residence. The term "power" in column 2 of Table 1 refers to total operating power of the transmitting operation in guestion in terms of effective radiated power (ERP), equivalent isotropically radiated power (EIRP), or peak envelope power (PEP), as defined in §2.1 of this chapter. For the case of the Cellular Radiotelephone Service, Subpart H of Part 22 of this chapter; the Personal Communications Service, Part 24 of this chapter and the Specialized Mobile Radio Service, Part 90 of this chapter, the phrase "total power of all channels" in column 2 of Table 1 means the sum of the ERP or EIRP of all co-located simultaneously operating transmitters owned and operated by a single licensee. When applying the criteria of Table 1, radiation in all directions should be considered. For the case of transmitting facilities using sectorized transmitting antennas, applicants and licensees should apply the criteria to all transmitting channels in a given sector, noting that for a highly directional antenna there is relatively little contribution to ERP or EIRP summation for other directions

#### Part 1.1310 (B) Limits for General Population/Uncontrolled Exposure



| f (MHz)      | E (V/m) | H (A/m) | S (mW/cm <sup>2</sup> ) | Average Time |
|--------------|---------|---------|-------------------------|--------------|
| 0.3-1.34     | 614     | 1.63    | 100                     | 30           |
| 1.34-30      | 824/f   | 2.19/f  | 180/f <sup>2</sup>      | 30           |
| 30-300       | 27.5    | 0.073   | 0.2                     | 30           |
| 300-1500     | -       | -       | f/1500                  | 30           |
| 1500-100,000 | -       | -       | 1.0                     | 30           |

#### **TEST RESULTS:**

$$\begin{split} S &= P_t^* G/4^* \pi^* r^2 \\ Pt &= transmit \ power = 0.10 \ mW \\ G &= 0 \ dBi = 1 \\ From \ 1.1310(b): \ S &= f/1500 <= 920/1500 = .613 mW/cm^2 \\ Solving \ for \ r &= 1.43 cm \end{split}$$

The installation manual will state that a minimum safe distance of 20cm must be maintained between the device and any nearby people.



#### 13.1.4 Out of Band Emissions

#### **STANDARD:**

**Part 15.247(c)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in \$15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in \$15.205(a), must also comply with the radiated emission limits specified in \$15.209(a) (see \$15.205(c)).

#### Part 15.205 Restricted Bands of Operation

Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| <br>              |                     |               |             |
|-------------------|---------------------|---------------|-------------|
| MHz               | MHz                 | MHz           | GHz         |
| 0.090-0.110       | 13.36-13.41         | 322-335.4     | 3600-4400   |
| 0.495-0.505 1     | 16.42-16.423        | 399.9-410     | 4.5-5.15    |
| 2.1735-2.1905     | 16.69475-16.69525   | 608-614       | 5.35-5.46   |
| 4.125-4.128       | 16.80425-16.80475   | 960-1240      | 7.25-7.75   |
| 4.17725-4.17775   | 25.5-25.67          | 1300-1427     | 8.025-8.5   |
| 4.20725-4.20775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2     |
| 6.215-6.218       | 73-74.6             | 1645.5-1646.5 | 9.3-9.5     |
| 6.26775-6.26825   | 74.8-75.2           | 1660-1710     | 10.6-12.7   |
| 6.31175-6.31225   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4  |
| 8.291-8.294       | 123-138             | 2200-2300     | 14.47-14.5  |
| 8.362-8.366       | 149.9-150.05        | 2310-2390     | 15.35-16.2  |
| 8.37625-8.38675   | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.41425-8.41475   | 156.7-156.9         | 2655-2900     | 22.01-23.12 |
| 12.29-12.293      | 162.0125-167.17     | 3260-3267     | 23.6-24.0   |
| 12.51975-12.52025 | 167.72-173.2        | 3332-3339     | 31.2-31.8   |
| 12.57675-12.57725 | 240-285             | 3345.8-3358   | 36.43-36.5  |

#### Part 15.209

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency of Emission | Field Strength | Field Strength |
|-----------------------|----------------|----------------|
| (MHz)                 | (µV/m)         | (dBµV/m)       |
| 30 - 88               | 100            | 40             |
| 88-216                | 150            | 43.5           |



| tron         | 217 070                                                                                                                                                                                                                                                                                                                     | 200                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                  |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | <u>216 – 960</u>                                                                                                                                                                                                                                                                                                            | 200                                                                                                                                                                                                                                                                 | 40                                                                                                                                                                                                                                               |
|              | Above 960                                                                                                                                                                                                                                                                                                                   | 500                                                                                                                                                                                                                                                                 | 54                                                                                                                                                                                                                                               |
| EST RESULTS: | The EUT transmitter radiated et 15.247(c) for intentional radiat transmitter that were not in the to be greater than 20dBuV/m le All spurious emissions of the d to be in compliance with the lin The EUT was tested from 30 M Emissions in the 30 MHz to 1 C the limit were recorded. When spectrum, the noise floor was r | emissions met the require<br>ors. All radiated spuric<br>restricted bands define<br>ess than the radiated em<br>evice that were in the re-<br>nits specified by 15.209<br>1Hz to the transmitter's<br>GHz that had less than a<br>no emissions were fou<br>ecorded. | rements established by P<br>bus emissions at the<br>d in 15.205(a) were four<br>hissions of the fundament<br>estricted bands were four<br>9(a).<br>10 <sup>th</sup> harmonic (9.186GH<br>a 20 dB margin in respect<br>nd in large sections of th |
|              | The worst case harmonic radia<br>in 15.205(a) was 76.6dBuV/m<br>less than the fundamental.                                                                                                                                                                                                                                  | ted emission outside of<br>at 1820MHz. This wa                                                                                                                                                                                                                      | the restricted bands defined from the second to be 32.3 dBu                                                                                                                                                                                      |
|              | The worst case harmonic radia 15.205(a) was determined to b 15.209(a) is 54 dBµV/m with a                                                                                                                                                                                                                                   | ted emission within the<br>e 67.3 dBµV/m peak. T<br>relaxation of 20 dB (74                                                                                                                                                                                         | e restricted bands define<br>The limit established by<br>4 dBµV/m).                                                                                                                                                                              |
|              | In compliance with Part 15.35 peak power to average power is                                                                                                                                                                                                                                                                | (b) - Pulsed Operation,<br>s addressed in Attachm                                                                                                                                                                                                                   | conversion of instantane<br>ent B.                                                                                                                                                                                                               |
| ST DATA:     | Refer to Attachment A for deta                                                                                                                                                                                                                                                                                              | iled test results                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                  |
|              |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                  |
|              |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                  |
|              |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                  |



#### 13.1.5 Power Spectral Density

#### STANDARD:

**Part 15.247(d)** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

#### **TEST RESULTS:**



The peak power spectral density was found to be approximately –10dbm in any 3kHz.



#### **13.2 CONDUCTED EMISSIONS**

| Rule:         | Part 15.107 (a), Part 15.207 (a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STANDARD:     | Part 15.107 (a), 15.207(a)<br>Except as shown in paragraphs (b) and (c) of this section, for an intentional<br>radiator that is designed to be connected to the public utility (AC) power line, the<br>radio frequency voltage that is conducted back onto the AC power line on any<br>frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed<br>the limits in the following table, as measured using a 50 mH/50 ohms line<br>impedance stabilization network (LISN). Compliance with the provisions of this<br>paragraph shall be based on the measurement of the radio frequency voltage<br>between each power line and ground at the power terminal. The lower limit<br>applies at the boundary between the frequency ranges.<br>Frequency QP (dBmV) (dBmV)<br>0.15-0.5 66-56* 56-46*<br>0.5-5 56 46<br>5-30 60 50<br>* Decreases with the logarithm of frequency |
| TEST RESULTS: | When the EUT active results were compared with the ambient response results, there were no detectable conducted signals produced by the EUT.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| TEST DATA:    | Refer to Attachment D for FCC Part 15.107; Power line Conducted Emissions Plots                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|               | Results contained in this report apply to test sample only                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



## ATTACHMENT A

15.247(c) – Radiated Emissions 15.205 – Restricted Bands

| [       |        |                | [1]    |                               | [4]                      |              | [2][3]                     |          | Dutv     |           |              |
|---------|--------|----------------|--------|-------------------------------|--------------------------|--------------|----------------------------|----------|----------|-----------|--------------|
|         |        |                | L * 3  |                               | Ant.                     | Cable        | Corrected                  |          | Cvcle    | Final     | I            |
| Freg    | Ant.   | l evel         |        | l evel                        | Factor                   | Loss         | Level                      | l imit   | Factor   | l imit    | Margin       |
| MH7     | Pos    | dRm            |        |                               | dR                       | dR           | dRuV/m                     | dRuV/m   | dR       | dRuV/m    | dR           |
| 1011.12 | 1 00.  | ubm            |        | ubu v                         | uD                       | 00           | abaviii                    |          | ub       | ubu v/iii | чь           |
| 2730    | V      | Q/ 1           | D      | 22 Q                          | 31.6                     | 22           | 57 7                       | 54       | 20       | 74        | 16.3         |
| 2730    | v<br>L | -04.1          | Г      | 22.8                          | 21.0                     | J.∠<br>2 2   | 57.7                       | 54       | 20       | 74        | 10.0         |
| 2/30    |        | -80.0          | ۲<br>D | 20.4                          | 31.0                     | 3.∠<br>0.0   | 55.∠<br>07.0               | 54       | 20       | 74        | 10.0         |
| 2755    | V      | -74.55         | Ч      | 32.5                          | 31.6                     | 3.2          | 67.3                       | 54       | 20       | /4        | 6.7          |
| 2755    | Н      | -78.14         | Ρ      | 28.9                          | 31.6                     | 3.2          | 63.7                       | 54       | 20       | 74        | 10.3         |
| 2760    | V      | -82.5          | Ρ      | 24.5                          | 31.6                     | 3.2          | 59.3                       | 54       | 20       | 74        | 14.7         |
| 2760    | н      | -78.5          | Ρ      | 28.5                          | 31.6                     | 3.2          | 63.3                       | 54       | 20       | 74        | 10.7         |
|         |        |                |        |                               |                          |              |                            |          |          |           | l            |
| 3640    | V      | -79.1          | Р      | 27.9                          | 33.4                     | 3.74         | 65.04                      | 54       | 20       | 74        | 9.0          |
| 3640    | Н      | -79.3          | Ρ      | 27.7                          | 33.4                     | 3.74         | 64.84                      | 54       | 20       | 74        | 9.2          |
| 3672    | V      | -79.58         | Ρ      | 27.42                         | 33.4                     | 3.74         | 64.56                      | 54       | 20       | 74        | 9.4          |
| 3672    | н      | -81.47         | Ρ      | 25.53                         | 33.4                     | 3.74         | 62.67                      | 54       | 20       | 74        | 11.3         |
| 3680    | V      | -82.6          | Ρ      | 24.4                          | 33.4                     | 3.74         | 61.54                      | 54       | 20       | 74        | 12.5         |
| 3680    | Н      | -83.3          | Ρ      | 23.7                          | 33.4                     | 3.74         | 60.84                      | 54       | 20       | 74        | 13.2         |
|         | .,     |                | _      |                               |                          | . =0         |                            |          |          | - 4       |              |
| 4550    | V      | -85.4          | Р      | 21.6                          | 34.8                     | 4.59         | 60.99                      | 54       | 20       | 74        | 13.0         |
| 4550    | H      | -82.9          | Ч      | 24.1                          | 34.8                     | 4.59         | 63.49                      | 54       | 20       | 74        | 10.5         |
| 4590    | V      | -83            | Р      | 24                            | 34.8<br>24.0             | 4.59         | 63.39                      | 54       | 20       | 74        | 10.0         |
| 4590    | H      | -88.4<br>00.2  | Р      | 10.0                          | 34.ŏ<br>22.4             | 4.59         | 57.99                      | 54<br>54 | 20<br>20 | 74<br>74  | 10.0         |
| 4600    | v<br>ц | -09.2<br>-87 3 | P      | 17.0                          | ১১.4<br>33 /             | 3.74<br>3.74 | 04.94<br>56 8/             | 04<br>54 | 20<br>20 | 74<br>74  | 17.1         |
| 4000    |        | -07.5          | Г      | 19.7                          | 55.4                     | 5.74         | 50.04                      | 94       | 20       | /4        | 11.2         |
| 7280    | V      | -108           | NF     | -1                            | 37.95                    | 62           | 43.15                      | 54       | 20       | 74        | 30.9         |
| 7280    | Ĥ      | -102.4         | P      | 4.6                           | 37.95                    | 6.2          | 48.75                      | 54       | 20       | 74        | 25.3         |
| 7344    | V      | -98.6          | P      | 8.4                           | 37.95                    | 6.2          | 52.55                      | 54       | 20       | 74        | 21.5         |
| 7344    | н      | -102.5         | Р      | 4.5                           | 37.95                    | 6.2          | 48.65                      | 54       | 20       | 74        | 25.4         |
| 7346    | V      | -105           | NF     | 2                             | 33.4                     | 3.74         | 39.14                      | 54       | 20       | 74        | 34.9         |
| 7346    | н      | -105           | NF     | 2                             | 33.4                     | 3.74         | 39.14                      | 54       | 20       | 74        | 34.9         |
|         |        |                |        |                               |                          |              |                            |          |          |           |              |
| 8190    | V      | -103           | NF     | 4                             | 39.3                     | 6.38         | 49.68                      | 54       | 20       | 74        | 24.3         |
| 8190    | Н      | -103           | NF     | 4                             | 39.3                     | 6.38         | 49.68                      | 54       | 20       | 74        | 24.3         |
| 8262    | V      | -103.5         | NF     | 3.5                           | 39.3                     | 6.38         | 49.18                      | 54       | 20       | 74        | 24.8         |
| 8262    | Н      | -103.5         | NF     | 3.5                           | 39.3                     | 6.38         | 49.18                      | 54       | 20       | 74        | 24.8         |
| 8266    | V      | -105.2         | NF     | 1.8                           | 33.4                     | 3.74         | 38.94                      | 54       | 20       | 74        | 35.1         |
| 8266    | Н      | -105.2         | NF     | 1.8                           | 33.4                     | 3.74         | 38.94                      | 54       | 20       | 74        | 35.1         |
| 0100    |        | 407.0          |        | 0.0                           | 40.0                     | 76           | 47 4                       | 54       | 20       | 74        | 00.0         |
| 9100    | V<br>L | -107.3         |        | -0.3                          | 40.∠<br>40.2             | 1.5          | 41.4                       | 54<br>54 | 20<br>20 | 74<br>74  | 20.0<br>26.6 |
| 9100    |        | -107.3         |        | -0.3                          | 40.2<br>40.2             | 7.5<br>7.5   | 41.4<br>17 1               | 54<br>54 | 20<br>20 | 74<br>74  | 20.0<br>26.6 |
| 0180    | v<br>н | 107.3          |        | -0.3                          | 40.∠<br>40.2             | 7.5          | 41.4<br>17 1               | 54<br>54 | 20<br>20 | 74<br>74  | 20.0         |
| 9100    | п<br>V | -107.5         | NE     | -0.3<br>1 <u>4</u>            | 40.2<br>33.4             | 2 74         | 47.4<br>28.54              | 54       | 20       | 74        | 20.0         |
| 0186    | ч      | -105.0         | NE     | т. <del>ч</del><br>1 <u>4</u> | 33. <del>4</del><br>33.4 | 3.74         | 30.0 <del>4</del><br>38 54 | 54       | 20       | 74        | 35.5         |
| 9100    |        | -105.0         | INI    | 1.7                           | 55.4                     | 5.74         | 50.07                      | 54       | 20       | / 7       | 55.5         |

Notes: See next page.



## **ATTACHMENT A (continued)**

15.247(c) – Radiated Emissions < 20dBc outside of restricted bands

|      |      |       | [1] |       | [4]    |       | [2][3]    |        | Duty   |        |        |
|------|------|-------|-----|-------|--------|-------|-----------|--------|--------|--------|--------|
|      |      |       |     |       | Ant.   | Cable | Corrected |        | Cycle  | Final  |        |
| Freq | Ant. | Level |     | Level | Factor | Loss  | Level     | Limit  | Factor | Limit  | Margin |
| MHz  | Pos. | dBm   |     | dBuV  | dB     | dB    | dBuV/m    | dBuV/m | dB     | dBuV/m | dB     |
|      |      |       |     |       |        |       |           |        |        |        |        |
| 920  | Н    | -28.3 | Ρ   | 78.7  | 28.6   | 1.6   | 108.9     | 88.9   | -      | 88.9   | -      |
|      |      |       |     |       |        |       |           |        |        |        |        |
| 1820 | V    | -64   | Ρ   | 43.0  | 28.4   | 2.4   | 73.8      | 88.9   | -      | 88.9   | 15.1   |
| 1820 | Н    | -61.2 | Ρ   | 45.8  | 28.4   | 2.4   | 76.6      | 88.9   | -      | 88.9   | 12.3   |
| 1836 | V    | -62.1 | Ρ   | 44.88 | 28.4   | 2.44  | 75.72     | 88.9   | -      | 88.9   | 13.2   |
| 1836 | Н    | -74.4 | Ρ   | 32.59 | 28.4   | 2.44  | 63.43     | 88.9   | -      | 88.9   | 25.5   |
|      |      |       |     |       |        |       |           |        |        |        |        |
| 5508 | V    | -82   | Ρ   | 25    | 36.3   | 4.82  | 66.12     | 88.9   | -      | 88.9   | 22.8   |
| 5508 | Н    | -82.6 | Р   | 24.4  | 36.3   | 4.82  | 65.52     | 88.9   | -      | 88.9   | 23.4   |
|      |      |       |     |       |        |       |           |        |        |        |        |
| 6426 | V    | -92.7 | Р   | 14.3  | 36.9   | 5.57  | 56.77     | 88.9   | -      | 88.9   | 32.2   |
| 6426 | н    | -89.8 | Р   | 17.2  | 36.9   | 5.57  | 59.67     | 88.9   | -      | 88.9   | 29.3   |
|      |      |       |     |       |        |       |           |        |        |        |        |

Notes:

[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer

[2] The Spectrum Analyzer settings are as follows:

Fundamental - Resolution Bandwidth = 120 kHz; Video Bandwidth = 300 kHz; Span = 10 MHz.

Harmonics - Resolution Bandwidth = 1 MHz; Video Bandwidth = 1 MHz; Span = 50 MHz.

[3] "Corrected Level" numbers in bold are RF signal levels. "Corrected Level" numbers in italics are noise floor and as such indicate that there is no RF signal at that level.

The "Antenna Correction Factor" and the "Cable Loss" have been factored in with the noise floor levels in

order to demonstrate what the "Corrected Level" of an RF signal at the noise floor level would have been equal to.

[4] The "Final Limit", in the case of the harmonics, represents XXX dB above the average limit in FCC Part 15.209

[5] Negative margins reflect beyond limit levels.

[6] The Antennas used were as follows:
Fundamental: Dipole - AN 12261
Harmonics: Double Ridged Guide - AN 6412

[7] Levels as read on the HP 8594E spectrum analyzer and corrected for amplifier gain where applicable.



## **ATTACHMENT A (continued)**

15.247(c) – Radiated Emissions

| < | 1GHz |  |
|---|------|--|
|   |      |  |

|        |      |       | [1] |       | [4]    |       | [2][3]    |        | Duty   |        |        |
|--------|------|-------|-----|-------|--------|-------|-----------|--------|--------|--------|--------|
|        |      |       |     |       | Ant.   | Cable | Corrected |        | Cycle  | Final  |        |
| Freq   | Ant. | Level |     | Level | Factor | Loss  | Level     | Limit  | Factor | Limit  | Margin |
| MHz    | Pos. | dBm   |     | dBuV  | dB     | dB    | dBuV/m    | dBuV/m | dB     | dBuV/m | dB     |
|        |      |       |     |       |        |       |           |        |        |        |        |
| 163    | V    | -84.1 | Ρ   | 22.9  | 12.7   | 0.6   | 36.2      | 43.5   |        | 43.5   | 7.27   |
| 163    | Н    | -86.6 | Ρ   | 20.4  | 12.7   | 0.6   | 33.7      | 43.5   |        | 43.5   | 9.77   |
| 196.6C | V    | -82.5 | Ρ   | 24.5  | 13.9   | 0.7   | 39.2      | 43.5   |        | 43.5   | 4.34   |
| 196.6C | Н    | -78.5 | Ρ   | 28.5  | 13.9   | 0.7   | 43.2      | 43.5   |        | 43.5   | 0.34   |
| 213    | V    | -79.1 | Ρ   | 27.9  | 12.6   | 0.8   | 41.2      | 43.5   |        | 43.5   | 2.27   |
| 213    | Н    | -79.3 | Ρ   | 27.7  | 12.6   | 0.8   | 41.0      | 43.5   |        | 43.5   | 2.47   |
| 246    | V    | -79.6 | Ρ   | 27.4  | 12.5   | 0.8   | 40.8      | 46     |        | 46     | 5.24   |
| 245.7  | Н    | -81.5 | Ρ   | 25.53 | 12.54  | 0.8   | 38.87     | 46     |        | 46     | 7.13   |
| 540.4  | V    | -82.6 | Ρ   | 24.4  | 18.16  | 1.23  | 43.79     | 46     |        | 46     | 2.21   |
| 540.4  | Н    | -83.3 | Ρ   | 23.7  | 18.16  | 1.23  | 43.09     | 46     |        | 46     | 2.91   |
| 540.9  | V    | -85.4 | Ρ   | 21.6  | 18.16  | 1.23  | 40.99     | 46     |        | 46     | 5.01   |
| 540.9  | Н    | -82.9 | Ρ   | 24.1  | 18.16  | 1.23  | 43.49     | 46     |        | 46     | 2.51   |
| 589.8C | V    | -83   | Ρ   | 24    | 18.72  | 1.3   | 44.02     | 46     |        | 46     | 1.98   |
| 589.8C | Н    | -88.4 | Ρ   | 18.6  | 18.72  | 1.3   | 38.62     | 46     |        | 46     | 7.38   |
| 786.4  | V    | -89.2 | Ρ   | 17.8  | 21.4   | 1.5   | 40.7      | 46     |        | 46     | 5.3    |
| 786.4  | Н    | -87.3 | Ρ   | 19.7  | 21.4   | 1.5   | 42.6      | 46     |        | 46     | 3.4    |
| 926.2  | V    | -92.7 | Ρ   | 14.3  | 22.8   | 1.65  | 38.75     | 46     |        | 46     | 7.25   |
| 926.2  | Н    | -89.8 | Ρ   | 17.2  | 22.8   | 1.65  | 41.65     | 46     |        | 46     | 4.35   |
| 982    | V    | -108  | NF  | -1    | 23.8   | 1.7   | 24.5      | 54     |        | 54     | 29.5   |
| 982    | Н    | -102  | р   | 4.6   | 23.8   | 1.7   | 30.1      | 54     |        | 54     | 23.9   |
|        |      |       | •   |       |        |       |           |        |        |        |        |

Notes:

[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer

[2] The Spectrum Analyzer settings are as follows:

Fundamental - Resolution Bandwidth = 120 kHz; Video Bandwidth = 300 kHz; Span = 10 MHz. Harmonics - Resolution Bandwidth = 1 MHz; Video Bandwidth = 1 MHz; Span = 50 MHz.

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The "Antenna Correction Factor" and the "Cable Loss" have been factored in with the noise floor levels in order to demonstrate what the "Corrected Level" of an RF signal at the noise floor level would have been equal to.

[4] The "Final Limit", in the case of the harmonics, represents XXX dB above the average limit in FCC Part 15.209

[5] Negative margins reflect beyond limit levels.

[6] The Antennas used were as follows:Fundamental: Dipole - AN 12261Harmonics: Double Ridged Guide - AN 6412

[7] Levels as read on the HP 8594E spectrum analyzer and corrected for amplifier gain where applicable.



## ATTACHMENT B

Part 15.35 (b) - Pulsed Operation Conversion from Instantaneous Peak Power to Average Power ERT Reader

The Unit Transmits Manchester Encoded Messages separated by a two to six second period of time. Each of the messages is 96 bits long.

Zooming in on a message length:

96 bits 96 bits  $\Rightarrow\Rightarrow\Rightarrow\Rightarrow\Rightarrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\Rightarrow\Rightarrow\Rightarrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\Rightarrow\Rightarrow\uparrow\uparrow$  $\Rightarrow\Rightarrow\Rightarrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\Rightarrow\Rightarrow\Rightarrow\uparrow\uparrow\uparrow\uparrow\uparrow\uparrow\Rightarrow\Rightarrow\uparrow$ 5.86 msec 5.86 msec  $-4 \pm 2$  Seconds -Bit rate is: 16.384 Kbits/Second. 96/16.384 Kbits / sec = 5.86 msec Message Period is: During the transmission of messages, the Transmit Duty Cycle can be computed. % Duty Cycle Transmit = (96 bits) (1/16.384 Kbits/Sec) (.5) (100%) / (100 msec)% Duty Cycle Transmit =2.93 % Note: The .5 factor is a result of Manchester Encoded Data. Expressing the correction factor for Duty Cycle in dB: dB Duty Cycle Transmit = 20 Log (Duty Cycle) dB Duty Cycle Transmit = 20 Log(.0293)dB Duty Cycle Transmit = -30.7 dB The maximum relaxation allowed per Part 15.35 (b) is 20 dB.



### ATTACHMENT C

Part 15.207 Power line Conducted Emissions

Plots



L1 500kHz to 30MHz



Report # W030117



FCC ID: EO9-ERTRDR-E



## ATTACHMENT D Photographs (Test Setup)

