UNISYS

**PCTC**
**Product Compliance Test Center**
**2476 Swedesford Road, Malvern, PA 19355**

# ELECTROMAGNETIC INTERFERENCE TEST REPORT

**Doc. 20040909R / Project No. 1116**

**TEST STANDARD: USA 47 CFR PART 15**

**Generation4 Outdoor Radio Remote Control**
**FCC ID: RXR0362018010**

**SCHULMERICH CARILLONS, INC.**
**SELLERSVILLE, PA**

**TEST DATE: September 13 - 14, 2004**
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## PREFACE

Previously, the Schulmerich Carillons Generation4 Outdoor Radio Remote Control (FCC ID: RXR0362018010) was tested (Unisys PCTC test report No. 20040415R, dated April 30, 2004) for the FCC Part 15 requirements. The remote control was found compliant with the FCC Part 15C (Intentional Radiation) and Part 15B (Unintentional Radiation) requirements and it was FCC certified. Schulmerich Carillons needs to replace one obsolete component (RF Transmitter) with its replacement part available from the same manufacturer. The replacement component has the same specification for the application inside the remote control as that of the one obsolete component. The replacement of obsolete component required to make two minor modifications – (1) removal of 20.5-ohm series resistor to the transmitting antenna input and (2) shortened the antenna feed line cable. All the changes made to the certified remote control are detailed in Section 1.4 of this report.

This test report documents the testing performed to verify the remote control's continuous compliance with the FCC Part 15C and Part 15B. The EUT, test instrument configurations, test procedures and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

## SUMMARY

The Schulmerich Carillons Generation4 Outdoor Radio Remote Control
(FCC ID: RXR0362018010), with Class II permissive changes, was tested to reassessed its continuous compliance with the standards listed below, and found to have the following characteristics:

| TEST | STANDARD | REQUIREMENT | RESULT |
|---|---|---|---|
| Radiated Emissions<br>- Intentional Radiation | FCC Part 15C,<br>Section 15.249<br>(Operating Band: 902 –928 MHz) | 900 MHz – 10 GHz | Below Max.<br>Permissible limit |
| Radiated Emissions<br>- Unintentional Radiation | FCC Part 15B,<br>Class B | 30 MHz – 5.00 GHz | Below Max.<br>Permissible limit |

### EUT EMI Modifications

The following modification was required for the Generation4 Outdoor Radio Remote Control hardware to meet the EMI requirements:

Shortened antenna feed line cable length from 7.81 inches to 3.38 inches.

| MEASUREMENT UNCERTAINTY | | | | |
|---|---|---|---|---|
| Measurement Type | Measurement Dist | Frequency Range | Measurement Limit | Expanded Combined Uncertainty |
| Radio Disturbance | 10 meters | 30 MHz to 1 GHz | Class A | 4.3 dB |
| Radio Disturbance | 10 meters | 30 MHz to 1 GHz | Class B | 5.0 dB |
| Radio Disturbance | 3 meters | 30 MHz to 1 GHz | Class B | 4.3 dB |
| Conducted Disturbance | N/A | 150 kHz to 30 MHz | Class A or B | 3.6 dB |

As all values of uncertainty are less than the CISPR 16-4:2002 recommendations, no adjustments to measured data presented in this report are required.

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## 1.0 Description of The Equipment Under Test (EUT)

| | |
|---|---|
| Equipment Identification | Generation4 Outdoor Radio Remote Control |
| Part Number | 036-2018-010 |
| ID Number | TP2 |
| Manufacturer | Schulmerich Carillons, Inc.<br>PO Box 903<br>1 Carillon Hill<br>Sellersville, PA 18960-0903 |
| Technical Contact | Chris Nadovich (JTA)<br>Gregory L. Schwartz |
| Condition Received | Acceptable for Test |
| Date Received | 9/13/04 |
| Sample Type | Production Unit |
| Equipment Classification | Remote Control Transmitter |
| Unisys Test Personnel | Itamar Gonen<br>Dipak Patel |

Unless otherwise noted in the individual test results sections, testing was performed on the EUT configured as follows.

### 1.1 General Description

The Generation4 Outdoor Radio Remote Control is a battery operated, handheld remote control unit. It is used primarily to control operation of the Schulmerich electronic carillon from a remote location. This transmitter transmits control signals to a receiving unit which communicates with the carillon equipment via. fiber optic cable. The Generation4 Outdoor Radio Remote Control has a permanently attached antenna.

The following is the list of Generation4 Outdoor Radio Remote Control transmitting frequencies:

903.37 MHz,
906.37 MHz
907.87 MHz
909.37 MHz
912.37 MHz
915.37 MHz
919.87 MHz
921.37 MHz


**Photo 1 – Generation4 Outdoor Radio Remote Control – Front View**

**Photo 2 –Generation4 Outdoor Radio Remote Control – Rear View**

## 1.2 Test Configurations

Testing was carried out on a single EUT configuration. The EUT was placed on a wooden table of 80 cm height. The EUT was evaluated with mounting it in the three different positions as identified below:

1. Vertical Straight Up
2. On Left Side
3. Flat on Back

### Detailed EUT Hardware Listing

The Generation4 has a permanently attached antenna. It incorporates the following printed circuit board assembly:

| Description | Manufacturer | Manufacturer's Model Number/Part Number |
|---|---|---|
| Transmitter PCB | Schulmerich Carillons | 036-1718-000 ( Rev B) |

### Test Support Items

The following device was used to verify the EUT operation.

| Description | Manufacturer | Part Number | Serial Number |
|---|---|---|---|
| Receiver | Schulmerich Carillons | 036-2017-010 | None |

## 1.3 Rationale for The Chosen Configuration

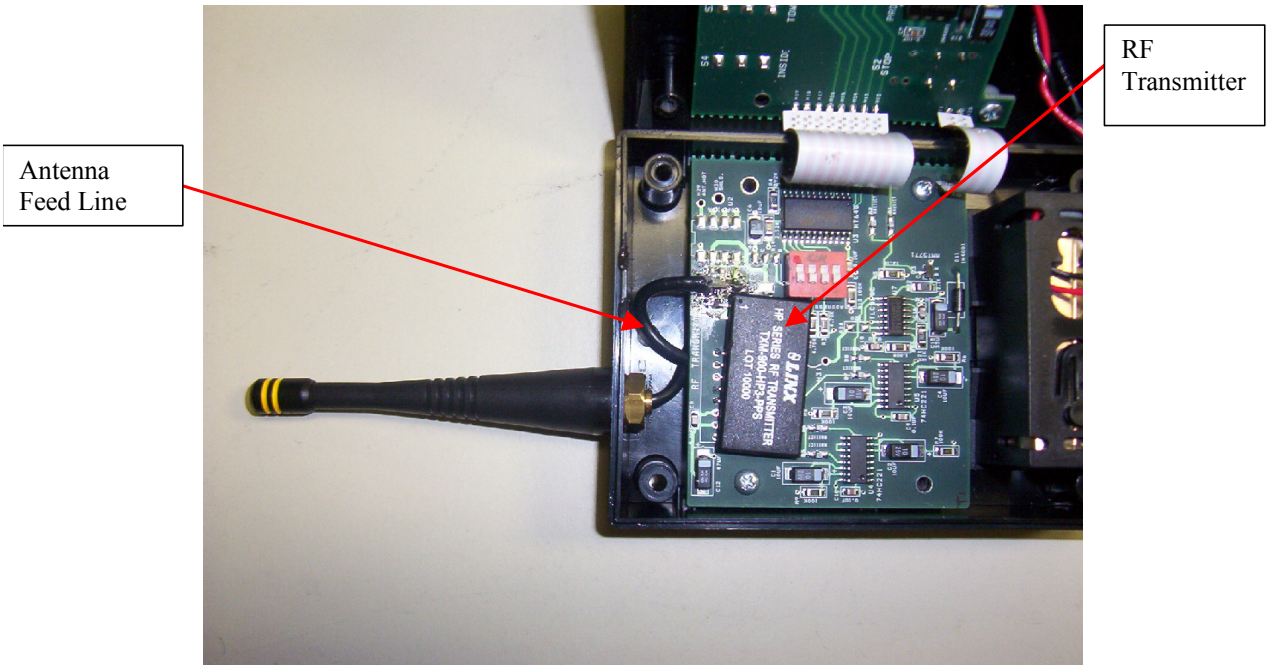
The tested configuration represents deliverable hardware.

## 1.4 EUT Modifications

The following changes were made to the FCC certified Generation4 Outdoor Radio Remote Control hardware:

(1) Replaced the obsolete RF transmitter module (LINX Technologies TXM-900-HP-II) with a LINX Technologies TXM-900-HP3-PPS RF transmitter module.
(2) Removed 20.5-ohm series resistor to the transmitting antenna input that was in previous version of the EUT.
(3) Shortened antenna feed line cable length from 7.81 inches to 3.38 inches.

Note that the above change no. (3) was made to meet the EMI requirements during this EMI evaluation.



## 2.0 Operation of The EUT During Testing

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

### 2.1 General

**Climatic Environment**

The following were the ambient conditions in the laboratory during testing:
Temperature: $22^{o}$ C ± $5^{o}$ C
Relative Humidity 50% ± 10% RH

**DC Power**

The Generation4 Outdoor Radio Remote Control is a battery-operated device. Testing was performed using a 9 VDC new battery.

### 2.2 Operating Mode

During intentional radiated emissions testing the Generation4 Outdoor Radio Remote Control was operated for continuous transmission at the following three selected transmitting frequencies:

903.37 MHz (Low)

909.37 MHz (Medium)

921.37 MHz (High)

Unintentional radiated emission testing on the Generation4 Outdoor Radio Remote Control was performed using two modes of operation: (i) Continuous transmission at 909.37 MHz, and (ii) Power ON - Standby mode.

### 2.3 Rationale for The Chosen Mode of Operation

The selected operating modes of the Generation4 Outdoor Radio Remote Control represent actual EUT operation of standby and RF transmission therefore constitute appropriate test modes. The selected test configuration duplicates the use of the Generation4 Outdoor Radio Remote Control by customers that may cause emissions.

## 3.0 Applicable Requirements, Methods and Procedures

### 3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and, where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirement at the discretion of the client, regulatory agencies, or other entities.

**USA**

47 CFR, Part 15, Radio Frequency Devices,
- Subpart B, "Unintentional Radiators".
- Subpart C, "Intentional Radiators".

### 3.2 Basic Test Methods and Procedures

The applicable regulatory product family or generic standards require that radio disturbance/interference tests be performed in accordance with the following:

- C63.4, 2001 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in The Range of 9 kHz to 40 GHz".

### 3.3 Deviations Or Exclusions From The Requirements And Standards

There were no deviations or exclusions from the requirements and standards.

## 4.0 Test Results

## 4.1 Radiated Emissions

### 4.1.1 Test Facility

The test site is an all weather, open field measurement facility defined by an elliptical area of 3258 square meters, which is free of reflective metallic objects and extraneous electromagnetic signals. A non-metallic A-Frame enclosure covers 172 square meters of the ellipse. This enclosure contains a ground level 5-meter diameter turntable, capable of rotating equipment through a complete 360 degrees, and a 3-meter and 10-meter test range with a remotely controlled antenna mast. The floor of the A-Frame and surface of the turntable are covered with a flat metal continuous ground plane. The ground plane extends outside the A-Frame to a distance of 35.6 meters from the center of the turntable. The width of the extension is 2.4 meters.

The ground plane, under the A-Frame enclosure, is covered with protective insulating material. A cellar located beneath the ground level of the A-Frame structure houses personnel and instrumentation for remote control of the antenna mast, the turntable, and other equipment above ground level. The test site complies with the Attenuation Measurements specified in ANSI C63.4 - 2001, and is registered with FCC, VCCI, BSMI, NEMKO and EZU.

For electric field radiated emissions, the EUT and support peripherals or devices required to facilitate EUT operation were positioned either directly on the turntable surface (floor standing equipment) or on a wooden table 80 cm. in height (tabletop equipment), depending on the size and status of the sample. Hardware not needed in the test field such as remote terminals or non-standard exercisers were placed in the basement below the turntable.

### 4.1.2 Radiated Emissions Test Procedure

**Radiated Emissions 30 MHz – 1000 MHz**

Initial measurements, for the purpose of identifying suspect emissions from the equipment under test, were performed by dividing the test frequency range into the following twenty bands:

| Band | Frequency Range | Band | Frequency Range | Band | Frequency Range |
|---|---|---|---|---|---|
| 1) | 30 - 40 MHz | 8) | 108 - 148 MHz | 15) | 570 - 670 MHz |
| 2) | 40 - 50 MHz | 9) | 148 - 165 MHz | 16) | 670 - 770 MHz |
| 3) | 50 - 88 MHz | 10) | 165 - 200 MHz | 17) | 770 - 855 MHz |
| 4) | 88 - 93 MHz | 11) | 200 - 300 MHz | 18) | 855 - 875 MHz |
| 5) | 93 - 98 MHz | 12) | 300 - 450 MHz | 19) | 875 - 892 MHz |
| 6) | 98 - 103 MHz | 13) | 450 - 470 MHz | 20) | 892 - 1000 MHz |
| 7) | 103 - 108 MHz | 14) | 470 - 570 MHz | | |

Each of these bands was monitored on a spectrum analyzer display while the turntable was initially positioned at the reference 0 degree point. A mast mounted broadband antenna was located at a distance of 3 meters from the periphery of the EUT(s). The antenna was set to a height of 1 meter, for the vertical Orientation and a height of 2.5 meters, for horizontal Orientation for these suspect emission scans. All emissions with amplitudes 8 dB or less below the appropriate regulatory limit were identified and saved for later source identification and investigation. This initial suspect identification procedure was repeated for turntable positions of 90, 180 and 270 degrees.

The source of questionable emissions was verified by powering off the EUT(s). Those emissions remaining were removed from the suspect list. Valid suspect emissions were then maximized through cable manipulation. The highest six signals or all within 4 dB of the limit, identified during this initial investigation, were then maximized by rotating the turntable through a complete 360 degrees of azimuth and then raising the antenna from 1 to 4 meters of elevation with the turntable positioned at the angle of maximum signal level. When the EUT(s) azimuth, antenna height and polarization that produced the maximum indication were found, the emission amplitude and frequency were remeasured to obtain maximum peak and quasi-peak field strength. The frequencies and amplitudes of RFI emissions are recorded in this report in units derived as follows:

***Field Strength (dBuV/m) = meter reading (dBuV) + antenna factor (dB/m)+ Cable Loss (dB)***

**Radiated Emissions above 1 GHz**

The required test frequency range above 1 GHz, was scanned manually by placing a Double Ridged Guide antenna at a distance of 3 meters from the perimeter of the equipment under test. Emissions were monitored using EMI Test Receiver ESIB 40 set for a 1 MHz bandwidth with rotating the turntable through a complete 360 degrees of azimuth. Both horizontal and vertical antenna polarities were investigated for suspect emissions. The support equipment and test item(s) were powered off in turn to determine the source of the emissions. The test procedure described above for 30 –1000 MHz was observed to maximize the emissions. The measurements were made with both peak and average detectors. The field strengths were recorded as follows:

***Field Strength (dBuV/m) = Meter reading (dBuV) + Correction Factor****

* Correction Factor includes Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

### 4.1.3 Radiated Emissions Test Results (9/13/04-9/14/04)

#### 4.1.3.1 Radiated Emissions - Intentional Radiator

The EUT was tested in 3 orientation positions to determine the worst-case orientation

1. Vertical Straight Up
2. On Left Side
3. Flat on Back

For the fundamental frequency emissions measurements the worst case was determined to be the Flat on Back EUT orientation.

## Fundamental Frequency Emissions

Fundamental Frequency = LOW
EUT Orientation = Flat on Back

| Freq | Q-Pk | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV/m] | Pol | [deg] | [cm] | [dB] | [dBµV/m] | [dB] |
| 903.31 | 90.47 | H | 228 | 100 | 27.2 | 94 | -3.53 |
| 903.31 | 81.86 | V | 137 | 132 | 27.2 | 94 | -12.14 |

Fundamental Frequency = MID
EUT Orientation = Flat on Back

| Freq | Q-Pk | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV/m] | Pol | [deg] | [cm] | [dB] | [dBµV/m] | [dB] |
| 909.31 | 90.75 | H | 222 | 100 | 27.4 | 94 | -3.25 |
| 909.31 | 77.84 | V | 226 | 261 | 27.4 | 94 | -16.16 |

Fundamental Frequency = HIGH
EUT Orientation = Flat on Back

| Freq | Q-Pk | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBmV/m] | [dB] |
| 921.31 | 92.1 | H | 220 | 100 | 27.8 | 94 | -1.9 |
| 921.31 | 80.33 | V | 221 | 155 | 27.8 | 94 | -13.67 |

***Overall Results:*** All fundamental radiated emissions, as recorded for all the three selected transmitting frequencies, at a distance of 3 meters from the Generation4 Outdoor Radio Remote Control, are below the 3 meter limit specified by FCC Part 15, Section 15.249.

## Harmonics of Fundamental Frequency Emissions (Upto 10 GHz)

The EUT was tested in 3 orientation positions to determine the worst-case orientation for the Harmonics of Fundamental Frequency Emissions.

1. Vertical Straight Up
2. On Left Side
3. Flat on Back

For the harmonics of fundamental frequency emissions measurements the worst case was determined to be the Vertical Straight Up EUT orientation.

## Average Detector Measurements

Fundamental Frequency = LOW
EUT Orientation = Vertical Straight Up

| Freq | Avg | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBuV/m] | [dB] |
| 1806.62 | 40.88 | H | 312 | 112 | -2.12 | 54 | -13.12 |
| 1806.62 | 47.97 | V | 189 | 100 | -2.12 | 54 | -6.03 |
| 2709.93 | 40.38 | V | 22 | 118 | 14.13 | 54 | -13.62 |
| 2709.93 | 41.31 | H | 345 | 128 | 14.13 | 54 | -12.69 |
| 3613.24 | 49.01 | H | 40 | 112 | 12.45 | 54 | -4.99 |
| 3613.24 | 40 | V | 241 | 122 | 12.45 | 54 | -14 |

Fundamental Frequency = MID
EUT Orientation = Vertical Straight Up

| Freq | Avg | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBuV/m] | [dB] |
| 1818.62 | 46.05 | V | 190 | 102 | -2 | 54 | -7.95 |
| 1818.62 | 39.32 | H | 312 | 109 | -2 | 54 | -14.68 |
| 2727.93 | 40.36 | V | 25 | 123 | 14.24 | 54 | -13.64 |
| 2727.93 | 44.01 | H | 62 | 184 | 14.24 | 54 | -9.99 |
| 3637.24 | 48.35 | H | 42 | 127 | 12.54 | 54 | -5.65 |
| 3637.24 | 44.59 | V | 15 | 189 | 12.54 | 54 | -9.41 |

Fundamental Frequency = HIGH
EUT Orientation = Vertical Straight Up

| Freq | Avg | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBuV/m] | [dB] |
| 1842.62 | 42.53 | V | 203 | 178 | -1.77 | 54 | -11.47 |
| 1842.62 | 34.43 | H | 154 | 217 | -1.77 | 54 | -19.57 |
| 2763.93 | 43.53 | H | 66 | 126 | 14.44 | 54 | -10.47 |
| 2763.93 | 38.48 | V | 339 | 149 | 14.44 | 54 | -15.52 |
| 3685.24 | 43.47 | V | 72 | 123 | 12.7 | 54 | -10.53 |
| 3685.24 | 48.09 | H | 34 | 108 | 12.7 | 54 | -5.91 |

## Peak Detector Measurements

Fundamental Frequency = LOW
EUT Orientation = Vertical Straight Up

| Freq | Pk | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBuV/m] | [dB] |
| 1806.62 | 45.41 | H | 312 | 112 | -2.12 | 74 | -28.59 |
| 1806.62 | 50.64 | V | 189 | 100 | -2.12 | 74 | -23.36 |
| 2709.93 | 50.89 | V | 22 | 118 | 14.13 | 74 | -23.11 |
| 2709.93 | 51.41 | H | 345 | 128 | 14.13 | 74 | -22.59 |
| 3613.24 | 55.46 | H | 40 | 112 | 12.45 | 74 | -18.54 |
| 3613.24 | 51.12 | V | 241 | 122 | 12.45 | 74 | -22.88 |

Fundamental Frequency = MID
EUT Orientation = Vertical Straight Up

| Freq | Pk | Ant. | Angle | Ht | CF | Limit | Delta |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBuV/m] | Pol | [deg] | [cm] | [dB] | [dBuV/m] | [dB] |
| 1818.62 | 49 | V | 190 | 102 | -2 | 74 | -25 |
| 1818.62 | 44.18 | H | 312 | 109 | -2 | 74 | -29.82 |
| 2727.93 | 51.26 | V | 25 | 123 | 14.24 | 74 | -22.74 |
| 2727.93 | 53.28 | H | 62 | 184 | 14.24 | 74 | -20.72 |
| 3637.24 | 54.91 | H | 42 | 127 | 12.54 | 74 | -19.09 |
| 3637.24 | 52.71 | V | 15 | 189 | 12.54 | 74 | -21.29 |

Fundamental Frequency = HIGH
EUT Orientation = Vertical Straight Up

| Freq [MHz] | Pk [dBuV/m] | Ant. Pol | Angle [deg] | Ht [cm] | CF [dB] | Limit [dBuV/m] | Delta [dB] |
|---|---|---|---|---|---|---|---|
| 1842.62 | 46.15 | V | 203 | 178 | -1.77 | 74 | -27.85 |
| 1842.62 | 41.62 | H | 154 | 217 | -1.77 | 74 | -32.38 |
| 2763.93 | 51.71 | H | 66 | 126 | 14.44 | 74 | -22.29 |
| 2763.93 | 49.58 | V | 339 | 149 | 14.44 | 74 | -24.42 |
| 3685.24 | 52.41 | V | 72 | 123 | 12.7 | 74 | -21.59 |
| 3685.24 | 54.84 | H | 34 | 108 | 12.7 | 74 | -19.16 |

***Overall Results:*** All the harmonic radiated emissions (Average and Peak), as recorded for all the three selected transmitting frequencies, at a distance of 3 meters from the Generation4 Outdoor Radio Remote Control, are below the applicable 3 meter limits specified by FCC Part 15C, Section 15.249.

### 4.1.3.2 Radiated Emissions - Unintentional Radiator

Testing was performed for EUT operating in (i) Continuously Transmit mode (ii) Power ON – Standby mode. No EUT signals found, so noise floor measurements were made as below:

**30 MHz - 1000 MHz (Quasi-Peak Detector)**

| Freq [MHz] | Q-Pk [dBuV/m] | Ant. Pol | Angle [deg] | Ht [cm] | CF [dB] | Limit [dBuV/m] | Delta [dB] |
|---|---|---|---|---|---|---|---|
| 40 | 23.55 | V | 1 | 100 | 17.1 | 40 | -16.45 |
| 225 | 11.56 | V | 1 | 100 | 13.78 | 46 | -34.44 |
| 420 | 19.6 | V | 1 | 100 | 19.32 | 46 | -26.4 |
| 610 | 22.96 | V | 1 | 100 | 22.94 | 46 | -23.04 |
| 840 | 26.6 | V | 1 | 100 | 26.24 | 46 | -19.4 |
| 990 | 29.15 | V | 1 | 100 | 28.1 | 54 | -24.85 |

**1GHz – 5GHz** (Average Detector)

| Freq [MHz] | Avg [dBuV/m] | Ant. Pol | Angle [deg] | Ht [cm] | CF [dB] | Limit [dBuV/m] | Delta [dB] |
|---|---|---|---|---|---|---|---|
| 1000 | 19.36 | V | 1 | 100 | -5.51 | 54 | -34.64 |
| 1700 | 23.05 | V | 1 | 100 | -3.15 | 54 | -30.95 |
| 2400 | 26.21 | V | 1 | 100 | 8.28 | 54 | -27.79 |
| 3100 | 28.83 | V | 1 | 100 | 10.42 | 54 | -25.17 |
| 3800 | 32.72 | V | 1 | 100 | 11.09 | 54 | -21.28 |
| 4500 | 31.89 | V | 1 | 100 | 11.91 | 54 | -22.11 |

***Overall Results:*** No EUT signals found at a distance of 3 meters from the Generation4 Outdoor Radio Remote Control with respect to 3 meter limit specified by FCC Part 15B, Class B products.

**Test Setup Photos**

**Radiated Emission Test Setup – Vertical Straight Up (Front View)**


**Radiated Emission Test Setup – Vertical Straight Up (Rear View)**

**Radiated Emission Test Setup – On Left Side**

**Radiated Emission Test Setup – Flat On Back**

## Appendix A – Test Equipment

| Description | Freq Range (Hz) | Model Number | Manufacturer | ID / SN | Last Cal Date |
|---|---|---|---|---|---|
| EMI Test Receiver | 20 Hz – 40 GHz | ESIB 40 | Rohde & Schwarz | C-062 | 11/4/03 |
| Antenna | 25M - 2G | LPB-2520/A | ARA | B962 | 4/7/04 |
| Controller, Tower and Turntable | NA | 2090 | EMCO | B812 | NA |
| Amplifier | 1G – 40G | NSP4000-44 | Miteq | B827 | 8/3/04 |
| Antenna | 1G – 12G | 96601 | EATON | U926 | 2/11/04 |