

1.0 PURPOSE

This test report applies to the Guardian Instruments *Data Radio* (see Fig. 1). This is a modular transmitter used in a variety of Guardian Instrument products. The *Data Radio* is designed to operate with either of two frequencies, 916.5MHz or 914.0MHz at data transmission rates of 12-19200 baud. Guardian manufactures a line of construction equipment instrumentation. This Guardian-manufactured instrumentation consists of but is not limited to:

Model 420 Display
Radio Tension Link
Radio Boom Angle Sensor
Radio Anti-2-Block Switch

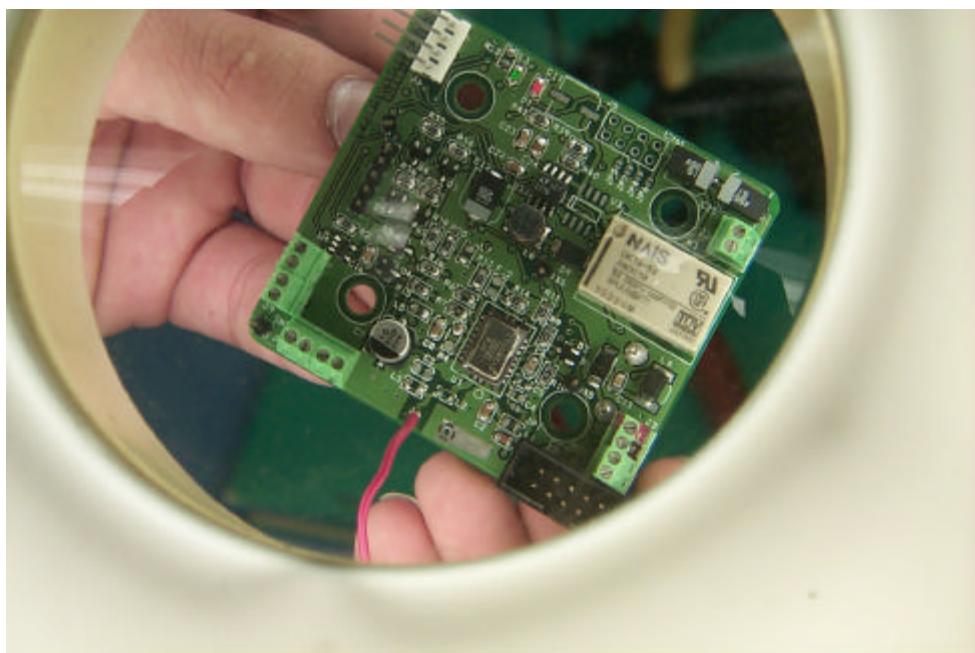


Figure 1

The purpose of this electromagnetic compatibility (EMC) Test Report is to give the FCC information on the radiated emission profile of the DATA RADIO as required for *47 CFR Part 15- Radio Frequency Devices, Subpart C-Intentional Radiators and Subpart B-Unintentional Radiators*. For sake of brevity, this standard will be referred to as FCC Part 15.

The heart of this device is either the RFM TR1000 Hybrid Transmitter designed for 916.5MHz operation or the TR1004 designed for 914.0MHz operation. The Data Radio can come supplied with either module. It is designed for modulation types on-off keyed (OOK) and amplitude-shift keyed (ASK) modulation. The modules maximum output power is 0.75mW. They are designed specifically for compliance to CFR47, Part 15.249.

FCC Part 15 testing is performed using the techniques and practices described in the *"American National Standard for Methods of Measurement of Radio Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9KHz to 40GHZ"*, ANSI C63.4. The target emissions levels are set using criterion set in FCC Part 15.



Since the Data Radio is designed for battery operation so no conducted emissions testing was necessary.

2.0 EQUIPMENT

2.1 GUARDIAN INSTRUMENTS Supplied Equipment

All tests described below were carried out on standard production units. The P/N of the device is 4954-003. The device comes in either 916.50MHz or 914.00MHz varieties.

2.2 EMCA Test Equipment

Name and Model Number	Serial Number	Calibrated	Next Calibration
Hewlett-Packard HP8546A Receiver	3520A00237 3448A00238	11 Nov. 2000	11 Nov. 2001
EMCO Biconilog 3142 Antenna 30MHz-1GHz	9803-1251	12 Aug. 2000	12 Aug. 2002
3M Semi-anechoic Chamber and Associated H/W (turntable, antenna mast, etc.)	N/A	N/A	N/A
EMCO 2075 Minimast (chamber)	9707-2061	N/A	N/A
EMCO 2090 Multi-Device Controller(chamber)	9704-1231	N/A	N/A
Pentium-based PC system	N/A	N/A	N/A

TDK RF Solutions Inc Emissions S/W Ver. 8.33	N/A	N/A	N/A
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3.0 PROCEDURE and RESULTS

3.1 Equipment Configuration

The date of the testing was 2001. Testing was done in the semi-anechoic chamber. Each version of the Data Radio (914MHz and 916MHz) were tested in stand-alone mode with the units configured for continuous transmit. Each module was placed on a wooden (non-conductive) table, 80cm high. The table was placed on a turntable inside the chamber for radiated emissions.

The equipment was arranged in the manner recommended in Fig 9(c) *Test Configuration Tabletop Equipment Radiated Emissions* of ANSI C63.4.



Figure 2

Figure 2 shows the test setup. The necessary DC-voltage was supplied by the supply located on the turntable. The Data Radio was modified to allow continuous broadcasting. This was necessary because a continuous signal was necessary for emissions profile measurement.

3.2 Environment

The temperature/humidity in the semianechoic chamber and the shield room were as follows:

Temperature	20°C
Humidity	30%

3.3 Radiated Emissions

3.3.1 Preliminary Scan

During testing, the limit line was adjusted. All data was taken at a 3m distance in the semianechoic chamber.

The test was computer driven/monitored. For prescans, the antenna was set at 1m, the turn table was rotated in 90° increments. The antenna was then raised to a height of 2m and the turntable was rotated in 90° increments. This was repeated for 3 and 4m. Initial sweeps were done with the antenna in vertical then horizontal polarity. The maximum peak value for each frequency was stored in computer memory and graphed.

All scanning was done in the semi-anechoic chamber. During the initial scans, the exact frequencies emitted by the EUT were identified. Initial scans used the Peak Detector. Any frequencies within 10dBuV of the limit line were identified. Radiated emissions measurements from 30-2000MHz, emissions measurements were made with the bilog antenna (EMCO 3142). Above 2000MHz, The EMCO 3115 horn antenna was used.

The first scan covered a frequency range of 30MHz to 2000MHz. This data was taken with the biconilog antenna in both vertical and horizontal polarities.

Figure 3 shows the horizontal/vertical peak data. Please note all emissions (measured in peak mode) from 30MHz–2000MHz, are below the Quasi-Peak limit line.

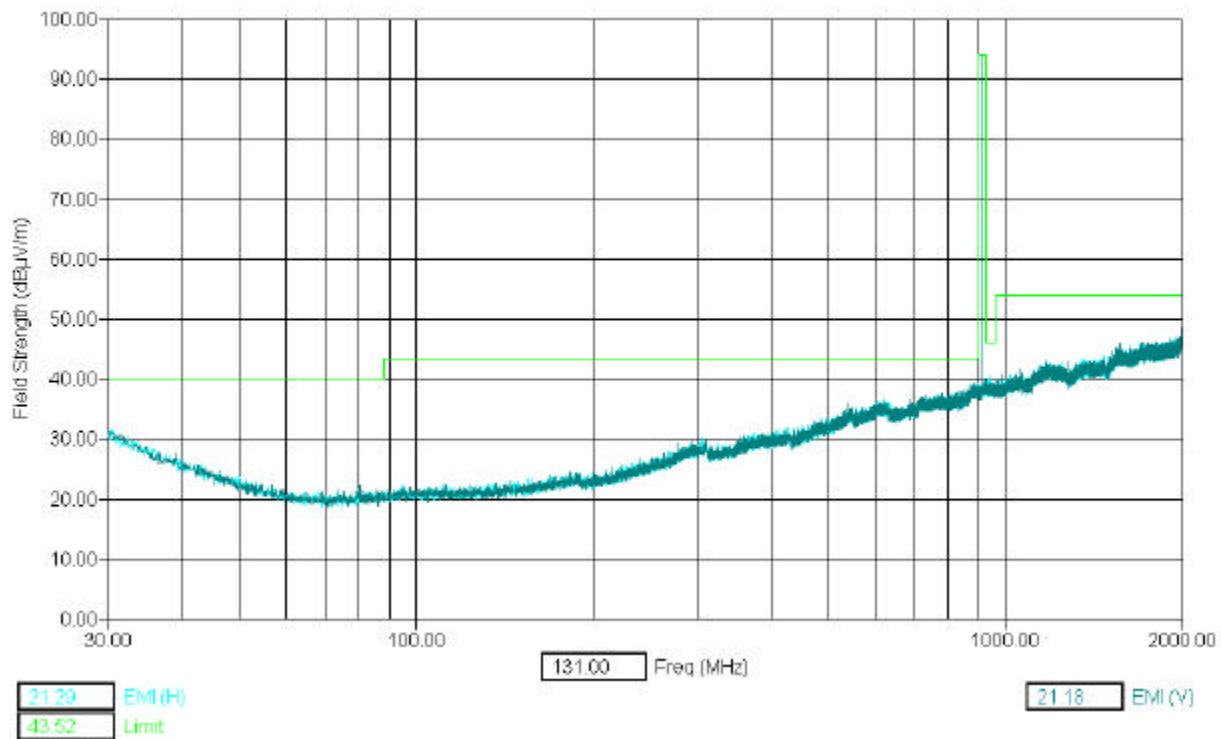


Figure 3: 914MHz Data Radio 30MHz-2GHz

Figure 4 shows the scan made for the 916.50MHz version of the Data Radio.

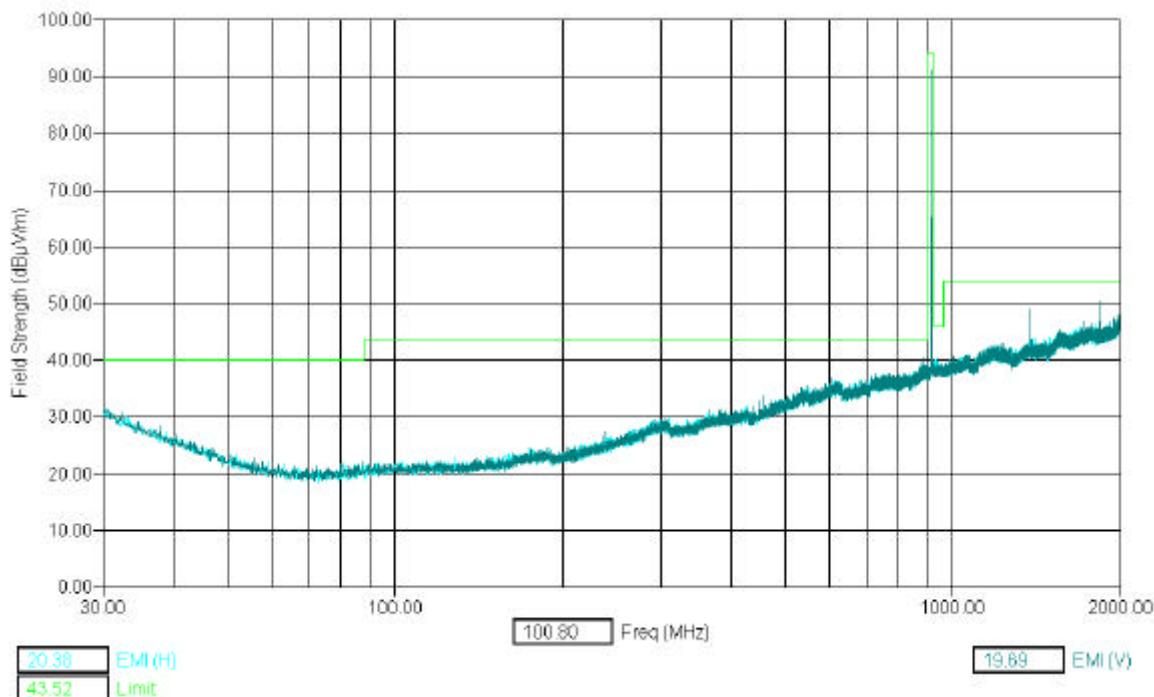


Figure 4: 916.5 MHz Data Radio 30MHz – 2GHz

3.3.2 Final Scan

Final scans were run differently from the prescans. Peaks within 10dB_{UV} of the limit were identified by the test S/W. These are the frequencies to be investigated using the quasi-peak detector.

Once a frequency has been identified, testing begins. The antenna is set initially at a height of 2m. The operating EUT is rotated/scanned continuously for 360°. The turntable rotates back to the angular position of maximum emissions. The antenna was then raised to a height of 4m. Scanning continued while the antenna height was adjusted. Once the scan was complete, the antenna was returned to the height of maximum emissions and the quasi-peak measurement completed.

Please note the preliminary scans indicated no points over the limit. The emissions from 30MHz to 2000MHz are well within limits. No further effort in this frequency range was required.

3.3.3 Harmonics

Specific measurements were taken of the primary radiating frequency harmonics.

Next the intentional radiating frequency of 914.50MHz and it's harmonics:

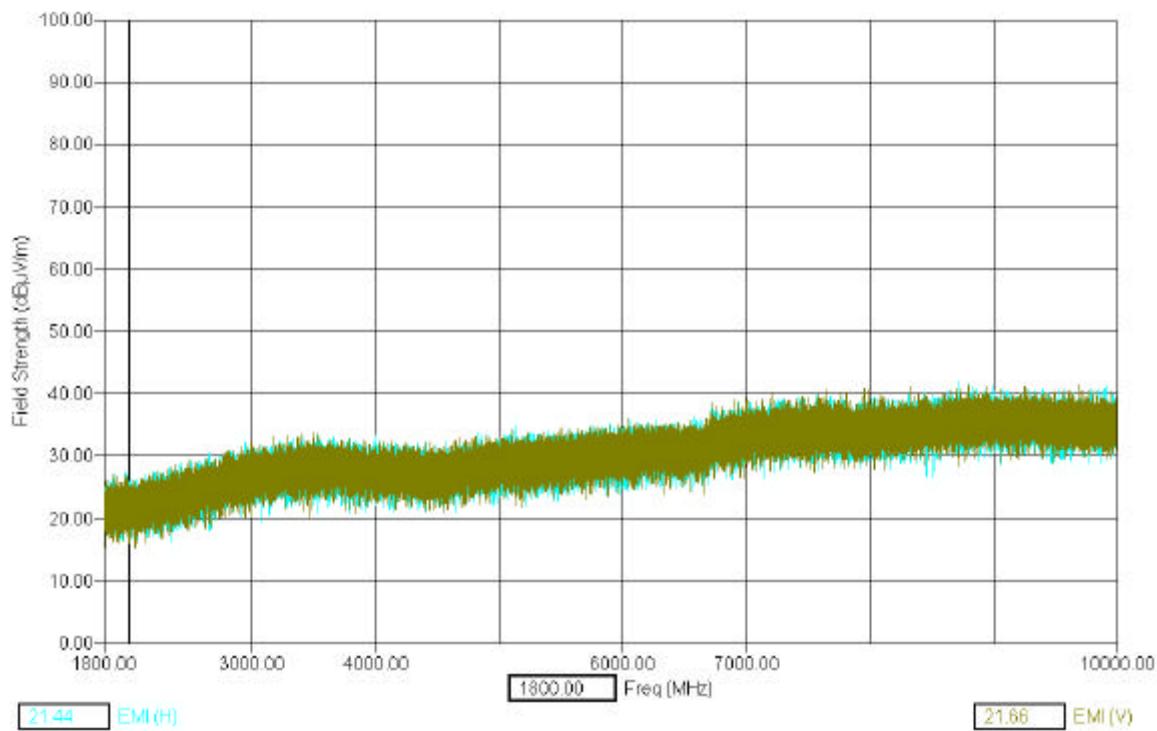


Figure 5: 914 MHz Data Radio 1.8GHz – 10GHz

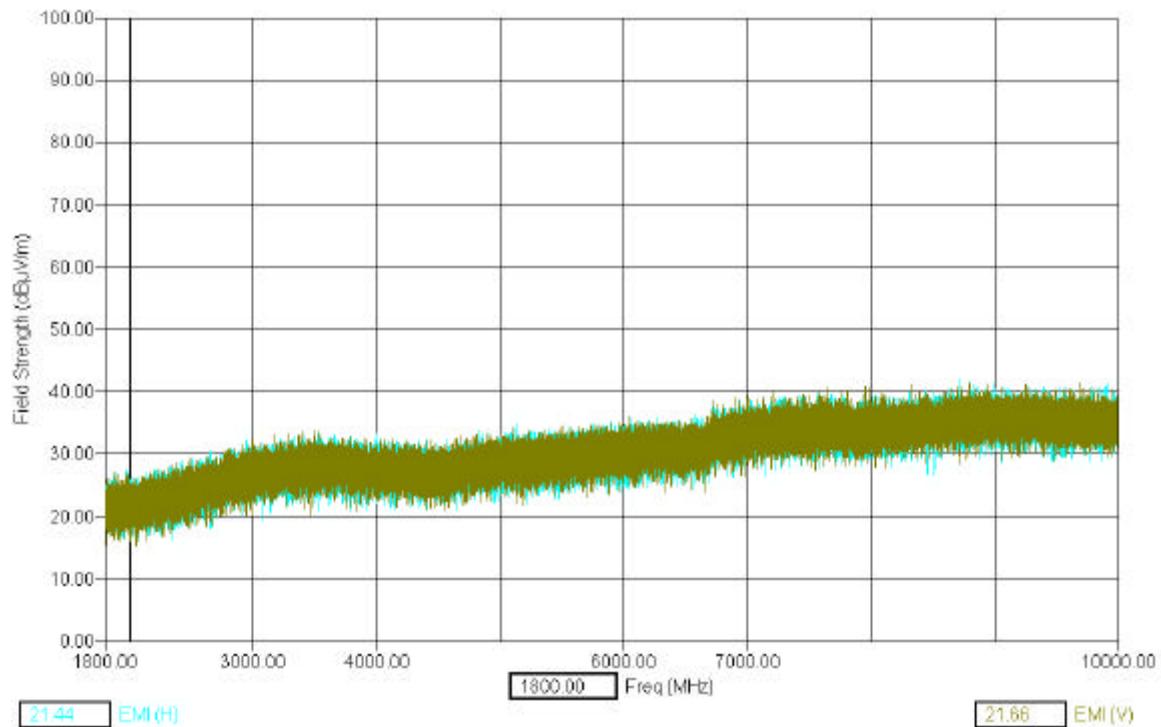


Figure 6: 916.5MHz Data Radio 1.8GHz – 10GHz

All peak data measurements of the harmonics were well below the quasi-peak limits. The limit for harmonics is 500 uV/m or 53.98 dBuV. We could detect no limits above the noise floor seen above.

3.3.4 Occupied Bandwidth

The DATA RADIO is an OOP/ASK-modulated device operating at either 914MHz or 916.50MHz. Occupied bandwidth measurements were made to demonstrate compliance with CFR47, Part 15.2249. This band is from 902-928MHz. The upper limit for this band is 50mV/m or 93dBuv/m. Outside of this band the limits are per CFR47, Part 15.209.

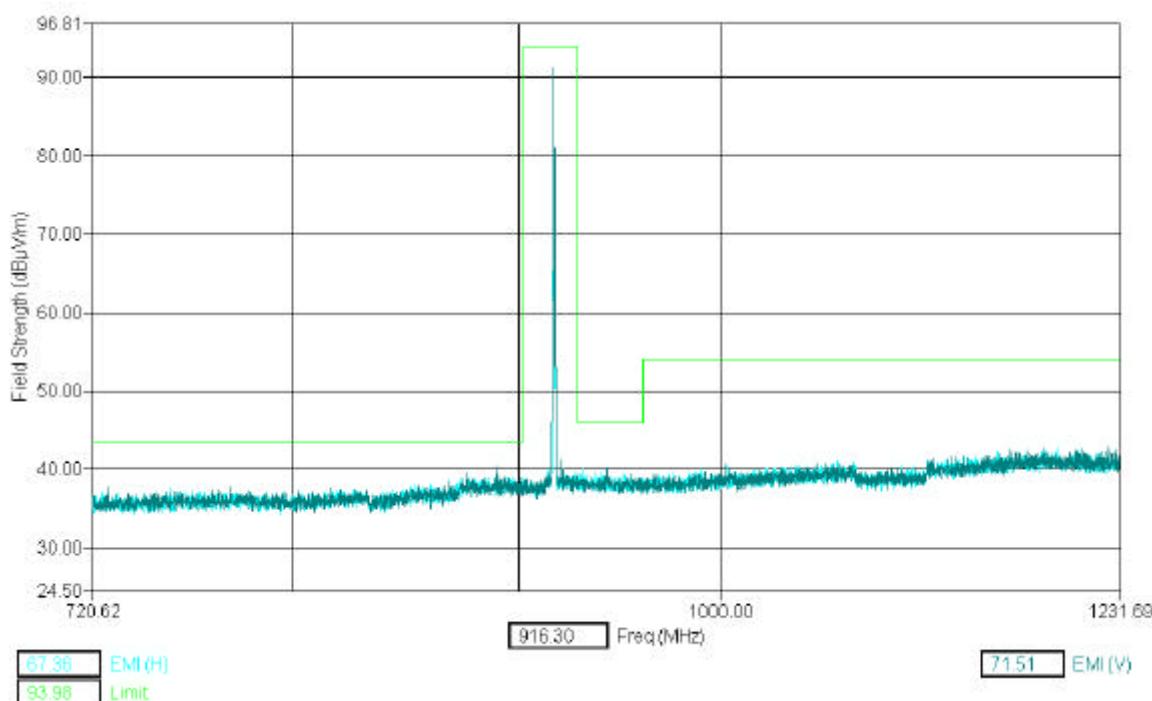
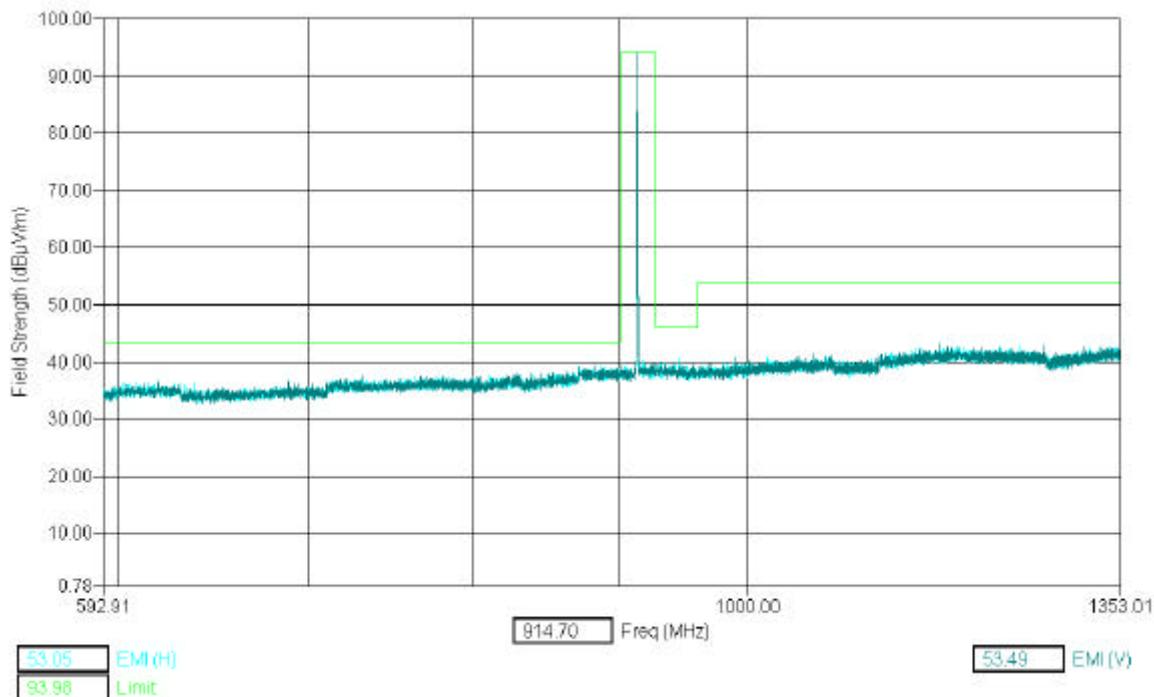


Figure 7: 916.5MHz Data Radio

**Figure 8: 914MHz Data Radio**

From Figures 7 and 8, it is obvious both signals fit neatly in the bandwidth in question.

3.4 Power Stability Data (CFR47 Part 15.31e)

The base power of the Data Radio as read off the receiver display. The DC power supply voltage was replaced with a new battery.

For 914.70MHz, the measured output at three meters (vertical polarization) was 92.0dB μ V/m. For 916.70MHz, the output was 91.18dB μ V/m.



4.0 Conclusion

Based on the data of the Guardian Instruments Data Radio it is the opinion of this test facility the EUT tested is compliant to CFR47 Part 15. The test results should be submitted to the FCC for their review and opinion.

Test Performed By:_____

Orlando Perez
EMC Technician

Approved By:_____

Michael E. Hill, NCE
Manager Test Facility