



nu-metrics®

A QUIXOTE COMPANY

**GROUNDHOG®
HARDWARE
INSTALLATION
MANUAL**

TABLE OF CONTENTS

Section	Description	Page
1.0	Introduction	2
2.0	Safety Information	4
3.0	Installation Preparation	5
4.0	Mounting the Antenna	7
4.1	Mounting an Omni-Directional Antenna	7
4.2	Mounting a Yagi Antenna	7
5.0	Mounting Solar Panel to Antenna Mast	8
6.0	Mounting Solar Panel to Wall	10
7.0	Mounting the BSR-2 Box	10
8.0	BSR-2 Box Equipment Installation	11
9.0	Installing the Base Station Repeater	12
9.1	Rooftop Base Station Mount	12
9.2	Self-Supporting Tower	13
9.3	Tripod	15
10.0	Grounding the BSR-2 Installation	15
11.0	Groundhog Housing Installation	16
12.0	Electronic Module Installation	16
13.0	Specifications	19
14.0	Groundhog Model G-1 and G-2 Installation Guide	21
15.0	Limited Warranty	29
16.0	Limitation of Liability	29
17.0	Service of Your Equipment	30

DISCLAIMER OF LIABILITY

A reasonable attempt has been made to insure the accuracy of the material in this manual. It is, however, supplied without warranty or representation of any kind. Nu-Metrics assumes no responsibility and shall have no liability of any kind arising from the use of this publication or the material contained herein. Nu-Metrics reserves the right to add, delete and/or change the material at any time. Since the conditions or methods of installation, operation, use and maintenance of this equipment are beyond its control, Nu-Metrics does not assume responsibility and expressly disclaims liability of loss, damage, or expense arising out of or in any way connected with any installation, operation or maintenance not performed by Nu-Metrics authorized service personnel.

PURPOSE OF THIS MANUAL

This manual gives an overview of the equipment installation process and provides guidelines for installing your Groundhog Wireless System hardware. Read the entire manual carefully before you begin any of the installation procedures. You should also first read and be familiar with the Groundhog Wireless System Operation Manual and Groundhog and RFM-915 Programming Guide before proceeding.

1.0 INTRODUCTION

This manual provides instructions for Groundhog Hardware Installation. The manual will help you install your groundhog counters, RFM-915 Radio Modules, Master Base Station and any repeaters necessary. The manual assumes the user has basic computer and electrical knowledge. Read the entire manual before beginning any of these procedures. Before jumping into the hardware installation, you must complete a Site Survey and fill out the necessary addressing and code forms. The equipment you will be installing is probably new to you so this section provides a brief description of each piece of equipment needed to set up your Groundhog Wireless Traffic Monitoring System.

G-1 AND G-2

Your Groundhog Wireless Traffic Monitoring System includes several components or modules. The Groundhog Models G-1, G-2, and G-2wx are permanent, in-pavement, self-contained, traffic monitors for wireless detection and transfer of traffic and weather data. The G-1 is a basic traffic volume monitor, ideally suited for highway congestion management with capabilities that include vehicle volume, occupancy and roadway surface temperature. The Model G-2 has additional capabilities of speed (15 bins), Class (length - 6 bins), occupancy, surface temperature and wet/dry pavement. The model G-2wx adds chemical analysis for measurement of ion quantity of anti-icing chemicals present.

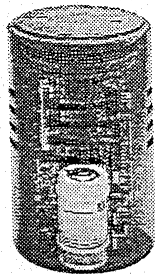


Figure 1A - Model G-1



Figure 1B - Model G-2 and G-2wx

BASE STATION REPEATER (BSR-2)

The typical Base Station Repeater (BSR-2) consists of equipment cabinet (BEC-02), battery cells (BC-33), lightning arrestor (LAC-4N), solar generator panel (SG-30), omni directional or yagi antenna, digital spread spectrum radio modem (RFM-915 transceiver), and optionally a weather data converter with precipitation, air temperature, humidity, and subsurface temperature sensors. The BSR-2 equipment can be mounted on a Roof Top Base Mount, Self Supporting Tower (AT-20 or 30), or it can be mounted on existing towers, poles, etc. A BSR-2 can function as a Local Base Unit (LBU), Repeater, or Master Data Collection Site.

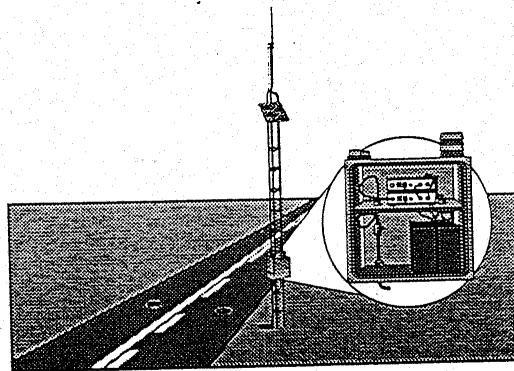


Figure 2 - BSR-2 Base Station Repeater

RFM-915

Vu-Metric's Model RFM-915 is a compact stand alone digital spread spectrum radio modem that can be used in many applications that demand high performance communications. The RFM-915 has the capability to operate within a large network as a Master, Local or Slave Station.

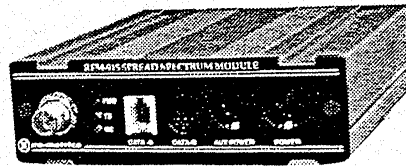


Figure 3 - RFM-915 Radio Module

MASTER COMPUTER DATA COLLECTION SITE

The Master Computer Data Collection Site generally consists of a BSR-2 functioning as a Local Base Unit (LBU). The RFM-915 in the LBU collects any transmitted data from BSR-2 Remote Data Sites or Repeaters. The data is then transferred by category 5 (CFC-5) cable to the Master CPU computer system at a central office location.

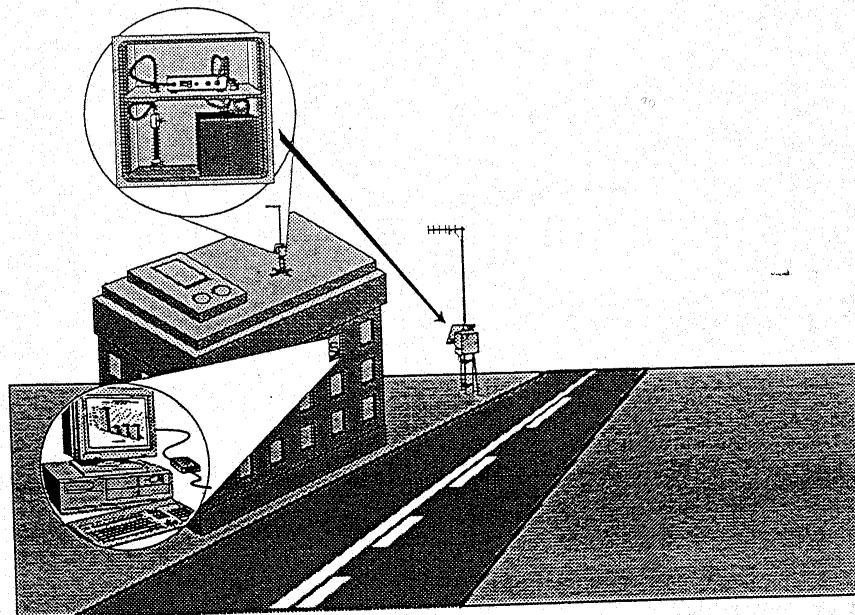


Figure 4 - Master Computer Data Collection Site

2.0 SAFETY INFORMATION

DANGER ! AVOID POWER LINES!

When following the instructions in this guide to install and connect or repair any equipment, take extreme care to avoid contact with overhead power lines, lights and power circuits. Contact with power lines, lights, and circuits may be fatal.

COMPLIANCE WITH FCC PART 15 CLASS A

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

COMPLIANCE WITH NATIONAL ELECTRICAL CODE (NEC)

This manual contains some instructions on how to make the installation in compliance with the National Electrical Code (NEC). Any wiring should either be placed in a conduit that is sunlight resistant and conforms to Article 351 of the NEC, or the wiring should be type UF cable rated sunlight resistant. If additional local installation codes apply, contact local inspection authorities. Before installing the Wireless System, check the electrical code guidelines in your area.

OUTDOOR EQUIPMENT GROUNDING

The outdoor equipment used in the Wireless Groundhog System is required to comply with local installation codes and the appropriate sections of the National Electrical Code (NEC), especially Article 810 and 820. These codes require proper grounding of the metal structure of the outdoor tower, tripod, antenna mast, and any connecting cable at a point where it enters a building. If you are having a professional make the installation, the installer must observe NEC and any local installation codes while proceeding with the installation.

ANTENNA WARNINGS AND PRECAUTIONS

Plan your installation procedure carefully and completely before you begin. To determine a safe distance from wires, power lines and trees:

1. Measure the height of your antenna.
2. Add this length to the length of your tower or mast, and then:
3. Double this total for the minimum recommended safe distance.

If you are unable to maintain this safe distance, you will want to move the antenna to a safer location. When installing your antenna, DO NOT use a metal ladder. DO NOT work on a wet or windy day. DO dress properly; shoes with rubber soles and heels, rubber gloves, long sleeve shirt or jacket. If the antenna assembly starts to drop, get away from it and let it fall. Remember, the antenna, mast and cables are excellent conductors of electrical current. Even the slightest touch of any of these parts to a power line completes an electrical path through the antenna and the installer - THAT'S YOU! If any part of the antenna system should come in contact with a power line - DON'T TOUCH IT OR TRY TO REMOVE IT YOURSELF. CALL YOUR LOCAL POWER COMPANY. They will remove it safely.

SOLAR PANEL WARNINGS AND PRECAUTIONS

- Photovoltaic (solar panel) modules generate direct current (DC) electricity when exposed to sunlight or other sources of light. Even though single modules produce low voltage and current, shocks and burns can still result from contact with panel output wiring. Note: PV panels do not have to be connected (i.e., powering a load) to generate electricity. Since panels produce electricity whenever light is present, the panel front surfaces should be completely covered by an opaque cloth or other material before electrical connections to the panel or other system components are handled.
- When using a storage battery with photovoltaic panels, battery manufacturer's safety recommendations should be followed. In some areas, local codes govern the installation and use of photovoltaic panels. In particular, these codes may specify requirements for panel installation on rooftops and exterior walls. The United States National Electrical Code (NEC) addresses the installation of photovoltaic devices and should be consulted for recommendations.

RESTRICTIONS

- Before installing your equipment, check the zoning codes, covenants and community restrictions in your area. Some rules prohibit installing towers, etc. There may be restrictions in your area that limit the mounting height of any equipment.

3.0 INSTALLATION PREPARATION

INSTALLATION PROCEDURES

- If you are installing the equipment yourself, you should feel comfortable with the types of construction practices that may be necessary for your installation. These may include but not be limited to:

- Climbing ladders
- Climbing on a roof or tower
- Drilling holes & handling small power tools
- Working around power lines
- Routing coaxial cable
- Operating power equipment (core drill, generator, etc.)
- Performing traffic control & safety procedures
- Handling electronic devices
- Basic computer operation

- If you do not feel comfortable performing these tasks, contact a professional contractor about having your system professionally installed.

PREINSTALLATION ACTIVITIES

- Before installing any hardware, a site survey and review should be conducted. Do not begin any hardware assembly or installation until this procedure is completed. First, carefully read and become familiar with all the manuals and documentation provided. Whenever you feel confident that you have a clear understanding of the theory and operation of the Wireless Data Collection System, you can conduct your site survey.

SITE SURVEY

- Obtain as much information about your proposed site as possible, including maps, aerial views, contour maps, building plans, utility plans, etc. Make copies of relevant maps that you can mark or draw on. This will provide a good base for planning the locations of your Groundhog Counters, Local Base Units (LBU's) and Master Data Collection Site.

- Study the direction and flow of traffic to determine possible locations for your Groundhog Traffic Counters. The counters must be installed in the center of a traffic lane so that vehicles pass directly over them. Locations will be determined differently depending on whether you are monitoring traffic on interstate highways, secondary roadways or in and out of shopping malls or parking lots. If the traffic is not channeled over the counter, some drivers will pass on either side and

