



Sensys™ Wireless Vehicle Detection System

Sensys Wireless Sensor Installation Guide

P/N 152-240-100-001 Rev E

November 2009

Sensys Networks
2560 Ninth Street, Suite 219
Berkeley, CA 94710
www.sensysnetworks.com

Contents

Introduction	5
What's Inside	5
Other Documents	5
Overview	7
Sensys Wireless Sensor	7
Sensys Wireless Sensor Package Contents	8
Sensys Wireless Sensor Label Information	8
Road Surfaces	9
Sensor Depths	9
Sensor Removal	9
Installation Procedures	10
Installation Crew Requirements	10
Required Equipment	10
Step-by-Step Procedures	12
Enclosing the Sensor in a Sensor Shell.....	12
Installing the Sensor/Shell Assembly into the Pavement.....	14

Document Properties

This document is reference material for the Sensys™ Wireless Vehicle Detection System from Sensys Networks, Inc.

P/N 152-240-100-001 Rev E

Sensys Networks, Inc. makes no representation or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose. Furthermore, Sensys Networks, Inc. reserves the right to revise this publication and to make changes from time to time in the content hereof without obligation of Sensys Networks, Inc. to notify any person or organization of such revisions or changes.

© 2007 - 2009 – All rights reserved.

Sensys and the Sensys logo are trademarks of Sensys Networks, Inc. All other products, names and services are trademarks or registered trademarks of their respective owners.

Regulatory Statements

FCC Compliance Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications to this product not authorized by Sensys Networks, Inc., could void the EMC compliance and negate the authority to operate the product.

RF Exposure Statement

This device has been tested and meets the FCC RF exposure guidelines. It should be installed and operated with a minimum distance of 20 cm between the radiator of RF energy and the body of users, operators or others.

Improper use or tampering with the device is prohibited and may not ensure compliance with FCC exposure guidelines.

Warnings

No Safety Switching

Sensys Networks, Inc. does not allow its equipment to be used for safety applications such as controlling a mechanical gate or switching a train to avoid a collision.

Lithium Thionyl Chloride Batteries

Sensys Networks uses Lithium Thionyl Chloride batteries in the following products:

- Sensors (VSN240-F, VSN240-T, VSN240-S)
- Repeaters (RP240-B, and RP240-B-LL)

Lithium batteries are widely used in electronic products because they contain more energy per unit - weight than conventional batteries. However, the same properties that deliver high energy density also contribute to potential hazards if the batteries are damaged. Improper use or handling of the batteries may result in leakage or release of battery contents, explosion or fire.

Following are the recommendations of the battery manufacturer for proper use and handling of batteries in the Sensys devices mentioned above:

- **DO NOT** charge or attempt to recharge the batteries (batteries are NOT rechargeable)
- **DO NOT** crush or puncture batteries
- **DO NOT** short-circuit the batteries
- **DO NOT** force over-discharge of the batteries
- **DO NOT** incinerate or expose batteries to excessive heating
- **DO NOT** expose battery contents to water
- **DO** dispose of batteries and devices containing batteries in accordance with local regulations

Sensys Networks sensors contain no serviceable parts and should never be disassembled. Installation and removal of sensors from pavement should only be done by trained personnel and care should be taken to insure that the sensor casing is not punctured or crushed.

Additional safety information is available from the battery's manufacturer:

- Sensor battery cell: http://www.able-battery.com/msds/ABLE_MSDS_ER14505.pdf
- Repeater battery cell: http://www.able-battery.com/msds/ABLE_MSDS_ER34615.pdf

Document Control

Sensys Networks continually reviews and revises its technical publications. Please address questions, suggestions or corrections to support@sensysnetworks.com.

Contact Information

Sensys Networks, Inc.
2560 Ninth Street, Suite 219
Berkeley, CA 94710 USA
+1 (510) 548-4620
www.sensysnetworks.com

CHAPTER 1

Introduction

This guide provides information and procedures for installing Sensys Wireless Sensors in conjunction with the Sensys™ Wireless Vehicle Detection System.

It is intended for use by Sensys customers, consultants, partners, dealers and others with an interest in the application of wireless communication technology to the challenges of traffic detection, management and control.

What's Inside

This guide includes the following information:

- Chapter One, *Introduction*, defines the purpose and scope of the guide
- Chapter Two, *Overview*, describes a Sensys Wireless Sensor and the contents of a product shipment
- Chapter Three, *Installation Procedures*, discusses considerations with the installation of Sensys Wireless Sensors and provides step-by-step instructions

Other Documents

General and Reference Information

- *The Sensys Wireless Vehicle Detection System – System Overview*
- *Sensys Wireless Vehicle Detection System Reference Guide*

Freeway and Arterial Applications

- *Design Guidelines for Freeway & Arterial Applications*
- *Configuration Guidelines for Freeway & Arterial Applications*
- *Installation Guidelines for Freeway & Arterial Applications*

Intersection Applications

- *Design Guidelines for Intersection Applications*
- *Configuration Guidelines for Intersection Applications*
- *Installation Guidelines for Intersection Applications*

Installation and Maintenance Procedures

- *Sensys Wireless Sensor Installation Guide*
- *Sensys Wireless Sensor Removal Guide*
- *Sensys Access Point Installation Guide*
- *Sensys Repeater Installation Guide*
- *Sensys Contact Closure Card Installation Guide*
- *Tools Required for Installing Sensys Equipment*
- *Replacing Batteries in the RP240B Repeater*

Application Notes

- *Using Sensys Networks With Motorcycles*
- *Executing Commands on a Access Point with HTTP*

Sensys Management Server

- *SNAPS Professional 2.0 Set Up and Operating Guide*
- *Sensys System Manager Set Up and Operating Guide*

Readers of this document are encouraged to contact Sensys Networks, Inc. (www.sensysnetworks.com) for the latest information, design guides, and best practices.

CHAPTER 2

Overview

This chapter describes a Sensys Wireless Sensor, the contents of a Sensor package, the label affixed to each Sensor, and the types of pavement into which Sensys Wireless Sensors can be installed.

Sensys Wireless Sensor

A Sensys Wireless Sensor is a magnetometer capable of low-power radio communications packaged in a small, hardened plastic case suitable for in-pavement mounting. (*Note: flush mounted Sensys Wireless Sensor shown at right.*)

Sensys Wireless Sensors detect changes in the earth's magnetic field to determine the presence or absence of vehicles relative to the detection zone of the Sensys Wireless Sensor. Detection “events” are transmitted via wireless radio communications to a Sensys Access Point where they are processed, stored and forwarded to other systems.

Prior to installation, a Sensor is enclosed in a simple, 2-piece molded plastic shell. The shell facilitates easy removal and redeployment of Sensors after maintenance or repair of the road surface.



Sensys Wireless Sensor Package Contents

Each Sensys Wireless Sensor is shipped with the items listed below. Verify that you have received all of them. In the event that some items are missing, contact Sensys Networks or the party that supplied the Sensors to you.

The items in a Sensys Wireless Sensor shipment include:

- One or more flush-mount Sensors
- One or more molded plastic Sensor shells
- *Sensys Wireless Sensor Installation Guide* (this document)
- Information sheet (one per device)

Factory Default Configuration

Sensys Wireless Sensors are shipped with a factory default configuration suitable for bench-testing the device and applicable to many field environments. The information sheet details the following Sensor attributes and configuration elements:

- *Sensor ID* – a globally unique identifier for the Sensys Wireless Sensor (expressed in HEX format)
- *RF channel* – a critical configuration property
- *Time slot* – a critical configuration property
- Firmware release version
- Circuit board revision number
- Age of battery
- System certification test results
- System test engineer's identifier

■ ■ Note: *SensorID*, *RF channel* and *Time slot* are essential for communicating with, and further configuring of, the Sensys Wireless Sensor. Save the information sheets for the party who will configure and use the network after it is installed. Refer to the Configuration chapter of the Sensys Wireless Vehicle Detection System Reference Guide for more information about these properties.

Sensys Wireless Sensor Label Information

A manufacturer's label is affixed to the top surface of each Sensys Wireless Sensor and contains essential identifying information for the device. The elements of the label are:

- *Part number*

- *Orientation arrow* – an arrow that points in the direction of normal traffic flow when the Sensys Wireless Sensor is properly installed
- *Orientation statement* – a text message (“This end up”) visible to the installer when the Sensys Wireless Sensor is properly placed in its hole prior to covering it with industrial-grade epoxy
- *Barcode* – an encoded representation of the device's unique id
- *Sensor ID* – a HEX string that identifies the Sensys Wireless Sensor in data reports and the TrafficDOT network management tool from Sensys Networks.
- *Sensor Type Designator* – Some Sensors are designed to operate only in stop bar modes (known as “T” model Sensors). These units carry an indication to that effect; Sensors that do not have such a designation (known as “F” model Sensors) can be used in both freeway/arterial and intersection applications.

Road Surfaces

Installation requires coring a hole approximately 4” (10 cm) in diameter, and 2 ¼” (6 cm) in depth in the target road surface. Sensys Wireless Sensors and the Sensys Wireless Vehicle Detection System are insensitive to the type of pavement and can be effectively used with any pavement type that allows a hole to be cored for Sensys Wireless Sensor installation.

Types of pavement include Superpave Hot Mix Asphalt (HMA); Stone Matrix Asphalt Portland Cement Concrete, including Jointed Plain Concrete Pavement, Jointed Reinforced Concrete Pavement, and Continuously Reinforced Concrete Pavement; open-graded HMA, including Open Graded Friction Course and asphalt-treated permeable materials (rubberized asphalt).

Sensor Depths

Sensors must be installed at a nominal depth of 2 ¼” (6 cm).

Note: Sensors **must** be installed at the nominal depth of 2 ¼” (6 cm). Doing otherwise voids the product license and warranty unless certified by Sensys Networks, Inc.

Sensor Removal

To provide for reuse and redeployment, Sensors should be removed prior to undertaking road maintenance, repair or resurfacing operations. See the Sensys document *Sensys Wireless Sensor Removal Guide* for more information and detailed procedures.

CHAPTER 3

Installation Procedures

This section discusses important installation considerations and provides step-by-step installation procedures. The topics covered are:

- [Installation crew requirements](#)
- [Required equipment](#)
- [Step-by-Step Procedures](#)

Installation Crew Requirements

Sensys Wireless Sensor installations are typically completed in under 15 minutes with a crew consisting of *(i)* a roadway drill operator and *(ii)* an assistant who operates a device to remove loose debris and dust from the hole in the pavement that will hold the Sensys Wireless Sensor. No special skills are required.

Required Equipment

Before installing a Sensys Wireless Sensor, ensure that the following components are available:

- Sensys Wireless Sensor(s)
- Molded plastic Sensor shell(s) (included)
- A minimum of one tube of FJS epoxy for each Sensys Wireless Sensor

A 2:1 ratio pack of Fabick Joint Seal (FJS), a two-component 100% solid silicone polyurea-based joint sealant is recommended. This self-leveling joint sealant displays fast cure times and excellent adhesion to concrete. In ambient temperatures from 20°F (-6.6°C) to 180°F (82.2°C) the epoxy cures in approximately five minutes.

- Coring bit suitable for creating a hole (4" diameter, 2 ¼" depth [10.2 cm, 5.7 cm]) in the target surface

Two types of 4-inch drill bits, each with 1 ¼" standard machine threaded sleeves, are recommended as shown in the following diagram.

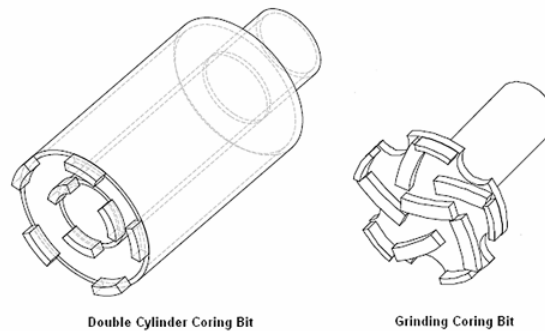


Figure 3.1 – Coring bits

For soft road surface, a 4" *double cylinder coring bit* is recommended. Once a 2" (5 cm) deep hole is drilled, chisel any remaining material so that the result is a flat bottomed hole. For harder surfaces, a 4" *grinding coring bit* is recommended.

Use a shop vacuum or other implement to ensure that the hole is free of all dust, debris and loose impediments.

- Coring drill and frame
- Cold chisel and club hammer or a power chisel
- A shop vacuum, brush or other implement suitable for removing dust and debris from a hole cored in the pavement
- Heat gun or propane torch (helpful in environments with significant roadway moisture)

Step-by-Step Procedures

Sensor installation consists of the following operations:

- Enclosing the Sensor in a Sensor shell
- Installing the Sensor/Shell assembly into the road

In most cases, enclosing Sensors in Sensor shells *before* going into the field results in more efficient installations and less impact on traffic due to road closures.

Enclosing the Sensor in a Sensor Shell

1. Lay out the Sensor and a Sensor shell on a flat work surface. Open the shell by separating the top from the bottom.



Figure 3.1 – Sensor and Shell

2. Place the Sensor (label side up) into the bottom of the Sensor shell. Grasp the top of the shell.



Figures 3.2, 3.3 – Placing Sensor in Shell¹

¹ The label on your Sensors may differ from the label depicted in this section.

3. Place the top of the shell over the Sensor matching the short alignment pins in the shell top to the holes in the shell bottom. The pins should fit easily into the holes.

Note: do not use excessive force to fit the pins into the holes.



Figures 3.4 – Fitting Top of Sensor Shell to Bottom of Sensor Shell

4. Gently pinch the edges of the shell together to seat the alignment pins. Use light pressure to press the edges together.

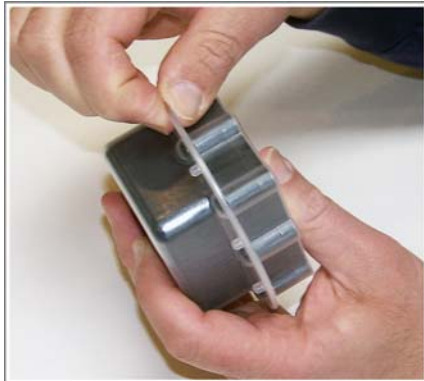


Figure 3.5, 3.6 – Pinching the Shell Edges Together to Seat the Pins.

5. Repeat the prior step at all (8) areas around the edge of the Sensor shell as shown below.

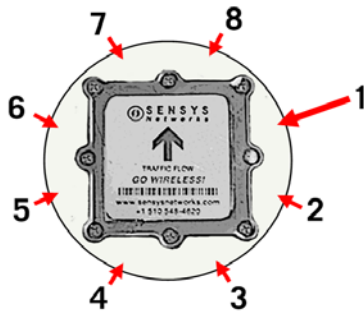


Figure 3.7 – Areas to Press the Edges of the Shell Together

A completed Sensor/Shell assembly is shown below. Ensure that the Sensor label is visible.



Figure 3.8 – Finished Sensor and Shell Assembly

Installing the Sensor/Shell Assembly into the Pavement

SAFETY WARNINGS:

- Always wear safety glasses, gloves and observe other precautions when removing Sensys Sensors.
- Do not puncture or crush Sensor when drilling, prying, or removing. Doing so may subject Sensor batteries to adverse shock resulting in explosion and release of harmful gases.

1. Find and mark the center of the desired Sensys Wireless Sensor location.
2. Core a hole approximately 4" (10 cm) in diameter, and 2¼" (6 cm) deep into the pavement. Check depth as your drill, remove debris periodically.

Note: avoid coring too deeply into the road. Optimal performance is attained by ensuring a minimum clearance of ¼" (0.6 cm) and a maximum clearance of ½" (1.3 cm) between the Sensor top and the road surface.



Figure 3.9 – Coring Sensor Hole

Note: install Sensors **only** at the nominal depth of 2¼" (6 cm). Doing otherwise voids the product license and warranty.

3. Vacuum or brush the hole clear of dust and debris.



Figure 3.10 – Clearing Sensor Hole

Ensure that the hole is dry as moisture may impede the curing of the epoxy. If moisture is observed, use the heat-gun or torch to dry the inside of the hole completely.

4. Apply epoxy to the bottom of the hole to a depth approximately 1/3 of the hole's total depth.



Figure 3.11 – First Epoxy Application

5. Place Sensor/Shell in hole. Verify the following:

- Label is visible
- Sensor is level
- Arrow on label points in the direction of traffic flow
- Sensor location and Sensor ID are recorded



Figure 3.12 – Placing the Sensor in Road

6. Fill the hole with epoxy, completely covering the Sensor and its shell.



Figures 3.13, 3.14– Filling Hole With Epoxy



Figure 3.15 – Installed Sensor

Note: when placing the Sensor in the hole some epoxy may flow around the flange edges.