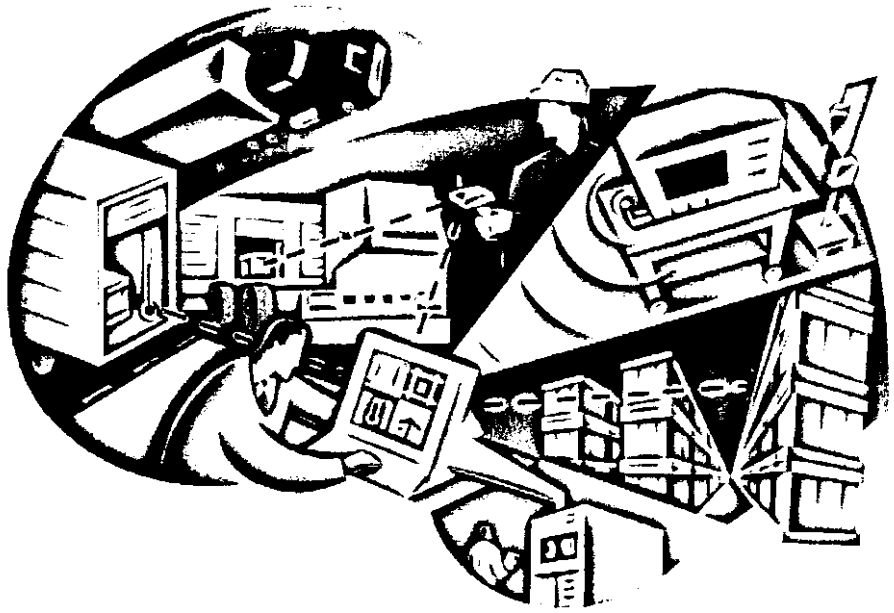
EXHIBIT 9:Operator's Manual for Savi Technology Model RFR-200/100

46 Pages

Savi RF Relay
Installation Guide



SAVI
TECHNOLOGY
A Raytheon Company

Savi RF Relay Installation Guide

Version 1.0

SAVI TECHNOLOGY

A Raytheon Company

First revision to the first edition (April 1998)
Order number DOC-2008
Part number 805-01709-001

Federal Communications Commission (FCC) Notice

The Federal Communications Commission has established technical standards regarding radio frequency energy emitted by computer devices. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference with radio/TV reception. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Warning

Changes or modifications to this equipment that are not expressly approved by Savi Technology could void the authority to operate this equipment.

Savi Technology is not responsible for radio / TV interference caused by using unauthorized cable or by making unauthorized changes to this equipment.

Preface

This manual exists to help you install both models of the Savi RF Relay. It assumes you are familiar with the Savi System and RFID equipment.

Related Publications

Savi System Installation Guide	*JDM-1004*
SaviReader 410R Installation Guide	*DOC-2001*
Savi Asset Manager User Guide	*DOC-2009*

NCB-RF Network Combiner Module Operator's Manual

LongRanger 2000 Spread Spectrum Modem Operator's Manual (modem model only)

Audience

This *Savi RF Relay Installation Guide* is written for RF technicians and site administrators. It assumes that you are familiar with RFID and computer equipment and the Savi System.

What's New in this Edition

This is the first revision to the first edition of *Savi RF Relay Installation Guide*.

Organization of this Manual

This guide describes how to install and maintain the Savi RF Relay.

Chapter 1, "Overview," describes the purpose and components of the Savi RF Relay.

Chapter 2, "Installation," describes the physical installation of the Savi RF Relay.

Chapter 3, "Configuration," describes how to configure the components of the Savi RF Relay.

Chapter 4, "Maintenance," discusses maintenance and troubleshooting for the Savi RF Relay.

Chapter A, "Savi System Description," describes the overall system of Savi hardware and software.

Conventions Used in this Manual

The table below explains the conventions of typography and usage in this book.

Typographic and usage conventions

Notation	*Example*	*Meaning and use*
note		***Note*** *Notes call attention to facts or advice that seem to deserve special attention.*
caution		***Caution*** *Cautions call attention to the possibility of damage to the product, the system, or your work (for example, potential loss of data).*
warning		***Warning*** *Warnings call attention to the possibility of injury to people.*
sans-serif typeface	Terminal Locked!	messages, prompts, window names, and other text as displayed on the screen, where column alignment is *not* important.
equal-spaced font	1005 DATA	examples of data files, program code, and other text where column alignment is important.
boldface type	**A:\INSTALL**	text you enter exactly as shown.
italic type	*name*.bmp or *tag_id*	a variable. The italicized text is replaced by the appropriate information. This can be something you type, such as the file name in the first example shown here, or displayed information, such as `tag_id` in the second example. Italic type is also used for *emphasis* of a word or phrase that is new or especially important.

Savi Technical Support

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Fax: (650) 428-0444
E-mail: help@savi.com
Web site: http://www.savi.com/

Problems with the product or the manual? After you have checked your connections and the Savi RF Relay Installation Guide, call Savi technical support at 1-888-994-SAVI (1-888-994-7284), between 9:30 a.m. and 5 p.m. Pacific Time, or send e-mail to help@savi.com at any time. Also, please contact Savi technical support if you have suggestions on how Savi can improve the next revision of the product or the manual.

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1 Overview

This chapter provides an overview of the Savi RF Relay.

Purpose

The Savi RF Relay provides a wireless link between SaviReaders and a host computer (Savi Server) in a Savi system. In situations where wired connections become impractical between a host computer and a network of SaviReaders (or between two sub-networks of SaviReaders), two Savi RF Relays can create a wireless connection. This wireless connection allows one host computer to control readers that monitor a much larger physical area than is possible using only wired connections.

Description

The Savi RF Relay is available in two models:

- basic model (RFR-100)
  This model provides a long-distance wireless link between two nodes (two readers, or a reader and a host computer) in an RS-485 network, using an RF modem, weather-proof case, and choice of long-distance antennas.
- LonWorks-capable model (RFR-200)
  This model adds to the basic model a LonWorks router (NCB-RF Network Combiner Module) that enables additional network capabailities.

Figure 1-1 shows the Savi RF Relay mounted in a NEMA (National Electrical Manufacturers Association) enclosure, with its antenna mounted on the same mast.

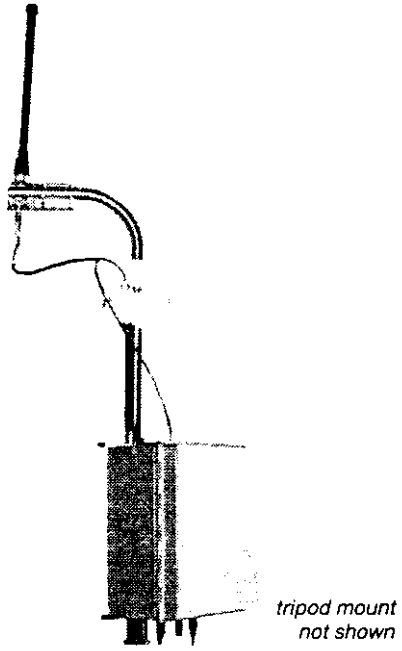

Figure 1-1 Savi RF Relay in NEMA weatherproof enclosure, antenna with up/down converter

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Figure 1-2 shows a block diagram of a LonWorks-capable Savi RF Relay (model RFR-200).

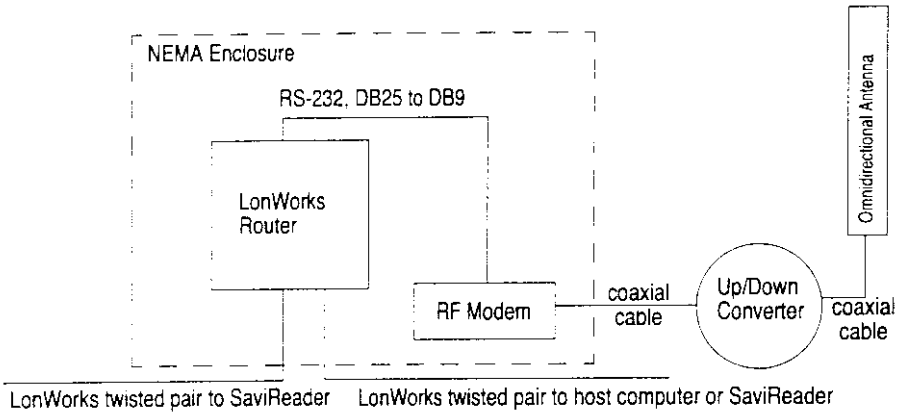


Figure 1-2 Block diagram of Savi RF Relay signal connections (model RFR-200)

As shown above, the Savi RF Relay connects serially in a Savi network.

RF Modem

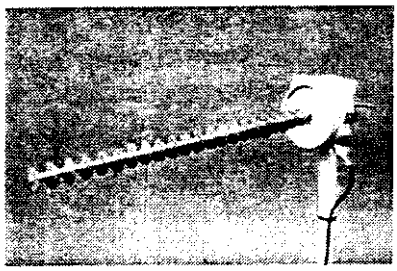
The LongRanger 2000 RF modem, used in both models of Savi RF Relay, is a wireless modem that uses spread-spectrum technology to communicate data reliably. The Savi RF Relay uses 2.4-GHz unlicensed spectrums.

Note

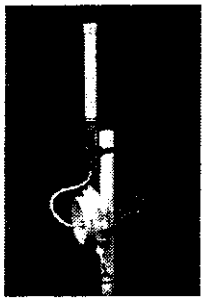
The LongRanger 2000 is also available in 900-MHz unlicensed spectrums.

The RF modem can be connected to different antennas to suit different configuration needs:

- A directional antenna communicates between two points, linking two Savi RF Relays at extra long range.
- An omnidirectional antenna communicates with multiple antennas simultaneously, linking several Savi RF Relays in a star configuration.



directional antenna supports point-to-point communication



omnidirectional antenna supports point-to-multipoint (star) communication

Figure 1-3 Direction and omnidirectional antennas for RF modem

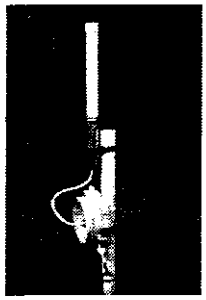
The 2.4-GHz RF modem includes an up/down converter connected between the antenna and the modem to compensate for signal loss in the antenna cable.

A standard RS-232 interface connects the LonWorks router to the RF modem. For initial configuration or diagnostic purposes, the modem can also connect to any other DTE device (computer) through a personal computer using the computer's RS-232 serial interface.

The RF modem uses standard Hayes-compatible AT commands sent through the serial port. Before installing the modem, you can change parameters such as frequency channel, output power, or DTE baud rate, for optimum performance. In most cases, the RF modem needs no change since it is factory optimized and tested for best performance.

Note

For more information on each AT command and other programming features, refer to the LongRanger 2000 Operator's Manual.



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LonWorks Router

The NCB-RF Network Combiner Module is a LonWorks-compatible router that provides intelligent routing capabilities between various network segments. The LonWorks router serves as an interface between a LonWorks-compatible wired network and the RF modem.

The LonWorks router connects directly to a LonWorks-compatible wired, twisted-pair network using a free topology FTT-10 transceiver built inside the device. The router connects to the RF modem through one of its two available RS-232 serial ports. The second port allows for a configuration where two back-to-back RF modems connect to a single router to provide extended RF range. In this configuration, the Savi RF Relay is used as a signal repeater.

In situations where a host computer needs to communicate with two networks of SaviReaders further apart than the range of the RF modem, you can configure the Savi RF Relay to use two RF modems connected to the LonWorks router. In such a configuration, each RF modem communicates with one SaviReader network through a directional antenna, effectively doubling the range of the Savi RF Relay.

Several programming switches configure the LonWorks router for use with a particular RF modem. Once you set the switches correctly, the LonWorks router is ready to use with an RF modem and requires no additional configuration.

*** *Note***

All Savi GateReaders 410R and some SaviReaders 410R are LonWorks-compatible and can connect directly to the LonWorks router using an appropriate network cable.

2 Installation

Installing the Savi RF Relay requires pre-planning your hardware needs to match your site and application. Refer to the *Savi System Installation Guide* for a description of the process of planning an RFID network, and discuss site-specific issues with your Savi customer service representative.

> **Note**
>
> *Although the Savi RF Relay replaces the Savi RF Link to provide wireless connections within the Savi System, it works with LonWorks networks and is not backwards-compatible with SaviNet (RS-485).*

This chapter discusses the LonWorks-capable model of Savi RF Relay.

Network Placement

Two Savi RF Relays bridge a distance of up to several miles as a wireless connection between a host computer and a SaviReader network, or between two or more sub-networks of SaviReaders within a network. Each Savi RF Relay connects to one device, either a SaviReader 410R or a host computer. Figure 2-1 shows a Savi RF Relay connected to a host computer that communicates by RF with a wired network of SaviReaders. Figure 2-2 shows a Savi RF Relay that bridges between a wired network of SaviReaders attached to a host computer and two other wired networks of SaviReaders.

Determine in advance where you will need to use Savi RF Relays to complete your Savi System, and then identify power sources, installation locations, and where cables will run. Make sure to avoid installing the Savi RF Relay on or close to metal surfaces to assure the best RF range.

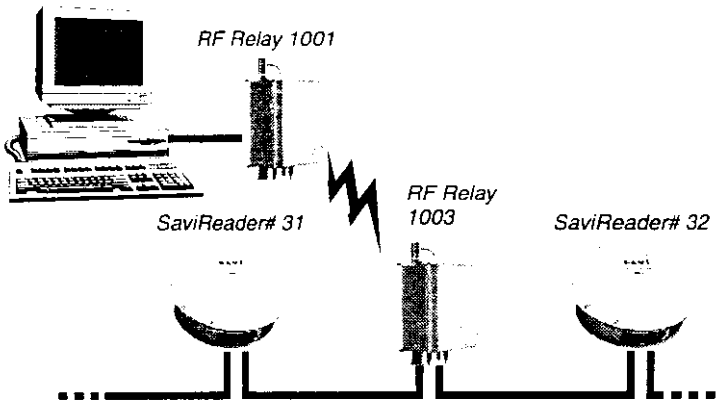

Figure 2-1 Two Savi RF Relays connecting a computer and a SaviReader wired network

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Relay
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SaviReader# 32

SaviReader wired network

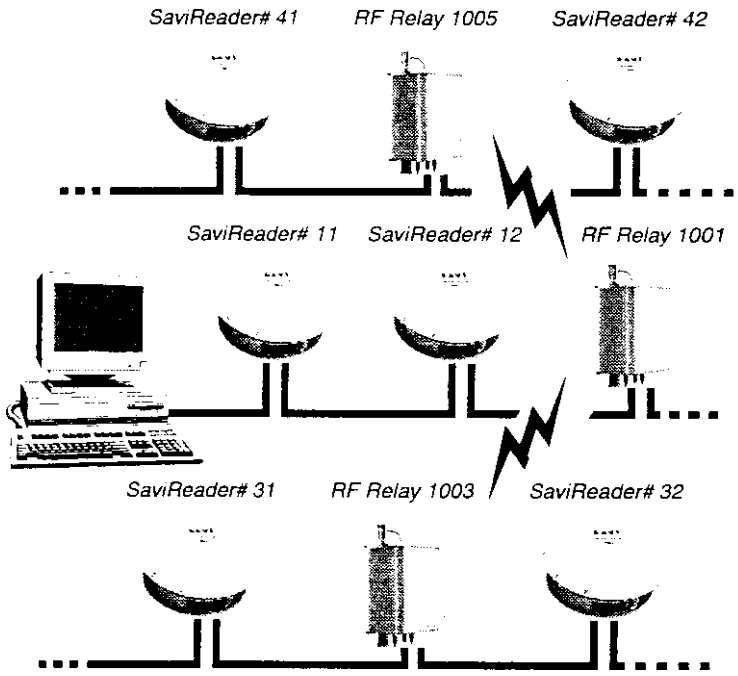

Figure 2-2 Savi RF Relays connecting two SaviReader wired networks

Physical Connections

Both the RF modem and LonWorks router in a Savi RF Relay use power adapters or special AC/DC and DC/DC power modules to accommodate different voltage supplies (12 VDC, 24 VDC, 110 VAC, or 220 VAC). Both units can operate over an extended temperature range (-32°C to 70°C) that supports outdoor functionality.

The RF antenna and its associated up/down converter come with their own mounting kit. The antenna connects to an antenna connector on the NEMA enclosure through a co-axial (coax) cable with a maximum length of 50 feet.

Glossary

active RFID — A type of RFID technology in which readers communicate with powered tags via RF signals.

asset — Any item that has a SaviTag attached to it, so the Savi System can track it. Assets are usually containers or vehicles.

beeper — A SaviTag feature that makes an audible noise and can be turned on or off remotely. The beeper is useful in locating an individual tag.

bit — A contraction of "binary digit." The smallest unit of information that a computer can hold. The value of a bit (1 or 0) represents a simple two-way choice, such as "on or off."

buffer — (1) An area of memory set aside for the specific purpose of holding data until needed. (2) A device or storage area that holds data temporarily to compensate for differences in rates of data flow, time of events, or amounts of data that can be handled by the device or process.

byte — A unit of information consisting of 8 bits. In ASCII code, a byte equals one character.

COM port — A communications port on the computer, through which it connects to RFID hardware such as an interrogator network, an HHI, or a Tag Docking Station. Four port choices are available in Savi software: COM1, COM2, COM3, and COM4.

command — An instruction that causes a device such as a computer or printer to perform some action. A command can be typed from a keyboard or selected from a menu with a mouse.

configuration — (1) The way you have your computer set up. (2) The total combination of hardware components that make up a computer system.

configure — To change hardware or software actions by changing settings. For example, you can configure hardware by resetting physical elements like DIP switches. You can also set configuration parameters in software.

default — A value, action, or setting that a computer system assumes, unless you give an explicit instruction to the contrary.

display — What you see on the screen of your computer monitor.

error message — A message displayed or printed to tell you of an error or problem in the execution of a program or in your communication with the system.

firmware — Program code stored permanently in read-only memory (ROM). Each Savi tag and interrogator contains firmware.

Hand Held Interrogator — A battery-powered, portable interrogator that can exchange information either with one tag or with all tags within its radio range. *See also* Savi MobileReader.

hertz (Hz) — The unit of frequency of vibrations or oscillation, defined as the number of cycles per second. Named for the physicist Heinrich Hertz.

HHI — Hand Held Interrogator.

Hz — *See* hertz.

interrogator — A device that uses radio communication to exchange information with tags. The Savi System includes both a Fixed Interrogator and a Hand Held Interrogator (HHI). *See also* reader.

interrogator ID — An identification number uniquely assigned by Savi to each interrogator. Savi software uses this number to identify an individual interrogator in the network. The interrogator ID is the serial number (S/N) on the interrogator's physical label.

KB — Kilobyte, usually as a measure of memory or disk space; 1024 bytes.

MB — Megabyte, usually as a measure of memory or disk space; 1024 KB or 1,048,576 bytes.

menu — A list of commands, from which you are to select one. Menus are usually to be pulled down from the menu bar near the top of a window. Some menus pop up when you click on a specific item or area.

modem — An electronic device that converts (*mo*dulates, *dem*odulates) data signals from the form used by one device (a computer) to that used by another (a telephone).

online help — Assistance you can access while a software program is running.

passive RFID — A type of RFID technology in which readers communicate with unpowered or low-powered tags by reading an RF signal reflected from the tag.

PC — (1) Personal computer. (2) Printed circuit. (3) Politically correct. *Also at least 10 other uses.*

port — A socket on the back panel of a computer where you plug in a cable for connection to a network or a peripheral device.

power adapter — A device that converts AC electricity into the DC electricity that a device such as the Tag Docking Station requires.

power cord — The connection between a hardware device and its source of electrical power. A power cord's source connector must match the receptacles commonly found where the unit is being used.

prompt — A message on the screen that tells you of some need for response or action. A prompt is usually in the form of a symbol, a message, a dialog box, or a menu of choices.

protocol — Communications protocol. A formal set of rules for sending and receiving data on a communication line.

random-access memory (RAM) — A type of computer memory that can be written to and read from. RAM commonly refers to the internal memory of your computer, where your data and programs live until you save them or the power is turned off on your computer.

read — To transfer information into a computer's memory from a source outside the computer (such as a disk or a tag).

reader — A device that uses radio communication to detect the presence of a tag or exchange information with a tag. The Savi System includes permanently mounted and portable readers for both active and passive RFID. *See also* interrogator.

read-only memory (ROM) — A type of computer memory whose contents can be read but not changed; used for storing firmware. *See also* firmware.

reset — To restore the default settings for a device with one action or command.

RF — Radio frequency, usually referring to signals used for communication between interrogators and tags and between RF link pairs.

RFID — Radio-frequency identification.

ROM — *See* read-only memory.

RS-232 — The physical and electrical communications protocols used between Savi equipment and the computer. With the RS-232 protocol, only a single interrogator or reader can be attached to the computer.

RSSI — Received Signal Strength Indicator. This number indicates the strength of the radio signal that the tag sends to the interrogator, and it provides an approximate indication of distance. A higher value indicates that the tag is closer to the interrogator.

Savi System — The collection of all Savi hardware and software products.

SaviTag — Any RFID tag produced by Savi Technology.

SealTag — A type of Savi RFID tag, distinguished by its distinctive shape, larger size, and the presence of extended memory.

string — An item of information consisting of a sequence of text characters (a character string) or a sequence of bits or bytes.

tag — A small, battery-powered radio transceiver that can store user-defined data in nonvolatile, read/write memory, and can be monitored and controlled by interrogators. Savi tags include SaviTags, SealTags, and TyTags.

tag ID — A decimal number that uniquely identifies each Savi tag. Savi establishes the ID when the tag is manufactured; it cannot be changed. The largest possible Savi tag ID is 1048575.

tag name — A string of 1 to 16 alphanumeric characters that provide another way of identifying an active tag. You assign the tag name.

TIRIS — Texas Instruments Registration and Identification System, a line of passive RFID hardware.

troubleshoot — To locate and correct an error or the cause of a problem or malfunction in hardware or software.

TyTag — A type of SaviTag, no longer available. TyTags are distinguished from SealTags by their distinctive shape, smaller size, and the absence of extended memory.

wakeup — A signal transmitted by the interrogator to wake up all the tags within its RF communications range. If a tag does not hear any other interrogator RF transmission for 30 seconds, it returns to its low-power mode.

write — To transfer information from the computer to another location, such as a tag or a disk.

Credits

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Colophon

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Final pages were printed in the U.S.A. on a Xerox® DocuTech® or Canon® high-speed publisher.

A Savi System Description

The Savi System uses state-of-the-art wireless technology to monitor, track, and locate assets and to remotely control operations in complex commercial, industrial, and military environments.

Savi System

The basic Savi System is a network of permanently mounted readers (also called interrogators) connected to a host computer that runs controlling software. A dedicated computer system with Savi software installed controls the network. Tags (also called transponders) attached to assets store asset data and communicate with readers by radio frequency (RF) on command. Pairs of RF relays or RF links can substitute for wired connections to extend the network as required.

Tags can store, transmit, and receive data and commands from readers, or when triggered by sensors. SaviTags and SaviReaders communicate through a proprietary radio-communications protocol, Savi Batch Collection.™ To gather asset information, operators use control software to send collection commands to tags through permanently mounted SaviReaders or Savi GateReaders, or from portable Savi MobileReaders.

The Savi Batch Collection System™ (BCS) protocol lets each reader maintain communications with all tags that lie within its radio "micro-cell," while providing additional security and advanced collection support. A SaviReader can store

data from all the tags within its radio range and can relay the data to the system operator either by real-time command or on a pre-programmed schedule. A Savi GateReader can support up to four antennas, reading tags in motion and discriminating between bi-directional lanes. Operators can use a Savi MobileReader to perform collections and exchange data with the tags wherever installing SaviReaders is not practical or where portability is desired.

Savi RFID System Solutions

Savi offers complete RFID system solutions that include the necessary hardware and software components required to manage complex asset tracking. Two such systems are the Savi InsideTRAK™ system and the Savi Yard Management System™.

Savi InsideTRAK

Savi's InsideTRAK system is a commercial, off-the-shelf RFID solution that allows users to track, monitor, and locate readily accessible capital assets. The system includes a SaviTag 310 which attaches to equipment so that it can be instantly located as it moves through a facility. The system improves logistics management and deters theft of high-cost capital assets.

Savi Yard Management System

Savi Yard Management System is a commercial RFID system that automates data collection and task assignment, from gate check-in and parking, to dock assignment and hostler operations. The system is controlled by Savi Asset Manager software with additional Gate, Dock, and Yard application modules.

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Savi Software Products

Savi System software products let customers manage and use RFID hardware products individually or in a network:

- Savi Asset Manager™
- Savi Mobile Manager™
- Savi Retriever™
- Savi Tools™

Savi Asset Manager

Savi Asset Manager monitors and controls Savi RFID components, collecting and disbursing data as needed for asset management and tracking. It is preinstalled in a desktop computer with a 17-inch monitor. Savi Asset Manager stores collected data in its local, relational database. It exports the data to your main SQL database or file system, either on demand or on a convenient schedule. It uses visual maps to help you control which physical areas are to be collected. You can collect information from any area on a regular schedule of your choice. Savi Asset Manager also includes a graphical user interface (GUI) to simplify your control tasks; you can close the GUI and still leave the Savi Asset Manager able to run scheduled events.Savi Asset Manager communicates with a variety of active and passive tags and readers through a modem, a SaviNet network, or a LonWorks network. It provides key network-management tools, including automatic network configuration and hardware tests.

Savi Mobile Manager

Savi Mobile Manager provides comprehensive RFID control software for the Savi MobileReader 410R. Savi Mobile Manager provides the same collection capabilities as Savi Asset Manager for use in warehouses, depots, and yards. Using Savi Mobile Manager, operators can collect tag data, upload

collected data to a host computer, read and write to individual tags, search for specific data in tags within range, locate a specific tag, and test RF background noise.Savi Mobile Manager expands on features of Savi's previous HHI software.

Savi Retriever

Savi Retriever automates the collection and forwarding of asset data. It uses a network of Savi readers to retrieve data from tags. It then forwards the collected information through a modem, local area network, or satellite transceiver to a central information system, thus allowing assets to be monitored and tracked at multiple sites. Once configured, all system functions are automated for unattended operation.

Savi Tools

The Savi Tools program lets you diagnose, troubleshoot, and test Savi hardware capability in a SaviNet. Savi Tools offers low-level control of Savi System hardware components in an easy-to-use graphical user interface. With SaviTools you can manage and fine-tune devices, collect data, define settings, and perform detailed system and network troubleshooting.

Savi RFID Hardware Components

Tags are small, radio transceivers that can store user-defined data in nonvolatile, read/write memory, and can be monitored and controlled by other devices. Active tags contain their own power source to generate a radio signal. Passive tags receive their power from an reader by radio frequency transmission.

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Tags are normally in an energy-conserving "sleep" mode until reception of a wake-up command from an reader. Each tag makes a distinctive beeping noise on command from an reader, thereby making individual tags easy to locate and identify.

Reader are electronic devices that send and receive signals from tags. They include a microprocessor to verify, decode, and route data for transmission to a host system, usually a computer with appropriate RFID management software installed.

The frequency of a reader's transmission determines its range and its ability to communicate with tags. An antenna, or multiple antennas, sends and receives transmissions. The antenna is either enclosed with the reader, or can be housed separately.

Savi System RFID components include:

- SaviTag 410™
- SaviTag 310 ™
- SealTag™
- SaviReader410R™
- Savi GateReader 410R™
- SaviReader 310R™
- Savi MobileReader 410R™
- Savi RF Relay™
- Savi RF Link™
- Savi Docking Station™
- Support for TIRIS and Amtech passive tags and readers

SaviTag 410

The SaviTag 410 has its own database engine and file system. It features up to 128 KB of read/write memory and a connector port for wired, high-speed data transfer. The SaviTag 410 supports tag-initiated communication triggered by system sensors. The tag is hermetically sealed in a plastic waterproof case that can withstand shock and vibration.

SaviTag 310

The SaviTag 310 contains a unique and permanent identification number for each tagged piece of equipment. Designed for use with the Savi InsideTRAK system, the SaviTag 310 is available with 128 bytes of read/write memory and 128 KB of random-access memory. The tag is hermetically sealed in a plastic waterproof case that can withstand shock and vibration.

SealTag

SealTags, available with 256 bytes of standard memory and as much as 128 KB of extended memory for mass data storage, are designed for applications in the transportation and logistics industries.

SaviReader 410R

The SaviReader 410R has an adjustable omni-directional range of up to 300 feet and can be networked to provide cellular coverage of a nearly unlimited area. Its power source can be 92 to 125 Vac, 184 to 250 Vac, or 6 to 15 Vdc. A portable tripod mount, a solar power unit, or a vehicle power cable are also available for use with the SaviReader. In addition, the SaviReader 410R supports active or passive communication with various RFID devices using SaviNet or Echelon LonWorks networks.

Savi GateReader 410R

The Savi GateReader410R is designed for RFID applications that require short-range, directed tag communication such as container and vehicle tracking at gates, checkpoints, or other passages. The dual-frequency gate reader features a 2.45-GHz wakeup signal, a 433-MHz standard signal, an

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adjustable range, and the ability to read tag information from a tag moving up to 25 mph with as many as three other tags in the reader's field. It can also distinguish between tags travelling along two adjacent vehicle lanes in opposite directions. The gate reader supports communication via modem or LonWorks network.

SaviReader 310R

The SaviReader 310R model features 128 KB of random-access memory that buffers data for retrieval by a host computer on demand. Designed for use with the Savi InsideTRAK system, the SaviReader 310R triggers an alarm and notifies security if any tagged asset is removed from a building or facility.

Savi MobileReader 410R

The Savi MobileReader410R is a portable, rechargeable, battery-powered unit that has all the functionality of the SaviReader 410R with an adjustable omni-directional range of up to 600 feet and an integrated bar-code reader. The Savi MobileReader 410R has memory to store the data it collects. Operators can display the data or transfer the data to a host computer. The Savi MobileReader 410R supports a variety of external data interfaces, including direct input from bar codes. The Savi MobileReader 410R is based on Intermec's JANUS platform, and feature a PCMCIA slot for expanded memory. Previous models of portable reader were called Hand Held Interrogator (HHI).

Savi RF Relay

The Savi RF Relay provides wireless network links between SaviReaders and a host computer. With an omni-directional range of 7,500 feet, Savi RF Relays support wired connections of up to 62 SaviReaders. It is available in two configurations:

- a LonWorks network configuration, which supports both active and passive RFID sub-networks
- relay configuration with RS-232 or RS-485 interface: a pair of Savi RF Relays replace one wired link in a network

Housed in a rugged NEMA enclosure, the Savi RF Relay communicates at 2.4 GHz; optional models communicate at 900 MHz.

Savi RF Link

The Savi RF Link allows wireless communication between SaviReaders and a host computer in a SaviNet (RS-485) network configuration. With an omni-directional range of nearly one mile, RS-232 or RS-485 cables connect each RF Link to a computer or (RS-485 only) to Fixed Interrogators. RF Links can also be configured as repeaters, allowing several miles of extension in effective SaviNet network coverage.

Note

The Savi System provides support for both active and passive RFID through the Echelon LonWorks network.

Savi Docking Station

Savi Docking Stations write data directly into the memory of SaviTags, cutting the time required to initiate a new tag or update an existing one. The Savi Docking Station connects directly to the SaviTag through a connector in the dock, and connects to a computer through a standard RS-232 cable. From either Savi Asset Manager or a companion Window NT

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software program, you can copy data files from the computer to tags or read data from tags, either to the screen or to computer files. You can process tags one at a time or in batches, through a file that associates tag ID numbers with data files.

Passive RFID

TIRIS tags are passive tags with a frequency range of 124.2–134.2 KHz. TIRIS readers can read tags at distances of up to 2 meters (6.5 feet) from their antennas. TIRIS readers are available in three models:

- standard model with antenna positioned within 10 feet of the reader
- remote model with antenna that can be located up to 1000 feet from the reader
- hand-held model

Amtech tags are passive tags with a read range of 50 feet or greater, and a frequency range of 915 MHz for North America or 2.45 GHz worldwide. The Amtech SmartPass Reader incorporates the ability to read tags at slow or high speed, to identify and validate vehicles on entry or exit, and to signal a gate to open or close. The Amtech system complies with ISO standards.

Two network connectors connect a Savi RF Relay to a SaviReader 410R or a host computer through a data cable.

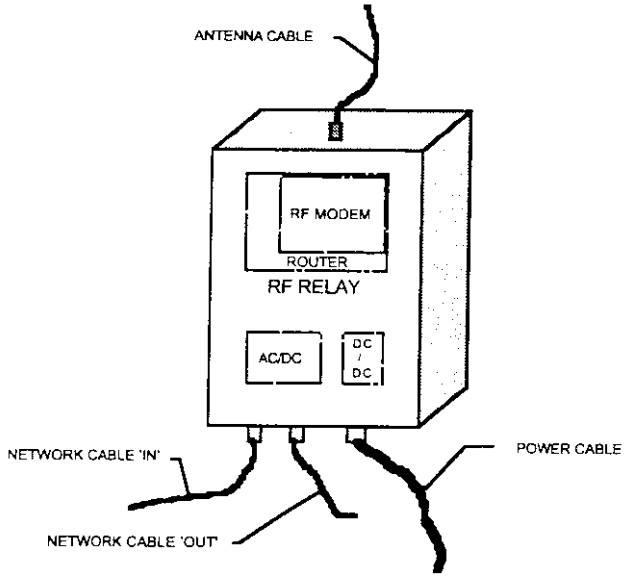

Figure 2-3 Layout of Savi RF Relay within NEMA enclosure

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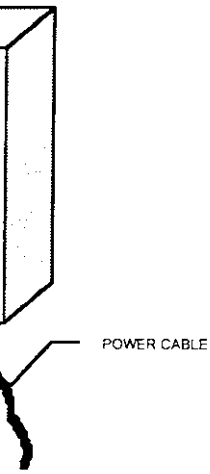

3 Configuration

This chapter describes how to connect and configure the Savi RF Relay in either point-to-point or point-to-multipoint configurations for the LonWorks-capable model.

Figure 3-1, "Internal connections of the Savi RF Relay (model RFR-200)," on page 3-3 shows all relevant connections between the antenna, the RF modem, and the LonWorks router.

Before you connect the RF modem and the LonWorks router together, each device must be properly configured.

Router Configuration

The LonWorks router requires no software configuration. The configuration switches on the rear panel determine all configuration settings. The following list describes the functions of each switch used on the router. For more detail, refer to the *NCB-RF Network Combiner Module User Documentation.*

- BAUD 1 and BAUD 2 switches control the baud rate for the two RS-232 serial ports. Each is a 16-value rotary switch (0–F) that lets you disable the corresponding port or enable it for a specific baud rate. The factory default setting for BAUD 1 is 7 (PORT 1 baud rate = 57600 bps). The factory default setting for BAUD 2 is 0 (PORT 2 = not used).
- MODE 1 and MODE 2 switches control automatic initialization of certain types of RF modems after they power up. Set the MODE 1 switch to 0 to instruct the LonWorks router not to send an initialization string to the modem,

because it is already manually pre-configured. (See "RF Modem Configuration.")

Table 3-1 Setting baud rates for the RF modem's serial ports

Switch setting	*Baud rate*
0	Disable
1	1200
2	2400
3	4800
4	9600
5	19200
6	38400
7	57600

- OPTION B labels a set of four DIP switches that control the two serial ports. Numbers 1 and 2 apply to PORT 1; numbers 3 and 4 apply to PORT 2. Set all DIP switches to the OFF position (up) to instruct the modem to use hardware flow control.
- OPTION A switches should be left in their factory default settings (all up).

The LonWorks router has three LEDs that indicate its operational status. For more information, refer to the *NCB-RF Network Combiner Module User Documentation*.

RF Modem Configuration

The RF modem in the Savi RF Relay uses standard Hayes-compatible commands for controlling and changing the modem's operation. You need a standard PC-based communications (terminal-emulation) software program to issue configuration commands to the modem directly. Examples of such programs include Terminal Program for Windows, PcPlus, or Mirror. The RF modem stores all user configuration settings permanently in nonvolatile memory.

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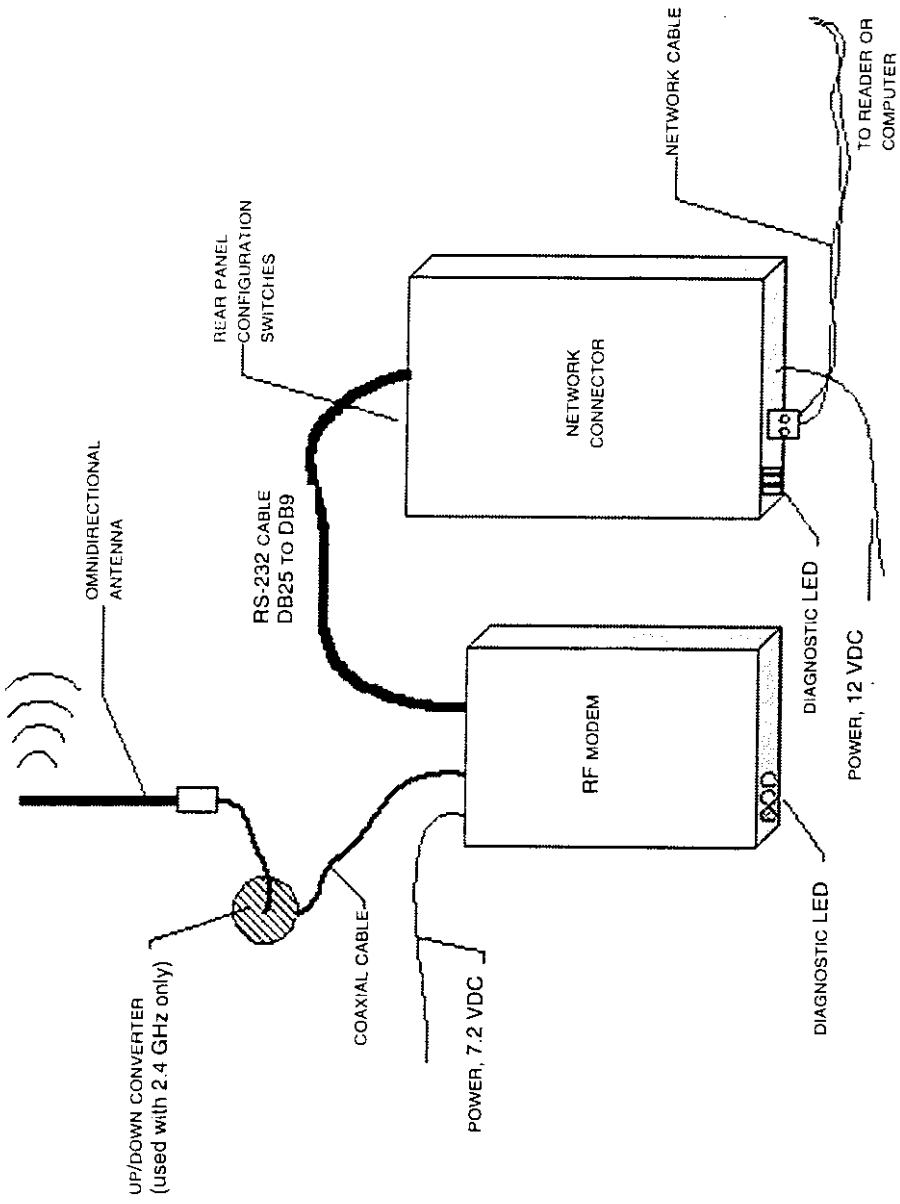

Figure 3-1 Internal connections of the Savi RF Relay (model RFR-200)

Like all Hayes-compatible modems, the RF modem has two operating modes: command mode and data mode. To configure the modem, it must be able to communicate with a computer running a communications program, and it must be set to command mode. In this mode, you can enter any desired configuration settings using the Hayes-compatible AT commands described in Table 3-2.

Before you begin, review the default factory settings for the RF modem to identify any settings that need to be changed. Refer to the *LongRanger 2000 Operator's Manual* for a complete list of default settings.

Caution

Make sure that the antenna is connected before powering up the modem.

To configure the RF modem:

1. Connect the RF modem to a personal computer's serial port using an RS-232 serial cable.
2. Start the communications program.

Note

You must set the communications parameters on your PC to match the modem's baud rate and data format. The default parameters are 9600 bps, 8 data bits, null parity, and 1 stop bit (9600-8-N-1). The LongRanger 2000 modem does not automatically match baud rates ("autobaud").

3. From your communications program, type +++ to change the modem from data mode to command mode. If the modem is already in command mode, skip this step.
4. Type **AT** and press Enter.

   When you are in command mode, any commands you type will echo to the computer (display on your computer screen). The modem will respond to each command you type with the message OK.
5. From Table 3-2 below, enter the configuration settings and wait for the modem to respond with OK.

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Table 3-2 Hayes-compatible AT commands for configuring the RF modem

Step #	*Command*	*Description*
1	**AT&F**	Invoke factory default setting. After this command, DTE speed will be set to 9600 bps.
2	**ATS52=152**	No RF address (broadcasting), Enable error detection, Disable Retries, Power up in "Data Mode"
3	**ATS53=1**	Number of characters in transmit buffer before start attempting RF transmission
4	**ATS54=1**	Time-out between bytes from host (20 ms increments)
5	**ATS55=100**	Maximum number of bytes in single packet
6	**ATS56=100**	Set RF transmit power (on 2.4-GHz model do not change value of this register)
7	**ATS57=3**	Selects transmit RF data rate of 64.516 Kbps
8	**ATS58=3**	Selects receive RF data rate of 64.516 Kbps
9	**ATS61=100**	Selects transmit RF channel 100
10	**ATS62=100**	Selects receive RF channel 100
11	**ATS70=0**	Do not insert 5 ms delay before RF transmission; Use random delay; Use Collision Avoidance; Use random delay when channel is idle.
12	**ATS71=10**	Random delay up to maximum of 10x10 ms
13	**ATS96=7**	Selects asynchronous serial baud rate of 57600 bps
14	**AT&K2**	Selects full H/W flow control
15	**AT&W**	Permanently store new configuration

Note

If you make a mistake, repeat the command to be sure that the modem stores the correct setting.

6. When done, type **ATD** and press Enter to return the RF modem to data mode.

Note

The RF modem must be in data mode to work properly. Make sure to return the modem to data mode before disconnecting from the computer.

7. Shut down the computer and power down the RF modem.
8. Disconnect the RF modem from the computer.
9. Reconnect the RF modem in the Savi RF Relay.
10. Apply power to the RF modem.

Once you connect a configured RF modem to the LonWorks router, the Savi RF Relay is ready to use.

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4 Maintenance

With minimal care, a Savi RF Relay should perform flawlessly. However, in the event that a problem with a Savi RF Relay occurs, this chapter should help you fix it.

Repair and Maintenance

The Savi RF Relay is designed to be maintenance-free. Savi RF Relays are manufactured with quality components and are thoroughly tested before delivery. As in any outdoor networked system, a periodic check of cables and enclosures exposed to the elements for possible physical damage is advisable.

Once installed in a standard NEMA enclosure (such as Hoffman A-1206CHSCFGW, 12"x10"x6"), the Savi RF Relay is weather-resistant.

Troubleshooting

In the unlikely event that a Savi RF Relay fails or problems occur that simple troubleshooting cannot solve, Savi technical support may recommend that you return the Savi RF Relay to Savi Technology.

Table 4-1 lists causes and solutions to problems that might occur with the Savi RF Relay.

Table 4-1 Possible problems and solutions

Problem	*Solution*
➢ No data flow	♦ Check that RF modem is in data mode. ♦ Check signal connection between the RF modem and the LonWorks router (model RFR-200). ♦ Check that the LonWorks configuration MODE switches match the the COM port you are using on the computer (model RFR-200). ♦ Check that the baud rate configured in the RF modem settings matches the baud rate set by the LonWorks MODE switch for the COM port (model RFR-200). ♦ Check the rear panel of the LonWorks router for correct configuration (model RFR-200).
➢ No power	♦ Confirm that power is available to the Savi RF Relay by checking any circuit breakers, power switches, or safety switches. ♦ If AC-powered, verify the presence and voltage of the power by connecting a test unit to the power source. Check the AC fuse. ♦ If DC-powered, check the DC power fuse on the Savi RF Relay, the source voltage (11 to 12 VDC), and the polarity of the connections. ♦ If solar-powered, verify the output voltage of the module to be 6 to 7 VDC. ♦ Verify that the power cable is securely plugged into the power source and the Savi RF Relay input. ♦ Try a different power source. ♦ Replace the power cable.
➢ Network cables damaged or disconnected	♦ Verify that the network cable is securely plugged into the Savi RF Relay. ♦ Verify that the network cable is securely plugged into the *correct* COM port on the computer. ♦ Verify that the cable itself is not damaged.
➢ COM port unavailable (possibly used for another device such as a mouse)	♦ Connect the Savi RF Relay cable to another COM port.
➢ Unknown	♦ Turn Savi RF Relay power off and then back on. ♦ Call Savi technical support.

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Technical Support

If your Savi RF Relay presents a problem that neither this manual nor troubleshooting tip can help you solve, you can contact Savi technical support in either of two ways:

- Telephone 1-888-994-SAVI (1-888-994-7284) (from North America only) or 1-650-428-0550 between 9:30 a.m. and 5 p.m. Pacific Time.
- Send e-mail to help@savi.com at any time.

Whether you use the telephone or e-mail, please have the details of the problems at hand when you contact Savi.