SaviReader 410R Installation Guide

Version 1.0

SAVI TECHNOLOGY

A Raytheon TI Systems Company

Savi Technology
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Operator's Manual

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- 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.

Warning

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

NOTE :- THIS PAGE REPLACES PAGE (iii)

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- Increase the distance between the equipment and the receiver.
- While observing the interference turn the suspect equipment off and back on. If the interference stops when the equipment is off and resumes when the equipment is on, the equipment is probably the source of the problem.
- Consult the dealer or an experienced radio/TV technician for additional advice.

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Preface

This manual exists to help Savi customers to install the SaviReader 410R as part of the Savi System.

Related Publications

Savi System Installation Guide	JDM-1004
Fixed Interrogator Installation Manual	JDM-1013
Savi Tools Reference Manual	JDM-1004
Savi Asset Manager Reference Manual	JDM-1012

Audience

This *SaviReader 410R Installation Guide* is written for technical personnel who are somewhat familiar with the Savi System and its components.

What's New in this Edition

This is the first edition of the*SaviReader 410R Installation Guide.*

Organization of this Manual

This guide describes how to install the SaviReader 410R.

Chapter 1, "Introduction," describes the features and available models of the SaviReader 410R.

Chapter 2, "SaviReader Installation," describes procedures for installing the SaviReader 410R.

Chapter 3, "Maintenance," describes maintenance and troubleshooting procedures for the SaviReader 410R, as well as technical support information.

Appendix 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 notice		***Caution*** *Caution notices call attention to the possibility of damage to the product, the system, or your work (for example, potential loss of data).*
warning notice		***Warning*** *Warning notices 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.
control key	CTRL+Z!	a keyboard control code. This example tells you to hold the control key while you press the Z key.

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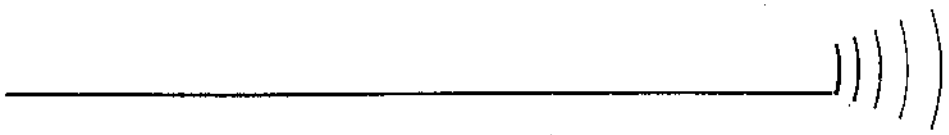


Tables

1 Introduction

The SaviReader410R is intended for use in permanent or semipermanent installation sites. SaviReaders perform tag collections and exchange data with tags as part of the Savi System.

Savi System

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

The system comprises tags (also called transponders), interrogators (also called readers), RF links, and a computer with RFID management software installed. Tags can store, transmit, and receive data and commands from interrogators, or can initiate communication when triggered by sensors.

SaviTags and SaviReaders communicate through Savi's proprietary radio communications protocol called Enhanced Batch Collection®. To gather asset information, collection commands are either relayed to tags from the computer, through fixed interrogators or gate interrogators, or issued directly by the operator from hand-held readers.

Please see Appendix A, "Savi System Description," for a more complete description of the system and its components.

SaviReader Description

The SaviReader 410R has an adjustable omnidirectional range of up to 600 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 24 VDC. A portable tripod mount, a solar power unit, or a cable for powering the reader from a vehicle are all available for use with the SaviReader.

The SaviReader 410R operates at 433.92 MHz. The reader communicates with both active and passive systems, accepts tag-initiated communications, and supports tag database files, group collections, and tag security functions.

Network Communications

The SaviReader 410R supports three types of network protocols: SaviNet (RS-485), Echelon's LonWorks network, and RS-232.

The SaviReader is compatible with SaviNet installations using the RS-485 protocol, and can be used in a mixed configuration which includes older Savi Fixed Interrogator 2.0 models.

Using the LonWorks network, the SaviReader 410R supports active or passive communication with various RFID devices. The LonWorks network is a robust network protocol designed for outdoor use. LonWorks is the preferred network since unlike SaviNet, it does not require a linear "bus" configuration of readers. It supports a "free topology" that allows for better RF coverage using less cable and with fewer configuration restrictions. (For more information about network configurations and restrictions using these protocols, please refer to the *Savi System Installation Guide*.)

The SaviReader 410R is also backwards compatible with the older RS-232 protocol used to connect a computer to a single reader. One of the new features of the SaviReader is its expanded RS-232 support for communications via RF or cellular modems.

Tag Communications

The SaviReader 410R supports new security features for the SaviTag 410, reads tag database files, and supports communications initiated by tags. When a SaviTag is triggered by a sensor to initiate communication with the host system, the SaviReader acknowledges the message from the tag and relays it to the system software. The SaviReader also manages tag communications from multiple tags simultaneously.

Specifications

SaviReader 410 models are designed for indoor or outdoor use in permanent or semi-permanent wide-area installations.

Table 1-1 SaviReader 410R specifications

PHYSICAL		
	Dimensions:	12 in. dia. x 5.5 in.
	Case Material:	Polypropylene with UV inhibitors
	Base Material:	Powder-coated aluminum
	Weight:	6.5 lbs.
ENVIRONMENTAL		
	Temperature:	-32°C to +70°C (operating)
		-40°C to +70°C (storage)
	Humidity:	100% condensing (MIL-STD-801E)
WIRELESS		
	Frequency:	433.92 MHz (transmit and receive); SAW stabilized local oscillator
	Range:	Up to 600 ft. (unobstructed)

Table 1-1 SaviReader 410R specifications

Transmission Power:	0.2 mW average EIRP
Modulation:	FSK; 50 KHz (peak deviation)
Receiver Sensitivity:	-98 dBm
Type:	Superheterodyne
IF Frequency:	10.7 MHz
IF Bandwidth:	500 KHz
Approval:	Unlicensed operation under FCC part 15.231 (August 1997)
DIGITAL	
Data Rate:	28 Kbps (RF tag communication) 38.4 Kbps for RS-485 SaviNet (network/computer comm.) 78 Kbps for twisted pair Lonworks (network/computer comm.)
Memory:	128KB RAM for interim tag data
POWER	
AC Source:	92-125 or 184-250 VAC, 50-60 Hz, 1-watt
DC: Source:	6-24 VDC, 100mA average (internally regulated)
Approval:	UL 1950 regulations (August 1997)

Models and Options

SaviReaders are supplied with network cables and power cables necessary for operation.

Available accessories include a solar power unit, a vehicle power cable, AC power adapter and cables, spare batteries, a battery charger, and mounting hardware. Please contact your Savi customer service representative for information about ordering additional equipment or accessories.

Table 1-1 shows various SaviReader options.

Table 1-2 SaviReader models

Model	Description	Frequency
SR-410R-001	SaviReader 410R	433.92 MHz
SR-410R-T-001	Transport-capable SaviReader 410R Includes vehicle power cable/adapter	433.92 MHz

Management Software

To communicate with SaviReaders, use one of these Savi software packages for RFID system management:

- Savi Asset Manager

  Asset Manager software is used for wide-area tracking to control and monitor Savi System components. It has a graphical user interface for ease of use when scheduling automated events or exporting tag collection data to your other business systems.

- Savi Retriever

  Retriever software operates fully unattended, collecting and forwarding asset data from multiple sites to a central business system.

- Savi Tools

  Savi Tools software is an easy-to-use diagnostic and low-level management tool. With Savi Tools you can fine-tune devices, collect data, define tag or network settings, and perform detailed system and network troubleshooting.

2 SaviReader Installation

Installing the SaviReader is a four-step process. First, a site plan should be consulted to determine the reader's location. Second, the reader must be positioned to enable the most efficient communication range. Third, power and network cables must be connected, and power must be supplied. Finally, communication between the SaviReader and the computer must be verified.

Site Planning

Please refer to the *Savi System Installation Guide* for complete instructions on conducting a site survey and planning your RFID network configuration. Once the site plan is in place, refer to it to determine the site locations for installing a SaviReader in the Savi System. Follow this manual to ensure the proper installation of each SaviReader.

Positioning the SaviReader

SaviReaders are designed to operate in a wide variety of environments. They are housed in rugged, weather-proof enclosures. In ideal conditions, (large, open, and unobstructed areas) SaviReaders can collect tags 600 feet away.

An area can contain factors which limit the SaviReader collection range, including:

- asymmetrical shape to the collection area
- obstructions such as multiple walls, chained areas, solid-core doors, and enclosures
- RF interference from other equipment such as computers, walkie-talkies, cellular phones, elevators, electrical motors, or other RF-emitting devices
- SaviReader mounting height of less than 30 feet
- difficult surface on tracked item, such as metal or RF-absorbent surface
- tag location relative to the SaviReader, such as behind a metal obstruction (as illustrated in Figure 2-1) or stacked under multiple layers

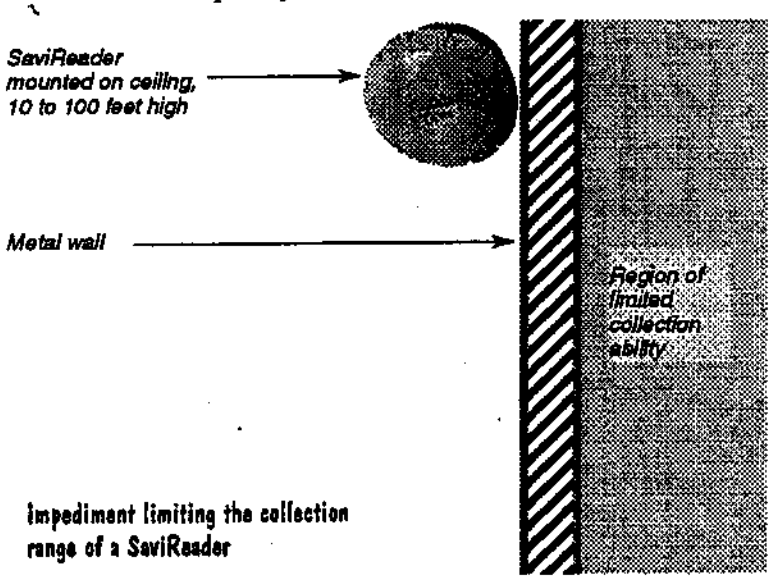


Figure 2-1 Impediment limiting the collection range of a SaviReader

Some of these factors might be beyond your control. The goal when positioning the SaviReader is to optimize advantages and reduce limitations to make the collection range as efficient as possible.

A SaviReader collects all tags within its range under all conditions. If the location forces you to use a less-than-ideal position for the reader, the collection range could be reduced requiring additional readers. For example, if a SaviReader

must be mounted on a wall, the collection range will not extend to the opposite side of the wall. You might need a second SaviReader to monitor the area behind the wall completely.

Each of the following recommendations is intended to optimize the collection range of the equipment. Whenever possible, place the SaviReader:

- in a horizontal plane, with its dome directed downwards
- as high off the ground as possible, within the range of 30 to 100 feet
- away from large metal surfaces
- with its LED panel visible from an operator's position

Installing the SaviReader

To install the SaviReader:

1. Choose the appropriate power cable for your power source.
   - The 220 VAC cable terminates in a European connector.
   - The 110 VAC cable terminates in a North American connector.

   The power source can be 6 to 24 VDC, 110 VAC, or 220 VAC. SaviReader does not require adjustment or modification for different power sources. An appropriate power cable is supplied, depending on the requirements specified when placing an order.

   You can also power the SaviReader from a Savi Solar Power Module, or by vehicle power. A fixed-length, molded cable is supplied with the Solar Power Module. The Vehicle Power Cable can be purchased as an accessory item.
2. On the SaviReader, plug the cable's six-pin connector into the socket next to the DC fuse holder.

a. Turn the connector so that its notch is on the side nearest the SaviReader's dome. (See Figure 2-2.)

b. Push the locking ring forward firmly and rotate clockwise to lock the connector.

Figure 2-2 Fuse holder, power and network connector ports

3. Connect the other end of the power cable to the appropriate power source (such as the Savi Solar Power Module or an AC outlet).
4. Connect the data cable to the SaviReader.
   a. The SaviReader is supplied with a 100-foot data cable that supports both LonWorks and RS-485. Plug the cable into the appropriate socket of the SaviReader, with the notch at the bottom.
   b. Push the locking ring forward firmly and rotate clockwise to lock the connector.
5. Connect the other end of the data cable to the computer.
   a. LonWorks requires an 8-foot network cable with its twisted-pair cable ends connected to small connector. The connector is then inserted into the computer port for the LonWorks PCNSI network card. the cable with connector is suppied with Savi software (such as Savi Asset Manager or Retriever). It is also available separately (Savi part number .... TBA ....)
   b. SaviNet requires an 8-foot network cable, with an RS-485-to-RS-232 converter that connects the

SaviReader to the computer. The cable with converter is provided with Savi software (such as Savi Asset Manager or Retriever) since only one computer-connector cable is required per network. It is also available separately (Savi part number 830-00911-001).

A single SaviReader can be connected to the RS-232 serial port on the computer using the RS-232 connector (DB9 connector, shown in Figure 2-3) on the SaviReader and a customer-supplied cable. Depending on the computer's port configuration, a DB9F-to-DB9F or DB9F-to-DB25M adapter might be required. The SaviReader is configured as a DCE device according to the RS-232 specification. The RS-232 configuration can only be used with Savi Tools, or a radio modem connection.

If the distance between the devices is greater than 100 feet, additional data cables are available (Savi part number 830-00169-100). A cable adapter (Savi part number 625-00921-001) is included to connect two cables.

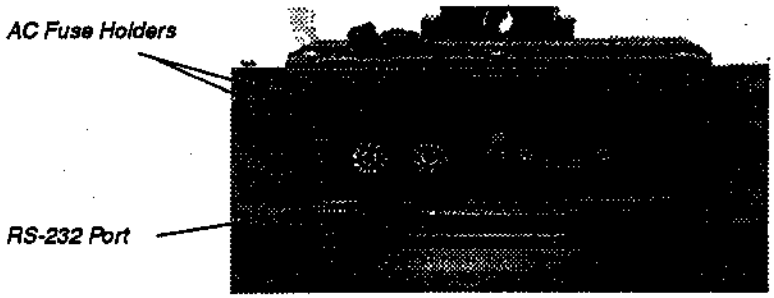


Figure 2-3 RS-232 connector and AC fuses

6. If required for a SaviNet installation, set the SaviReader to repeater mode. (LonWorks network does not require repeaters.) Due to signal degradation limitations when using SaviNet, large network installations (more than 30 SaviReaders in serial connection or more than 3000 feet of signal cable in the network) require that every 30th SaviReader (or more often if required) be configured as a repeater.

Network communications for a SaviNet (RS-485) configuration require that the first and last SaviReaders in the network be configured as repeaters, to terminate the signal line.

A SaviReader set in repeater mode intercepts and reconditions the communication signals that are passed through it.

a. To set the SaviReader to repeater mode, remove the spare fuse access door.

b. Press the repeater button.

   The RPT indicator on the LED display panel illuminates when the SaviReader is in repeater mode.

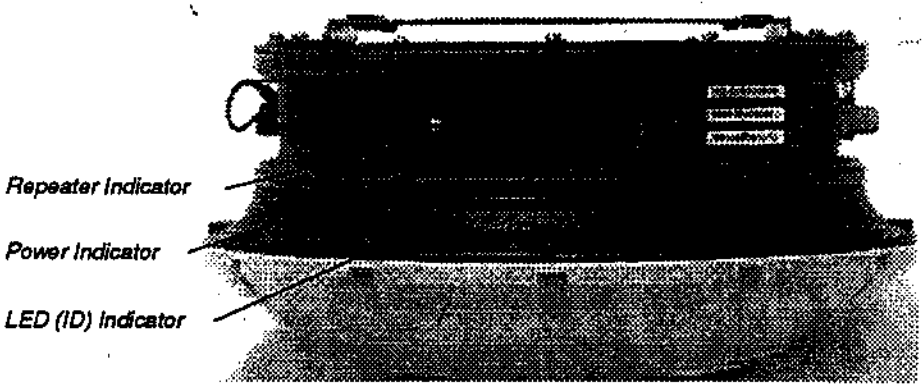


Figure 2-4 LED display panel

7. For a LonWorks installation, be sure to teminate the very last reader in a serial configuration. The "network out" port is terminated using a terminator cap with an internal resistor (Savi part number 830-01281-100), as shown in fig...

   <insert graphic>

   The first reader in the serial chain of readers does not need to be terminated since the computer (PCNSI) network card has a built-in terminator.

8. Supply power to the SaviReader.

Observe the indicators and the seven-segment display on the LED display panel as shown in Figure 2-4. The power indicator should be illuminated whenever power is present. If you set the repeater mode in step 6, the RPT indicator is also illuminated.

9. If at any time you are not sure that the SaviReader is operating properly, reset the interrogator by disconnecting and then reconnecting the live power cable.

Note

The SaviReader has a "watchdog" sensor that automatically resets the interrogator if power fluctuations or other interruptions occur that might effect the reader's performance.

During the initial power-on sequence, the SaviReader displays its identification number (ID) in the LED as a sequence of five digits. For example, SaviReader ID number 1234 displays the numbers 0, then 1, then 2, then 3, and then 4 in sequence during the initialization sequence.

After this display, two indicators flash at different frequencies. One is the center bar of the segmented display and the other is a small indicator within the segmented display. Failure of the indicators to flash indicates a non-operational SaviReader.

After resetting the interrogator, the SaviReader should repeat the power-on sequence described above.

The SaviReader is now ready for you to verify communication functions.

Verifying SaviReader Communication

To confirm that a SaviReader is installed and functioning correctly, it is necessary to verify that:

- the computer can communicate with the SaviReader
- the SaviReader can collect tags in the collection area

- the SaviReader can communicate with each specific tag in the collection area

Use a computer with a test program installed (such as Savi Tools) to perform these procedures verifying SaviReader communications:

1. If using SaviTools, connect the (laptop) computer to the RS-232 port and start the software program.
2. If necessary, enter the SaviReader ID.
3. Verify that the selected SaviReader is detected on the network.
4. Verify that the SaviReader is able to communicate with tags by performing a tag collection.
5. Verify that the SaviReader is able to communicate with specific tags by attempting to beep each tag.

Refer to the reference material accompanying the test program software for specific instructions on performing the above functions. When these procedures have been completed successfully, the SaviReader is installed and operational. The next section describes mounting operations.

Mounting the SaviReader

The SaviReader can be removed from any of the mounting hardware listed below. However, you might want to be sure that the reader is operational and verified on the network before mounting it in any hard-to-reach position.

RFID hardware can be physically attached in any position or location. If an installation requires a special attachment, a custom fixture can be developed and manufactured.

Mounting kits available from Savi Technology include:

- Wall Mounting Kit
- Fence Mounting Kit
- Beam Mounting Kit

- Pole Mounting Kit
- Office Mounting Kit

Wall Mounting Kit

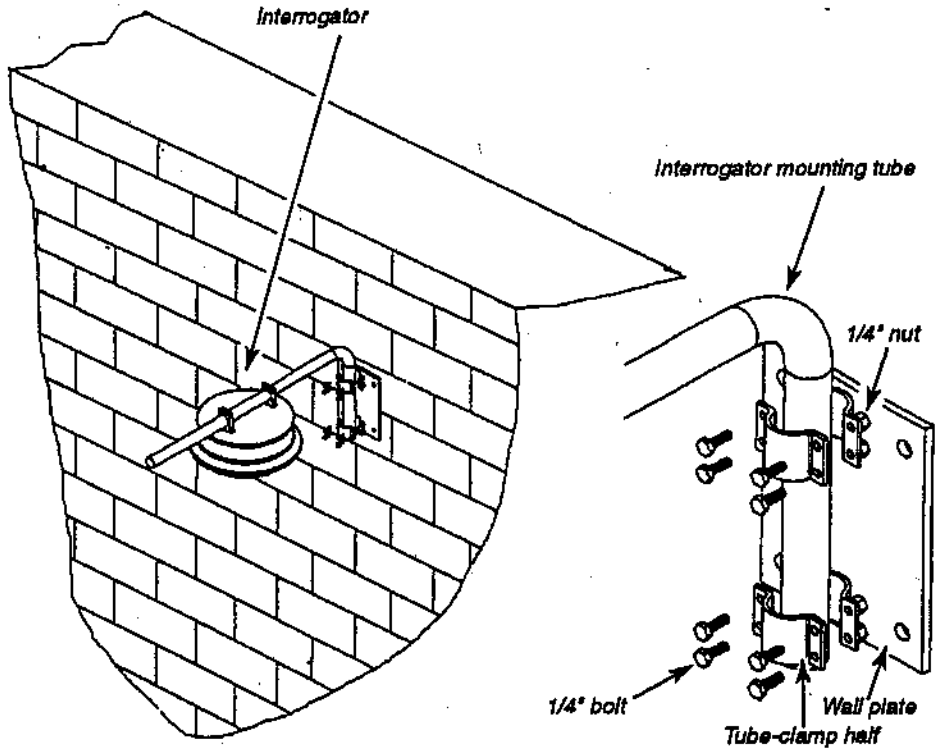


Figure 2-5 Wall Mounting Kit

To assemble the Wall Mounting Kit:

1. Attach the wall plate to the wall, using at least four bolts (not supplied) with a diameter of $^3/_8$ inch to $^1/_2$ inch.
2. While holding a tube-clamp half to a mating half on the wall plate, insert a $^1/_4$-inch bolt through the holes and then screw a $^1/_4$-inch nut onto the bolt.

Note

Do not tighten the nut yet.

3. Repeat step 2 for the other tube-clamp half.
4. While the assembly is loose, position the interrogator mounting tube between the clamp halves.
5. For each of the two tube clamps, evenly tighten the four bolts until the clamp halves meet.
6. Use the plastic tie wraps to attach power and data cables to the mounting tube.

Fence Mounting Kit

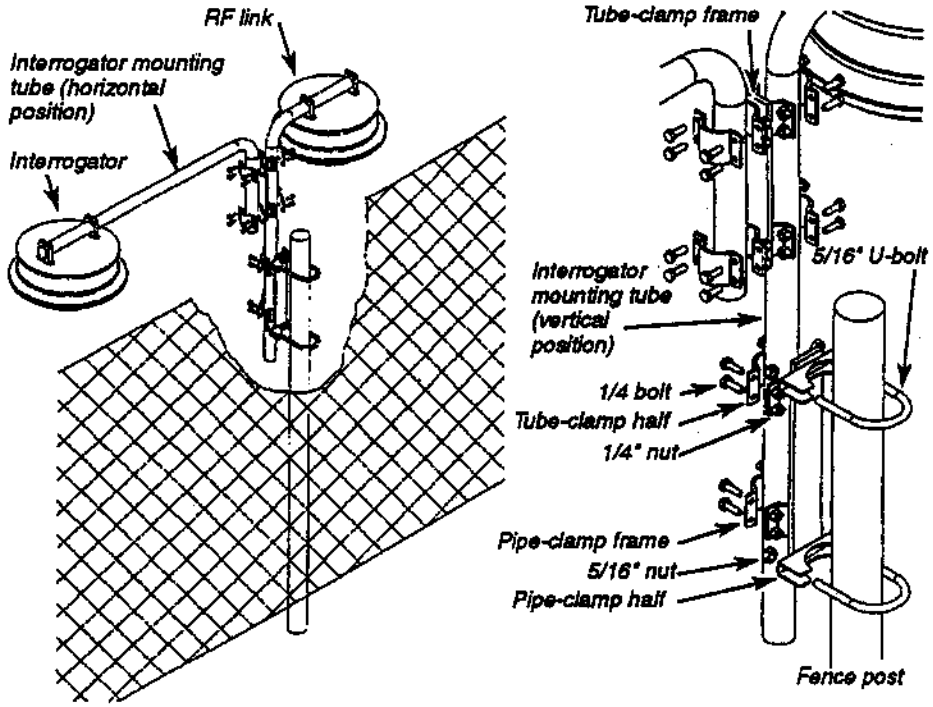


Figure 2-6 Fence Mounting Kit

To assemble the Fence Mounting Kit:

1. While holding the pipe-clamp frame against the post, insert the U-bolts around the post and through the pipe-clamp halves.
2. Screw the $^{5}/_{16}$-inch nuts onto the U-bolt and tighten them.
3. While holding a tube-clamp half to a mating half on the pipe-clamp frame, insert a $^{1}/_{4}$-inch bolt through the holes and then screw a $^{1}/_{4}$-inch nut onto the bolt. Do not tighten the nut yet.
4. Repeat step 3 for the other tube-clamp half.
5. While the assembly is loose, position the interrogator mounting tube between the clamp halves and the clamp frame, with the long end parallel to the post.
6. Evenly tighten the four bolts for each clamp until the clamp halves meet.
7. While holding the tube-clamp frame against the interrogator mounting tube, insert the eight $^{1}/_{4}$-inch bolts.
8. Evenly tighten the bolts until the clamp halves meet.
9. Repeat steps 5 through 8 to assemble the second interrogator mounting tube.
10. Use the plastic tie wraps to attach power and data cables to the mounting tube.

Beam Mounting Kit

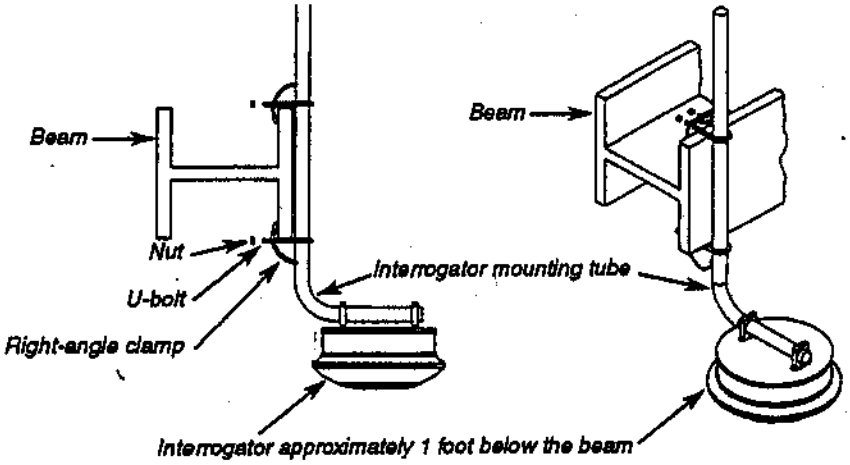


Figure 2-7 Beam Mounting Kit—vertical orientation

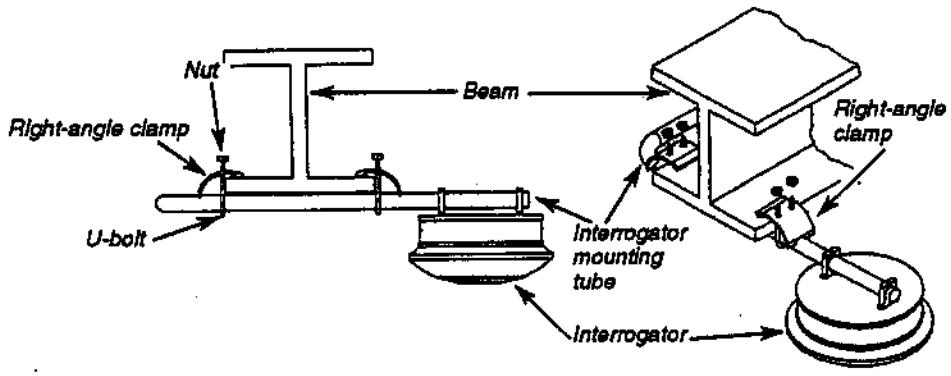


Figure 2-8 Beam Mounting Kit—horizontal orientation

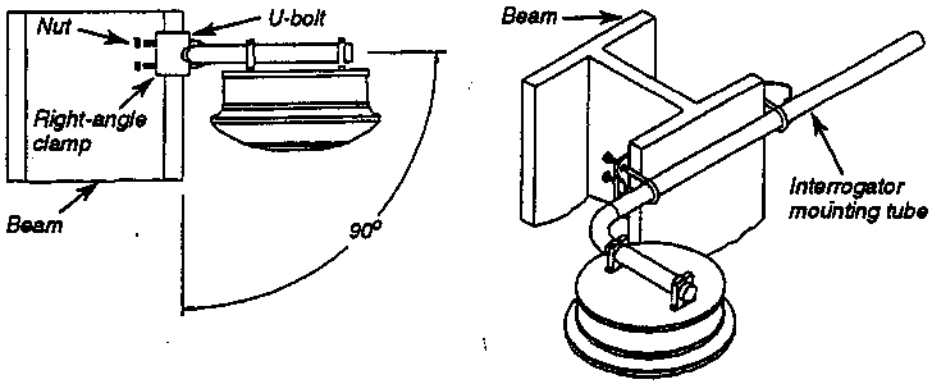


Figure 2-9 Beam Mounting Kit—perpendicular orientation

To assemble the Beam Mounting Kit:

1. Insert the U-bolts through the right-angle clamp.
2. Screw a nut onto each arm of each U-bolt. Do not tighten these nuts yet.
3. Repeat step 2 for the other right-angle clamp.
4. Slide the right-angle clamps into the interrogator mounting tube and position the assembly onto the beam as shown.
5. Evenly tighten the bolts for each clamp.
6. Use the plastic tie wraps to attach power and data cables to the mounting tube.

Pole Mounting Kit

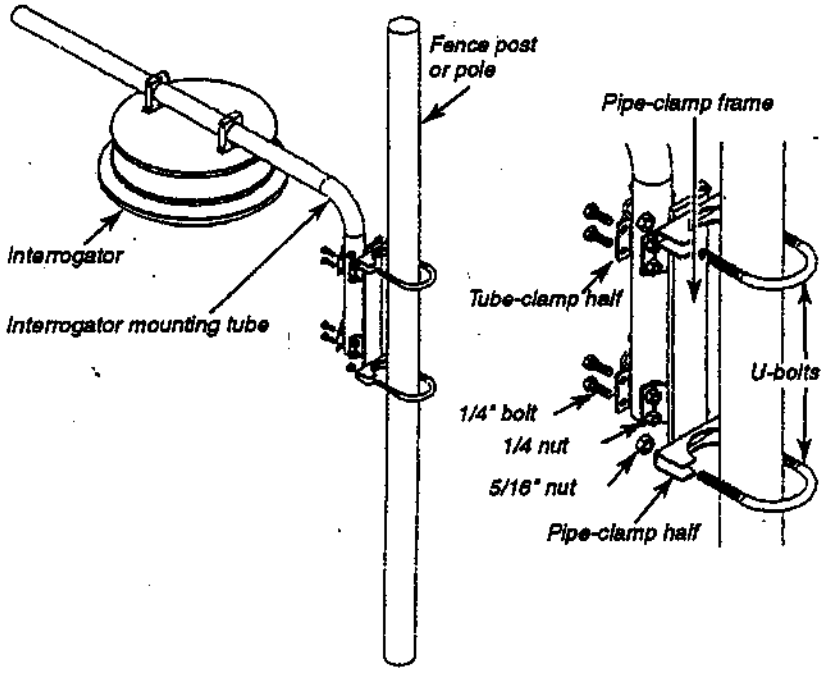


Figure 2-10 Pole Mounting Kit

To assemble the Pole Mounting Kit:

1. While holding the pipe-clamp frame against the post, insert the U-bolts around the post and through the two halves of the pipe clamp.
2. Screw the $^{5}/_{16}$-inch nuts onto both arms of each U-bolt and tighten them.
3. While holding a tube-clamp half to a mating half on the pipe-clamp frame, insert a $^{1}/_{4}$-inch bolt through each hole and then screw a $^{1}/_{4}$-inch nut onto each bolt.

Note

Do not tighten these nuts yet.

4. Repeat step 3 for the other tube-clamp half and its mating half.

5. While the assembly is loose, position the interrogator tube between the clamp halves.
6. For each of the two tube clamps, evenly tighten the four bolts until the clamp halves meet.
7. Use the plastic tie wraps to attach power and data cables to the mounting tube.

Office Mounting Kit

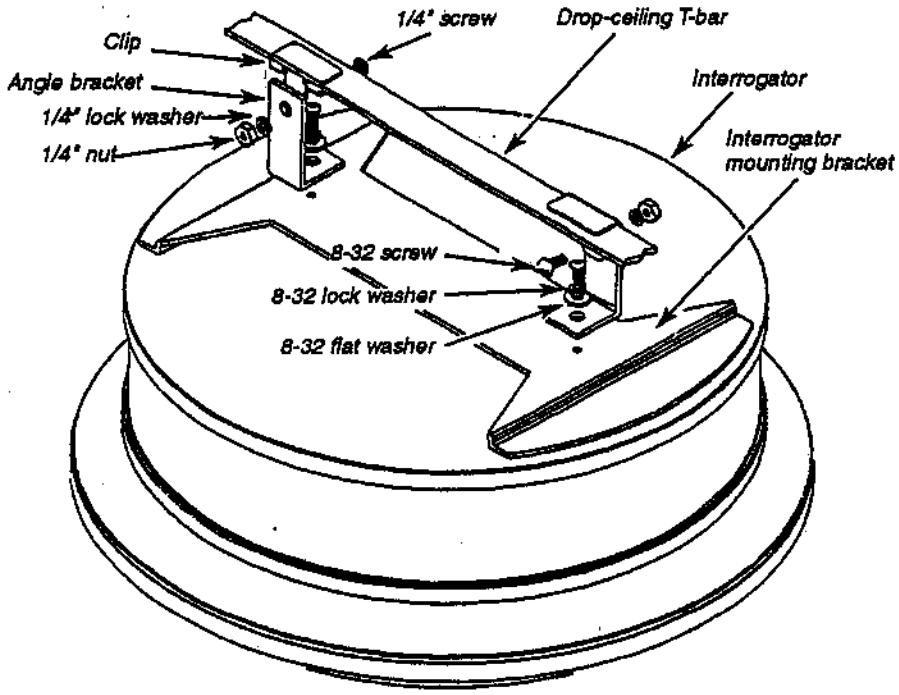


Figure 2-11 Office Mounting Kit

To assemble the Office Mounting Kit:

1. Slide an 8-32 lock washer onto an 8-32 screw.
2. Slide an 8-32 flat washer onto the same screw.
3. Insert the screw through the hole on the short end of the bracket.

4. Thread the screw into the interrogator's mounting bracket and tighten it.
5. Repeat steps 1 through 4 for the other 8-32 washers and screw.
6. Insert a 1/4-inch screw through a clip and an angle bracket, as shown.
7. Slide a 1/4-inch washer onto the same screw.
8. Screw a 1/4-inch nut onto the same screw and tighten it.
9. Repeat steps 6 through 8 for the other clip.
10. Holding the assembly near the ceiling, snap the open ends of the clips onto opposite sides of the ceiling T-bar.
11. Use the plastic tie wraps to attach power and data cables to the ceiling T-bar as required.

If you have any problems communicating with the reader during or after the installation, please see Chapter 3, "Maintenance," for troubleshooting procedures.

3 Maintenance

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

Repair and Maintenance

SaviReaders are designed to be maintenance-free. They are manufactured with the highest-quality components and are thoroughly tested before delivery.

The SaviReader is equipped with primary power fuses for circuit protection. Two AC power fuses are mounted on the back panel of the reader. The DC power fuse is mounted as shown in Figure 2-2, "Fuse holder, power and network connector ports," on page 2-4. A spare DC fuse is stored inside the access door in a fuse holder, shown in Figure 3-1. By removing the cap covering the DC power fuse, you can use the spare fuse to replace the original. This fuse is a 5-amp, 125-volt, miniature, non-time-delay fuse, Savi part number 670-00624-003 (BUSSMAN type GMW-5 or equivalent).

Fuse cover cap *Fuse holder*

Figure 3-1 Spare DC power fuse

In the unlikely event that a SaviReader fails or problems occur that simple troubleshooting cannot solve, the SaviReader should be returned to Savi Technology.

Troubleshooting

Table 3-1 lists causes and solutions to problems that might occur with the SaviReader 410R.

Table 3-1 Possible problems and solutions

Problem	Solution
➢ No power (indicator light is not blinking)	♦ Confirm that power is available 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, verify the continuity of the DC power fuse on the SaviReader, the source voltage (6 to 24 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 SaviReader 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 SaviReader. ♦ Verify that the network cable is securely plugged into the *correct* COM port on the computer. COM1 is usually a DB9M connector. COM2 is usually a DB25M connector. ♦ If using a cable adapter, verify the connections. ♦ If using the RS-485 cable, verify that the converter setting is DCE.

Table 3-1 Possible problems and solutions

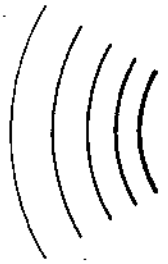
Problem	Solution
➢ Repeater mode failure	♦ If a SaviReader set in repeater mode fails, communication problems with the "downstream" devices might occur. ♦ If this is the first or the last SaviReader in the network, verify that the repeater (RPT) indicator LED is flashing. ♦ Reset the SaviReader to repeater mode by pressing the push button behind the spare-fuse access door (Figure 3-1).
➢ ID needs confirmation	♦ Reset the power (by disconnecting and then reconnecting the live power cable) to view the SaviReader serial number, which flashes in sequence after the reader is reset. ♦ Compare the SaviReader serial number to the ID used in the management software.
➢ COM port unavailable (possibly used for another device such as a mouse)	♦ Connect the SaviReader cable to another COM port.
➢ Unknown	♦ Turn power off and then back on. ♦ Call Savi technical support.

Technical Support

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

- Telephone 1-800-428-0556 (North America only) or 1-415-428-0550 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.



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 system comprises tags (also called transponders), interrogators (also called readers), RF links, integrated products, and a computer with controlling software installed. Tags can store, transmit, and receive data and commands from interrogators, or when triggered by sensors. SaviTags and interrogators communicate through a proprietary radio communications protocol, Savi Enhanced Batch Collection®. To gather asset information, collection commands are either relayed from the computer to tags, through Fixed Interrogators or Gate Interrogators, or issued directly by the operator from Savi MobileReaders.

The Savi Enhanced Batch Collection protocol lets each interrogator maintain communications with all tags that lie within its radio "micro-cell," while providing additional security and advanced collection support. A Fixed Interrogator 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 preprogrammed schedule. A Gate Interrogator can support up to four antennas, reading tags in motion and discriminating between bi-directional lanes. An operator can use the Savi MobileReader to perform collections and

exchange data with the tags wherever the installation of Fixed Interrogators is not practical or where portability is desired.

Savi RFID System Solutions

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

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 310which 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 Software and Integrated Products

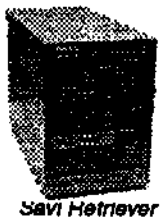
Savi System software and integrated products control the RFID hardware, either individually or in a network. These products include:

- Savi Asset Manager
- Savi Retriever
- Savi Tools™
- Savi Tools Pro

- Tag Docking Station
- TAV Tools for Tag Docking Station

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. 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. Asset Manager also includes a graphical user interface (GUI) to simplify your control tasks; you can close the GUI and still leave the Asset Manager able to run scheduled events. Asset Manager communicates with a variety of active and passive tags and readers via modem, SaviNet or LonWorks networks.



Savi Retriever

Savi Retriever automates the collection and forwarding of asset data. It uses a network of Savi interrogators 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.

The Savi Tools program lets you diagnose, troubleshoot, and test Savi hardware capability. 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 Tools Pro has all the features of Savi Tools plus advanced commands to configure the Savi network and interrogator settings. It also lets you display any tag's standard or extended memory.

Tag Docking Station

Tag Docking Stations write data directly into the memory of SealTags, cutting the time required to initiate a new tag or update an existing one. The Tag Docking Station connects

directly to the SaviTag through a four-pin connector in the sliding dock, and connects to the computer through a standard RS-232 cable. The companion Windows program lets you 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.

TAV Tools for Tag Docking Station is a special control program; it extends the functionality of the Tag Docking Station to let you read and write tags using the TAV (Total Asset Visibility) format.

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 interrogator by radio frequency transmission.

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

Interrogators, or readers, are electronic devices that send and receive signals from tags. Interrogators 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 an interrogator's transmission determines its range and its ability to communicate with tags. An antenna, or multiple antennas, send and receive transmissions. The antenna is either enclosed with the reader, or can be housed separately.

Savi System RFID components include:

- SealTag
- SaviTag 410
- SaviTag 310
- SaviReader410R
- SaviReader 410GR
- SaviReader 310R
- Savi MobileReader
- RF Link
- Support for Amtech and TIRIS passive tags and readers

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.

SaviTag 410

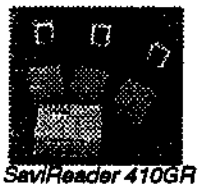
The SaviTag 410 has its own database engine and file system. It features up to 128K bytes of read/write memory, and a connector port for wired high speed data transfer. The SaviTag 410 supports tag-initiated communication triggered by system sensors.

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 128K bytes of random access memory. The tag is hermetically sealed in a plastic waterproof case that can withstand shock and vibration.

SaviReader 410R

The SaviReader 410R has an adjustable omnidirectional range of up to 600 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 24 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.



SaviReader 410GR

The SaviReader410GR is a gate interrogator model 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 interrogator features a 2.45 GHz wakeup signal, a 433 MHz standard signal, an 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 readers field. It can also distinguish between tags travelling along two adjacent vehicle lanes in opposite directions. The gate interrogator supports communication via modem or LonWorks network.

SaviReader 310R

The SaviReader 310R model features 128K bytes 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

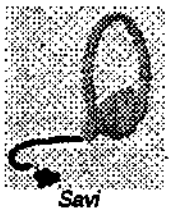
Savi MobileReaders (formerly Hand Held Interrogator, or HHI) are portable, rechargeable, battery-powered units that have all the functionality of the Fixed Interrogator with an adjustable omnidirectional range of up to 200 feet. They provide infrared wakeup of SealTags, so an HHI can establish radio communication with a specific SealTag without requiring the operator to know the SealTag's identification number. The MobileReader has memory to store the data it collects. The operator can display the data or transfer the data to the computer. The MobileReader supports a variety of external data interfaces, including direct input from bar codes. The MobileReaders are based on Intermec's JANUS platform, and feature a PCMCIA slot for expanded memory.

RF Link

RF links allow wireless communication between Fixed Interrogators and a host computer. With an omnidirectional range of nearly one mile, RS-232 or RS-485 cables connect each RF link to a computer or (RS-485 only) to interrogators. RF links can also be configured as repeaters, allowing several miles of extension in effective network coverage.

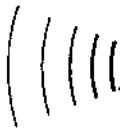
The Savi system now provides extended support for both active and passive RFID through the LonWorks network.

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 is ISO compliant.



Savi MobileReader100R

TIRIS tags are passive tags with a frequency range of 124.2–134.2 KHz, and a read range of up to 2 meters. TIRIS readers are available in three models: a standard model whose antenna are positioned within 10 feet of the reader, a remote model whose antenna can be located as far as 1000 feet from the reader, and a hand-held model.



Glossary

active — (RFID systems are called "active" when the transponder, or tag, contains its own battery to generate an RF transmission. *Contrast with* passive.

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.

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

collection — The process in which an interrogator collects the ID numbers of all tags that are within its radio range.

collection search — A type of collection in which the interrogator collects ID numbers from only those tags that match a specified search definition. Collection searches are useful for finding which containers or pallets contain a specific item. *Contrast with* tag database search.

collection threshold — A criterion for selecting tags based on how many times a tag has been collected.

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.

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

data file — A computer file that contains information to be written to a tag or data written from a tag.

data format — The form in which information is stored, manipulated, or transferred.

destination — A disk or tag that receives data.

extended memory — Random-access memory (RAM) in SaviTags. This memory is RAM with a battery back-up power source. Extended memory is available in several sizes, from 8 KB to 128 KB. *Contrast with* standard memory.

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

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

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).

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.

local — Capable of direct communication using wires only, as opposed to remote. An RF link communicates between local and remote interrogators.

local node — A node that is connected to the computer by cable.

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

node — An element within a network. The computer communicates with nodes. Savi software recognizes six types of nodes: interrogators, RF links, and computers, each of which can be connected to local or remote networks.

passive — An RFID system is called "passive" if the transponders (tags) receive the energy they required to generate RF transmission from a reader.

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.

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 from a tag's memory using a source outside the tag (such as an interrogator).

reader — A device that detects the presence of a tag. *See* 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.

remote — At a distance; not connected directly by wires.

remote node — A node that is connected to the computer by RF links, not by a direct cable.

repeater — *See* RS-485 repeater.

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 and RS-485 — The physical and electrical communications protocols used between Savi equipment and the computer. With the RS-232 protocol, only a single interrogator or RF link can be attached to the computer. With the RS-485 protocol, multiple Fixed Interrogators and RF links can be attached. Savi software supports operations with both protocols.

RS-485 repeater — A device in an interrogator or RF link that, when enabled, intercepts and reconditions the communication signals that pass through it.

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 — An RFID tag with advanced features produced by Savi Technology.

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

standard memory — Erasable programmable read-only memory (EEPROM) that is part of every Savi tag. SaviTags have 128 or 256 bytes of standard memory, to hold configuration information such as the tag ID number and tag name. The first 43 bytes of standard memory are reserved for Savi functions. *Contrast with* extended memory.

standard node — A node that requires an immediate RS-485 acknowledgment from the local RF link when sending an RS-485 packet to a remote node. An interrogator is a standard node.

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 SealTags and TyTags.

tag database search — A type of collection in which the interrogator queries only the current tag to match a specified search definition. Tag database searches are useful for finding additional information about the items on one pallet or in one container, once the container has been located.

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

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

TAV — Total Asset Visibility, a set of data formats proprietary to Savi.

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