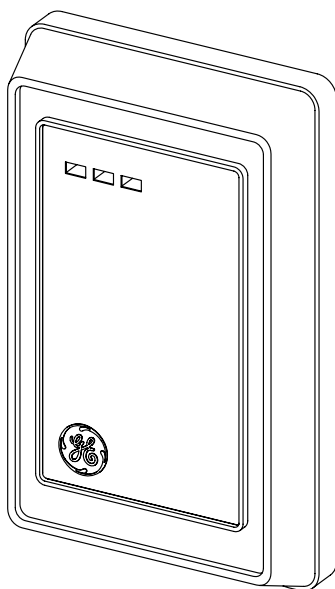


Model 94x, 97x Proximity Reader Installation Manual



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Regulatory



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Introduction

This manual is an installation guide for the GE Models 940, 941, 970, 971, 972, and 973 proximity readers. Throughout this guide, the abbreviation 94x represents reader models 940 and 941. The abbreviation 97x represents reader models 970, 971, 972, and 973.

The 94x and 97x readers while similar in functionality offer a variety of features making them suitable for different applications. The 94x and 97x readers are designed to mount on standard U.S. gang boxes. The 94x readers are single-gang box size. The 97x readers are sized for larger dual gang box installation, offer greater badge read range, and a keypad option.

Models 940 and 970 give the greatest all-around badge read range for their respective sizes, making them ideal for most installations.

Models 941 and 971 are tuned for installation on metal mounting plates. The standard metal mounting plate shields the reader from the effects of a metal wall, which would otherwise dramatically reduce the read range. The optional back-to-back metal mounting plate shields the reader from the effects of a metal wall and makes the reader unidirectional; ideal for direct back-to-back reader installations.

Models 972 and 973 are dual gang size readers, identical to the 970 and 971 respectively, except for their built-in twelve-position keypad. This feature makes these readers ideal for installations requiring keypad PIN entry in addition to a valid badge read.

Safety

Radio interference



WARNING: This is an FCC Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take adequate measures.

Electrostatic discharge (ESD) precaution



WARNING: Circuit board components are vulnerable to damage by electrostatic discharge (ESD). ESD can cause immediate or subtle damage to sensitive electronic parts. An electrostatic charge can build up on the human body and then discharge when you touch a board. A discharge can be produced when walking across a carpet and touching a board, for example. Before handling any board, make sure you dissipate your body's charge by touching ground. This discharges any static electricity build-up.

Product features

The GE Model 94x/97x Reader offers:

- Intelligent bidirectional communication between the reader and microcontroller, which can be accomplished up to 5,500 feet.
- The ability to read all ISO ProxLite™, ProxLite, and Entrée badges and key tags.
- Field changeable DIP switches allow all 94x and 97x readers to operate in one of four distinct operating modes: Wiegand (4001), F/2F, Supervised, and Silent Supervised.
- Rugged, weather-resistant, molded ABS construction with integral backplate.
- Standard 12V operation.
- A clear, logical user interface with three LEDs and a switch selectable beeper with volume control.
- Built-in tamper alarm also detects removal from wall.
- External tamper alarm option.
- Tactile keypad (Models 972 and 973 only) for Personal Identification Number (PIN) input.

System requirements

Host software	<ul style="list-style-type: none">Secure Perfect® Edition 3.0 or laterPicture Perfect™ 1.7 or later
Microcontrollers	<ul style="list-style-type: none">Micro/2Micro/4Micro/5-PX with 2RP or 8RPMicro/5-PXN with 2RP or 8RPM5PXNplus with 2RP or 8RPMicro/PX-2000Micro/PXN-2000M2000PXNplusM3000PXNplus with 2RP or 8RP
Microcontroller firmware	<ul style="list-style-type: none">For Micro/2 and Micro/4: Secure Perfect: Version 5 or later Picture Perfect: Version 1.7.0 or laterFor Micro/5-PX, Micro/5-PXN, Micro/PX-2000 and Micro/PXN-2000: Secure Perfect: 3.1.0.6 or later Picture Perfect: 1.7.0 or later
Badge and keytag formats	<ul style="list-style-type: none">ISO ProxLiteProxLiteEntréeProximity Perfect <p>Note: Proximity Perfect cards are obsolete however they are supported by the Model 94x/97x readers.</p>

Technical specifications

For UL compliant installation notes, refer to [“UL” on page 44](#).

Operating temperature range	-31 F (-35 C) to +151 F (+66 C)
Relative humidity	5% to 95% (non-condensing)
Physical dimensions	(HxWxD)
Model 94x	4.75" (121 mm) x 2.9" (74 mm) x 0.90" (23 mm)
Model 97x	4.75" (121 mm) x 5.5" (140 mm) x 0.90" (23 mm)
Index of protection	IP55
Color	Light gray and black
Power supply	Nominal 12VDC, 75mA, 150mA or 200mA dependent on the power setting selected. See Table 1 “Power level switch settings,” on page 24
Cable specifications	Belden 8725 or equivalent, 20 AWG minimum, shielded pairs
Maximum cabling distance ^a	The maximum cable distance between the reader and the microcontroller is influenced by a number of factors including wire gauge and reader power level setting. See Table 3 “Cable distances,” on page 25 .
Read range	Determined by the reader’s power level setting and other environmental conditions. See Table 2 “Read range by model number,” on page 24 .
Pinouts	The reader is supplied with a ten-wire cable. On one end is a keyed connector that mates with the J1 connector on the back of the reader. The other ends are stripped ready for connection to the field wiring using a terminal block or in-line splice connectors.

- a. The reader will work well with unshielded cable in most environments. No company, including GE, can guarantee that data will be reliably transmitted over long distances on unshielded cable in every installation.

Parts list

- Model 940 Reader (single-gang) gray
- Model 940 Reader (single-gang) black
- Model 941 Reader (single-gang metal mount) gray
- Model 941 Reader (single-gang metal-mount) black
- Model 970 Reader (dual-gang) gray
- Model 970 Reader (dual-gang) black
- Model 971 Reader (dual-gang metal-mount) gray
- Model 971 Reader (dual-gang metal-mount) black
- Model 972 Reader (dual-gang with keypad) gray
- Model 972 Reader (dual-gang with keypad) black
- Model 973 Reader (dual-gang metal mount w/keypad) gray
- Model 973 Reader (dual-gang metal mount w/keypad) black
- Optional Tamper Key Tool
- 94x Plastic Backplate (gray)
- 94x Plastic Backplate (black)
- 97x Plastic Backplate (gray)
- 97x Plastic Backplate (black)
- Standard 941 Metal Mounting Plate (gray)
- Standard 941 Metal Mounting Plate (black)
- Standard 971/973 Metal Mounting Plate (gray)
- Standard 971/973 Metal Mounting Plate (black)
- Optional Back-to-Back 941 Metal Mounting Plate (gray)
- Optional Back-to-Back 971/973 Metal Mounting Plate (black)
- 94x Weather-resistant Gasket
- 97x Weather-resistant Gasket
- Reader Cable

Refer to the GE Product Catalog for part numbers and ordering information.

Installation overview

The following steps are general instructions for installing the 94x/97x reader. Each step is explained in further detail in the sections that follow.

1. Mount the reader backplate.
Refer to “Mounting the reader” on page 8.
2. Configure the reader.
Refer to “Configuring the reader” on page 20.
3. Connect the reader.
Refer to “Connecting the reader” on page 28.
4. Test the reader.
Refer to “Testing the reader” on page 36.

Mounting the reader

The reader comes with a backplate suitable for mounting directly onto standard U.S. electrical gang boxes (Model 94x onto single-gang box and Model 97x onto dual-gang box). The reader may also be mounted directly onto a hollow wall.

Important:

- Readers should not be mounted within three feet of a computer terminal. Some terminals radiate electrical noise that may reduce the effective maximum read range.
- Never mount Models 940, 970 or 972 on or near metal. Metal effects the tuning of the reader and may severely degrade its performance, decreasing read range and increasing current draw.
- Models 941, 971 and 973 are factory tuned to work with a metal back and must be mounted with the metal mounting plate to operate correctly.
- A gasket is supplied with the reader to form a weather-resistant seal between the mounting surface and the inside of the reader for outdoor installations. The gasket should be located on the inside surface of the reader's plastic backplate. For outdoor installations, where the reader is mounted in direct exposure to weather, a bead of silicone caulking should be applied between the reader and the wall to prevent water from entering the back of the reader.

Back-to-back readers

Models 941, 971 and 973 Readers are suitable for back-to-back installation (to provide in/out access control). Using the standard metal mounting plates, the two readers should be mounted with their centers offset by at least 10 inches to provide interference-free operation. Using the optional back-to-back metal mounting plates allows the two readers to be mounted directly opposite each other on a 4-inch thick wall.

External tamper feature

The Model 94x/97x Readers are also equipped with an external tamper feature. This feature can be activated by removing the key on the backplate prior to mounting.

Model 94x only: Apply the mounting method as shown in *Figure 1, Recommended Additional Mounting Instructions for External Tamper Switch Activation* to mounting instructions in *Figure 2, "Model 940 Reader - Gang Box Mounting"* *Figure 3, "Model 940 Reader - Direct Wall Mounting"* *Figure 4, "Model 941 Reader - Gang Box Mounting"* and *Figure 5, "Model 941 Reader - Direct Wall Mounting"* if you are using the external tamper feature.

Note: In order for this feature to work properly, the reader mounting surface must be flush with the backplate.

Mounting diagrams

The figures listed below begin on the next page. Refer to the appropriate figure for the type of reader you are mounting.

- *Figure 1, Recommended Additional Mounting Instructions for External Tamper Switch Activation*
- *Figure 2, “Model 940 Reader - Gang Box Mounting,” on page 12.*
- *Figure 3, “Model 940 Reader - Direct Wall Mounting,” on page 13.*
- *Figure 4, “Model 941 Reader - Gang Box Mounting,” on page 14.*
- *Figure 5, “Model 941 Reader - Direct Wall Mounting,” on page 15.*
- *Figure 6, “Model 970/972 Reader - Gang Box Mounting,” on page 16.*
- *Figure 7, “Model 970/972 Reader - Direct Wall Mounting,” on page 17.*
- *Figure 8, “Model 971/973 Reader - Gang Box Mounting,” on page 18.*
- *Figure 9, “Model 971/973 Reader - Direct Wall Mounting,” on page 19.*

Figure 1. Recommended Additional Mounting Instructions for External Tamper Switch Activation

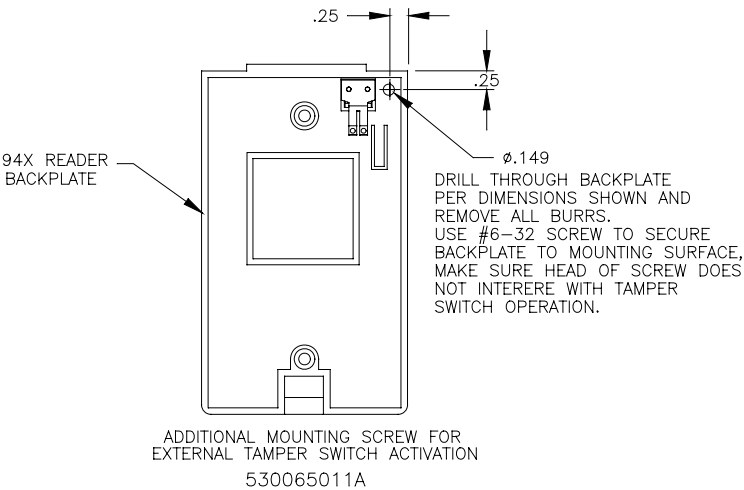
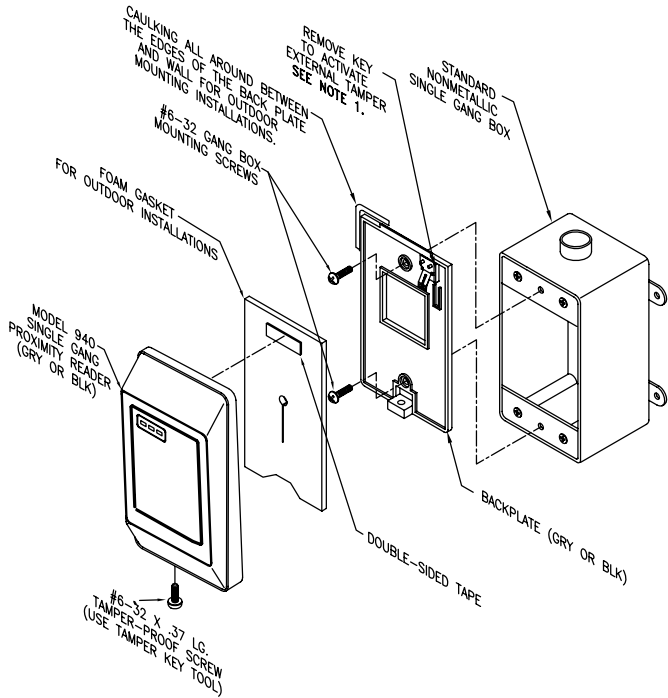


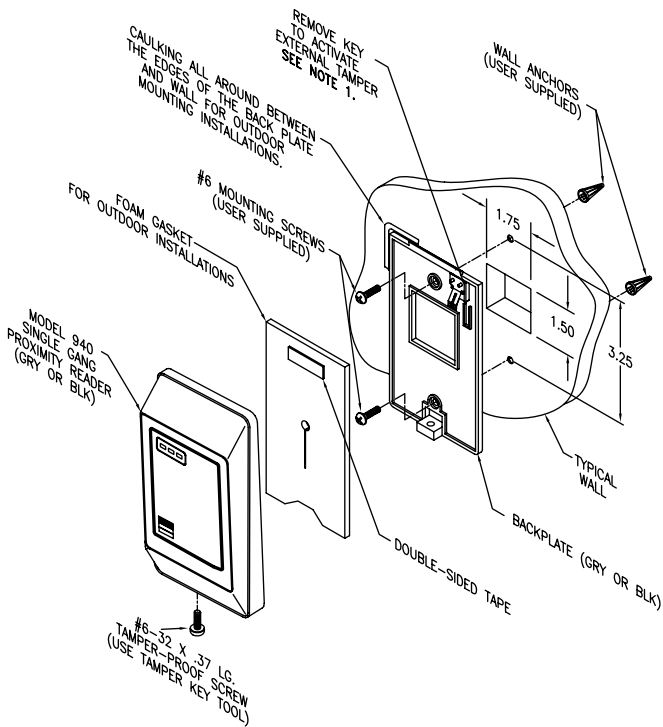
Figure 2. Model 940 Reader - Gang Box Mounting



NOTES:

1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE FOR THIS FEATURE TO FUNCTION PROPERLY. IN ADDITION, IT IS RECOMMENDED THAT ANOTHER MOUNTING SCREW BE INSTALLED IN THE TOP RIGHT CORNER OF THE BACK PLATE TO PREVENT FALSE TAMPER ALARMS (TRAVEL OF SWITCH IS ONLY 1/16" [1.6MM]). REFER TO EXTERNAL TAMPER FEATURE SECTION FOR ADDITIONAL INSTRUCTIONS AND A MOUNTING DIAGRAM DISPLAYING HOLE SIZE AND LOCATION.

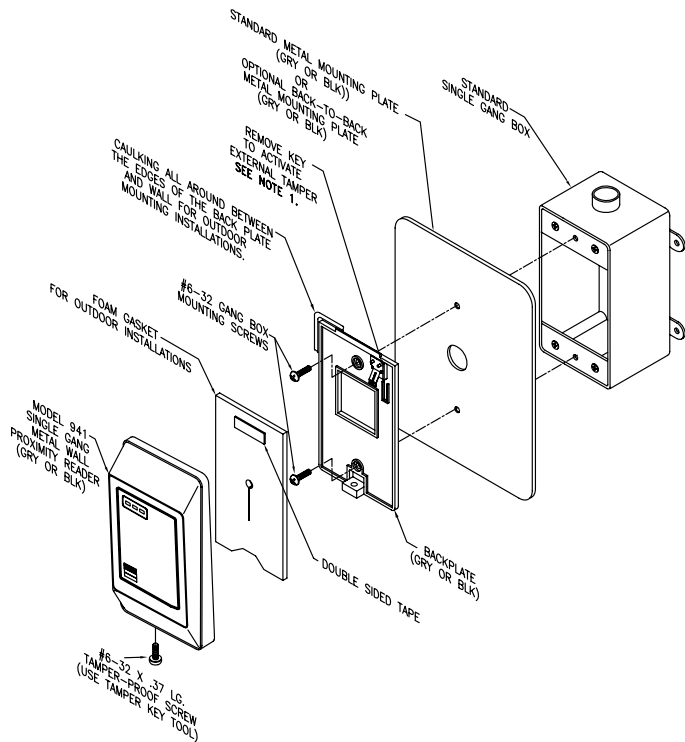
Figure 3. Model 940 Reader - Direct Wall Mounting



NOTES:

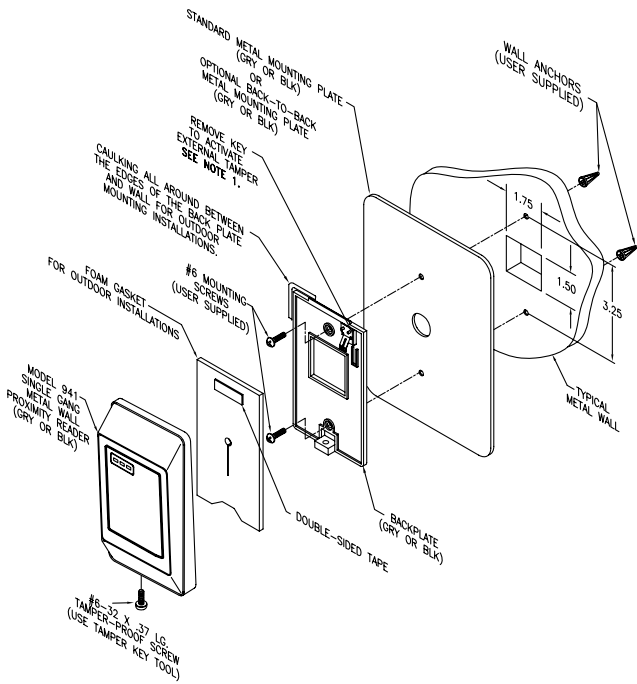
1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE FOR THIS FEATURE TO FUNCTION PROPERLY. IN ADDITION, IT IS RECOMMENDED THAT ANOTHER MOUNTING SCREW BE INSTALLED IN THE TOP RIGHT CORNER OF THE BACK PLATE TO PREVENT FALSE TAMPER ALARMS (TRAVEL OF SWITCH IS ONLY 1/16" [1.6MM]). REFER TO EXTERNAL TAMPER FEATURE SECTION FOR ADDITIONAL INSTRUCTIONS AND A MOUNTING DIAGRAM DISPLAYING HOLE SIZE AND LOCATION.

Figure 4. Model 941 Reader - Gang Box Mounting



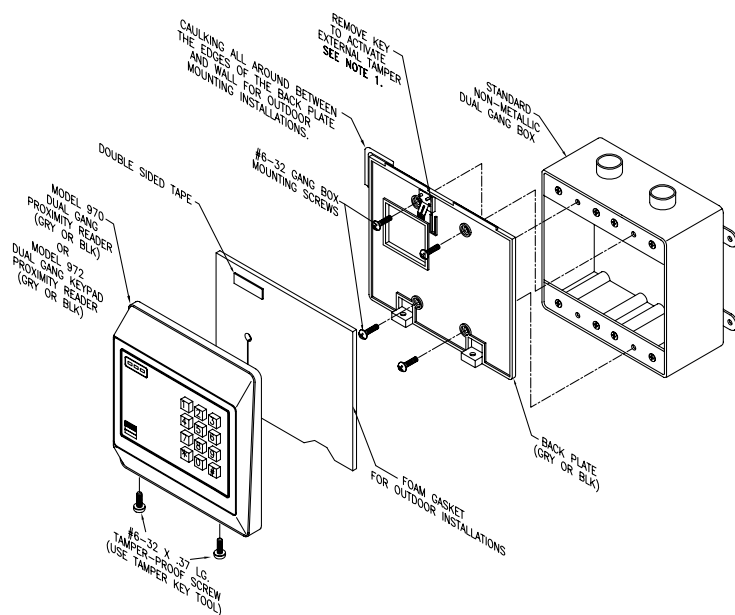
NOTES1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE FOR THIS FEATURE TO FUNCTION PROPERLY. IN ADDITION, IT IS RECOMMENDED THAT ANOTHER MOUNTING SCREW BE INSTALLED IN THE TOP RIGHT CORNER OF THE BACK PLATE TO PREVENT FALSE TAMPER ALARMS (TRAVEL OF SWITCH IS ONLY 1/16" [1.6MM]). REFER TO EXTERNAL TAMPER FEATURE SECTION FOR ADDITIONAL INSTRUCTIONS AND A MOUNTING DIAGRAM DISPLAYING HOLE SIZE AND LOCATION.

Figure 5. Model 941 Reader - Direct Wall Mounting



NOTES:
1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE FOR THIS FEATURE TO FUNCTION PROPERLY. IN ADDITION, IT IS RECOMMENDED THAT ANOTHER MOUNTING SCREW BE INSTALLED IN THE TOP RIGHT CORNER OF THE BACK PLATE TO PREVENT FALSE TAMPER ALARMS (TRAVEL OF SWITCH IS ONLY 1/16" [1.6MM]). REFER TO EXTERNAL TAMPER FEATURE SECTION FOR ADDITIONAL INSTRUCTIONS AND A MOUNTING DIAGRAM DISPLAYING HOLE SIZE AND LOCATION.

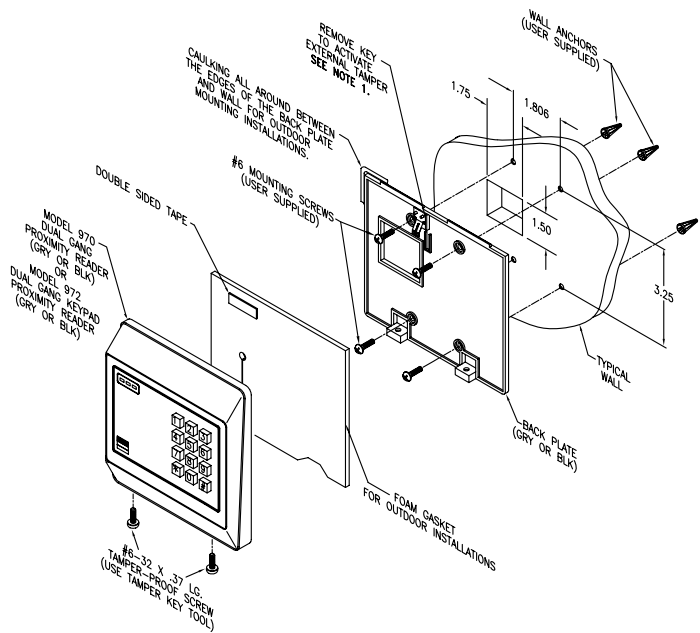
Figure 6. Model 970/972 Reader - Gang Box Mounting



NOTES:

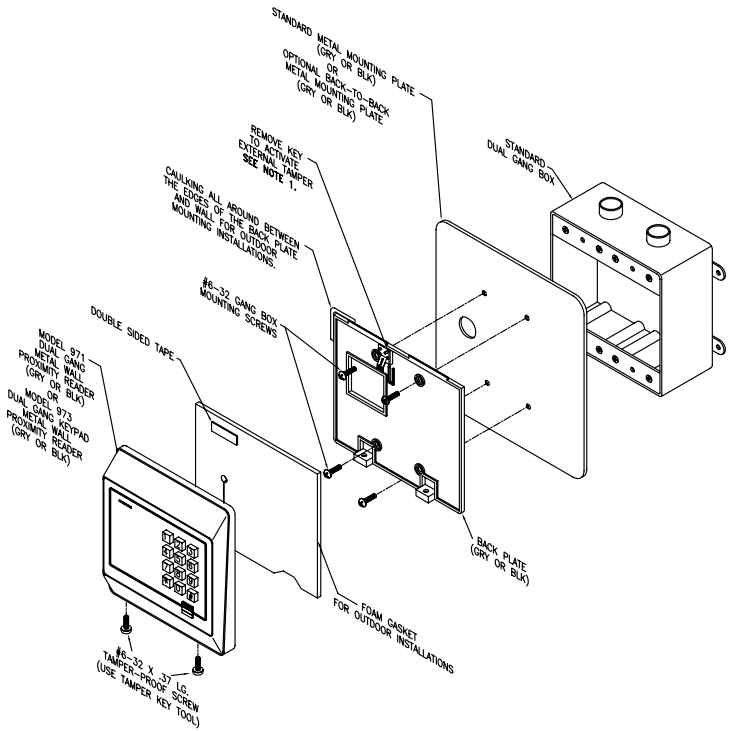
1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE, FOR THIS FEATURE TO FUNCTION PROPERLY.

Figure 7. Model 970/972 Reader - Direct Wall Mounting



NOTES:
1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE. FOR THIS FEATURE TO FUNCTION PROPERLY.

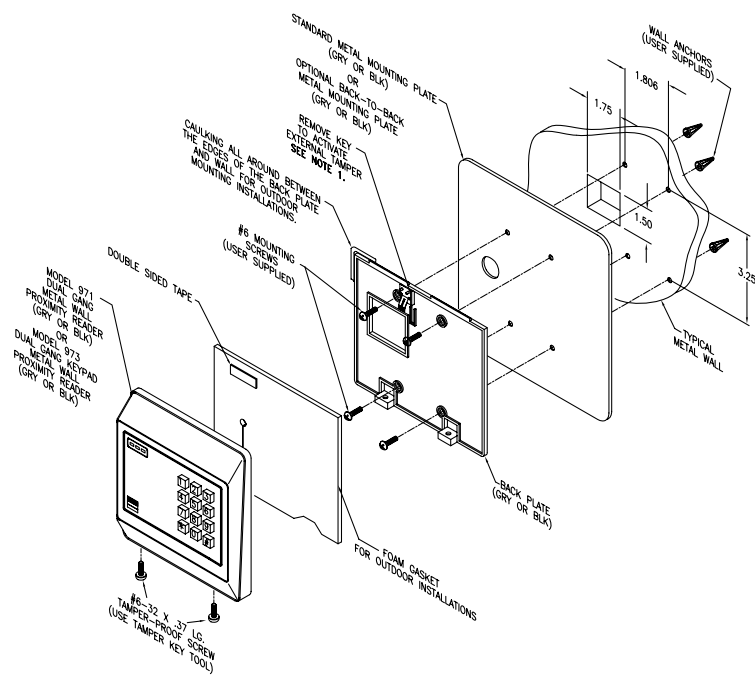
Figure 8. Model 971/973 Reader - Gang Box Mounting



NOTES:

1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE, FOR THIS FEATURE TO FUNCTION PROPERLY.

Figure 9. Model 971/973 Reader - Direct Wall Mounting



- NOTES:
1. READER MOUNTING SURFACE MUST BE FLUSH WITH BACK PLATE, FOR THIS FEATURE TO FUNCTION PROPERLY.

Configuring the reader

Switch settings

Two banks of four DIP switches located on the back of the reader are used to select the reader power level, operating mode, and beeper sound level. Please note that the location and orientation of switch block SW2 have changed for readers manufactured after December, 2002 as illustrated in *Figure 10, “Model 94x/97x Reader, J1 Connector and DIP Switch Locations (PCB Assembly P/N 100079002 manufactured 12/02 or later),” on page 22.*



CAUTION:

Power should be removed from the reader while switch settings are changed.

Selecting reader power level

The reader's power requirement is selected using four DIP switches. The optimum power level will vary with each installation. Higher power levels give improved read range for badges, while lower power levels allow greater cabling distance between the reader and the microcontroller. A detailed explanation is provided below. The figures on the next page show the location of the DIP switches. The tables that follow the figures give the switch settings along with the read ranges and cable distances.

Explanation of Read Range/Cable Distance/Power Level:

Maximum badge read range is determined by the distance at which the field transmitted by the reader is just strong enough to wake up the badge. Therefore, the higher the reader's transmission power, the greater the badge read range will be. The trade-off for increased read range is a decrease in the maximum cabling distance between the reader and the microcontroller. The

trade-off between read range and cabling distance is common to all proximity badge readers. The power selection switches on the 94x/97x readers allow the optimum power setting to be selected to suit individual installations.

For example: On the high power setting, giving the greatest badge read range, the reader typically requires 200mA of supply current from the microcontroller. If there is 1,000 feet of 22-AWG cable between the reader and the microcontroller, the total reader power and power return path is 2,000 feet. Since 22-AWG cable has a typical resistance of 16 ohms per 1,000 feet, the total resistance in the reader's power and power return wire is 32 ohms. By Ohms Law ($V=IR$), it follows that the total voltage dropped in the reader power and power return wires will be 6.4V ($6.4V = 200mA \times 32 \text{ Ohms}$). Therefore, the reader supply voltage will drop from 12V at the microcontroller to 5.6V ($12V - 6.4V$) at the reader. Such a supply voltage is too low for the reader to function reliably.

If the low power setting is selected, the badge read range is reduced. However, the reader now typically requires only 75mA of supply current; therefore, the voltage drop in the power and power return wires is much less. In this case, the reader supply voltage will only be reduced to 9.6V; high enough for reliable operation.

Figure 10. Model 94x/97x Reader, J1 Connector and DIP Switch Locations
(PCB Assembly P/N 100079002 manufactured 12/02 or later)

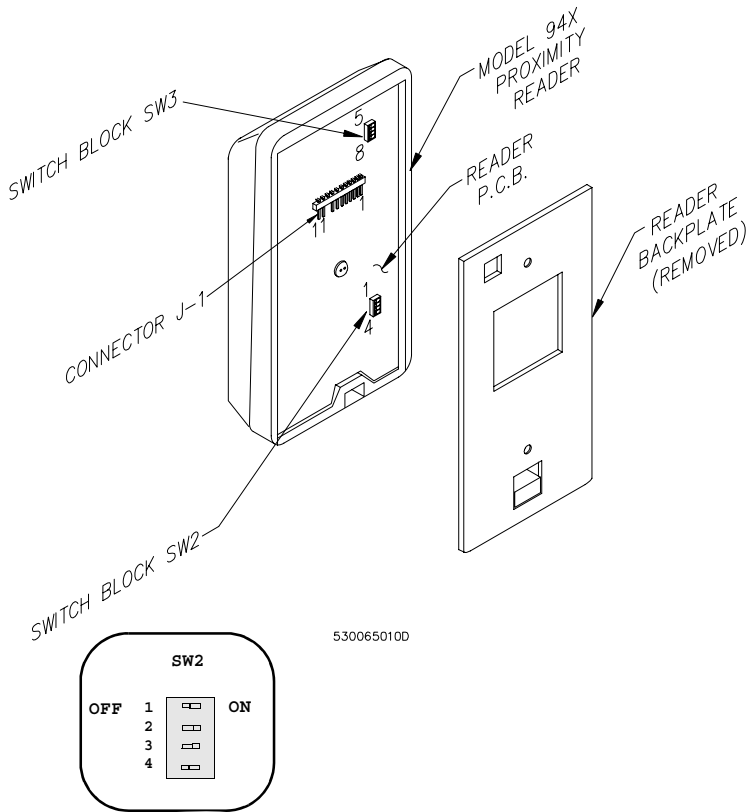
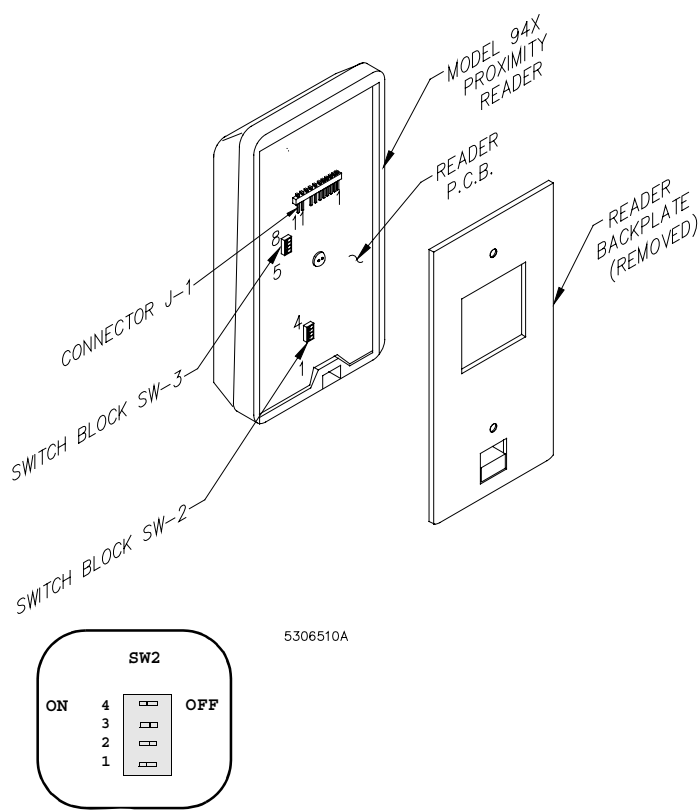


Figure 11. (PCB Assembly P/N 100079001 manufactured prior to 12/02)



CAUTION: Power should be removed from the reader while switch settings are changed.

The table below shows the switch settings for each of the three power levels.

Table 1. Power level switch settings

Power Level	Switch 1	Switch 2	Switch 3	Switch 4
LOW	OFF	ON	ON	OFF
MEDIUM	ON	OFF	OFF	ON
HIGH	ON	ON	ON	ON

The table below gives the read ranges for each of the readers based on the power level settings. All read ranges are typical maximums.

Table 2. Read range by model number

Power level	97x	94x
LOW	5 in 127 mm	4 in 102 mm
MEDIUM	6 in 152 mm	5 in 127 mm
HIGH	7 in 178 mm	6 in 152 mm

in = inches
mm = millimeters

The table below gives the maximum cabling distances between the reader and the microcontroller for each of the three power levels.

Table 3. Cable distances

Power level	13.6 Volts (see Note 1)		12 Volts (see Note 1)	
	18 AWG	22 AWG	18 AWG	22 AWG
LOW	5500 ft 1676 m	2000 ft 610 m	3500 ft 1067 m	1500 ft 457 m
MEDIUM	2200 ft 671 m	900 ft 274 m	1100 ft 335 m	450 ft 137 m
HIGH	600 ft 183 m	250 ft 76 m	See Note 2	See Note 2

Note:

- 1 Reader supply voltage measured at microcontroller: 13.6V is nominal when line powered, 12V is nominal when battery powered.
- 2 Not recommended for 12V, battery-backed installations.
- 3 All cable distances are typical maximums.
- 4 Readers powered by a local 12 VDC power supply will have a maximum cable distance of 5,500 feet (1676 m) of 22-AWG telephone wire for all power level settings.

Selecting operating mode

Field changeable DIP switches allow all 94x and 97x readers to operate in one of four distinct operating modes: Wiegand (4001), F/2F, Supervised, and Silent Supervised.

In the unsupervised modes, the reader communicates with the microcontroller over a unidirectional Wiegand or F/2F data link that carries badge data only.

In the supervised modes, the reader communicates with the microcontroller over a bidirectional F/2F data link, that carries badge data, supervision messages, exit request and door switch status, and microcontroller acknowledgments and commands.

Silent Supervised mode is ideal for installations where no audible or visual indication of communication loss with the microcontroller is desired at the reader.

The table below shows the DIP switch settings for each of the four operating modes.

Table 4. Operating mode DIP switch settings

Operating mode	Switch 5	Switch 6
Wiegand ^a	OFF	OFF
F/2F ^b	ON	OFF
Supervised F/2Fb	OFF	ON
Silent supervised F/2Fb	ON	ON

a. ProxLite badge data is sent using 40-bit (4001) Wiegand format. Keyboard information is sent using 8-bit Wiegand format.

b. All ProxLite badge data is sent using a 12-digit F/2F format.

Selecting beeper sound level

The table below shows the DIP switch settings for the three beeper sound levels.

Table 5. Beeper sound level DIP switch settings

Beeper sound level	Switch 7	Switch 8
Normal	ON	ON
Low	ON	OFF
Off	OFF	ON

Connecting the reader

For pinout and wiring information, refer to the following:

- *Pinouts on page 28*
- *Wiring diagrams on page 29*

Note: To maintain CE compliance, shielded cable and connections must be used as shown in the section, *“CE/FCC compliance” on page 46.*

Pinouts

The table below shows the pinouts for connecting the reader to the microcontroller. Connector J1, pin 1 is to the right as you view the connector from behind the reader. See *Figure 10* on page 22 and *Figure 11* on page 23.

Table 6. Pinouts

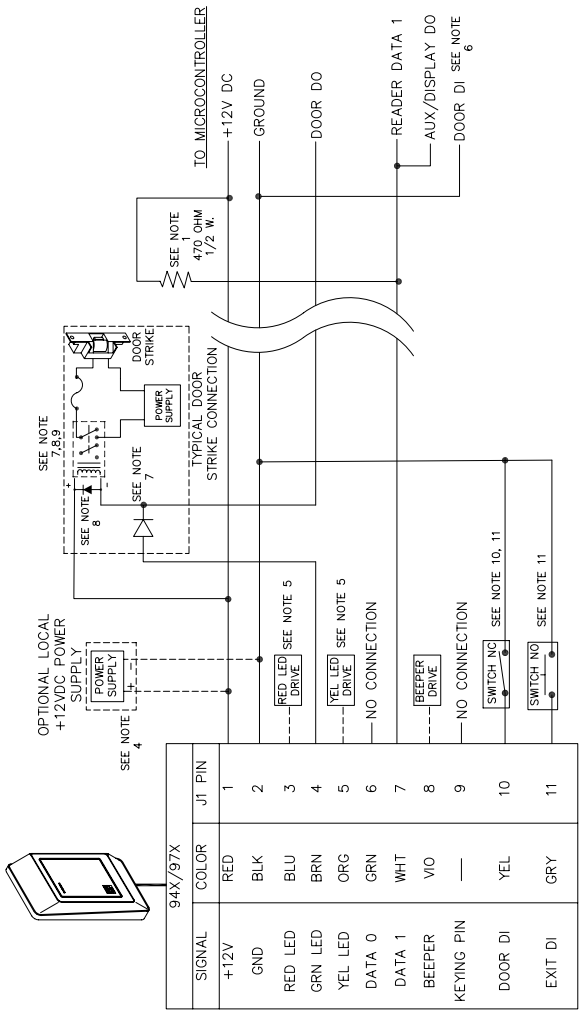
Connector: J1 Pin number	Signal	Pigtail Wire Color
1	+12 VDC	Red
2	Ground	Black
3	Red LED External Drive	Blue
4	Green LED External Drive	Brown
5	Yellow LED External Drive	Orange
6	Reader Data 0	Green
7	Reader Data 1	White
8	Beeper External Drive	Violet
9	Keying Pin	
10	Door DI (Door Contact Switch)	Yellow
11	Exit DI (Exit Request Button)	Gray

Wiring diagrams

See the wiring diagrams that follow for details on connecting the reader to the microcontroller based on the mode of the reader.

- *Figure 12, “Wiring diagram, Model 94x/97x Supervised F/2F Mode,” on page 30.*
- *Figure 13, “Wiring diagram, Model 94x/97x Unsupervised F/2F Mode,” on page 32.*
- *Figure 14, “Wiring diagram, Model 94x/97x Unsupervised Wiegand Mode,” on page 34.*

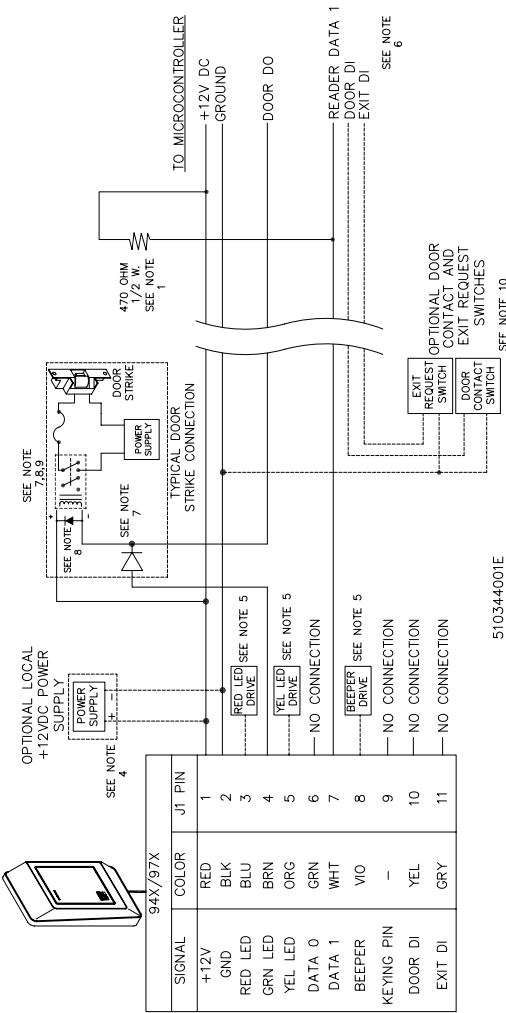
Figure 12. Wiring diagram, Model 94x/97x Supervised F/2F Mode



Note: (Unless otherwise specified):

- 1 For Micro/2/4/5 only: a 470 ohm, 1/2W, pull-up resistor is required between +12 VDC and READER DATA 1. The pull-up resistor should be installed at the microcontroller's terminal block. Resistors are supplied with the reader.
- 2 Shielded cable is recommended in electrically noisy environments.
- 3 If using shielded cable, connect all shields together at the microcontroller end. Connect to the ground stud in the lower left corner of Micro/2/4/5 cabinets using 14-AWG wire. No shield connections at the reader.
- 4 If using a local power supply, do not connect +12V line from the microcontroller to the reader. However, the negative side of the power supply must be connected to the microcontroller (pin 2 on the reader port). Keep the wiring from power supply to reader less than 50 feet.
- 5 Switching the external indicator drives to GND activates the indicator. High impedance or +12V deactivates indicators. These drives may also be connected to user supplied, external indicating circuitry.
- 6 Refer to the appropriate system manual to determine whether this connection is required for door switch operation.
- 7 Blocking diodes may be 1N5817 or GE part number 521224001 (included with reader). The diode must be installed in a secure location, not accessible through the reader removal.
- 8 Protection diodes may be 1N4002, 1N4003, or 1N4004 (installer supplied) for the door strike assembly.
- 9 Fuse, power supply, door strike, and relay are provided by the installer.
- 10 If the door contact switch is not used, link reader pin 10 to pin 2.
- 11 Request to exit (REX) terminals on the reader are not to be connected for UL listed installations.

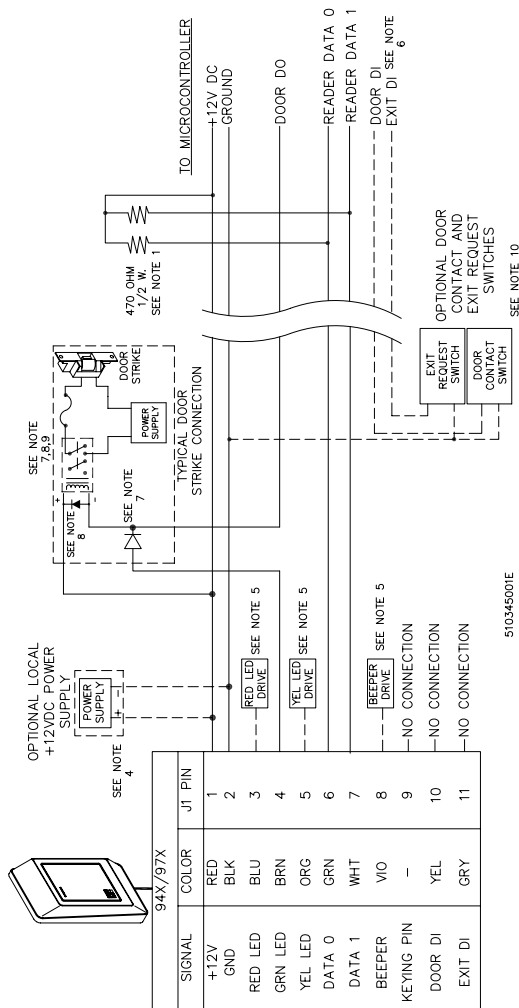
Figure 13. Wiring diagram, Model 94x/97x Unsupervised F/2F Mode



Note: (Unless otherwise specified):

- 1 For Micro/2/4/5 only: a 470 ohm, 1/2W, pull-up resistor is required between +12 VDC and READER DATA 1. The pull-up resistor should be installed at the microcontroller's terminal block. Resistors are supplied with the reader.
- 2 Shielded cable is recommended in electrically noisy environments.
- 3 If using shielded cable, connect all shields together at the microcontroller end. Connect to the ground stud in the lower left corner of Micro/2/4/5 cabinets using 14-AWG wire. No shield connections at the reader.
- 4 If using a local power supply, do not connect +12V line from the microcontroller to the reader. However, the negative side of the power supply must be connected to the microcontroller (pin 2 on the reader port). Keep the wiring from power supply to reader less than 50 feet.
- 5 Switching the external indicator drives to GND activates the indicator. High impedance or +12V deactivates indicators. These drives may also be connected to user supplied, external indicator driving circuitry.
- 6 Refer to the appropriate system manual for specific wiring details.
- 7 Blocking diodes may be 1N5817 or GE part number 521224001 (included with reader). The diode must be installed in a secure location, not accessible through the reader removal.
- 8 Protection diodes may be 1N4002, 1N4003, or 1N4004 (installer supplied) for the door strike assembly.
- 9 Fuse, power supply, door strike, and relay are provided by the installer.
- 10 Request to exit (REX) terminals on the reader are not to be connected for UL listed installations.

Figure 14. Wiring diagram, Model 94x/97x Unsupervised Wiegand Mode



Note: (Unless otherwise specified):

- 1 For Micro/2/4/5 only: two 470 ohm, 1/2W, pull-up resistors are required; one between +12 VDC and READER DATA 1, the other between +12 VDC and READER DATA 0. The pull-up resistors should be installed at the microcontroller's terminal block. Resistors are supplied with the reader.
- 2 Shielded cable is required. Belden 8725 wire is recommended. Do not pair DATA 1 and DATA 0.
- 3 If using shielded cable, connect all shields together at the microcontroller end. Connect to the ground stud in the lower left corner of Micro/2/4/5 cabinets using 14-AWG wire. No shield connections at the reader.
- 4 If using a local power supply, do not connect +12V line from the microcontroller to the reader. However, the negative side of the power supply must be connected to the microcontroller (pin 2 on the reader port). Keep the wiring from power supply to reader less than 50 feet.
- 5 Switching the external indicator drives to GND activates the indicator. High impedance or +12V deactivates indicators. These drives may also be connected to user supplied, external indicator driving circuitry.
- 6 Refer to the appropriate system manual for specific wiring details.
- 7 Blocking diodes may be 1N5817 or GE part number 52124001 (included with reader). The diode must be installed in a secure location, not accessible through the reader removal.
- 8 Protection diodes may be 1N4002, 1N4003, or 1N4004 (installer supplied) for the door strike assembly.
- 9 Fuse, power supply, door strike, and relay are provided by the installer.
- 10 Request to exit (REX) terminals on the reader are not to be connected for UL listed installations.

Testing the reader

Follow the steps below to verify that the reader is working correctly.

1. Check all cabling and electrical connections from the reader to the microcontroller. Refer to the wiring diagrams on [page 30](#), [page 32](#), and [page 34](#).
2. Verify that the microcontroller is properly configured. Refer to the appropriate GE microcontroller manual.
3. Verify that the reader switches are properly set for the power setting, cabling type, distance, and desired mode of operation. *See “Switch settings” on page 20.*
4. Apply power to the reader and verify that the yellow LED is on. You may want to use a multimeter to test the voltage at the reader’s pigtail connector J1, using ground (pin 2) as a reference. The power pin (pin 1), data lines (pins 6 and 7) and door DO (pin 4) should all read approximately 12V.
5. Check that the proper version of firmware is installed in the microcontroller. Refer to the appropriate microcontroller manual.
6. Close the tamper switch by joining the reader and backplate.

Note: If external tamper is activated, make sure the reader backplate mounting surface is flush with backplate.

When all wires are connected to the reader, ensure that the supervision function is operating properly (if a supervised mode is selected), by verifying that the reader is not sounding a short triple beep every 30 seconds, and the red LED is not flashing slowly (every 2 seconds). If

such an alarm is present, refer to the troubleshooting guide at the end of this manual.

Note: In silent supervised mode, no indication of loss of supervision is provided, except badges will not be read.

7. Select a known good ProxLite test badge. Be sure the badge is properly entered in the host system, and the micro badge data format matches the reader. If the reader is used with a keypad (Models 972 and 973 only), assign a proper PIN.
8. Check that the door is secure. Present the badge to the reader. Observe that the reader beeps briefly and the yellow LED blinks off.
9. If the reader is used with a keypad (Models 972 and 973 only), enter a PIN. Refer to the host manual for instructions on entering the PIN. Observe that the green LED turns on indicating a valid access has been granted by the host.
10. Open the door. This verifies that the door strike operates correctly.

Troubleshooting the reader

If the operation of a component is in doubt, substitute a known good component and retry the system. Always verify wiring against wiring diagrams before powering up the system.

The troubleshooting guide is divided into three sections. The first section is applicable to all installations, the second section provides additional diagnosis for unsupervised readers, and the last section provides additional diagnosis for supervised readers.

All installations

All LEDs are on and the beeper is on (if enabled): Usually, an indication that the reader's voltage is too low. This may be caused if the wrong reader voltage is selected at the microcontroller or the cable is too long between the reader and the microcontroller.

1. Measure the reader supply voltage at the microcontroller. It should read between 12 and 15 VDC. If the voltage is correct, continue to step 2 below. If the voltage is incorrect, refer to the appropriate microcontroller manual and correct the voltage.
2. Set the reader to low power mode if the cable distance is too long (See [Table 1 "Power level switch settings," on page 24](#)). This may correct the problem.
3. If the problem is still present, while in low power mode, measure the voltage between J1 pin 1 (power) and J1 pin 2 (ground). This voltage should be greater than 8 VDC and less than or equal to the reader supply voltage. If the voltage is too low, correct the wiring. If the voltage is correct, replace the reader.

None of the LEDs are on: Check that the beeper is enabled (See [Table 5 “Beeper sound level DIP switch settings,” on page 27](#)), then present a known good ProxLite test badge to the reader while listening for the beeper.

If the beeper sounds, the reader is faulty and should be replaced. If the beeper does not sound, check the power connections to the reader and check the reader supply voltage at connector J1 pin 1.

The green LED is always on: The green LED indicates that the door strike is open. It is controlled by the input on connector J1 pin 4.

1. Disconnect the wire on J1 pin 4. If the green LED stays on, the reader is faulty and should be replaced. If the green LED goes off then the problem is most likely not in the reader.
2. Reconnect the wire on J1 pin 4 and measure the voltage at J1 pin 4. Low voltage turns on the green LED. If the voltage is low, check to see if the host system is turning on the door strike.

The beeper doesn’t sound and the yellow LED doesn’t blink when a badge is presented to the reader OR the badge read range is very poor: When the beeper sounds and the yellow LED blinks off, it indicates that a badge has been read and its data sent to the microcontroller.

Note: The beeper will not sound if it has been disabled. (See [Table 5 “Beeper sound level DIP switch settings,” on page 27](#).)

1. Models 941, 971 and 973: Check that the metal backplate is installed correctly. See the appropriate installation drawing in this manual for details.

All other models: Be sure they are not mounted on or near a metal wall or large metal object.

2. Check that the reader is not mounted within 3 feet (1 meter) of a computer terminal or within 10 inches (250 mm) of another proximity reader. The only exception to this 10-inch (250 mm) limit is for 941, 971, and 973 readers installed with the optional, back-to-back, metal mounting plates.
3. Present a test badge (known to be working) to the reader. If the beeper and yellow LED still fail to indicate a valid badge read and send, replace the reader with a reader that you know is working correctly. If this corrects the problem, the original reader is faulty and should be replaced. If this does not correct the problem, the badge is probably defective.

The door does not open and the green LED does not turn on when a badge is presented:

1. Verify that the badge and reader are properly entered into the system.
2. Verify that the door strike and the green LED are wired correctly. Since the green LED and the door strike are separate indicators, this problem is not an indication of a defective reader.

The green LED does not turn on, but the door strike unlocks the door when a valid badge is presented:

1. Verify that the door DO is wired correctly. Refer to the appropriate wiring diagram.
2. Disconnect the wire from J1 pin 4 (green LED) and connect J1 pin 4 to J1 pin 2 (ground). If the green LED is now on, the reader is good and the connection to the reader is defective. If the green LED does not turn on, replace the reader.

Green LED turns on but the door does not open: Verify correct door strike wiring and operation. The reader is functioning properly.

The beeper is always on and/or the yellow LED is off: The yellow LED blinks off and the beeper sounds while a key is pressed (Models 972 and 973 only), as long as the reader DIP switches are not set to disable the beeper.

False or intermittent tamper alarms: Verify that the reader mounting surface is flush with the backplate. If you continue to experience problems with tamper operation, clean the contacts on the PC board as well as the contact fingers on the backplate.

Unsupervised modes only

The reader sounds a short triple beep every 30 seconds and the red LED flashes quickly (every 400 ms): Indicates a tamper violation. Verify that the reader housing is properly secured to the backplate. If an external tamper is used, review the appropriate recommended mounting instructions. If the reader is secure and mounted properly, then the reader is faulty and should be replaced.

Supervised modes only

Reader sounds a short triple beep every 30 seconds and the red LED flashes slowly (every 2 seconds): The reader has lost communication with the microcontroller.

1. Check the reader to microcontroller wiring. Refer to the appropriate installation drawing. Verify that the AUX DO is jumpered to the READER DATA 1 on the microcontroller.

2. Verify that the correct pull-up resistor is installed on the microcontroller. See *Figure 12, “Wiring diagram, Model 94x/97x Supervised F/2F Mode,” on page 30.*
3. Verify that the microcontroller has the correct firmware for a supervised reader. Refer to the manual that came with your microcontroller for instructions.
4. Try the reader on a different reader input of the microcontroller. If this corrects the problem, then the microcontroller is probably causing the problem.
5. Replace the reader with one you know is working correctly. If this corrects the problem, then the reader is probably faulty and should be replaced.
6. If none of the above steps have identified the problem, there may be a significant noise source present in the installation that is interfering with the reader-to-microcontroller communications. If this is the case, use shielded wire for reader-to-microcontroller connections.

The beeper sounds and the yellow LED blinks off more than once when a valid badge is presented: The beeper sounds and the yellow LED blinks off every time badge data is sent to the microcontroller. When a badge is presented to the reader, data is transmitted from the badge to the reader. The reader interprets and checks the data received to make sure it has not been corrupted. The reader then sends the data to the microcontroller and waits approximately 1/3 of a second for the microcontroller to acknowledge receipt. If no acknowledge is received during this time, the reader resends the data causing the beeper to sound again and the LED to blink off. After the third unacknowledged attempt, the reader stops trying and indicates a communications error. This feature is useful in troubleshooting marginal installations where a high level of electrical noise may cause the reader to make multiple attempts at communications.

1. If multiple beeps occur regularly, refer to the installation drawings to verify that the correct pull-up resistor has been added to the microcontroller.
2. Replace the reader with one you know is working correctly. If this solves the problem, the original reader is probably faulty and should be replaced. If the problem persists, use shielded cable between the microcontroller and the reader.

The reader sounds a short triple beep every 30 seconds and the red LED flashes quickly (every 400 ms): Indicates a tamper violation. Verify that the reader housing is properly secured to the backplate. If an external tamper is used, review the appropriate recommended mounting instructions. If the reader is secure and mounted properly, then the reader is faulty and should be replaced.

The beeper and/or red LED are always on: The microcontroller may command the reader to turn on the red LED and the beeper as long as the reader DIP switches are not set to disable the beeper. If the door status switch input at J1 pin 10 is not tied to ground, the reader informs the system that the door is open. The system may then activate the alarm at the reader. If this is not the problem, then the system software probably told the reader to activate its alarm. Refer to the appropriate system manual for conditions that cause the software to activate the alarm. If it appears that no such system command is active, replace the reader with one you know works correctly. If this solves the problem, the original reader is faulty and should be replaced.

The green LED flashes quickly (every 400 ms): This indicates that the microcontroller has requested a PIN entry on a Model 972 or 973 Reader with a keypad. For all other models, check the reader configuration on your system to be sure a keypad reader was not selected.

Regulatory approvals

UL



UL Listed Installations

Specifications for UL compliance are shown below:

- Operating Temperature Range: +32 F (+0 C) to +120 F (+49 C)
- Relative Humidity: 85%
- The Model 94x/97x readers were evaluated by UL for indoor use only.

CE



Manufacturers
Declaration of Conformity

For



Product Identification: 430084001/2
430084501/502
430085001/2
430085501/502
430088001/2
430088501/502

Model/type:

Model 940
Model 941
Model 970
Model 971
Model 972
Model 973

BOM revision level: Q
BOM revision level: P
BOM revision level: Q
BOM revision level: P
BOM revision level: Q
BOM revision level: P

Category (description): Proximity Reader

Brand: GE Security

Manufacturer: GE Security
Suite 100
791 Park of Commerce Blvd.
Boca Raton, Florida 33487
USA

EU Representative: GE Security B.V.
Kelvinstraat 7
6003 DH Weert
The Netherlands

Concerning	R&TTE		
	EMC	Safety	Radio
A sample of the product has been tested by:	PSE 12955 Bellamy Brothers Blvd. Dade City, FL 33525	PSE 12955 Bellamy Brothers Blvd. Dade City, FL 33525	
Test report reference	02F3511/02F3521	02P351/02P352	02F351C/02F352C
Applied standards	EN50130-4(1998)	EN60950 (2000)	EN300 330 v.1.3.1(04-2001)

Equipment class identifier (RF products falling under the scope of R&TTE)

☐ Not Applicable

☒ None (class 1 product)

☐  (class 2 product)

Means of Conformity:

We declare under our sole responsibility that this product is in conformity with Directive 93/68/EEC (Marking) and/or complies with the essential requirements and all other relevant provisions of the 1999/5/EC (R&TTE) based on test results using harmonized standards in accordance with the Directives mentioned.

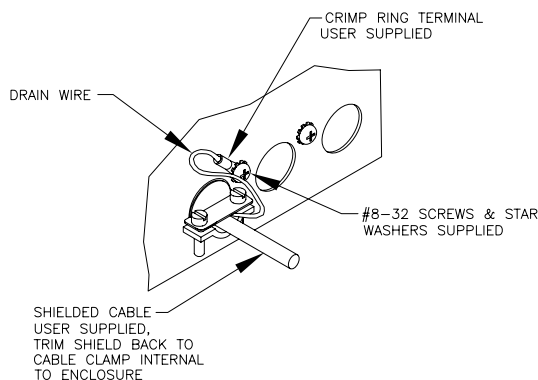
The use of this product is not allowed in Greece.

CE/FCC compliance

To make the Model 94x/97x reader installation CE and FCC compliant, the cable connecting the reader to the microcontroller must have its shield grounded at the microcontroller, according to one of the methods specified in the figures below.

Note: Do not make shielded connections at the reader.

*Figure 15. Typical installation (Internal to the micro)
Using shielded cable/drain wire*



*Figure 16. Typical installation (External to the micro)
Using shielded cable/drain wire*

