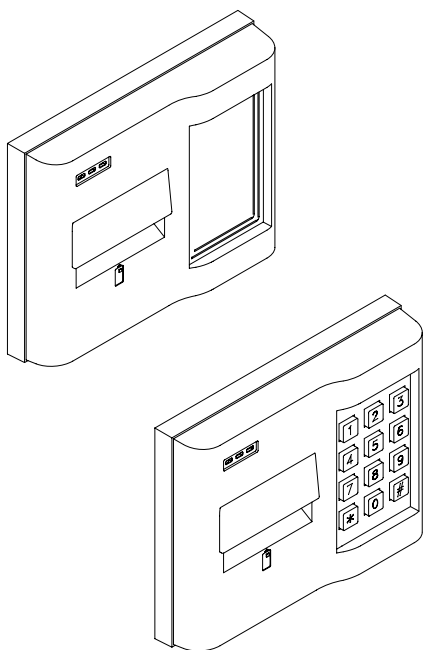




# Model 820/825 Contact Smart Card Reader Installation Manual



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<b>Intended use</b>	<p>Use this product only for the purpose it was designed for; refer to the data sheet and user documentation. For the latest product information, contact your local supplier or visit us online at <a href="http://www.gesecurity.com">www.gesecurity.com</a>.</p>
<b>Regulatory</b>	<div>   </div>

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# Introduction

This manual is an installation guide for the GE Models 820 and 825 Smart Card Readers. Throughout this guide the abbreviation 82x will stand for reader Models 820 and 825.

The 82x reader is designed to mount on a standard U.S. dual electrical gang box.

The Models 820 and 825 Readers are identical in their functionality, except that the Model 825 includes an integrated keypad used for the entry of a personal identification number (PIN).

In the supervised F/2F mode, the reader communicates with the microcontroller through a bi-directional data link which carries:

- Keypad data (Model 825 only).
- Smart card ID data.
- Command responses.
- Exit request switch and door status switch messages.
- Supervision messages.
- Microcontroller acknowledgments and commands.

The GE Model 82x readers use a DES set-up card to initialize the user's DES key into the reader, which allows DES/Triple DES encryption for smart card authentication when using DES-CBC-MODE compatible smart cards.

## Safety

### 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 Models 820 and 825 Smart Card Readers offer:

- Cabling distance up to 3,000 feet (914.4 meters). See *“Technical specifications” on page 5.*
- Ability to read many different types of single, multi-application, and asynchronous microprocessor smart cards.
- Standard 12 VDC operation.
- Two supervised digital switch inputs for interfacing exit request and door contact switches.
- A tactile back-lit keypad (supervised Model 825) for personal identification number (PIN) entry.
- Rugged, weather-resistant, molded Polycarbonate construction with integral backplate.
- DES/Triple DES encryption for DES-CBC-MODE compatible smart card authentication.
- Wiegand 4002 Communications for use with GEM PLUS MPCOS-3DES and GEM PLUS MPCOS-EMV Cards.
- Built-in or external tamper.
- Optional Cold Weather Kit.

## System requirements

Host software	<ul style="list-style-type: none"> <li>Secure Perfect® Edition 3.0 or later</li> <li>Picture Perfect™ 1.7 or later</li> </ul>
Microcontrollers	<ul style="list-style-type: none"> <li>Micro/2 (Picture Perfect only)</li> <li>Micro/4 (Picture Perfect only)</li> <li>Micro/5-PX with 2RP or 8RP</li> <li>Micro/5-PXN with 2RP or 8RP</li> <li>M5PXNplus with 2RP or 8RP</li> <li>Micro/PX-2000</li> <li>Micro/PXN-2000</li> <li>M2000PXNplus</li> <li>M3000PXNplus with 2RP or 8RP</li> </ul>
Micro firmware	<ul style="list-style-type: none"> <li>For Micro/2 and Micro/4: Picture Perfect: Version 1.7.0 or later</li> <li>For 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</li> </ul>
Badge and keytag formats	<ul style="list-style-type: none"> <li>Smart Card ID: 16 digits</li> <li>Smart Card PIN: 4 digits</li> <li>Orga ICC 6/1 EMV</li> <li>GEM PLUS MPCOS-3DES</li> <li>MPCOS-EMV</li> <li>MULTOS</li> </ul>



## Technical specifications

For UL compliant installation notes, refer to *"UL" on page 30*.

Operating temperature range	-13 F (-25 C) to +185 F (+85 C)
Relative humidity	0% to 95% (non-condensing)
Physical dimensions (HxWxD)	4.75" (121 mm) x 6.00" (152 mm) x 1.35" (34 mm)
Index of protection	IP22 (IEC 529)
Input voltage range	12 to 13.6 volts +/- 5% measured at the microcontroller
Reader power consumption	100mA @ 12 VDC nominal
Maximum cabling distance <sup>a</sup>	3000 ft (914 m) @ 12 VDC with 20 AWG cable
Standards	<p>Reader:</p> <ul style="list-style-type: none"> <li>• ISO 7816-1, -2, -3, -4 (T=0 &amp; T=1)</li> <li>• EMV 2.0 (T=0 &amp; T=1)</li> <li>• ANSI X3.92-1981</li> </ul> <p>Card Acceptor Device:</p> <ul style="list-style-type: none"> <li>• ISO-6 and ISO-8, lifetime of 500,000 operations</li> </ul>
Agency approvals	<p>FCC Class A</p> <p>CE</p> <p>UL 294 (UL verified for indoor use only.)</p>

a. The maximum cabling distance of 3,000 ft (914.4 meters) is influenced by a number of factors including wire gauge and reader power requirements.

## Parts list

- Model 820 Reader (dual gang)
- Model 825 Reader (dual gang with keypad)
- Optional Tool, 1/8 inch Hex Tamper Key
- Optional Cold Weather Kit

Refer to the GE price list for part numbers and ordering information.

## Installation overview

The following steps are general instructions for installing the 82x reader. Each step is explained in further detail in the sections that follow.

1. Install reader backplate.  
*Refer to “Mounting the reader” on page 8.*
2. Set the switches and the jumpers.  
*Refer to “Configuring the reader” on page 12.*
3. Connect the reader.  
*Refer to “Connecting the reader” on page 13.*
4. Test the reader.  
*Refer to “Testing the reader” on page 20.*

## Mounting the reader

The reader comes with a backplate suitable for mounting directly onto standard U.S. electrical dual gang boxes. The reader may also be mounted directly onto a hollow wall. The reader extends 1.625 inches into the back box or wall. If the reader is mounted on an outside wall, a bead of silicone caulking should be applied between the reader and the wall to prevent water from entering the back of the reader.

## Preparing the backplate

1. Prior to mounting the backplate, remove the connector cutout to suit the installation.
2. Punch or cut to enable off-the-wall tamper.
3. For mounting installations other than a standard dual gang box or 5029 plate, select other mounting hole locations on the backplate. Place the backplate face down on a flat surface and then using a small Phillips head screw driver or round punch, punch through selected mounting holes.

## 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, “Model 82X Reader - Gang box mounting,” on page 9.*

*Figure 2, “Model 82X Reader - Gang box with gasket mounting,” on page 10.*

*Figure 3, “Model 82X Reader - Direct wall mounting,” on page 11.*

Figure 1. Model 82X Reader - Gang box mounting

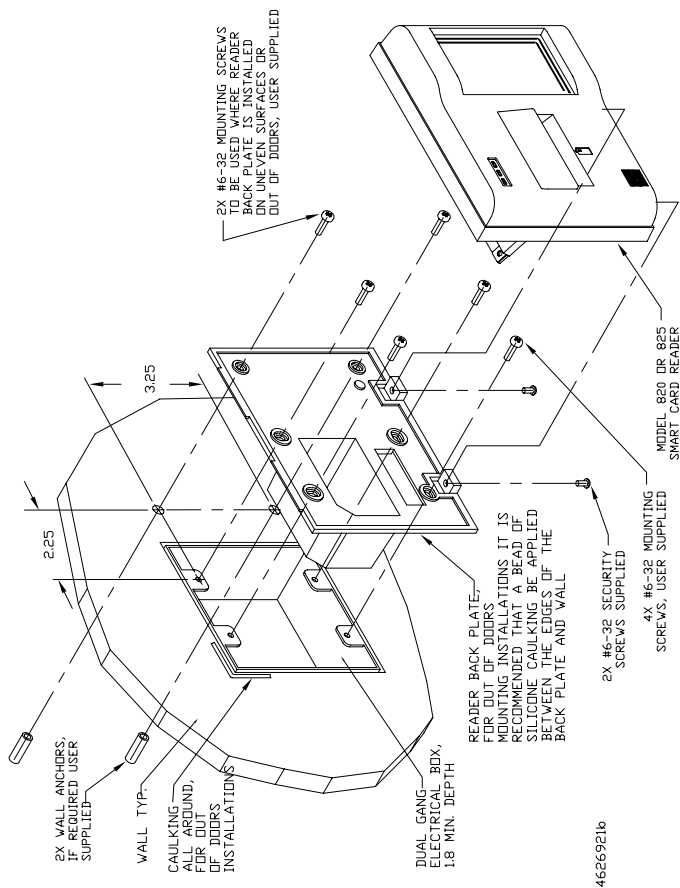
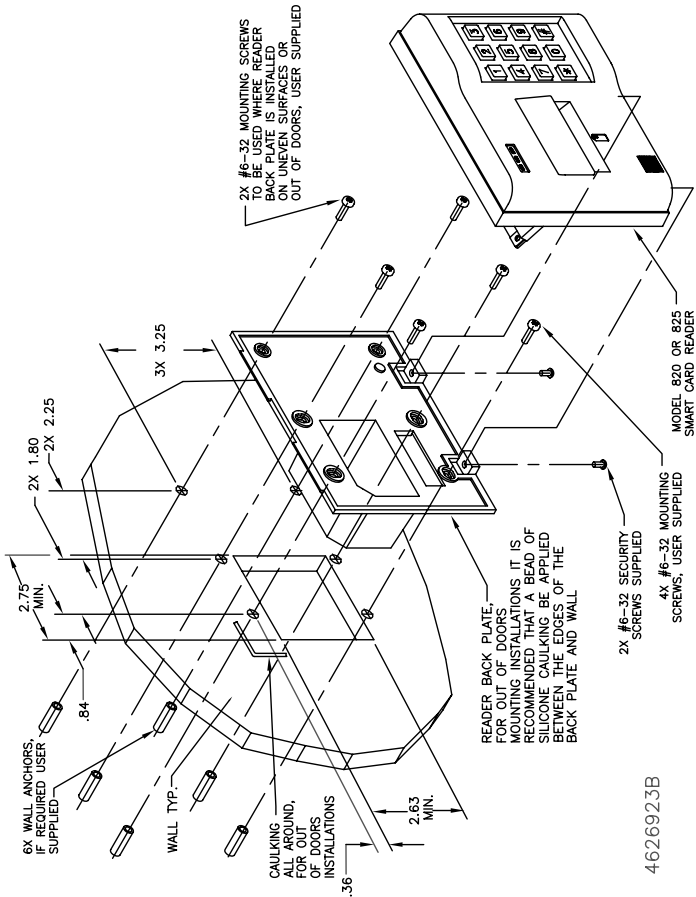




Figure 3. Model 82X Reader - Direct wall mounting



## Configuring the reader

### Digital Input (Door Contact and Exit Request)

The 82x Readers have a 4-state supervised door contact switch input and an exit request switch input. The state of both switch inputs is periodically reported to the microcontroller, but changes to switch inputs are reported immediately.

The door contact (alarm) and exit request are both configured for 4-state reporting. If used, then end-of-line resistors (2 at 1,000 ohms each) are required.

1. Install the door contact and the two end-of-line resistors (installer-supplied) at the contact.
2. Wire the door contact/end-of-line resistors to JP2 pin 8 and JP2 pin 9.
3. Install the exit request contact and the two end-of-line resistors (installer-supplied) at the contact.
4. Wire the exit request/end-of-line resistors to JP2 pin 10 and JP2 pin 11.



## Connecting the reader

For pinout and wiring information, refer to the following:

- *Pinouts on page 13*
- *Wiring Diagrams on page 15*

**Note:** To maintain CE compliance, shielded cable and connections must be used as shown in the section, *"CE/FCC compliance" on page 32.*

### Pinouts

*Table 1* on page 14 shows the pinouts for connecting the reader to the microcontroller. Connector JP2, pin 1 is to the right as you view the connector from behind the reader. See *Figure 4*.

*Figure 4. Model 82x Reader, JP2 Connector Location*

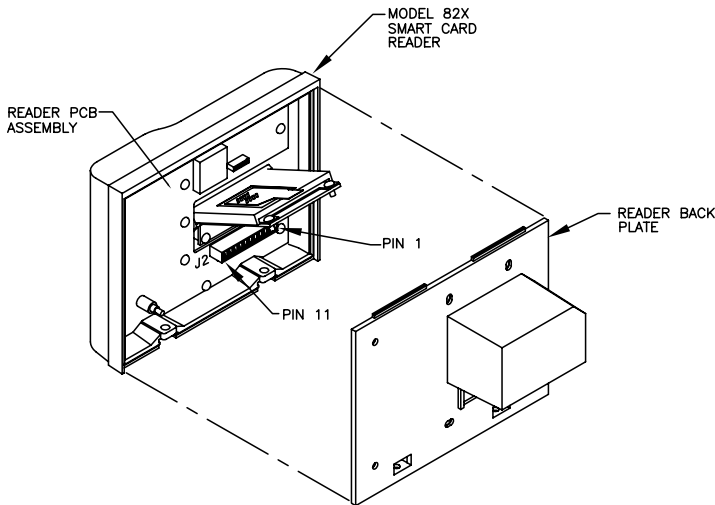


Table 1. Pinouts for the JP2 connector

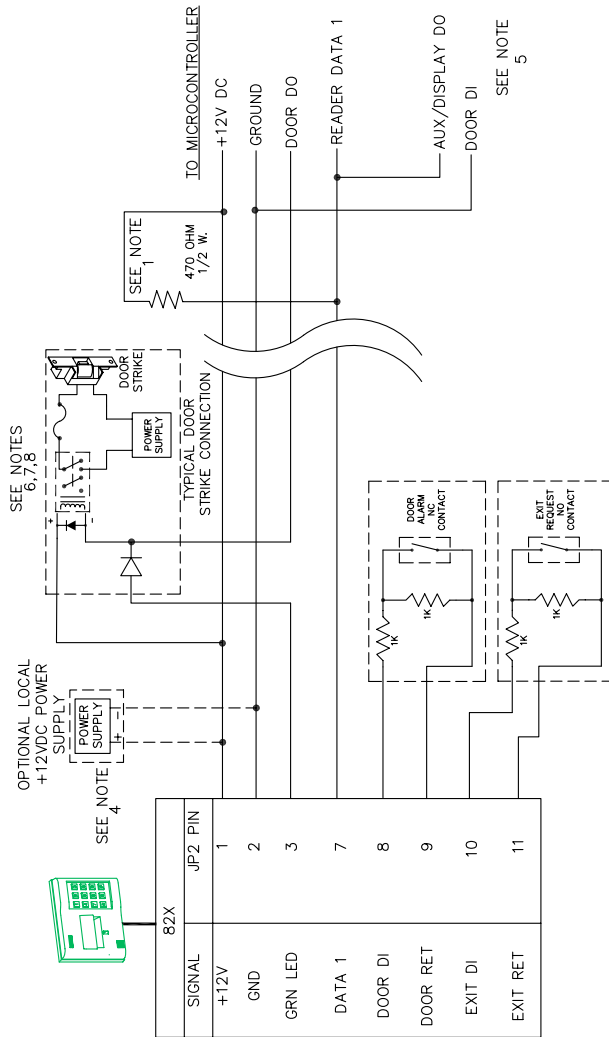
Pin #	Signal	Cable color (Belden)
1	+12 VDC	
2	Ground	
3	Green LED	
4	RS-232 RX (Factory Only)	
5	RS-232 TX (Factory Only)	
6	Reader Data 0	
7	Reader Data 1	
8	Door DI (Point)	
9	Door DI (Return)	
10	Exit DI (Point)	
11	Exit DI (Return)	

## Wiring Diagrams

Use the following wiring diagrams to connect the reader to the micro.

- Refer to *Figure 5, “Wiring Diagram, Model 82x - Supervised F/2F Mode,” on page 16.*
- Refer to *Figure 6, “Wiring Diagram Model 82x - Wiegand 4002 Mode,” on page 18.*

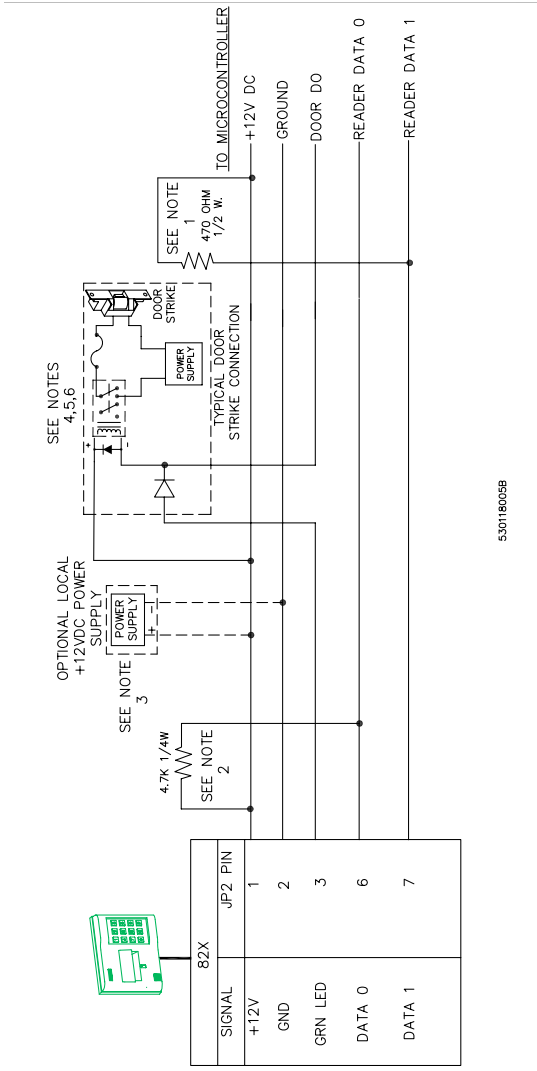
Figure 5. Wiring Diagram, Model 82x - Supervised F/2F Mode



**Note:** Unless otherwise specified:

- 1 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. A resistor is supplied with the reader.
- 2 Shielded cable is recommended in electrically noisy environments.
- 3 If using shielded cable, connect all shields together at the micro end. Connect to 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 micro (pin 2 on the reader port). Keep the wiring from power supply to reader less than 50 feet.
- 5 Refer to the appropriate system manual to determine whether this connection is required for door switch operation.
- 6 Blocking diodes may be 1N4148 or similar (installer supplied), and located in a secured area.
- 7 Protection diodes may be 1N4002, 1N4003, or 1N4004 (installer supplied) for the door strike assembly.
- 8 Fuse, power supply, door strike, and relay are provided by the installer.

Figure 6. Wiring Diagram Model 82x - Wiegand 4002 Mode



**Note:** Unless otherwise specified:

- 1 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. A resistor is supplied with the reader.
- 2 A 4.7K ohm, 1/4W, pull-up resistor is required between +12 VDC and READER DATA 0. The pull-up resistor should be installed at the microcontroller's terminal block. A resistor is supplied with the reader.
- 3 If using a local power supply, do not connect +12V line from the microprocessor to the reader. However, the negative side of the power supply must be connected to the micro (pin 2 on the reader port). Keep the wiring from power supply to reader less than 50 feet.
- 4 Blocking diodes may be 1N4148 or similar (installer supplied), and located in a secured area.
- 5 Protection diodes may be 1N4002, 1N4003, or 1N4004 (installer supplied) for the door strike assembly.
- 6 Fuse, power supply, door strike, and relay are provided by the installer.

# Testing the reader

## Indicators

A tricolor LED (red, yellow, and green) and a beeper are incorporated into the reader and operate as indicated in *Table 2*.

*Table 2. Indicators*

Condition	Standard indicators (S2-6 = OFF)
Power-on Self Test	All LEDs turn on, all LEDs turn off, 1 short beep
Reader Ready	Yellow LED on continuously
Card Read	Yellow LED blinks off briefly, 1 short beep
PIN Entry (Model 825 in supervised mode only)	Yellow LED blinks off, Green LED flashes quickly, 1 short beep every time a key is pressed, 1 beep (500ms) to indicate an invalid PIN entry
Valid Access	Yellow LED on continuously, Green LED on until door strike is deactivated.
Loss of Communication (Supervised mode only)	Red LED flashes slowly, 3 short beeps every 30 seconds
Tamper (Supervised)	Red LED flashes quickly, 3 short beeps every 30 seconds
Tamper (Unsupervised)	Red LED on continuously, 3 short beeps every 30 seconds
Reader wired for 4-state supervision, but S2-3 configured for 2-state	Red LED flashes quickly 5 times every 10 seconds, 5 short beeps every 10 seconds



Perform the following test procedure to verify correct operation of the Model 82x reader:

1. Check all cabling and electrical connections from the reader to the microcontroller. Refer to the wiring diagrams on [page 16](#) and [page 18](#).
2. Verify that the microcontroller is properly configured. Refer to the appropriate microcontroller manual.
3. 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 connector JP2, using ground (pin 2) as a reference. The power pin (pin 1) and data lines (pin 7) should read approximately 12V.
4. To activate the DES cryptogram capability, initialize the reader DES set-up key. Refer to [“DES key initialization” on page 23](#).
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. When all wires are connected to the reader, ensure that the supervision function is operating properly 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 [“Troubleshooting the reader” on page 25](#).
7. Select a known, good smart card. Be sure the card is properly entered in the host system.
8. Check that the door is secure. Insert the card into the reader. Observe that the reader beeps briefly and the yellow LED blinks off.

9. If the reader is used with a keypad (Model 825 only), enter a PIN when the green LED flashes. 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.

## Operating the reader

The reader first determines the type of smart card inserted using the answer to reset. Once the type of card has been determined, the reader will look for an access control application and the 16 digit access ID will be read from the card.

Each time the reader reads a smart card, the yellow LED blinks off briefly and the beeper sounds. On systems configured for PIN entry, the green LED flashes to indicate that keypad data is expected.

## Asynchronous microprocessor cards

Asynchronous microprocessor cards use a DES/Triple DES cryptogram to verify the authenticity of the card. The user's DES key(s) will be initialized into the reader using a special set-up key card. Only if the reader has been initialized with a DES key will it use the cryptogram. See [DES key initialization](#) for more information.

If the reader verifies that the cryptogram from the card was created using the correct card-based key, the reader will acknowledge a valid card read via the yellow and green LED and beeper and immediately send the card access ID to the microcontroller via the supervised F/2F interface if no PIN is required.

## DES key initialization

The smart cards used have a DES/Triple DES cryptogram capability; the reader must be initialized with the same DES set up key used to generate the card-based key. This is achieved by creating a DES set up key card using the set up key card generation equipment from the smart card manufacturer or the Model 82P Smart Card Applications Programmer Version 2.0. Once the set up key card has been created, it should be inserted into the reader while the reader is removed from its backplate and therefore in a tampered state. The reader reads and stores the DES set up key(s) and uses it to verify the DES cryptogram for every card transaction.

Perform the following sequence to store the DES set up keys into the reader:

1. Remove the reader from the back plate while the reader is powered on. This puts the reader into tamper mode. The yellow LED remains on while the red LED flashes.
2. Insert the DES key set-up card into the reader. The red LED stops flashing.

When the reader finishes reading the DES keys from the set-up card, the reader beeps once, the green LED flashes once, and the red LED flashes twice.

3. Remove the DES key set-up card from the reader. The red LED flashes again.
4. Press and hold the tamper switch on the back of the reader for approximately one second and then release. The red LED stops flashing.
5. Replace the reader on the backplate. You have one minute to replace the reader. At the end of the one minute period, the reader beeps once, and the red and green LEDs flash once.

The reader is now ready to read a card.

## Keypad verification

If the reader has a keypad (Model 825 only), the user is prompted to enter a PIN by the green LED. The PIN always starts with the '\*' key and end with the '#' key and consists of four numeric digits. The PIN is sent to the card for validation. The beeper indicates an invalid PIN entry. After one invalid PIN entry, the reader terminates the card transaction and the card must be removed from the reader. Upon valid pin entry, the access control ID is sent to the microcontroller using the supervised F/2F interface.

If an asynchronous microprocessor smart card is used, the card verifies the PIN entry with the PIN stored on the card. The reader blinks the yellow LED off and the beeper sounds while a key is pressed. If the PIN is incorrect, the reader sounds 5 short beeps to indicate a re-try is required.

## Supervised F/2F mode operation

The reader sends smart card data or reader status data to the microcontroller approximately once every second and waits for an acknowledgment from the microcontroller. The reader continues sending the data until an acknowledgment is received. If an acknowledgment is not received after the third attempt, the reader stops reading smart cards, the red LED starts flashing slowly (every 2 seconds), and a short triple beep sounds every 30 seconds. Once the reader receives an acknowledgment, it begins reading smart cards again, the beeper stops sounding, and the red LED stops flashing.

## Reader tamper operation

The 82x Readers incorporate a tamper switch. While the reader is separated from its backplate, all normal smart card reading

functions are disabled and a tamper condition is indicated by a triple beep every 30 seconds. The red LED flashes quickly (every 400 ms) and all communications with the microcontroller are suspended, taking the reader offline. In addition, the DES encryption key stored in the reader is corrupted. A new DES key can be set up in the reader using a set up key card while the reader is in this tampered state.

## 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.

**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 by having the wrong reader voltage selected at the microcontroller or too long a cable 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. If the problem is still present, while in low power mode, measure the voltage between JP2 pin 1 (power) and JP2 pin 2 (ground). This voltage should be greater than 9 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:** Insert a known good test smart card into 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 ...

- that the card was not inserted backwards,
- the power connections to the reader, and
- the reader supply voltage at connector JP2 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 JP2 pin 3.

1. Disconnect the wire on JP2 pin 3. 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 JP2 pin 3 and measure the voltage at JP2 pin 3. Low voltage turns on the green LED. If the voltage is low, check to see if the host system is energizing the door strike.

**The beeper doesn't sound and the yellow LED doesn't blink when a card is inserted into the reader:** When the beeper sounds and the yellow LED blinks off, it indicates that a smart card has been read and its data will be sent to the microcontroller if the optional PIN entry is valid.

1. Present a test smart card (known to be working) to the reader. If the beeper and yellow LED still fail to indicate a valid smart card read, check that ...
  - the card is not inserted backwards,
  - the card contains a valid access control application, and

- the reader's DES set-up key has been initialized correctly with a valid DES set-up key card.

If the problem is still not corrected, 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 smart card is probably defective.

**The door does not open and the green LED does not turn on when a smart card is inserted:**

1. Verify that the card 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 smart card is presented:**

1. Verify that the door DO is wired correctly. Refer to the appropriate wiring diagram.
2. Disconnect the wire from JP2 pin 3 (green LED) and connect JP2 pin 3 to JP2 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.

**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.
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 at 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 which is interfering with the reader-to-microcontroller communications. If this is the case, use shielded wire for reader-to-microcontroller connections.

**The reader sounds a short triple beep every 30 seconds and the red LED flashes quickly (every 400ms):** Indicates a tamper violation.



**The reader sounds a short triple beep every 30 seconds and the red LED is on continuously:** Check that the 4-state supervised switches are connected with two 1K resistors to the door contact and the exit request inputs or, if the inputs are not used, that a 1K resistor is installed at the reader connector. See *Figure 5, “Wiring Diagram, Model 82x - Supervised F/2F Mode,” on page 16.*

**The beeper and red LED are always on:** The microcontroller may command the reader to turn on the red LED and the beeper. If the door status switch input is not used, the reader may inform 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.

## Regulatory approvals

### UL



### UL Listed Installations

Specifications for UL compliance are shown below:

- The Cold Weather Kit was not evaluated by UL.
- The Model 82x readers were evaluated by UL for indoor use only.

CE



Manufacturers  
Declaration of Conformity  
For



**Product Identification:** 430122001  
430123001

**Model/type:** Model 820  
Model 825

**Category (description):** Smart Card Reader  
Smart Card Reader plus Keypad

**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

**BOM revision level** :D


**BOM revision level** :D

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	98F241C	1R04085	
Applied standards	EN55022: 1994/ A1:1995	EN50130-4(1995) +A1(1998)	

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

☒ Not Applicable

☐ None (class 1 product)

☐  (class 2 product)

Means of Conformity:

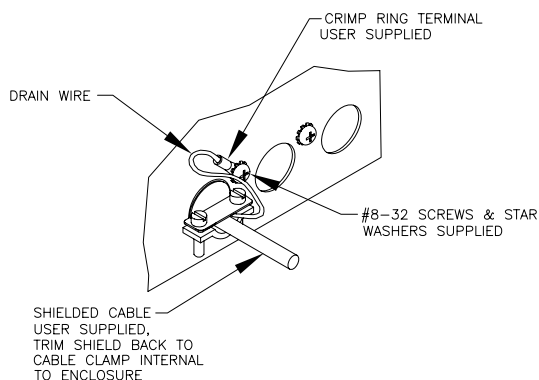
We declare under our sole responsibility that this product is in conformity with Directive 93/68/EEC (Marking) and/or complies with the essential requirements and all other relevant provisions of the 1999/5/EC (R&TTE) based on test results using harmonized standards in accordance with the Directives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

## CE/FCC compliance

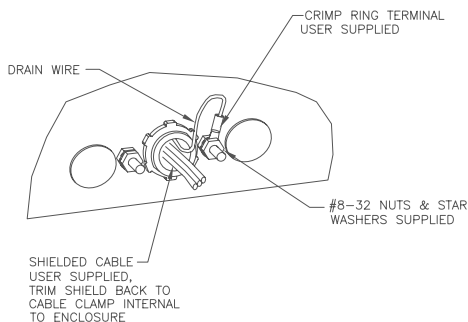
To make the Model 82x reader installation CE and FCC compliant, the cable connecting the reader to the micro must have its shield grounded at the micro, according to one of the methods specified in the figures below.

**Note:** Do not make shielded connections at the reader.

*Figure 7. Typical installation (Internal to the micro)  
Using shielded cable/drain wire*



*Figure 8. Typical installation (External to the micro)  
Using shielded cable/drain wire*



## Notes

## Notes

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