



ALIEN TECHNOLOGY

Hardware Setup Guide

For The

ALR-9780 and ALR-9750-A

RFID Readers

**Four Antenna and Two Antenna
915MHz Passive Tag Readers**

Release: v01.03.00



ALIEN™

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Alien Technology Corporation
18220 Butterfield Blvd.
Morgan Hill, CA 95037
www.alientechnology.com

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FCC COMPLIANCE

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

Any change or modification to this product voids the user's authority to operate per FCC Part 15 Subpart A. Section 15.21 regulations.

INDUSTRY CANADA COMPLIANCE

Operation is subject to the following two conditions: (1) this device may not cause interference and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with an antenna having a maximum gain of 6dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

CAUTION

Reader antennas should be positioned so that personnel in the area for prolonged periods may safely remain at least 23 cm (9 in) in an uncontrolled environment from the antenna's surface. See FCC OET Bulletin 56 "Hazards of radio frequency and electromagnetic fields" and Bulletin 65 "Human exposure to radio frequency electromagnetic fields."



Alien Technology

RFID Reader User's Guide

(ALR-9780 and ALR-9750-A RFID Readers)

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CHAPTER 1

Introduction

This *Hardware Setup Guide* provides instructions for installing and operating the ALR 9780 and ALR 9750-A RFID Readers.

This book is designed for use by RFID system integrators and software developers. (Those who wish to develop software products and extended systems that take full advantage of the RFID Readers' capabilities.)

For an overview of RFID technology and a glossary of terms, please refer to the *RFID Primer* included with your RFID Reader Developer's Kit.

For an overview of the communication interfaces to the Readers, please refer to the *Software Interface Guide* included with your RFID Reader Developer's Kit.

Audience

For the purposes of this book, we assume the readers of the *Hardware Setup Guide*:

- Are competent PC users
- Have minimal previous knowledge of radio-frequency identification technology.
- Are experienced in software development and/or hardware systems integration.

RFID Reader Overview

The Alien RFID reader is designed to read and program Class I NanoBlock tags (see below) and issue event reports to a host computer system. The host computer can be locally connected to the reader or at a remote network location.

The RFID Reader is delivered with the following components and accessories:

- RFID Reader and Class 1 NanoBlock Tags
- External antenna(s) and coaxial cable(s)
- One RS-232 serial cable (for host computer)
- Power supply
- Documentation on CD-ROM

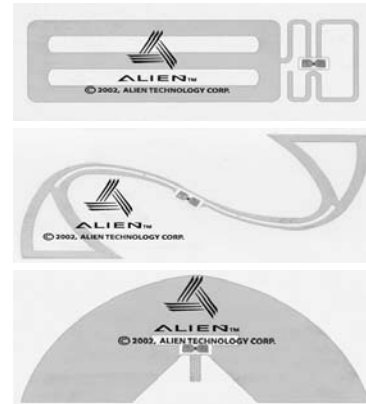
Class 1 NanoBlock Tags

The ALR-9780 and ALR-9750-A RFID readers are designed to read and program Alien's Class 1, NanoBlock Tags.

These tags comply with the MIT Auto ID Centers' open specification for RFID.

Class I tags are "Passive" devices. That is they do not have an onboard power source. They are powered by the RF energy transmitted by the reader.

They communicate with the Reader by means of "Backscatter Modulation". That is, they do not actually transmit anything; they merely change their reflective characteristics in a systematic way and reflect RF energy back to the reader. An analogy to the way the tag works is the way you can use a mirror to transmit information using light from the sun.



Examples of Alien NanoBlock tag and antenna designs.

Requirements

To interface with the RFID Reader you will need the following:

- A PC running Windows 98 or higher, with CD-ROM drive and an available RS-232 serial port.
- Standard 120 VAC power.
- Host software (Alien demo software or your own custom software).
- RFID Tags (AIDC Class 1 compliant)
- Standard power cord (desired length) with grounded, 3-pronged plugs

Specifications

Specifications for key components of the RFID Reader system are provided in the tables below:

RFID Reader

Name	Alien Multi-Port General Purpose RFID Reader
Part Number	ALR 9780 or ALR 9750-A
Architecture	Point-to-multipoint reader network
Frequency	902.6 MHz – 927.4 MHz
Hopping Channels	63
Channel Spacing	400 KHz
Channel Dwell Time	< 0.4 Seconds
RF Transmitter	< 30 dBm at the end of 15 ft LMR-195 cable.
Modulation Method	On Off Keying (OOK)
20 db Modulation Bandwidth	< 400 KHz
RF Receiver	2 Channels
Power Consumption	25 Watts (120 VAC at 500 mW)
Communications Interface	RS-232, LAN TCP/IP
Inputs/Outputs	2 or 4 coax antenna, 8 logic I/O, com port, LAN, power
Dimensions	(L) 19 cm (7.5 in) x (W) 28 cm (11 in) x (D) 5 cm (2 in)
Weight	Approximately 1.8 kg (4 lb)
Operating Temperature	0°C to +50°C (+32 °F to +122°F)

RFID Reader External Antenna

3 dB Beamwidth	E-plane: 65 degrees • H-plane: 65 degrees
Frequency	902-928 MHz
Gain (dBi)	5.73 dBi
Polarization	Circular
RF Connector	15 ft LMR-195 with Reverse-Polarity TNC
VSWR	1.5:1
Dimensions	(cm) 22 x 27 x 4 • (in) 8.5 x 10.5 x 1.65
Weight	.57 kg • 1.25 lb

3 dB Beamwidth	E-plane: 40 degrees
Frequency	902-928 MHz
Gain (dBi)	6.0 dBi
Polarization	Linear
RF Connector	15 ft LMR-195 with Reverse-Polarity TNC
VSWR	1.5:1
Dimensions	(cm) 19.5 x 28 x 4 • (in) 7.75 x 11.25 x 1.65
Weight	.57 kg • 1.25 lb

Mechanical

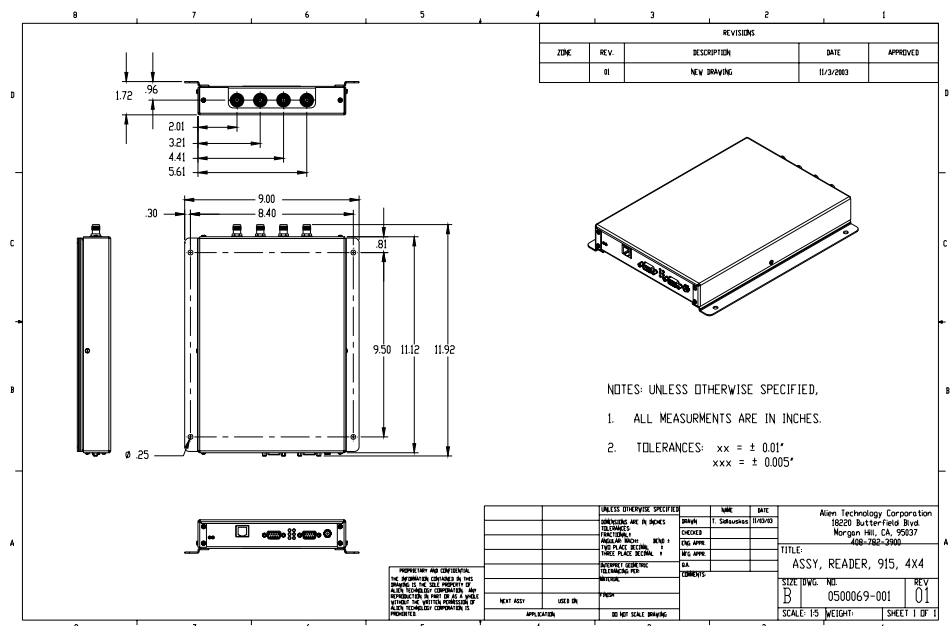
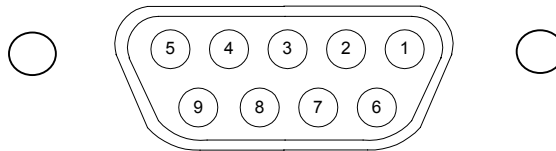


Figure 1. Outline Drawing of the ALR-9780 (ALR-9750-A has the same physical layout with two antenna ports.)

RS-232 Port Pinouts

RS232 Connector (Female DB-9F)	
Pin 1	DCD Connected to Pin 6
Pin 2	TR1 Transmit Data (Output)
Pin 3	RC1 Receive Data (Input)
Pin 4	DTR Connected to Pin 6
Pin 5	Ground
Pin 6	DSR Connected to Pin 4
Pin 7	RTS Connected to Pin 8
Pin 8	CTS Connected to Pin 7
Pin 9	Not Connected

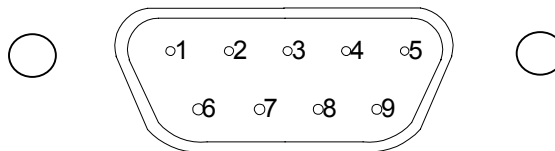
RS232 CONNECTOR (FEMALE) –LOOKING AT READER



IO Port Connector Pinouts

I/O Port Connector (Male DB-9M)	
Pin 1	Output 0
Pin 2	Output 2
Pin 3	Input 0
Pin 4	Input 2
Pin 5	Ground
Pin 6	Output 1
Pin 7	Output 3
Pin 8	Input 1
Pin 9	Input 3

I/O PORT CONNECTOR (MALE) –LOOKING AT READER



Reader Schematics

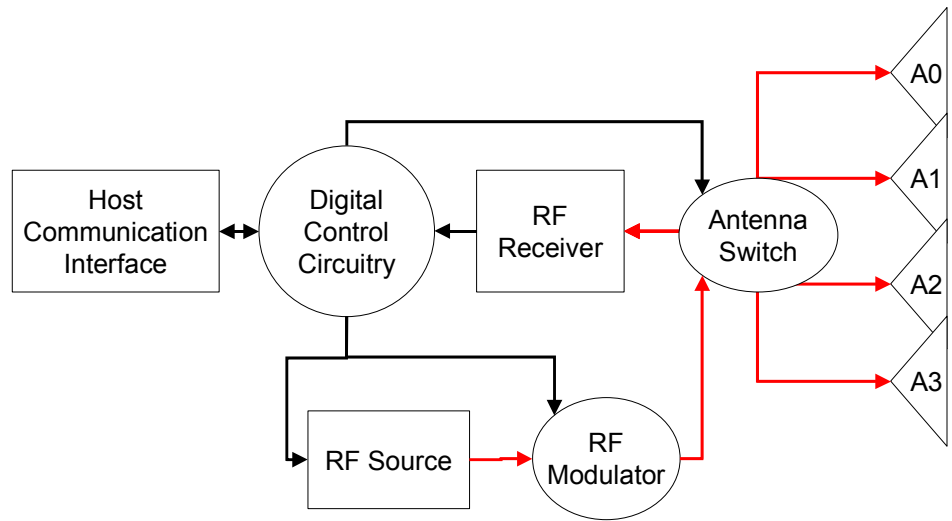


Figure 2. System Architecture for the ALR 9780 Reader

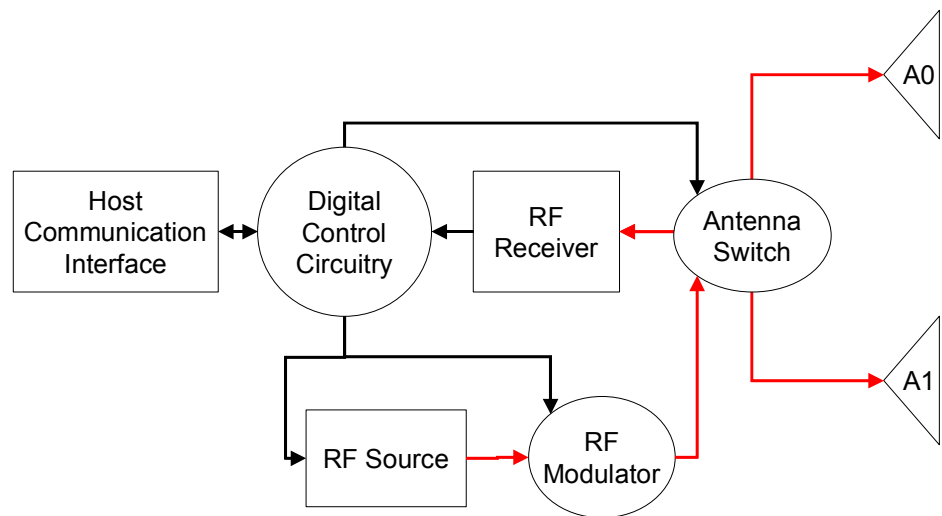


Figure 3. System Architecture for the ALR 9750-A

CHAPTER 2 Reader Hardware Installation and Operation

This chapter describes the RFID Reader and provides installation and operation information.

Requirements

In order to interface with the RFID Reader you will need the following:

- PC running Windows 98 or higher, with CD-ROM drive (for demo system software) and one available RS-232 serial port.
- Standard 120 VAC power.
- Host software (either Alien's demo software or your own custom software).
- Tags (AIDC Class 1 compliant)
- Standard power cord (desired length) with grounded, 3-pronged plugs

Receiving the RFID Reader

Your RFID Reader Developer's Kit will be shipped with the items listed below. Please verify the contents of your received shipment before assembling.

- RFID Reader
- Antenna with coaxial cable
- RS-232 reader-to-PC cable
- Reader power supply and cables (two sections: one attached, one detached)
- CD-ROM containing demonstration software, user guides and documentation
- Assortment of tags

Picture of Developer's Kit Contents



The RFID Reader contains two types of external interfaces: connector ports and LEDs. One panel contains I/O connectors and LEDs. The opposite panel contains the antenna ports

Reader I/O Panel

The I/O panel (shown below) contains the following features:

- Power connector
- 9-pin D male I/O connector
- 6 Diagnostic LEDs (RF Power, RX, TX, CPU Power, Sniff/, Lock/green)
- 9-pin D female RS-232 serial port
- LAN TCP/IP port
- Network Activity LEDs

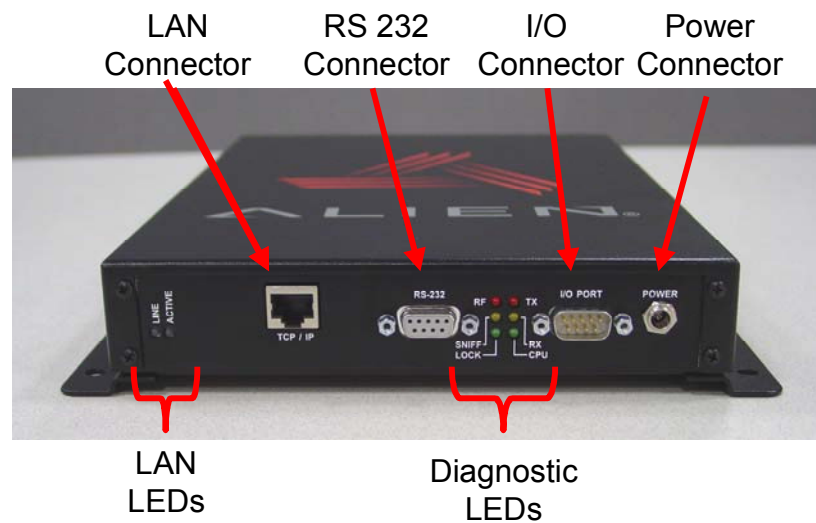


Figure 4. Reader Connections and LEDs

Diagnostic LEDs

The LEDs provide external indication of three conditions:

- **CPU Power (green)**. Indicates power is applied to the reader.
- **RF On (red)**. Indicates that RF is being emitted by the reader.
- **Sniff (yellow)**. Indicates tag signal has been detected, though it may not yet be strong enough to complete a transaction.
- **Lock (green)**. Indicates a tag has been read.
- **TX (red)**. Indicates transmission of data on serial line to a host.
- **RX (yellow)**. Indicates receipt of data on serial line from a host.

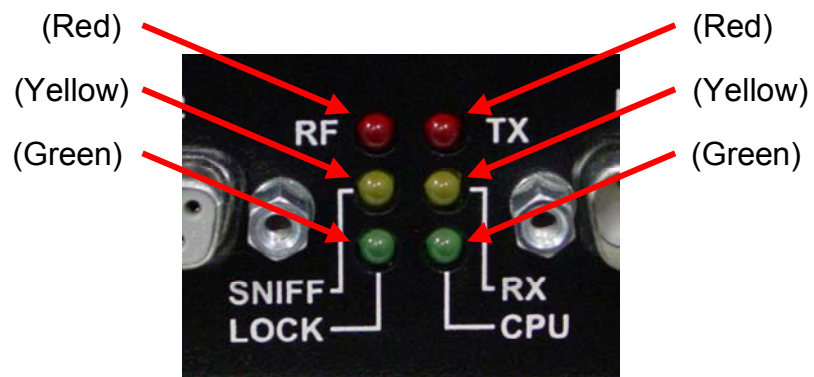


Figure 5. Reader Diagnostic LEDs

Antenna Panel

The antenna panel (opposite the reader's I/O panel) contains either two or four coax antenna connector ports as shown below. These are reverse-polarity TNC connectors.



Figure 6. Antenna Connections

System Assembly and Bench Test

Assembling the RFID Reader system is very easy. We recommend you set up the system and verify its operation in a bench test configuration (shown below) before installing it in a live application.

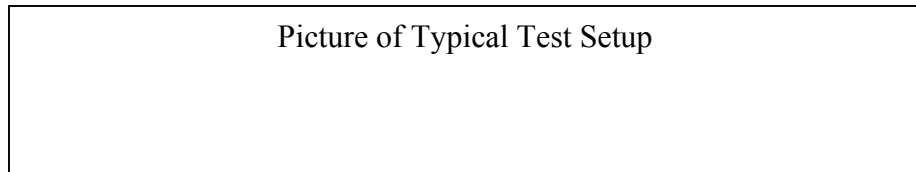


Figure 7. Typical Bench Test Setup

Bench Test Configuration

1. **Situate the Reader on a tabletop.** Ensure the following conditions:
 - Two standard 120 VAC outlets are available nearby (one for reader, one for PC if needed).



Figure 8. RS232 and Power Connections

- Sufficient space is available on the tabletop for the PC, reader and antenna.
2. **Connect the RS-232 cable to the reader.**
 - Align the male cable connector so that its shape and pins match the shape and holes of the female DB-9 serial port.



Figure 9. RS232 Connector

- Push the aligned connector into the port.
 - Finger-tighten the screws to secure the cable/connector to the reader.
3. **Connect the RS-232 cable to the serial port on the PC.**
 4. **Connect the power supply to the reader.**
 - Using the thin cable attached to power supply, push the connector into the port until it is securely seated.
 5. **Connect the coaxial cable(s) to antenna port(s) (1-4).**
 - Antenna port 1 is on the right if viewing reader with flange side down. The ALR 9780 has four (4) antenna ports. The ALR 9750-A has two (2) antenna ports.
 - Align the coax cable's center pin and push into the port
 - Screw the fitting from the cable end onto the reader connector *clockwise* until finger tight to secure the cable to the reader.



Figure 10. Antenna Connections

- Connect additional antennas to their respective port and tighten fittings clockwise until finger tight.
6. **Plug power cord into power supply.**
 - Use the female end of a standard 3-pronged power cord.
 7. **Plug the power supply cable into the wall outlet and verify power.**
 - The red LED will be illuminated when power is on.
 8. **Plug in the PC (if necessary) and turn it on.**
 - If the PC is a laptop operating on battery power, it is not necessary to plug it into the wall outlet.
 9. **Launch the desired host software application.**

- You may use Alien's demo system software or custom software developed per the reader-host protocol for your specific application.

You are now ready to bench test or demonstrate the RFID Reader system.

Bench Test Procedure

1. Access an operational mode suitable for bench testing.

- Select a mode that will allow multiple consecutive reads of a single tag.
- Refer to the applicable software application user guide for specific instructions.

2. Position the reader to you can see the LEDs.

- You may also want to position the PC so you can view the monitor simultaneously for later tests.

3. Move a tag slowly into the antenna's range.

- Begin with the tag well outside the expected range (~15-20 ft) and move it toward the antenna while observing the LEDs.

4. Verify the Sniff LED illuminates when the tag approaches the read window.

- Sniff is the yellow LED.

5. Verify the Lock LED illuminates when the tag is inside the read window.

- Lock is the green LED.

6. Verify the host receives the tag data.

- Refer to indications specified in applicable user guide to verify the tag was read successfully.

7. If bench test conditions are verified, proceed to installation.

NOTE: To perform a hard reboot of the system, simply cycle power on the reader.

Installation

The following Installation section provides basic guidance for configuring components in your RFID system. You should consider the overall design of your specific system before permanently mounting the equipment.

Installation involves all the same connection steps required for bench test. However, instead of situating equipment on a tabletop, the reader and antenna and their accessories will be mounted in your application environment.

The photo below shows a reader with single antenna side-mounted at a loading dock door for a portal application. This configuration may be used to automatically identify tagged objects moving in and out of this door. Those tagged objects may be pallets and cases on pallets, crates, equipment and vehicles, or personnel.

A second or more (optional) antenna(s) may be mounted on the opposite side of the portal to better capture tags in a less than optimal position relative to the first antenna (for example, tagged cases on the opposite side of a pallet).

Picture of a system configured at a dock door.

Requirements

Before installing your RFID Reader system, you will need the following:

- PC running Windows 98 or higher, with CD-ROM drive (for demo system software) and one available RS-232 serial port
- Standard 120 VAC power for the reader location and PC location
- Host software
- (Optional) extra antennas (if desired for additional coverage)
- Any additional RS-232 cables or antenna coax cables needed to accommodate routing requirements
- Standard grounded, three-pronged power cord of desired length
- Mounting hardware suitable for the surface to which equipment is to be attached (e.g., wood screws, moly-bolts, brackets, etc.)

Figure 11. RFID Reader system configured for a single-antenna portal application.



Figure 12. View of the Reader Showing Mounting Holes

Hardware Installation Procedure

1. Select mounting position for antenna(s).

CAUTION: Reader antennas should be positioned so that personnel in the area for prolonged periods may safely remain at least 23 cm (9 in) in an uncontrolled environment from the antenna's surface. See FCC OET Bulletin 56 "Hazards of radio frequency and electromagnetic fields" and Bulletin 65 "Human exposure to radio frequency electromagnetic fields."

- Mount the antenna(s) at the periphery of the desired read window (either overhead or at the side), so that the position of the most distant tag passing through the window is no farther from the antenna than the maximum range specified for your system design.
- Position the antenna(s) at a height approximately midway between the highest and lowest expected tag position. (For example, a pallet tag may be the lowest tag position to be read, while the top-most case on a fully stacked pallet may represent your highest tag position.)
- If you are using two antennas, mount the second antenna in a mirror-image of the first antenna's position, unless otherwise indicated in your system design specification.
- **NOTE:** To maintain compliance with FCC regulations, only use antennas supplied with the unit.

2. Select mounting position for reader.

- Reader should be positioned close enough to the antenna to accommodate the cable length without putting strain on the connectors.
- Be sure power is available to the selected reader location.

3. Select location for host PC.

- Situate the host PC within 50 ft of the reader in a safe location away from vehicular and foot traffic.

4. Install reader.

- Secure the reader through the two mounting holes on either flange to its mounting location (wall, post, mounting bracket) using appropriate hardware.
- If desired, position the reader so that the LEDs are easily observed.

5. Install antennas.

- Secure each antenna through the mounting holes on either flange to its mounting location using appropriate hardware.

6. Connect antennas to reader.

- Route coax cables from antennas to reader according to your system design specifications and secure them properly.
- Align the connector for each cable with the reader antenna port, push into the port, and finger-tighten screw fitting.

7. Connect reader power.

- Push the power supply connector into the reader port.
- Plug the female end of the power cord into the power supply.
- Plug the male end of the power cord into the 120 VAC outlet.

8. Connect reader to host PC.

- Align the RS-232 connector with the corresponding serial port on the reader and push the connector onto the pins. Finger-tighten the screws to secure the cable to the reader.
- Align and connect the other end of the RS-232 with the serial port on the PC.

9. Connect power to the PC.

System Operation: Software Control

The RFID Reader is controlled from software running on a host system that communicates with the reader using a text-based protocol. All applications use this protocol to communicate with the reader.

You may operate the reader from your own application code using this interface, use the example code provided on the Developer's Kit CD or use the Alien RFID Gateway application; a demonstration program, also included on your Developer's Kit CD.

For details, refer to either the *Software Interface Guide* or the *Demonstration Software Guide* described briefly below.

Software Interface Guide

The text-based interface mentioned above is described in detail in the *Software Interface Guide*. Using this interface, the reader can be configured to read tags when queried or on one of a variety of event triggers (e.g., a rising edge on one of the I/O pins or a timer.).

Tag data acquired in response to these triggers can be transmitted to the host in a number of formats (e.g., text, XML or custom) and under a number of conditions (e.g., on a new tag being observed, or a tag disappearing from view).

If you are a software developer, the *Software Interface Guide* provides the information you will need to connect to the reader from a host computer, communicate with it, and customize its performance.

Demonstration Software Guide

The *Demonstration Software Guide* describes the installation and operation of the Alien RFID Gateway Application.

The Alien RFID Gateway Application is a useful demonstration program that allows users to explore the reader's functionality and build customizable demos with a user-friendly interface.

Using the Gateway, the various operating modes of the reader can be controlled and custom interactive demos can be constructed using sounds images and text.