ALIEN TECHNOLOGY

NANOSCANNER READER

(2450MHz Battery System)

USER GUIDE

2450MHz Battery

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.

CAUTION

Reader antennas should be positioned so that personnel in the area for prolonged periods may safely remain at least 20 cm (7.9 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

Nanoscanner Reader User Guide

Table of Contents

CHAPTER 1
Introduction

The *Nanoscanner Reader User Guide* provides instructions for installing and operating the Nanoscanner reader. It also covers the reader firmware protocol in detail for use in configuring reader-host communications and developing application software.

This book is designed for use by those who wish to develop software products and extended systems that take full advantage of the Nanoscanner reader's capabilities.

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

Audience

For the purposes of this book, we assume the readers of the *Nanoscanner User Guide*:

- Are competent PC users.

- Have minimal previous knowledge of radio-frequency identification technology.

- Are experienced in software development and/or hardware systems integration.

Nanoscanner Reader Overview

The Nanoscanner is delivered with the following components and accessories:

- Nanoscanner reader and tags

- Two antennas (1 transmit, 1 receive) with 2 coaxial cables

- RS-232 reader-to-PC cable (with 9-pin male and female connectors)

- Reader power supply and cables (two sections: one attached, one detached)

- *Nanoscanner Reader User Guide on CD-ROM*

Requirements

In order to fully interface with the Nanoscanner reader you will need the following:

- PC running Windows 98 or higher, with CD-ROM drive and one available RS-232 serial port.
- Standard 120 VAC power.
- Host software (Alien demo software or your own custom software).
- Alien battery-powered backscatter tags
- Standard power cord (desired length) with grounded, 3-pronged plugs

Specifications

Specifications for key components of the Nanoscanner reader system are provided in the tables below:

NANOSCANNER READER

Name	Nanoscanner Reader
Part Number	0500017-001
Model Number	B2450R01
Architecture	Point-to-multipoint reader network
Frequency	2402 MHz – 2480 MHz
Hopping Channels	79
Channel Spacing	1000 KHz
Channel Dwell Time	< 0.3 Seconds
RF Transmitter	< 30 dBm
Modulation Method	On Off Keying (OOK)
20 db Modulation Bandwidth	TBD
RF Receiver	2 channels
Power Consumption	25 Watts (120 VAC at 500 mW)
Communications Interface	RS-232, LAN TCPI/IP
Inputs/Outputs	2 coax antenna, 8 logic I/O, comm ports, power
Dimensions	(cm) 17.8 x 24.1 x 6.7 (in) 7 x 9.5 x 2.63
Weight	Approximately 1.8 kg (4 lb)
Operating Temperature	0°C to +50°C (+32 °F to +122°F)

NANOSCANNER READER TRANSMIT AND RECEIVE ANTENNAS

3 dB Beamwidth	Azimuth 55° Elevation 55°
Frequency	2402 MHz - 2480 MHz
Gain (dBi)	≤ 6 dBi
Polarization	Circular
RF Connector	Reverse-gender TNC
VSWR	1.5:1
Dimensions	(cm) 15.2 x 15.2 x 3.2 ● (in) 6 x 6 x 1.25
Weight	.27 kg ● 0.6 lb

RS-232 PORT PINOUTS

RS232 Connector (female)	
Pin 1	Connected to pins 4 and 6
Pin 2	Request to send from host
Pin 3	Clear to send to host
Pin 4	Connected to pins 1 and 6
Pin 5	Ground
Pin 6	Connected to pins 1 and 4
Pin 7	Receive (Rx) from host
Pin 8	Transmit (Tx) to host
Pin 9	Not Connected
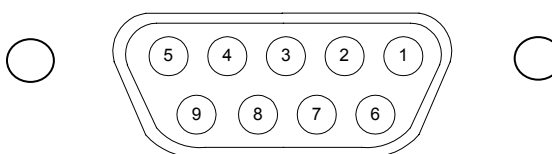
I/O Port Connector (male)	
Pin 1	Out 0
Pin 2	Out 1
Pin 3	Out 2
Pin 4	Out 3
Pin 5	Ground
Pin 6	In 0
Pin 7	In 1
Pin 8	In 2
Pin 9	In 3

NOTE: Reader I/O pins can be configured for high-to-low or low-to-high transitions through software control.

RS-232 Serial Cable	DB-9 male/female serial

Tag Overview

Battery-powered backscatter tags are used exclusively in this Alien 2450 MHz system.

FEATURES AND BENEFITS

- Long-range tag/sensor/actuator – up to 30 meters

- 2450MHz, FCC Part 15 unlicensed power levels

- >512 bytes read-write memory

- 4 I/O pins, with A->D and D->A converter

- Expandable read/write NV memory, capable of being expanded to 256K bytes if needed using I2C bus and the addition of external flash memory chips

INTERNAL AND EXTERNAL INTERFACE CAPABILITIES

- Temperature sensing/recording

- Tamper detection (banding material broken, box opened, etc.)

- Shock, vibration, tilt and acceleration monitoring

- Enabling and disabling electronic devices (security)

- Beeping or blinking tags for quick location and alarms

Alien battery-powered backscatter tag: outer case (above) and (transparent case showing internal circuitry (below).

BENEFITS OF BATTERY-POWERED OVER BEAM-POWERED BACKSCATTER TAGS

- Higher performance-to-price ratio

- Monitoring (e.g., temperature logging, time-based tamper detection)

- Better accuracy (longer range = more margin at a shorter range

- Lower-power readers (unlicensed)

- Multi-region (worldwide) antenna (Only needs to modulate and backscatter the reader's signal. RF energy is not powering the device.)

- Range and bearing – positioning possible

BENEFITS OF BACKSCATTER TAGS OVER "ACTIVE" TRANSMITTER TAGS

- Lower cost, simpler circuitry

- Longer battery life

- Stealthier (safer in sensitive environments, e.g., airplane)

- No transmitter tags can be used worldwide due to licensing issues, spectral pollution, etc.

TAG BLOCK DIAGRAM

The following diagram illustrates the design of the battery-powered backscatter tag.
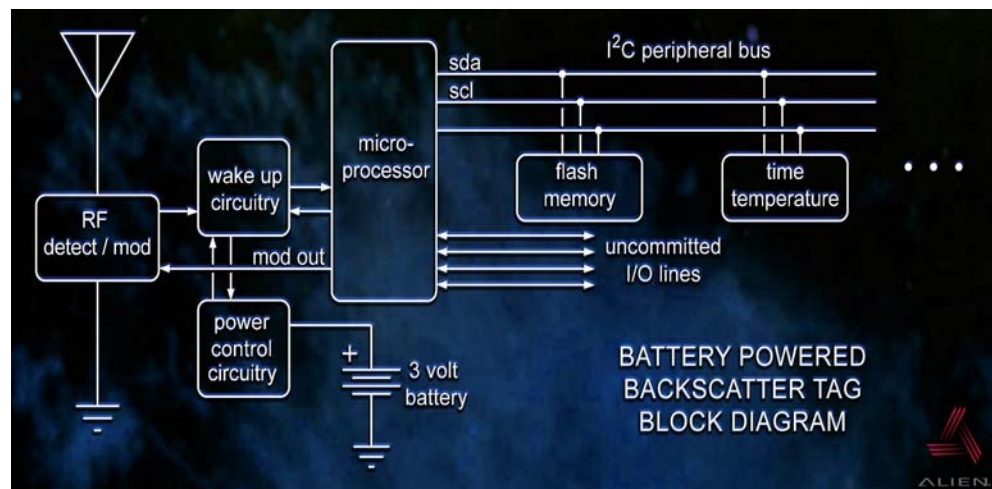
Applications for 2450 MHz Battery-powered Backscatter Tag/Reader Systems

A variety of applications have already been identified that can benefit from the use of battery-powered backscatter tags and readers, including the following:

- Long range identification

- Vehicle-asset tracking

- Supply chain automation

- Time temperature monitoring

- Tamper detection (safe/secure supply chain)

- Security/ access systems

- Sensor monitoring

- Immobilizer / beeper / LED (can control outputs)

- Passive tag data storage for hierarchical asset tracking systems

- Location capability has been proven

Reader Block Diagrams

2450MHz Reader Front End

Receive Antenna

Transmit Antenna

LNA

Modulation Switch

2402 - 2480 MHz Source

From DSP

90 degrees

Low Pass Filter

Lattice Amp/Filter

Q to DSP

Q channel

Pi Pad

10.7 MHz Band Pass Filter

10.7MHz IF Source

I Channel

Pi Pad

10.7 MHz Band Pass Filter

Low Pass Filter

Lattice Amp/Filter

I to DSP
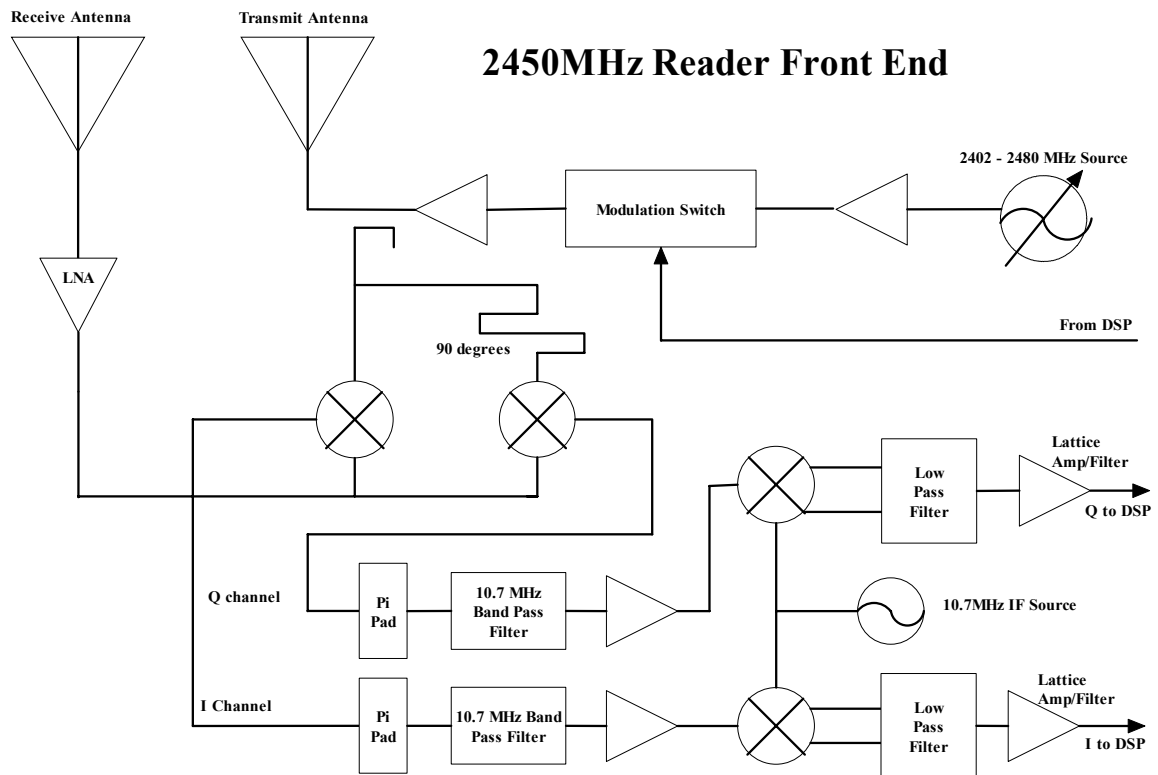
2450MHz Reader Logic Blocks

Mod Out

I channel

256KHz 12-bit A/D

Source Frequency

Q channel

256 KHz 12-bit A/D

TMS320C5402 Digital Signal Processor

Rabbit LAN TCP/IP Interface (Optional)

Optically Isolated RS-485 (Optional)

RS-232 Standard Serial Port

Power Control

Digital I/O Signal Block

V1

V2

V3

Power Control Circuitry

12VDC In
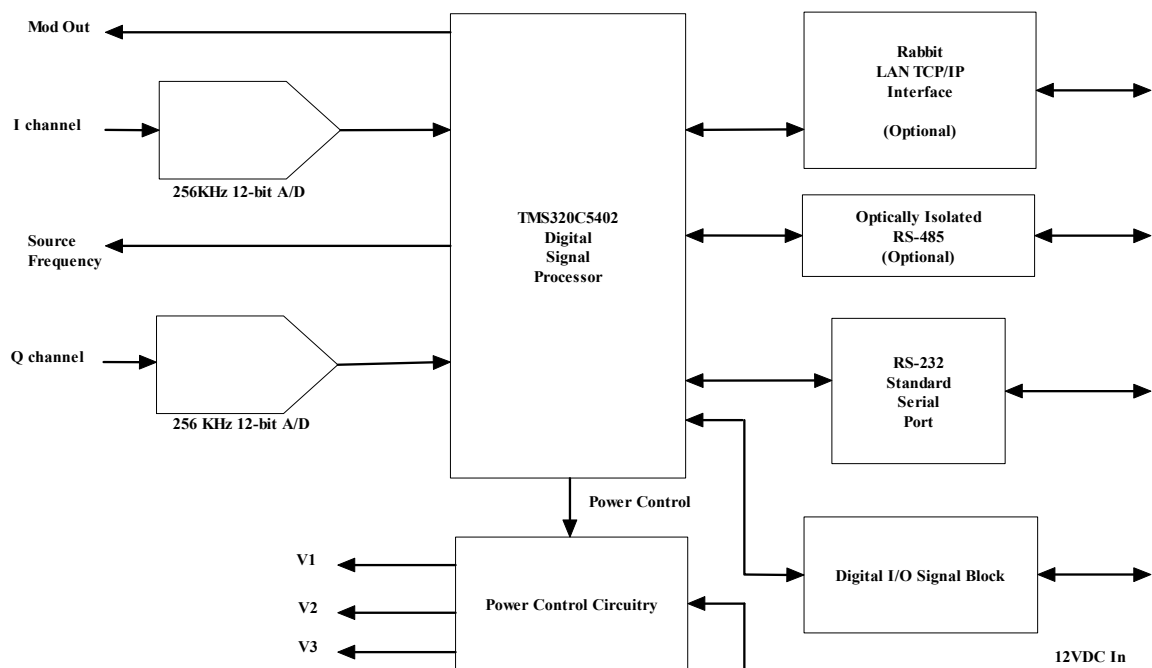
CHAPTER 2
Installation and Operation

This chapter describes the Nanoscanner reader and provides installation and operation information. Later chapters detail networking and the Reader<–>Host protocol, which will allow you to create software that will interact with the reader and perform the desired processing functions.

Requirements

In order to fully interface with the Nanoscanner 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).

- Alien battery-powered backscatter tags

- Standard power cord (desired length) with grounded, 3-pronged plugs

Receiving the Nanoscanner Developer's Kit

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

- Nanoscanner reader

- Two antennas (1 transmit. 1 receive) with 2 coaxial cables

- RS-232 reader-to-PC cable (with 9-pin male and female connectors)

- Reader power supply and cables (two sections: one attached, one detached)

- CD-ROM containing demonstration software, user guides and documentation

- Assortment of tags

Nanoscanner Reader Features

The Nanoscanner reader contains only two types of external user interface: connector ports and LEDs. One panel contains I/O connectors and LEDs. The side panel contains the antenna ports

I/O PANEL

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

- Network LEDs (2)

- LAN TCP/IP port

- 9-pin D male I/O port

- Reader LEDs (6)

- 9-pin D female RS-232 serial port

- Power connector
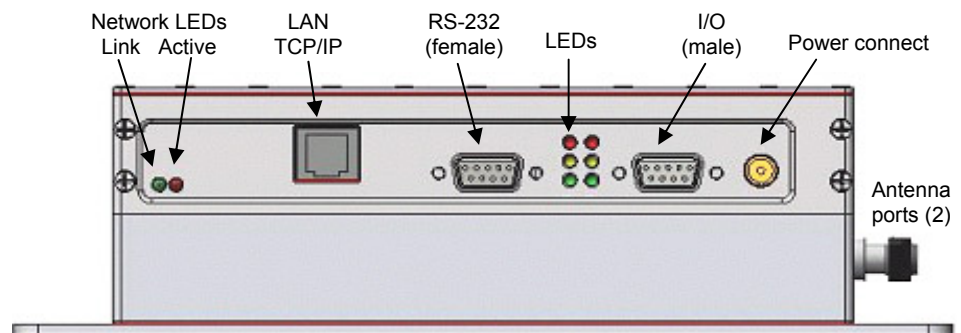
Reader I/O panel

LED DESIGNATIONS

Reader LEDs provide external indication of six conditions as shown in both the illustration below and the table that follows it:
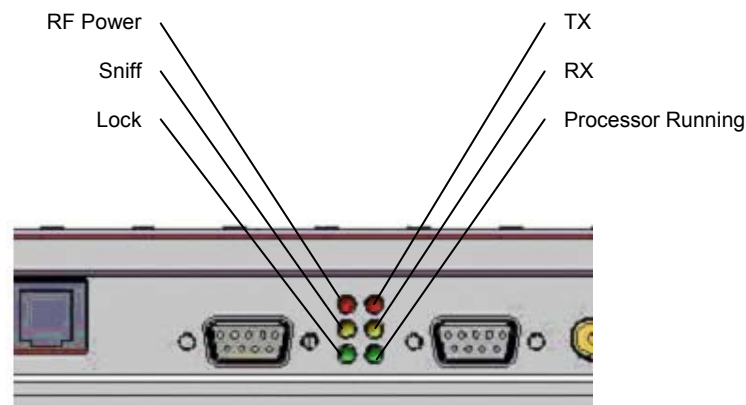
Reader LED designations on I/O panel

Reader LEDs				
Left Column LEDs			**Right Column LEDs**	
Red	**RF on**		**Red**	**Comm TX** Communications transmit to processor
Yellow	**Sniff** Detect tag signal		**Yellow**	**Comm RX** Communications receive from processor
Green	**Lock** Lock on tag signal		**Green**	**Processor Running**

Network LEDs			
Green	**Link**	**Red**	**Active**

ANTENNA PANEL

The antenna panel (perpendicular to the reader's I/O panel) contains two coax antenna connector ports as shown below. These are reverse-gender connectors.
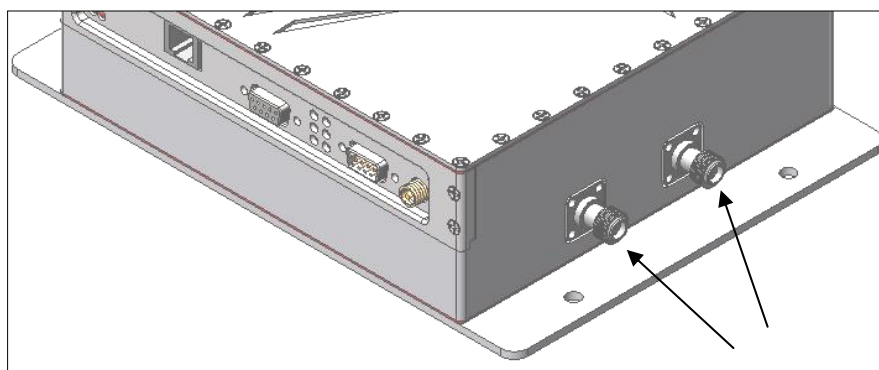
Antenna ports (reverse gender)

Either antenna can be used on either port, but both antennas are required for reader operation.

System Assembly and Bench Test

Assembling the Nanoscanner reader system is very easy.

We recommend you set up the system and verify its operation in a bench test configuration before installing it in a live application.

You will need two available 120 VAC wall outlets.

Bench Test or Demo Connections

1. **Situate the PC on a tabletop.** Ensure the following conditions:

    *   Two standard 120 VAC outlets are available nearby (one for reader, one for PC if needed).

    *   Sufficient space is available on the tabletop for the PC, reader and antenna.
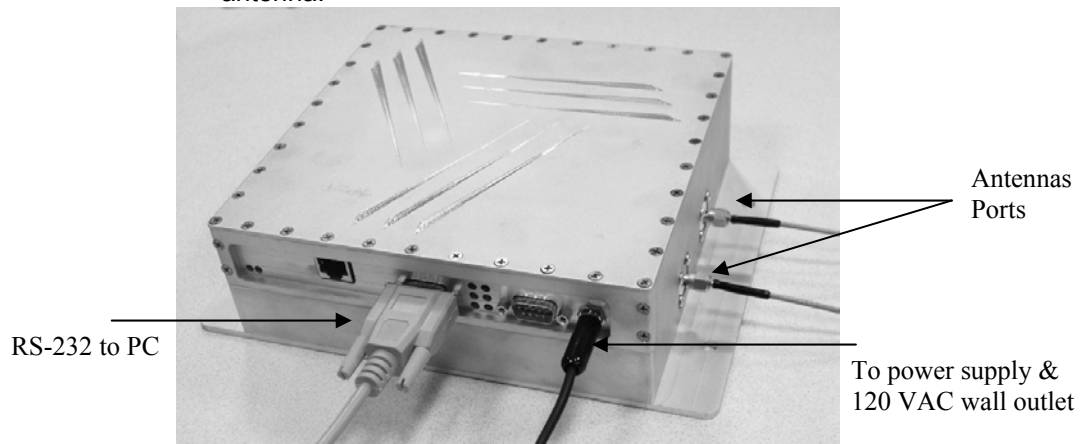
2. **Connect the RS-232 cable to the reader.**

    *   Align the cable connector so that its shape and pins match the shape and holes of the DB-9 serial port.

    *   Push the aligned connector into the port.

    *   Finger-tighten the screws to secure the cable/connector to the reader.

Reader I/O panel
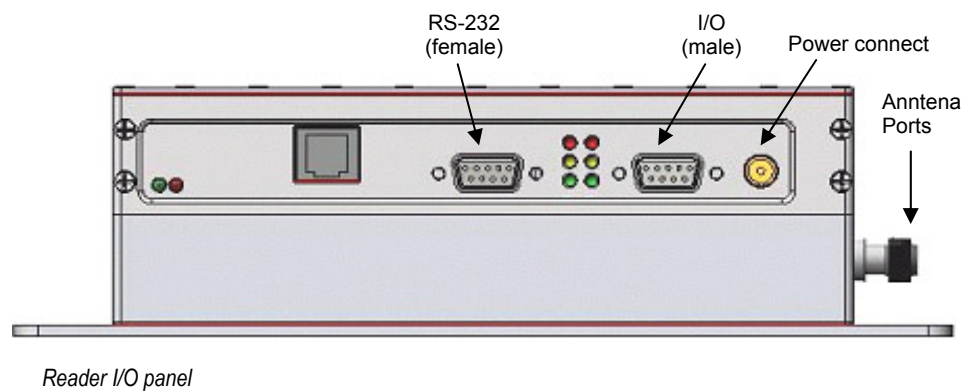
3. **Connect the RS-232 cable to the serial port on the PC.**

4. **Connect antenna coaxial cables to each antenna port (0 and 1).**

    -   You can use either antenna on either port.

    -   Antenna port 1 is on the right if viewing reader with flange side down. Port 0 is on the left.

    -   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.
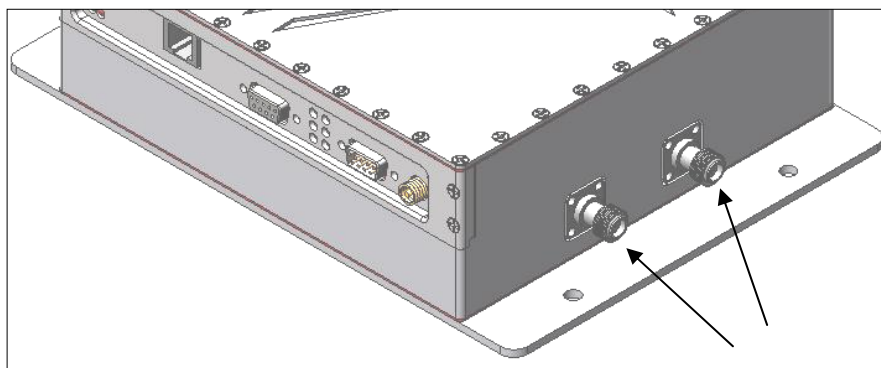
Antenna ports (reverse gender)

*CAUTION: **Antennas must be attached before connecting power to the reader**. Applying power without both antennas connected (or the ports properly terminated) can damage the reader.*

5. **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.

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 *RFID Gateway* 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 Nanoscanner 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. **Shield a tag in a metal enclosure or enclosed in your hand.**

    *   Begin with the tag shielded from the reader antennas 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 on the left-hand column of LEDs at the center of the reader I/O panel.

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

    *   Lock is the green LED in the left-hand column of LEDs at the center of the reader I/O panel.

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: If all conditions appear to be operational but system fails to read tags, disconnect system power and reapply power to perform a hard reset.

System Design

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

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 mounted in your application environment.

Antennas should be mounted about ½ meter (1.5 ft) apart, situated at the average height at which tags are expected to be presented to the system.

Requirements

Before installing your Nanoscanner 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

■ Any additional RS-232 cables or connectorized 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.)
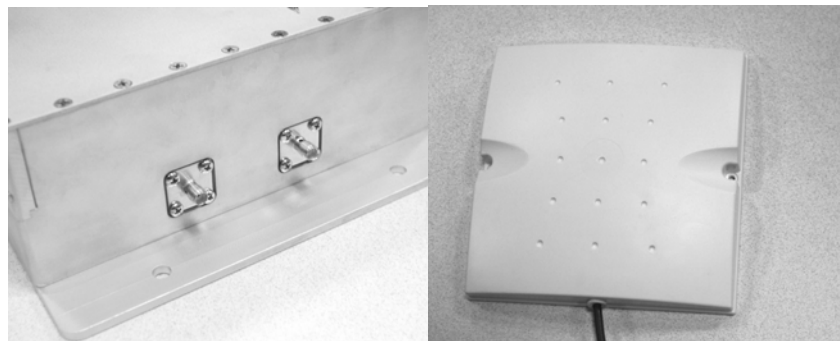
Installation Procedure

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 20 cm (7.9 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."

   Note: *Only the antennas supplied with the unit can be used in order to comply with FCC regulations.*

   • Mount the antennas 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.

   • Place the antennas within about 1/2 meter (1.5 ft) apart. Mounting them closer than may result in crosstalk between the two antennas.

   • Position the antennas 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.)

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 three 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 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.

CAUTION: Antennas must be attached before connecting power to the reader. Applying power without both antennas connected can damage the reader.

8. **Connect power to the reader.**

    - 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.

9. **Connect power to the PC.**

System Operation

SOFTWARE DEVELOPERS

If you are a software developer, the balance of this document provides the information you will need to install the reader on the host computer, communicate with it, and customize its performance via text commands to enable reader operation tailored to the desired application.

CUSTOM SYSTEM USERS

If you are a custom system user, please refer to your host software user guide for information regarding system and software operations.

ALIEN RFID GATEWAY DEMO SOFTWARE USERS

If you are using the Alien RFID Gateway demonstration software, please refer to the *Demonstration Software Guide*.

CHAPTER 3
Nanoscanner System Overview

This chapter provides an overview of the major features found in a Nanoscanner reader.

Specific instructions for setting up a reader are provided in Chapter 4: Reader-Host Communications Installation.

Reader commands and their uses are covered in Chapter 5: Reader-Host Protocol.

Introduction

The most basic function of the Nanoscanner reader is to read RFID tags and to allow a user or application access to a list of these tags.

The Nanoscanner reader is designed to perform this function either connected to a host via serial cable, or on a network as a standalone unit or in conjunction with other readers on the network.

To assist in the networked operation, the reader has two important features designed to simplify network management:

- Reader Heartbeats allow network applications to easily discover readers on a network.

- Autonomous Mode reading allows unattended readers to look for tags and send notification messages to listening services on the network when certain conditions arise.

These important concepts, along with the basics of communicating with the reader, are discussed in this chapter.

Communicating with the Nanoscanner

Overview

Commands can be issued to the Nanoscanner in one of three ways:

- Serial communication

- Network communication

- Web-based interaction

SERIAL COMMUNICATION

Commands can be issued to the Nanoscanner using a direct serial connection from a computer to the reader. The following settings are required for the serial communication:

Baud Rate   : 115200

Data Bits   : 8

Parity   : None

Stop Bits   : 1

Flow Control   : None

NETWORK COMMUNICATION

Commands can be issued to the Nanoscanner over the Internet or Intranet. The reader is equipped with a standard Ethernet port (10 Base T) allowing it to be physically connected to a network. By default the Nanoscanner will use DHCP to wake up and join a network. If DHCP is not available on the network, the Nanoscanner can be manually configured for the network via Serial communication.

By default the Nanoscanner will listen to incoming commands over port 23, the standard Telnet port.

WEB BASED COMMUNICATION

The Nanoscanner contains a built in Web-server that allows all aspects of the reader to be controlled and configured via web pages served up by the reader. This web server operates on the standard port 80 used by most web servers.

Reader Discovery and the Reader Heartbeat

One of the problems common to many network appliances is simply discovering where the device is on the network. To operate these devices over the network, users must know the device's IP address.

If an IP address is hard-coded into the device, this problem is solved, and often a label on the device will detail this IP address.

However, many systems do not use a hard-coded IP address, requiring the user or system to assign an address each time the device is booted up (this is called DHCP, dynamic host configuration protocol).

DHCP and Device Auto Discovery

The DHCP mode of operation eliminates the need for the user to perform network configuration for the device. The device simply is plugged into the network socket, booted-up and immediately becomes a citizen of the network.

However, the user still needs to learn the IP address of the device; all that is known at this point is that the device does have an IP address and has booted itself on the network. The actual IP address the device is using is still not known.

Serial Interrogation

One of the simplest methods to find out the reader's IP address is to connect via the serial connection and type the command "get IPaddress'" to return the IP address currently in use by the device.

However, this requires a physical connection between a host computer and the reader—a connection that in many cases is simply impractical to set up.

Network Heartbeats

The preferred way to find out a reader's IP address is to listen for it on a network.

Once a reader has booted successfully onto a network it will repeatedly send out an electronic heartbeat to this network. This heartbeat can be listened for by network applications, and provides enough information about the reader to locate it on the network and begin communication with it.

In network parlance, the heartbeat message is sent via UDP packets (universal datagram packets) to all network addresses on the reader's subnet.

There are two relevant configuration options available via the reader's command line or web interface to affect this heartbeat:

- **Set | Get HeartbeatTime:** This command specifies the time interval separating successive heartbeat messages sent out over the network. The time is specified in seconds, with a value of zero turning off the heartbeats. The default value for this setting is 30 seconds, i.e., send out a heartbeat message every 30 seconds.

- **Set | Get HeartbeatPort.** This command specifies the port number to address the UDP heartbeat messages to. This port number is the port number that must be listened to by interested parties on the network. The default value for this setting is 3988, i.e., send out a heartbeat message to UDP port 3988 of every machine on the subnet.

The format of the heartbeat is a small XML text-based message, containing information about the reader (name and type), the reader's network connection (IP address and command port) and the length of time before the next heartbeat will be sent out.

```
<Alien-RFID-Reader-Heartbeat>
    <ReaderName>Alien RFID Reader</ReaderName>
    <ReaderType>Alien RFID Tag Reader (Class BPT /
    2450Mhz)</ReaderType>
    <IPAddress>10.1.60.5</IPAddress>
    <CommandPort>23</CommandPort>
    <HeartbeatTime>30</HeartbeatTime>
</Alien-RFID-Reader-Heartbeat>
```

The Reader Name parameter in the message is the user-defined name associated with the reader. This name can be set by a user to help identify which reader is which.

- For example, multiple readers in a warehouse may be named "loading bay 1", "loading bay 2" etc., thus providing a clear indication as to the physical location of the reader.

The Reader Type parameter details the specific type of reader sending out the heartbeat. This information is hard-coded into the reader's firmware and is not user-configurable.

The IP Address and Command Port parameters detail the location of the reader on the network. The IP address is simply the network address of the reader. The command port is the port number on which the reader is listening for incoming user commands. Typically this is port 23, the standard telnet port, allowing a user to communicate with the reader over the network by typing "telnet 23" into most computers.

Heartbeat Time parameter. The final piece of information in the heartbeat message is the time to the next heartbeat. This time (in seconds) enables any application software to detect whether a reader is powered-down or the network connection breaks; if a new heartbeat is not received after the expected time period, then such an interruption to normal service can be detected.

HEARTBEATS AND SOFTWARE

The Nanoscanner Reader Developer's Kit that accompanies the Nanoscanner reader provides source code and software libraries to listen for and understand these network heartbeats in both Java and Visual Basic languages.

The Alien RFID Gateway application, also bundled with the development kit, uses the Java version of these libraries to build its active reader list on the main screen.

Tag List Concepts

During normal operation the Nanoscanner maintains an internal list of the tags that are *active*.

Active tags are those read by the reader at least once within a predefined time period. Any new tags presented to the reader are added to this list, and any tags that have not been seen for a while are removed from the list.

At any time a programmatic call can be made to the reader to retrieve this list of tags.

```
8000 0100 8820 FFA4 1010 A3EF
```
New tags detected are added to the tag list.

```
8000 1010 A3EF 0100 8820 3F02
8000 1010 A3EF 0400 0232 3F06
8020 1010 A3EF 0150 2057 3F12
A000 1045 A3DF 0400 0232 3F06
C280 1010 A3EF 0150 2057 3F12
```
Reader Tag List...

All tags listed are active.

```
8020 459E A3EF 0150 2057 3B00
```
Tags not read for a while are removed from the list.
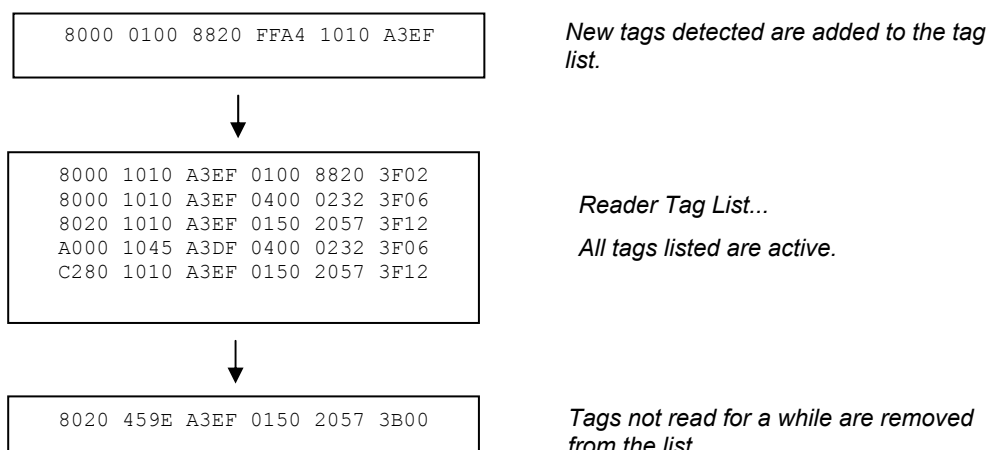
The reader always has a concept of "what's out there", internally represented by the reader Tag List

Persist Time

The persist time defines the duration between the time a tag was last read and the time it is removed from the Tag List. Setting this value to a small time (~1 second) will cause the Tag List to contain only what the reader has seen in the last second, i.e., a fair representation of what the reader sees at any one time. Setting the persist time to a long duration allows a history of tags to be built up. For example, setting the persist time to 1 hour allows a list to be built up detailing all the tags read over the last hour.

Tag Details

Each entry in the Tag List is stored as the Tags' unique 96-bit ID, followed by a 16 bit checksum (used to verify the ID was correclty read), followed by the read count (the number of times the tag has been read in the current session), the discovery time (the time the tag was first seen), and the antenna (the antenna ID that tag was last read from).

Tag List Size

The Tag List is currently configured to hold up to 500 unique tag IDs and their associated data.

Reading Tags over the Network

The Alien RFID reader provides two methods with which to read tags: interactive mode and autonomous mode.

- **In interactive mode**, the controlling application must issue commands to the reader to read tags. This command will always return immediately with a list of tags in view of the reader.

- **In autonomous mode**, the reader is set up to constantly reads tags, and to initiate a conversation with a network listener when certain events arise.

While both methods are equally valid, the choice of method will usually be determined by the needs of the controlling application.

Although it may be easier and require less coding to work in interactive mode, a little investment in programming effort lets the user set up autonomous mode to provide a more scalable system for multiple readers.

Interactive Mode

Reading tags in interactive mode is as simple as issuing a single command to the reader via its network interface.

BASIC TEXT TAG READ COMMAND

This command is "get taglist". The result is a text-based list of tags that the reader can see, for example:

Tag:041C 1820 2812 4080 0000 AB54, CRC:97FC, Disc:2003/01/21 02:24:00, Count:1, Ant:0
Tag:1155 8B14 5661 D40B 0001 F456, CRC:04C1, Disc:2003/01/21 04:14:47, Count:1, Ant:0

XML TAG READ COMMAND

At any time the format of the taglist can be specified using the *set tagListFormat* command. One of the options is XML format which would return the same tag list as:

```
<Alien-RFID-Tag-List>
<Alien-RFID-Tag>
    <TagID>041C 1820 2812 4080 0000 AB54</TagID>
    <CRC>97FC</CRC>
    <DiscoveryTime>2003/01/21 02:24:00</DiscoveryTime>
    <ReadCount>1</ReadCount>
    <Antenna>0</Antenna>
</Alien-RFID-Tag>
<Alien-RFID-Tag>
    <TagID>1155 8B14 5661 D40B 0001 F456</TagID>
    <CRC>04C1</CRC>
    <DiscoveryTime>2003/01/21 02:24:00</DiscoveryTime>
    <ReadCount>1</ReadCount>
```

                                     `<Antenna>0</Antenna>`
                              `</Alien-RFID-Tag>`
                              `</Alien-RFID-Tag-List>`

Autonomous Mode

Autonomous mode is a multi-stage configuration and operation mode that enables hands-free monitoring of tags.

- The first stage requires you to issue a series of configuration commands to the reader. These commands detail how and when to read tags, and then when tags are found, who to tell.

- Once configured, the reader can be left to operate on its own.

  The application must then set up a listening service to listen for messages from the reader detailing any tags that it has read.

One of the major benefits to this mode of operation is that many readers can be configured to send tag messages to a single network application. Thus, a single application can listen for and process data from multiple readers over the network.

Defining the Autonomous Read Operation

Autonomous mode functionality is summarized in the state diagram shown below. Fundamentally, a reader operating in Autonomous Mode moves between several states: *Waiting*, *Working*, *Evaluation* and *Notification*. Waiting, Working and Evaluation states have associated with them an optional digital output state that is set upon entering the state. Movement from one state to another is initiated by an expiration of a timer, a trigger event on one or more of the digital input lines or changes to the tag list.

Each element of the State Diagram is described below. Associated with each element are one or more commands that are used to configure the reader.

ENTER AUTONOMOUS MODE (Not shown on the state diagram.)

The user puts the reader into Autonomous Mode with the `AutoMode` command. `Set AutoMode = On` puts the Reader into Autonomous Mode. `Set AutoMode = Off` returns it to Interactive Mode.

WAITING STATE

Upon entering Autonomous Mode, the reader automatically enters the Waiting State. While waiting for a Start Working Trigger (see below) the reader holds the digital output lines at a value set by the `AutoWaitOutput` command. (i.e., `Set AutoWaitOutput=3` would cause both output lines to go high when the reader is in the Waiting state.)

START WORKING TRIGGER

The receipt of a trigger pattern on the digital input lines will cause the reader to move from the Waiting state to the Working state. The start condition is set by the `AutoStartTrigger` command. The `AutoStartTrigger` command takes two parameters, a rising edge pattern and a falling edge pattern. `Set AutoStartTrigger = 2,0` would cause the reader to enter the working state on receipt of a rising edge on pin 2. `Set AutoStartTrigger= 0,3` would cause the reader to enter the working state after the receipt of a falling edge on both pins one and two. `Set AutoStartTrigger= 0,0` causes the reader to immediately drop into the Working state. Note: One cannot mix rising and falling edge patterns with the current version of Nanoscanner firmware.
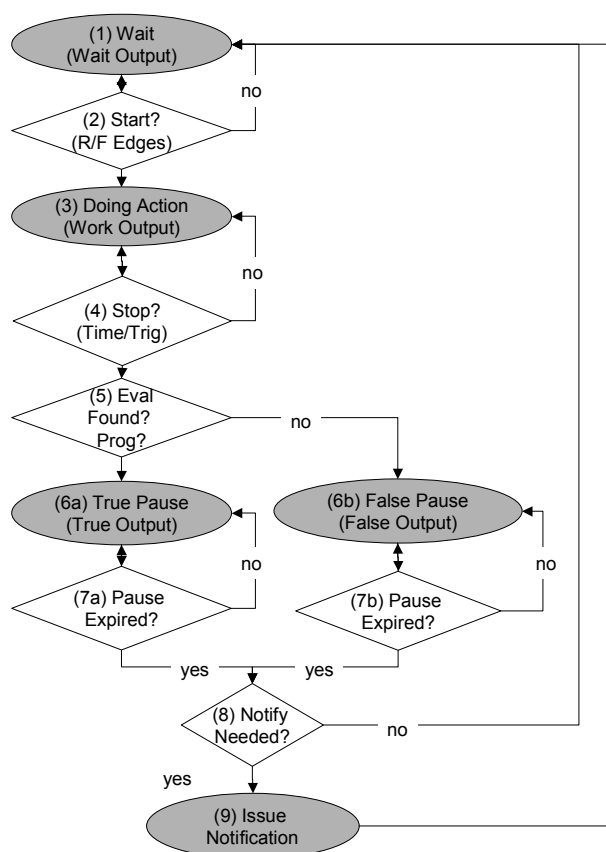
Autononmous Mode State Diagram

WORKING STATE

In the working state, the reader holds the digital output lines at the value defined by the `AutoWorkOutput` command. `Set AutoWorkOutput =3` would hold both output lines high while the reader is working. The action the reader performs while in the working state is determined by the `AutoAction` command. `Set AutoAction = Acquire` causes the reader to repeatedly acquire tag list data

using the parameters set in the `AcquireMode` and `PersistTime` commands. The reader continues working until the Stop Working Trigger conditions are met. (See below)

STOP WORKING TRIGGER

Like the Start Working Trigger, the Stop Working Trigger can be a change on the digital input lines. Use the `AutoStopTrigger` command with a rising,falling edge pattern to set the trigger conditions. `Set AutoStopTrigger = 1,0` would look for a rising edge on pin 1 to leave the Working state. In addition, one may use the `AutoStopTimer` command to repeat the Working action for a specified period of time. (i.e., Set AutoStopTimer = 1300 would cause the reader to perform the Working action for 1.3 seconds and then perform the Evaluation.)

EVALUATION

At the Evaluation decision point, the reader looks to see if new Tags have been added to the tag list since the last evaluation. If so, it drops to the True Pause state, if not, it drops to the False Pause state. Note: the Evaluation looks at the tag list and thereby is dependent on the state of the `PersistTime` variable.

TRUE/FALSE PAUSE

After evaluation, the Reader sets the output lines to the values specified in the `AutoTrueOutput` and `AutoFalseOutput` commands. This condition is held for `AutoTruePause` or `AutoFalsePause` milliseconds before the test for Notification. `Set AutoTrueOutput = 1` and `Set AutoTruePause=20` would cause the reader to hold pin 1 high and pin 2 low for 20 milliseconds before returning to the Waiting State.

NOTIFY NEEDED TRIGGER

The reader checks if Automatic Notification is enabled, (`NotifyMode=On`) and if the notification conditions are met to see if a notification should be issued. Notify conditions are set by the state of the `NotifyTrigger` command and may be set to "add" "remove" "change" or "true" "false".

If a notification is to be issued, the tag list data is sent to the `NotifyAddress`. The Reader then returns to the Waiting state.

Autonomous Mode Examples

EXAMPLE 1. BACKGROUND READING

In this case, we would like the reader to monitor the tag field continuously. The application will periodically poll for the tag list. If a new tag is seen, pin 1 will be flashed high for 50 msec. Otherwise, pin 2 will be flashed high for 50 msec.

```
AutoModeReset
Set AutoAction=Acquire
```

```
Set AutoStartTrigger=0,0
Set AutoStopTimer = 0
Set AutoTrueOutput =1
Set AutoTruePause =50
Set AutoFalseOutput = 2
Set AutoFalsePause = 50
Set AutoMode=On
```

EXAMPLE 2. TRIGGERED READING

Here a forklift will cause an electric eye to send a pulse to the reader. We want
the reader to look for the rising edge on this pulse and look for tags for 1.8
seconds before going back to the Wait state. We wont make any changes to the
output pins.

```
AutoModeReset
Set AutoAction=Acquire
Set AutoStartTrigger=1,0
Set AutoStopTimer = 1800
Set AutoTruePause =0
Set AutoFalsePause = 0
Set AutoMode=On
```

EXAMPLE 3. TRIGGERED READING W/NOTIFICATION

A trigger is used to start the reading. If a tag is found, send an email message.
After the email is sent, return to the waiting state.

```
AutoModeReset
Set AutoAction=Acquire
Set AutoStartTrigger=1,0
Set AutoStopTimer = 0
Set AutoTruePause =0
Set AutoFalsePause = 0
Set NotifyAddress = Borg@AlienTechnology.com
Set MailServer= sigourney.alien.com
Set NotifyTrigger=Add
Set NotifyMode=On
Set AutoMode=On
```

Notification Mode

The last stage in configuring the autonomous mode is to tell the reader under what conditions to notify listeners about tag lists. Listeners (network applications / people) will be notified only when preset conditions arise, such as when new tags are read, or tags disappear from view.

- **Set NotifyTime = time (secs)**

    The NotifyTime command instructs the reader to send out a copy of its tag list to a listener every *n* seconds, regardless of changes to the tag list or not. Thus, this is a simple, predetermined way to force the reader to send out its tag list to a listener.

- **Set NotifyTrigger = trigger**

    The NotifyTrigger command specifies a trigger that must occur before a tag list is sent out to a listener. There are a number of permissible triggers than can be set:

Trigger Name	Meaning
ADD	Send message when new tag is read and added to the tag list
REMOVE	Send message when a tag is removed from the tag list
CHANGE	Send message when a tag is either added to or removed from the tag list
TRUE	Send messages when the evaluation task of the autonomous state loop evaluates to true, i.e., typically when tags are added
FALSE	Send messages when the evaluation task of the autonomous state loop evaluates to false, i.e., typically when tags are not found

Defining the Notification Address

You must tell the reader where to send notification messages to when it is operating in autonomous mode.

The Alien reader can be instructed to send out messages over the internet to a specified machine or over email to specified email address. This is configured using a single command:

- **Set NotifyAddress = address**

    The format of the address indicates the method of delivery:

NotifyAddress	Description
user@domain.com	Send a message via e-mail to the address specified. The address is specified in standard email form, i.e., user@domain.com *NOTE: the MailServer parameter must be configured for this to work.*
hostname:port	Send a message to a specified port on a networked machine. The address takes the form "hostname:port." For example, "123.01.02.98:3450" or "listener.alientechnology.com:10002"
serial	Send a message to the serial connection. The word "serial" is used as the address. The word is not case sensitive.

Defining the Notification Format

You must tell the reader the format required for any tag list that it sends out. When a notification message is sent out it contains two parts to its document:

- The first part of the document details the reader that sent the message and the reason the message was sent.

- The second part to the message is a list of tags (either newly added or removed tags, or the complete list of tags as seen by the reader):

The format of the message is configured using a single command:

- **Set NotifyFormat = format**

    The format may be one of the following:

NotifyFormat	Description
text	Tag lists are sent out as plain text messages, one tag ID per line.
xml	Tag lists are sent out as an XML text format

- Text formatted tag lists take the form:

```
#Alien RFID Reader Auto Notification Message
#ReaderName: Spinner Reader
#ReaderType: Alien RFID Tag Reader (Class BPT / 2450Mhz)
#IPAddress: 10.1.70.13
#CommandPort: 23
#Time: 2003/01/21 12:48:59
#Reason: TEST MESSAGE
Tag:1115 F268 81C3 C012 0000 4523, CRC:2483, Disc:2003/01/21 09:00:51, Count:1, Ant:0
Tag:0100 0100 0002 0709 1234 A34E, CRC:8594, Disc:2003/01/21 11:00:10, Count:1, Ant:0
Tag:1054 A334 54E1 7409 F983 2DE5, CRC:2083, Disc:2003/01/21 11:50:03, Count:1, Ant:0
#End of Notification Message
```

- XML Formatted tag lists take the form:

```
<Alien-RFID-Reader-Auto-Notification>
  <ReaderName>Spinner Reader</ReaderName>
  <ReaderType>Alien RFID Tag Reader (Class BPT / 2450Mhz)</ReaderType>
  <IPAddress>10.1.70.13</IPAddress>
  <CommandPort>23</CommandPort>
  <Time>2003/01/21 12:49:22</Time>
  <Reason>TEST MESSAGE</Reason>
<Alien-RFID-Tag-List>
<Alien-RFID-Tag>
  <TagID>0102 0304 0506 0709 0020 1020</TagID>
  <CRC>87B4</CRC>
  <DiscoveryTime>2003/01/17 11:37:01</DiscoveryTime>
  <Antenna>0</Antenna>
  <ReadCount>1413726</ReadCount>
</Alien-RFID-Tag>
<Alien-RFID-Tag>
  <TagID>2283 1668 ADC3 E804 E456 0293</TagID>
  <CRC>9FD0</CRC>
  <DiscoveryTime>2003/01/19 07:01:19</DiscoveryTime>
  <Antenna>0</Antenna>
  <ReadCount>1</ReadCount>
</Alien-RFID-Tag>
</Alien-RFID-Tag-List>
</Alien-RFID-Reader-Auto-Notification>
```

Listening for Tags over the Network

When a reader has been configured for autonomous mode, all interactive communications with the reader can be stopped and it can be left to work on its own.

It is then up to the network application to listen for any notification messages from the reader.

Libraries are provided in the Nanoscanner Reader Developer's Kit to provide this functionality in both Java and Visual Basic languages. In both cases, setting up a listening service is a simple coding task, involving less than 10 lines of code.

CHAPTER 4
Reader⇔Host Communications Installation

The Nanoscanner reader is designed to be programmed using simple ASCII text-based commands from any programming language.

Introduction

The CD provided with your Nanoscanner Reader Developer's Kit includes extensive examples of code developed by Alien for the Nanoscanner using Java and VisualBasic programming languages. These examples will serve as models for developing new software for the reader.

This section of the *Nanoscanner Reader Developer's Guide* describes how to install the reader on a host computer, as well as how to issue commands and interact with the reader using three different methods:

- Command line operation over serial communication.

- Command line operation over Telnet communication.

- HTML based operation over Web communication.

Whether using direct serial communication with the reader or using one of the network communication options, you will require serial communications for initial reader installation.

Audience

For the purposes of this chapter, it is assumed that users:

- May be IT specialists, network specialists or programmers.

- Will operate the reader via the host either with direct serial communication or via network.

- Have minimal previous knowledge of radio-frequency identification technology.

Additionally, it is assumed that:

- Users installing the reader via direct serial communication are skilled in the application of RS-232 serial protocol.

- Users installing the reader for network communication are skilled in basic network configuration.

- Programmers are competent in at least one programming or scripting language and have the ability to issue ASCII-based commands with that language.

Requirements

Serial communication requires:

- A text-based serial communications program (such as Windows HyperTerminal) running on any computer.

Ethernet communication requires:

- An Ethernet network.

- Standard Web browser or Telnet communication program

Conventions

The following conventions are used in this section:

- Keys to be pressed are shown in brackets and all caps. Example: Press the [ENTER] key.

- Upon entering any command instruction, you must press [ENTER] to send the command.

- Specific characters and commands to be typed in are shown within quotation marks. Example: At the prompt type "Set DHCP=ON".

- Values to be provided and typed in by the user are shown within brackets in upper and lowercase. Example: At the prompt type "Set IPaddress=[IP address value]" or "Set IPaddress=xxx.xxx.xxx.xxx." The actual command typed in would appear as: "Set IPaddress=10.1.60.5".

- Nanoscanner reader commands are case insensitive. Although, for clarity, the commands may be shown in upper and lower case in this document, you may type them in all lowercase characters, if you prefer.

- A space is required between the command (verb) such as "get" or "set" and the specific parameters as in the example "Get IPaddress." However, no space is required between the parameter elements such as "IP" and "address."

Setting up Reader-Host Communications

You can interact with the reader via the three methods mentioned earlier: direct serial, Telnet and Web. Serial and Telnet communications both involve command line operation. Web communication uses HTML.

Command Line Operation: Direct Serial Communication

This method is required for installing a new Nanoscanner, whether directly or via network. Serial communications requires no preconfiguration and can be performed easily with most computers.

This method enables real-time operation of the reader via a serial communications ("comm.") port. Serial communication is the simplest means by which to connect the reader to the host and implement ASCII command protocol.

Command Line Operation: Telnet Communication

Telnet communication requires a network connection via the reader's Ethernet port and allows the reader to operate like a Telnet server.

This mode offers the same form of command line interaction with the Nanoscanner, but requires the Nanoscanner to be configured for and running on a network in order to use it.

HTML-Based Operation: Web Communication

This mode allows you to operate and interact with the reader via the Web interface. Web mode offers the simplest means of interaction via a series of HTML pages and Java Applets served up by the Nanoscanner itself. All interaction with the reader takes place inside a standard Web browser such as Internet Explorer or Netscape Navigator.

NOTE: Before for you can configure the reader for network (Telnet or Web) access, you must first set up the reader for direct serial communications.

By default, all Nanoscanner readers are preconfigured to use DHCP when presented with an Ethernet connection. However, you must first establish a direct serial connection in order to learn the reader's IP Address.

Installing Reader on Host via Serial Port (ALL)

Whether you will ultimately be operating the reader directly via serial communications or via a network connection, you will need to install the reader initially using the serial port instructions.

NOTE: Example screens shown in this section are from HyperTerminal.

1. Ensure the reader is properly connected to power and at least one antenna per installation instructions in Chapter 2.

2. Connect one end of the serial cable to the reader's COM port and the other end to either COM port 1 or COM port 2 on the host computer.

3. Launch the desired serial communications program (such as HyperTerminal which is supplied with Windows 98 and 2000).

4. Enter (or verify) the following settings to configure the serial communications program:

   - Baud Rate: 115200
   - Data Bits: 8
   - Parity: None
   - Stop Bits: 1
   - Flow Control: None

Once configured, the software should allow you to communicate with the Nanoscanner.

- HyperTerminal example configuration screens are shown below:
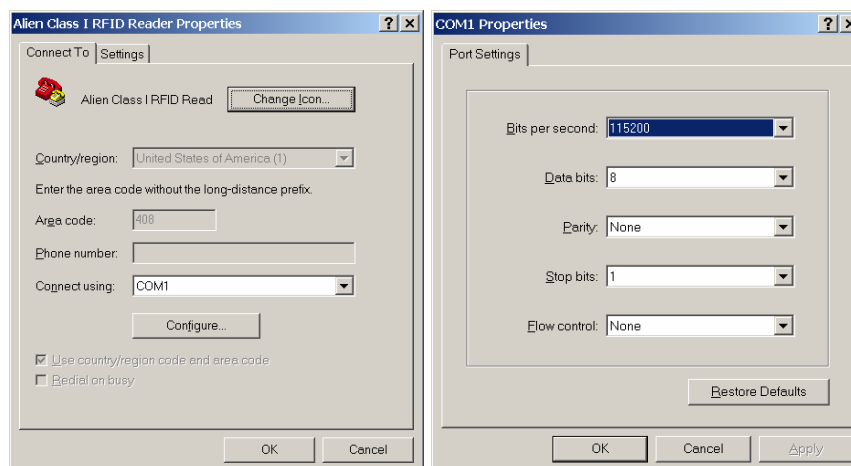
5. At the command prompt, you may now type any command followed by the [ENTER] key to submit the command.
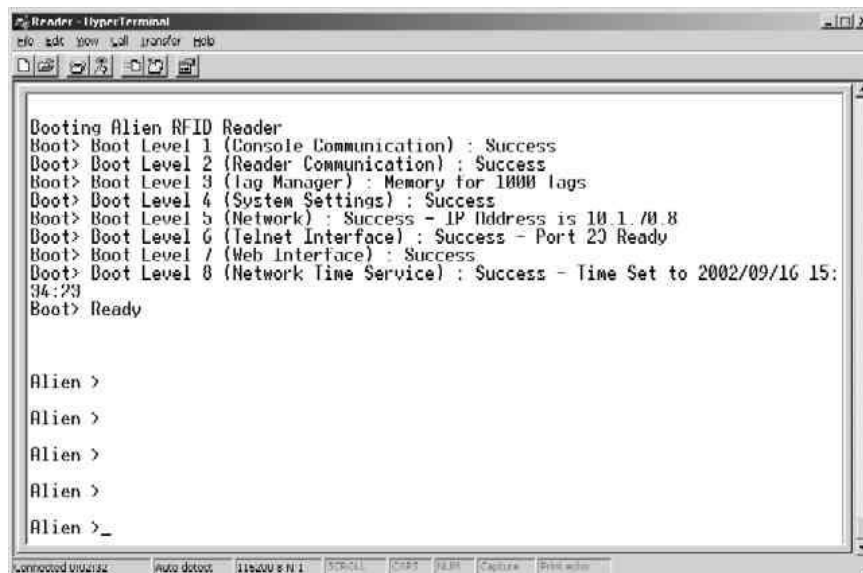
The following basic commands are helpful in verifying the reader-host interface:

- Help (or "h") – Provides a list of all commands available

- Info (or "i") – Provides a list of current settings for the reader

- Get TagList – Scans field immediately for tags and reports the results

NOTE: Nanoscanner reader commands are case insensitive and may be typed in all lowercase characters, if preferred.

For a detailed explanation of all commands available, please refer to Chapter 6: Reader–Host Protocol.

Network Installation (Optional)

To configure the system for network operation, you will use the commands shown under the NETWORK heading.

There are 5 NETWORK commands that may be used for network configuration:
- Get | Set DHCP (On of Off)
- Get | Set IP address
- Get | Set Netmask
- Get | Set Gateway
- Get | Set DNS

1. To access the command list, type "H" or "Help".

2. If DHCP (Dynamic Host Configuration Protocol - an automatic configuration protocol that runs on many networks) is supported at your site, proceed to step 3.

    If DHCP is NOT supported at your site, skip to step 6.

If DHCP is supported at your site:

3. Type "Set DHCP=ON".

    - DHCP will automatically configure the other four parameters.

4. Issue the command "Get IPaddress" and the reader will return its assigned address.

5. Skip to step 9.

If DHCP is <u>not</u> supported at your site:

6. Type "Set DHCP=OFF".

    - Reader will return the message "DHCP = OFF".

7. Contact your system administrator for the following parameter values:

    IPaddress
    Netmask (or sub-netmask)
    Gateway
    DNS

8. Type each of the 4 commands below with the assigned values:

    Set IPaddress=xxx.xxx.xxx.xxx
    Set Netmask=xxx.xxx.xxx.xxx (or sub-netmask)
    Set Gateway=xxx.xxx.xxx.xxx
    Set DNS=xxx.xxx.xxx.xxx

    - If value is accepted, the reader will return accepted value.

- If value is not accepted, reader will return "0.0.0.0".

9. Type "Reboot" to reboot the reader and implement the commands.

To verify your network connection to the reader:

10. Launch a browser.

11. Enter the reader's assigned IP address.

- If the IP address is valid, the Alien reader portal will display.

Web portal (above)

Telnet portal (right)
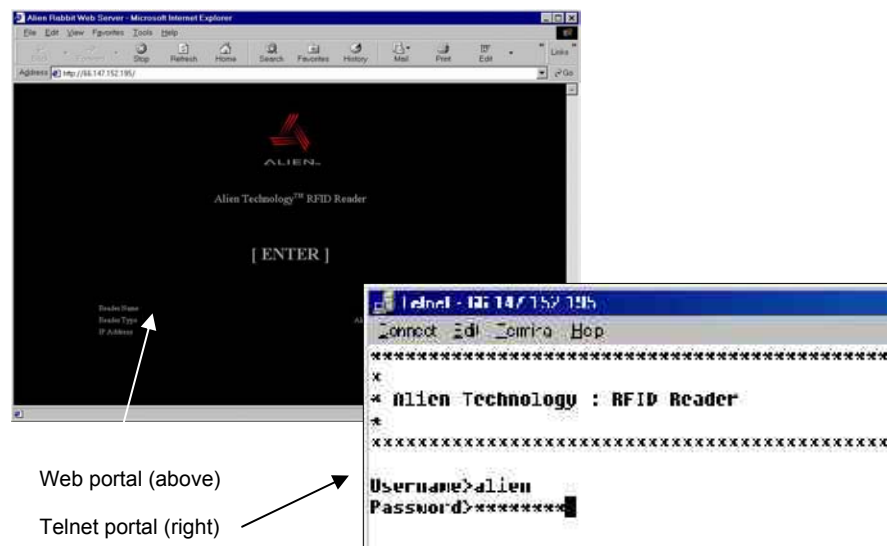
12. For Web access, click the [ENTER] box.

For Telnet access, skip to step 13.

13. At the prompt, enter your username and password. (These are case sensitive and must be typed as specified.)

Current settings are:

- Username = alien

- Password = password

14. You are now ready to interact with the reader via commands.

- For Telnet operation, you will be using the text command lines in the same manner as in direct serial communication. The only difference is in the use of the "Q" command to quit the Telnet session.

- For Web operation, you will be using the HTML screens as shown.

Reader commands and instructions for their use in both command line and HTML operations are provided in the next chapter, Chapter 5: Reader-Host Protocol.

CHAPTER 5

Reader⇔Host Protocol

The Reader <–> Host protocol is a text-based communications protocol for configuring and operating the Alien Nanoscanner RFID reader for enterprise host systems connectivity.

Introduction

This chapter describes the programming interface that links the Alien Nanoscanner RFID reader to the outside world.

For a overview of the reader system, see Chapter 3: Nanoscanner System Overview.

For instructions on setting up reader operation via a host computer, see Chapter 4: Reader-Host Communications Installation.

Reader Operation Overview

As detailed in Chapter 4, you may interact with the reader and configure its operation using either of two methods:

- Text-based command line operation (via direct serial or Telnet connection)

- Web-based HTML operation

For the purposes of these instructions, the serial and Telnet operations will be considered essentially identical. Where any significant differences exist in the command line operation methods or the Web-based HTML operation, the instructions will note those exceptions.

Text-Based Command Line Operation

To interact with the reader via command line operation you must either be communicating directly with the reader via the serial port connection to the host, or via the Internet and a Telnet connection.

In both cases the screens will look similar and will thus be considered identical for the purposes of the instructions that follow.

Telnet connection (right)

Direct serial connection via HyperTerminal (below)
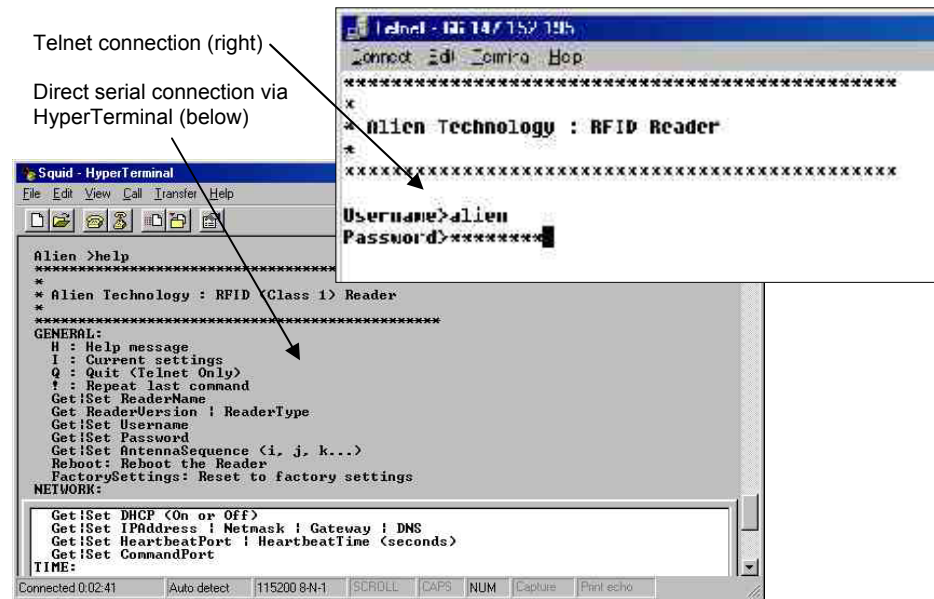
Telnet Exceptions:

- *In Telnet operation you must issue the command "Q" to quit the session.*

- *Accessing reader control via Telnet requires an authorized user name and password (both of which can be changed via the General command set).*

Web-based HTML Operation

The Nanoscanner reader includes a built-in Web server that can serve up a number of easy-to-use Web pages for configuring and using the reader.

Like Telnet, the Web connection also requires an authorized user name and password.

Most of the pages served up by the Web server are simple HTML pages.
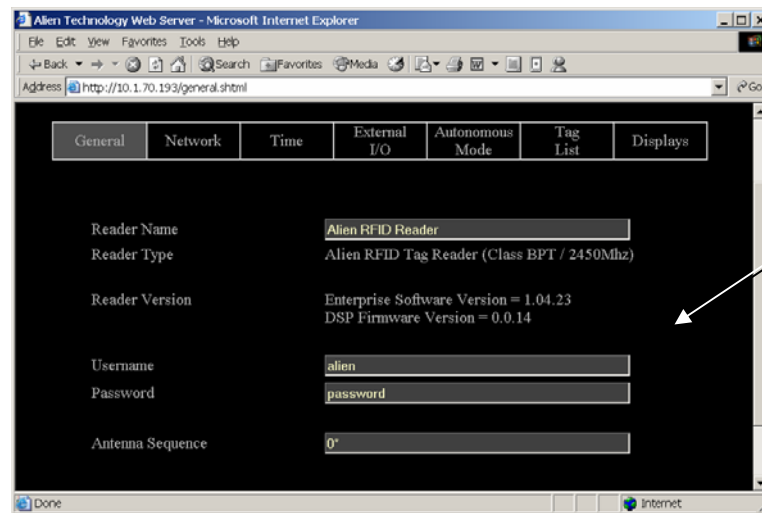
Web-based HTML screen showing general commands tab with username and password fields.

However there also a number of simple Java Applets that are used to provide an interactive environment for reading tags in the field. These Java Applets are all Java 1.1 compliant applets and will work in standard Netscape and Internet Explorer browsers.

Once access with the reader has been established through the Web, you may execute any of the reader commands discussed in this chapter. The presentation of these commands differs from command-line operation only in the simplicity and convenience of the HTML screens and prompts.

Commands Overview

There are two distinct categories of reader-host command: those initiated by the enterprise host (interactive commands), and those initiated by the reader itself (autonomous commands).

INTERACTIVE COMMANDS

Interactive commands are initiated by a programmer, who creates and issues a command to the reader. The reader always responds to these commands with an immediate reply.

Interactive commands are used to configure and operate the reader, as well as to interrogate tags and retrieve stored lists on demand.

AUTONOMOUS COMMANDS

Autonomous commands instruct the reader to perform certain tasks, without human intervention, according to conditions set by the programmer.

These commands typically tell the reader to read tags and then send messages to the outside world based on user-defined triggers. For example, the reader can be instructed to search the field until it sees a tag, then to read the tag and mail the tag ID to a specified email address.

Command Format

All commands between the enterprise host system and the reader are human readable ASCII text-based messages. For example, a command to set the logical name of the reader using the Set Reader Name command takes the form:

Set ReaderName = My Alien Reader [CR][LF]

All commands to the reader are single line ASCII commands. These commands are always terminated by a single carriage return / line feed character pair [CR][LF], ascii code 0x0D followed by ascii 0x0A.

All replies from the reader are either single line or multiple line ASCII replies. These replies are always terminated by a single carriage return / line feed character pair [CR][LF] followed by a NULL character, ASCII codes 0x0D, 0x0A, 0x00. Where a reply comprises multiple text lines, each line is separated by a single carriage return / line feed character pair [CR][LF], ascii code 0x0D followed by ASCII 0x0A.

An example of a single line command / response is:

>Get ReaderName[CR][LF]
>ReaderName = Alien Reader[CR][LF][0]

An example of a multiple line command / response is:

>Get ReaderVersion[CR][LF]
>ReaderVersion = 1.0[CR][LF]
 FirmwareVersion = 1.0[CR][LF]
 SoftwareVersion = 1.0[CR][LF][0]

Commands are case <u>in</u>sensitive, i.e., "set readername" is equivalent to "Set ReaderName."

Suppressing Command Prompts

By default all commands are set up for interactive use over a serial console or telnet style interface. Consequently replies are always followed by a command prompt indicating that user input is required. Often this command prompt is not required, especially when client software is written that programmatically communicates with the reader. To account for these applications, all command prompts can be suppressed by making the first character of any command be an 0x1 character. For example:

INTERACTIVE COMMAND FORMAT

Alien> get ReaderName[CR][LF]
ReaderName = Alien Reader[CR][LF][0]
Alien>[CR][LF]

NON-INTERACTIVE COMMAND FORMAT

[1]get ReaderName[CR][LF]
ReaderName = Alien Reader[CR][LF][0]

XML Commands

There are a few cases where text-based replies and messages are formatted in XML format for easier computer parsing. The following messages are sent in XML format:

- Heartbeat Messages (see Heartbeat command description).

- Notification Messages (if notifyFormat = xml; see Notify command description).

- The Get TagList commands (if tagListFormat = xml)

Command Summaries

Command List

General Commands
- Help
- Info
- ! *(repeat last command)*
- Q (Quit) *Telnet Only*
- Get|Set ReaderName
- Get ReaderType
- Get ReaderVersion
- Get|Set Username
- Get|Set Password
- Get|Set AntennaSequence
- Reboot
- FactorySettings

Network Configuration Commands
- Get|Set DHCP
- Get|Set IPAddress
- Get|Set Gateway
- Get|Set Netmask
- Get|Set DNS
- Get|Set HeartbeatPort
- Get|Set HearbeatTime
- Get|Set CommandPort

Time Commands
- Get|Set Time
- Get|Set TimeZone
- Get|Set TimeServer

External I/O Commands
- Get|Set ExternalOutput
- Get ExternalInput

Tag List Commands
- Get|Set AcquireMode
- Get|Set PersistTime
- Get TagList (n)
- Get|Set TagListFormat
- Clear TagList
-

Autonomous Mode Commands
- Get|Set AutoMode
- Get|Set AutoWaitOutput
- Get|Set AutoStartTrigger
- Get|Set AutoWorkOutput
- Get|Set AutoAction
- Get|Set AutoStopTrigger
- Get|Set AutoStopTimer
- Get|Set AutoTrueOutput
- Get|Set AutoTruePause
- Get|Set AutoFalseOutput
- Get|Set AutoFalsePause
- AutoModeReset

Notify Mode Commands
- Get|Set NotifyMode
- Get|Set NotifyAddress
- Get|Set NotifyFormat
- Get|Set NotifyTime
- Get|Set NotifyTrigger
- Get|Set MailServer
- NotifyNow

Command List with Functions

GENERAL COMMANDS

Command	Description
Help (or "h")	List all reader commands available.
Info (or ("i")	List all current reader settings.
Get TagList	Scan the field, read tags and report. (see Tag List Commands for details.)
! *(exclamation mark)*	Repeats the last command issued.
Q	Quit session (TELNET ONLY)
Get ReaderName Set ReaderName	Allows an arbitrary name to be associated with and retrieved from the reader.
Get ReaderType	Get a description of the reader type
Get ReaderVersion	Get the reader software/hardware versions.
Get Username Set Username	Get and Set the Username used for the Network based access control
Get Password Set Password	Get and Set the Password used for the Network based access control
Get AntennaSequence Set AntennaSequence	Get and Set the antenna port sequence the reader should use.
Reboot	Reboot the reader.
FactorySettings	Reset the reader to its original factory settings.

NETWORK CONFIGURATION COMMANDS

Command	Description
Get DHCP Set DHCP	Turn on or off the DHCP mode for the reader. If DHCP is on, the reader will automatically configure itself for the network on power-up.
Get IPAddress Set IPAddress	Set and Get the network ID (IP Address) of the reader. If DHCP is enabled this will be set automatically.
Get Gateway Set Gateway	Set and Get the network gateway. If DHCP is enabled this will be set automatically.
Get Netmask Set Netmask	Set and Get the subnet mask. If DHCP is enabled this will be set automatically.
Get DNS Set DNS	Set and Get the domain name server. If DHCP is enabled this will be set automatically.
Get HeartbeatPort Set HeartbeatPort	The reader periodically sends out heartbeat messages to the network. The port over which this is done can configured.
Get HeartbeatTime Set HeartbeatTime	Set and Get the time interval, in seconds, between successive heartbeats.
Get CommandPort Set CommandPort	The reader reacts to commands over the network only if they are directed at a specific command port on the reader. This port can be configured using these commands.

TIME COMMANDS

Command	Description
Get Time Set Time	Get and Set the real time clock on the reader in Local time.
Get TimeZone Set TimeZone	Get and Set the time zone offset from UTC for the real time clock.
Get TimeServer Set TimeServer	Get and Set the location of a network time server.

EXTERNAL IO COMMANDS

Command	Description
Get ExternalOutput Set ExternalOutput	Get and Set the External Output pin values.
Get ExternalInput	Get the External Input pin values.

TAG LIST COMMANDS

Command	Description
Get AcquireMode Set AcquireMode	Specifiy how the Nanoscanner reads tags.
Get PersistTime Set PersistTime	Get the current list of active tags the from reader in plain text format.
Get TagList (n)	Get the current list of active tags the from reader in plain text format.
Get TagListFormat Set TagListFormat	Set and Get the format for tag lists.
Clear TagList	Clear the list of active tags on the reader.

AUTONOMOUS MODE COMMANDS

Command	Description
Get AutoMode Set AutoMode	Switch auto mode on and off.
Get AutoWaitOutput Set AutoWaitOutput	Speicify the value of the output pins while in wait mode.
Get AutoStartTrigger Get AutoStartTrigger	Get and Set the trigger that sends the auto mode state into working state.
Get AutoWorkOutput Set AutoWorkOutput	Specify the value of the output pins while in work mode.
Get AutoAction Set AutoAction	Get and Set the action to perform in auto mode
Get AutoStopTrigger	Set and Get the external trigger that will move the auto mode state from work mode to evaluate mode.

Set AutoStopTrigger	
Get AutoStopTimer Set AutoStopTimer	Set and Get the timer that will move the auto mode state from work mode to evaluate mode.
Get AutoTrueOutput Set AutoTrueOutput	Specify the value of the output pins when the auto mode evaluation returns a True condition.
Get AutoTruePause Set AutoTruePause	Set and Get the pause time after the auto mode evaluation returns a True condition.
Get AutoFalseOutput Set AutoFalseOutput	Specify the value of the output pins when the auto mode evaluation returns a False condition.
Get AutoFalsePause Set AutoFalsePause	Set and Get the pause time after the auto mode evaluation returns a False condition.
AutoModeReset	Reset all automode values to their default states.

NOTIFY MODE COMMANDS

Command	Description
Get NotifyMode Set NotifyMode	Switch notify mode on and off.
Get NotifyFormat Set NotifyFormat	Get and Set the format for tag lists pushed out in notify mode.
Get NotifyAddress Set NotifyAddress	Get and Set the address to push tag lists to.
Get NotifyTime Set NotifyTime	Get and Set the time interval for automatically pushing tag lists.
Get NotifyTrigger Set NotifyTrigger	Get and Set the trigger for pushing tag lists.
Get MailServer Set MailServer	Set and Get an SMTP mail server. This is only required if notification email messages are sent out.
NotifyNow	Send an immediate message via the notification system.

Using the Commands

This section describes each command, its use and the response formats.

*NOTE: Nanoscanner reader commands are case **in**sensitive, that is, you can use upper or lower case, or any combination thereof, and the reader will understand the command. Capitalization of commands is used in this document and in actual command responses is solely for the purpose of readability.*

General Commands – Text Based

General commands cover basic reader and antenna functions and information.

HELP (H)

This command lists all reader commands available. You may also type just the letter "h" to send this command.

INFO (I)

This provides a list of current reader settings. You may also type just the letter "i" to send this command.

!

This command (exclamation mark) asks the reader to repeat the last command issued.

Q (QUIT)

(For Telnet operation only) The Quit command allows you to exit the current Telnet session.

GET TAGLIST

This instructs the reader to scan the field for tags, read them and report the results. (For more details, see the Get TagList command under the Tag List Commands section.)

GET READERNAME
SET READERNAME

The reader can be assigned an arbitrary text name to aid identification in multiple-reader environments. This name can be retrieved and changed at any time throughout reader operation.

Example	
Command	>Get ReaderName
Response	>ReaderName = My First Alien Reader
Command	>Set ReaderName = My Second Alien Reader
Response	>ReaderName = My Second Alien Reader

GET READERTYPE

The reader type can be retrieved using this command. The resulting text will be a single-line reply describing the model number of the reader and related information.

Example	
Command	>Get ReaderType
Response	>ReaderType = Alien RFID Tag Reader (Class 1 / 915MHz)

GET READERVERSION

The reader version can be retrieved using this command. The resulting text is a multi-line reply. Each line of the reply describes the version number of a major reader component.

Example	
Command	>Get ReaderVersion
Response	>Enterprise Software Version = 1.05.01
	Micro Firmware Version = 02.04.18
	DSP Firmware Version = 02.13.02

GET USERNAME
SET USERNAME

The reader can be operated over the network. When operated in this mode it uses a simple username/password authentication scheme to stop unwelcome visitors accessing it. This command allows the username to be defined and obtained.

- A username/password pair is not required when operating the reader via serial connection.

- The default username setting is "alien" *NOTE: The username is case sensitive and must be entered in all lowercase.*

Example	
Command	>Get Username
Response	>Username = alien
Command	>Set Username = hal
Response	>Username = hal

GET PASSWORD
SET PASSWORD

The reader can be operated over the network. When operated in this mode it uses a simple username/password authentication scheme to stop unwelcome visitors accessing it. This command allows the password to be defined and obtained.

- A username/password pair is not required when operating the reader via serial connection.

- The default password setting is "password" *NOTE: The password is case sensitive and must be entered in all lowercase.*

Example	
Command	>Get Password
Response	>Password = password
Command	>Set Password = 1234fab
Response	>Password = 1234fab

GET ANTENNASEQUENCE
SET ANTENNASEQUENCE

The reader can support the use of multiple antennas. This command allows the user to select which antenna port(s) to use and in what sequence.

NOTE: Currently, the reader supports only one set of antennas on port 0.

- **If using only one antenna**, you will assign just one antenna port number.

- **To instruct the reader to cycle through the antenna list** on each successive tag read, enter the port designations for all antennas to be used (0 and 1) and the order in which they should be used.

  Multiple antennas are specified by passing in a comma separated list as the argument. An asterisk (*) by a number indicates the antenna currently in use. The default value is 0.

Example	
Command	>Get AntennaSequence
Response	>AntennaSequence = 0*
Command	>Get AntennaSequence
Response	>AntennaSequence = 0, 1*
To always use antenna 1:	
Command	>Set AntennaSequence =1
Response	>AntennaSequence =1
To cycle between antenna 0 and antenna 1:	
Command	>Set AntennaSequence =0, 1
Response	>AntennaSequence =0*, 1

REBOOT

The Reboot command will immediately cause the reader to reboot itself.

Example	
Command	>Reboot
Response	>Reader is rebooting now !

FACTORYSETTINGS

The FactorySettings command will reset all settings in the reader to their default values.

Example	
Command	>FactorySettings
Response	>All settings have been reset !

General Commands – Web Based

General commands are issued via the Web page to manipulate reader and antenna functions and access information.

Web view
General tab
covers all Get
and Set
general
commands...

...Plus

Reboot

and
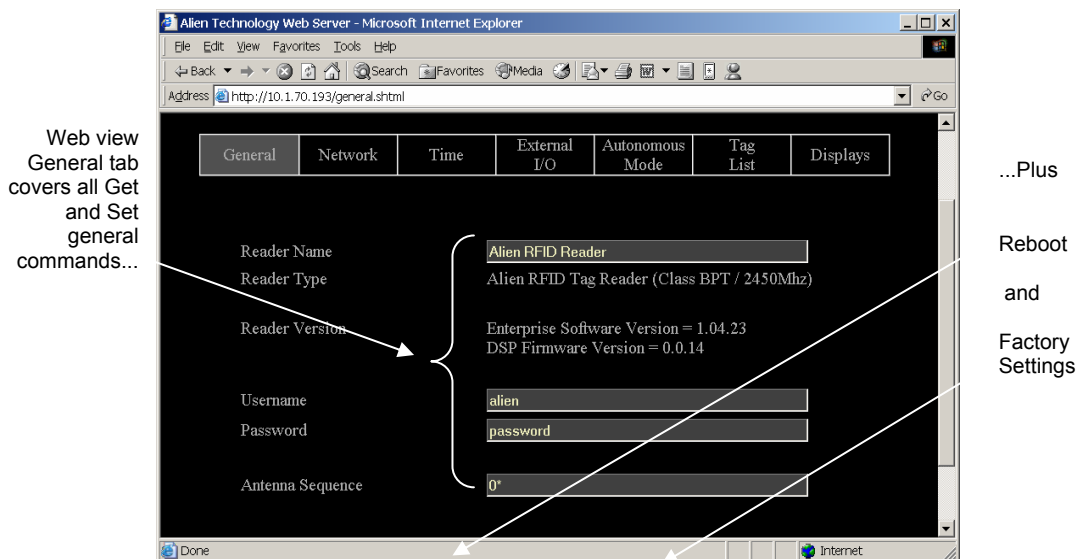
Factory
Settings

COMMANDS/OPERATIONS VIA WEB GENERAL TAB

Command equivalents found on the Web-based "General" tab are:

- Get | Set ReaderName

- Get ReaderType and Reader Version

- Get | Set Username

- Get | Set Password

This screen
lets you
cancel or
continue to
reset reader
to factory
settings.
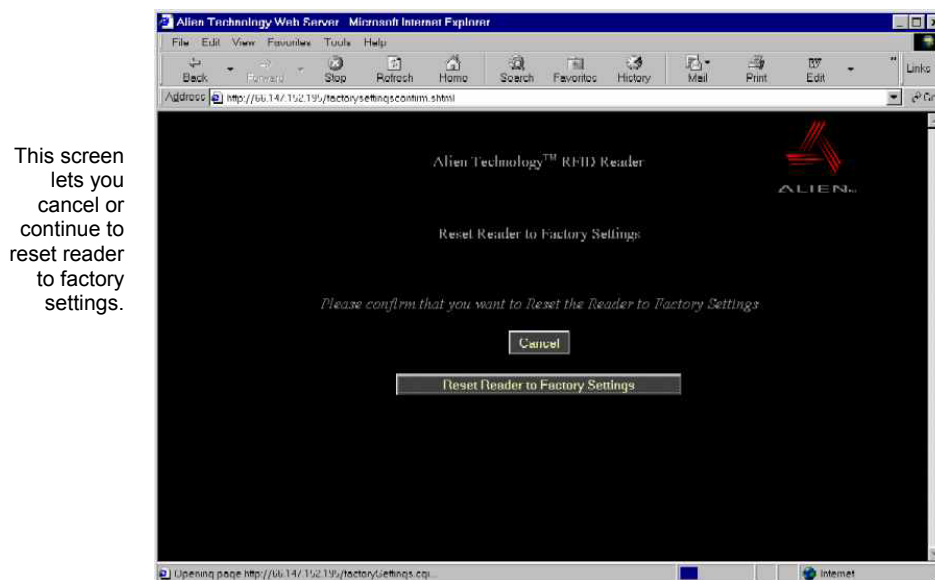
- Get | Set AntennaSequence

- Reboot

- Factory settings (see below)

When you click on the "Reset reader factory settings" option at the bottom of the General tab screen, you will have an opportunity to change your mind before the command is accepted.

At this second screen you may click -[CANCEL] to stop the reset, or you can click the [Reset Reader Factory Settings] button to proceed.

Network Configuration Commands – Text Based

These commands allow you to configure and retrieve settings related to reader communications with the network.

GET **DHCP**
SET **DHCP**

The reader supports automatic network configuration using the widely available DHCP protocol. If DHCP is available at the reader installation site, this protocol can be switched on. If DHCP is not available or not desired the use of this protocol can be switched off.

* Valid command parameters are ON and OFF.

* The default setting is ON.

NOTE: After making changes with this command, you must reboot the reader to implement the changes.

Example	
Command	>Get DHCP
Response	>DHCP=ON
Command	>Set DHCP=OFF
Response	>DHCP=OFF

GET **IPADDRESS**
SET **IPADDRESS**

If DHCP is not used for automatic configuration, the reader must be manually configured for use on a network. The IPAddress command pair allow you to assign and retrieve the host's IP address.

NOTE: After making changes with this command, you must reboot the reader to implement the changes.

Example	
Command	>Get IPAddress
Response	>IPAddress =12.34.56.78
Command	>Set IPAddress =34.55.33.12
Response	>IPAddress =34.55.33.12

GET **GATEWAY**
SET **GATEWAY**

If DHCP is not used for automatic configuration, the reader must be manually configured for use on a network. The gateway command pair allow the network gateway to be assigned and retrieved.

* Gateway must be specified as a numerical IP address.

NOTE: After making changes with this command, you must reboot the reader to implement the changes.

Example	
Command	>Get Gateway
Response	>Gateway=34.56.78.90
Command	>Set Gateway=12.56.23.01
Response	>Gateway=12.56.23.01

GET NETMASK
SET NETMASK

If DHCP is not used for automatic configuration, the reader must be manually configured for use on a network. The subnet mask command pair allow the subnet mask to be assigned and retrieved.

- A subnet mask must be specified as a numerical IP address.

NOTE: After making changes with this command, you must reboot the reader to implement the changes.

Example	
Command	>Get Netmask
Response	>Netask=255.255.255.128
Command	>Set Netmask=255.255.255.0
Response	>Netmask=255.255.255.0

GET DNS
SET DNS

If DHCP is not used for automatic configuration, the reader must be manually configured for use on a network. The DNS command pair allow the DNS server location to be assigned and retrieved.

- A DNS server must be specified as a numerical IP address.

NOTE: After making changes with this command, you must reboot the reader to implement the changes.

Example	
Command	>Get DNS
Response	>DNS=12.34.56.78
Command	>Set DNS=45.224.124.34
Response	>DNS=45.224.124.34

GET HEARTBEATPORT
SET HEARTBEATPORT

The reader can be configured to periodically send out a heartbeat message to the network. This heartbeat takes the form of a single UDP packet (Universal Datagram Packet) broadcast out to the entire subnet that the reader is configured for.

The Set HeartbeatPort command allows you to configure the actual port number that this packet is sent out to.

Listening for this heartbeat can be used to initially locate a reader on a network and subsequently make sure that the reader is still alive.

• The default port setting for this command is 3988

The format of the UDP packet is a single XML document detailing the reader:

```
<Alien-RFID-Reader-Heartbeat>
    <ReaderName>Alien RFID Reader</ReaderName>
    <ReaderType>Alien RFID Tag Reader (Class 1 / 915Mhz)</ReaderType>
    <IPAddress>10.1.60.5</IPAddress>
    <CommandPort>23</CommandPort>
    <HeartbeatTime>30</HeartbeatTime>
</Alien-RFID-Reader-Heartbeat>
```

NOTE: Changes made with this command will take effect immediately.

Example	
Command	>Get HeartbeatPort
Response	>HeartbeatPort=3004
Command	>Set HeartbeatPort=10002
Response	>HeartbeatPort=10002

GET HEARTBEATTIME
SET HEARTBEATTIME

The reader can be configured to periodically send out a heartbeat message to the network. This heartbeat takes the form of a single UDP packet (Universal Datagram Packet) broadcast out to the entire subnet that the reader is configured for.

The time interval between heartbeats can be assigned and retrieved using this command.

• All intervals are specified in seconds.

• A setting of zero (seconds) will suspend the output of any further heartbeats.

• The default setting for this command is 30 seconds.

NOTE: Changes made with this command will take effect immediately.

Example	
Command	>Get HeartbeatTime
Response	>HeartbeatTime=30
Command	>Set HeartbeatTime=60
Response	>HeartbeatTime=60

GET COMMANDPORT
SET COMMANDPORT

The reader can be configured and operated over the network using standard network sockets. The CommandPort settings are used to assign and retrieve the exact port number used by the reader for this network connectivity.

•   The default setting for this command is 23 (the standard Telnet port)

Changes to this setting do not affect serial communication and/or Web communication with the reader.

NOTE: Changes made with this command will take effect immediately.

Example	
Command	>Get CommandPort
Response	>CommandPort=23
Command	>Set CommandPort=10004
Response	>CommandPort=10004

Network Commands – Web Based

Network commands are issued via the Web page to set up and access reader networking parameters.

Web view
Network tab
covers all Get
and Set
network
commands.

Toggles DHCP
On and Off
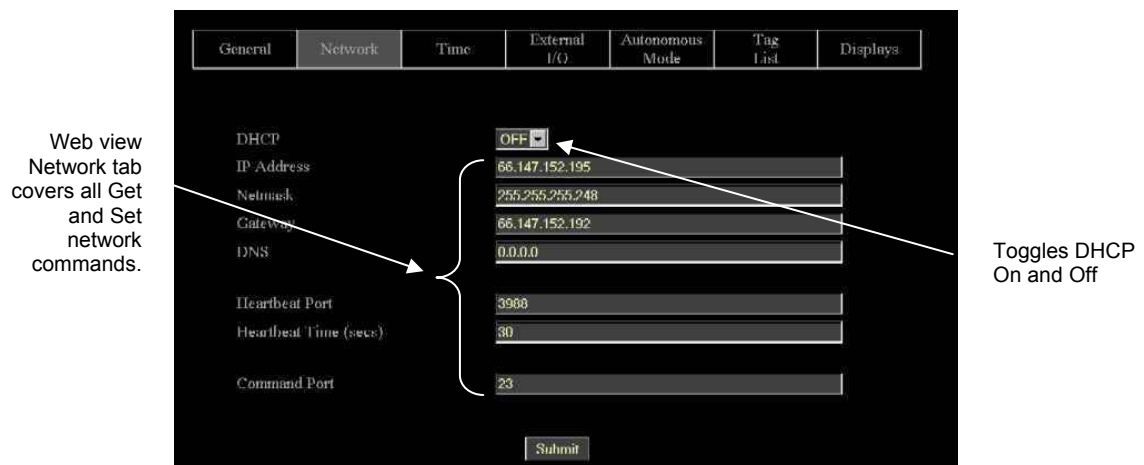
COMMANDS/OPERATIONS VIA WEB NETWORK TAB

Command equivalents found on the Web-based "Network" tab are:

•   Get DHCP

- Set DHCP (toggles DHCP On and OFF)

- Get | Set IPaddress

- Get | Set Gateway

- Get | Set Netmask

- Get | Set DNS

- Get | Set HeartbeatPort

- Get | Set HearbeatTime

- Get | Set CommandPort