ALIEN TECHNOLOGY

# NANOSCANNER READER

**2450MHz Battery System**
**v01.02.00**

# USER GUIDE

ALIEN™

**2450MHz Battery**

## Copyright Acknowledgements



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



## 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

**To meet FCC/Industry Canada RF Safety guidelines, 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. This device must not be co-located or operating in conjunction with any other antenna or transmitter. 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

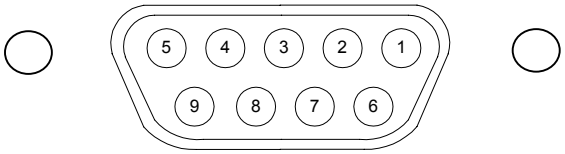
| | |
|---|---|
| **Name** | Nanoscanner Reader |
| **Part Number** | 0500017-001 |
| **Model Number** | B2450R01-A |
| **Architecture** | Point-to-multipoint reader network |
| **Frequency** | 2410 MHz – 2471.64 MHz |
| **Hopping Channels** | 75 |
| **Channel Spacing** | 833 KHz |
| **Channel Dwell Time** | < 0.3 Seconds |
| **RF Transmitter** | < 30 dBm |
| **Modulation Method** | On Off Keying (OOK) |
| **20 db Modulation Bandwidth** | 500KHz |
| **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** | 2410 MHz – 2471.64 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.*

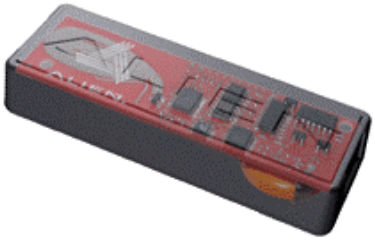
### OTHER COMPONENTS

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

## Tag Overview

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


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



### FEATURES AND BENEFITS

- Long-range tag/sensor/actuator – up to 30 meters
- 2450MHz, FCC Part 15 unlicensed power levels
- 12 byte ID (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

### 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

### BENEFITS OF BATTERY-POWERED OVER BEAM-POWERED BACKSCATTER TAGS

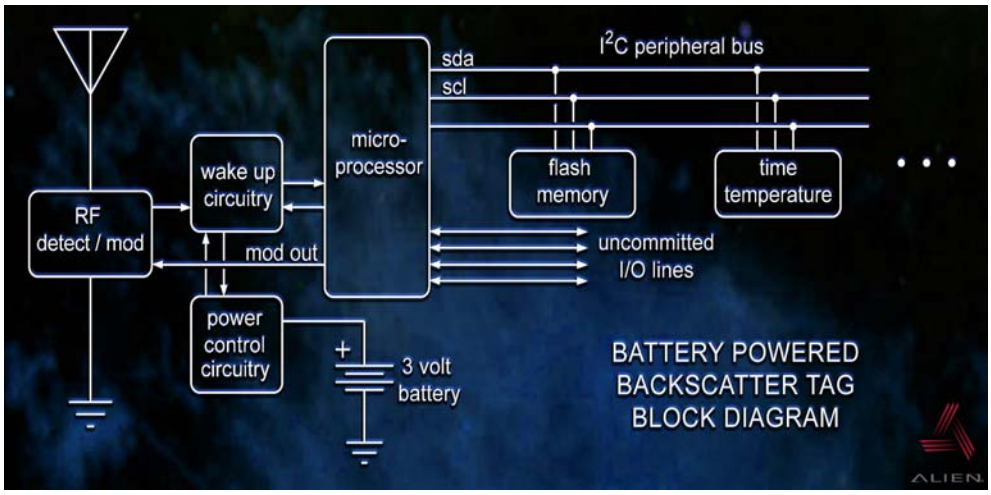
- Higher performance-to-price ratio
- Monitoring (e.g., temperature logging, time-based tamper detection)
- Better accuracy (longer range = more margin at a shorter range
- Lower-power readers (unlicensed)
- Multi-region (worldwide) antenna (Only needs to modulate and backscatter the reader‘s signal. 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.



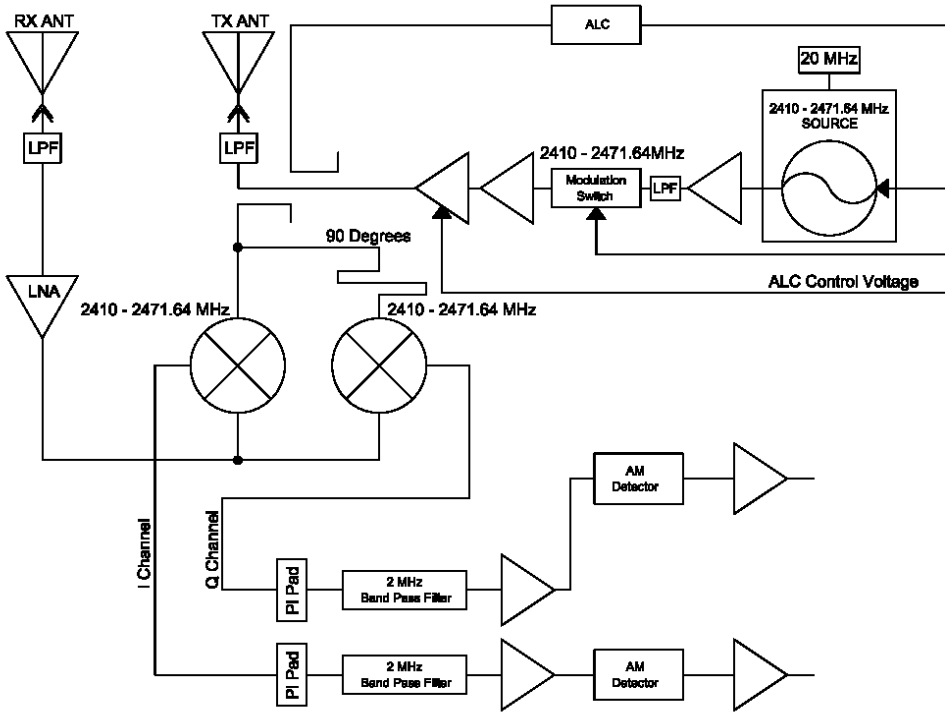

## Applications for 2450 MHz Battery-powered Backscatter Tag/Reader Systems

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

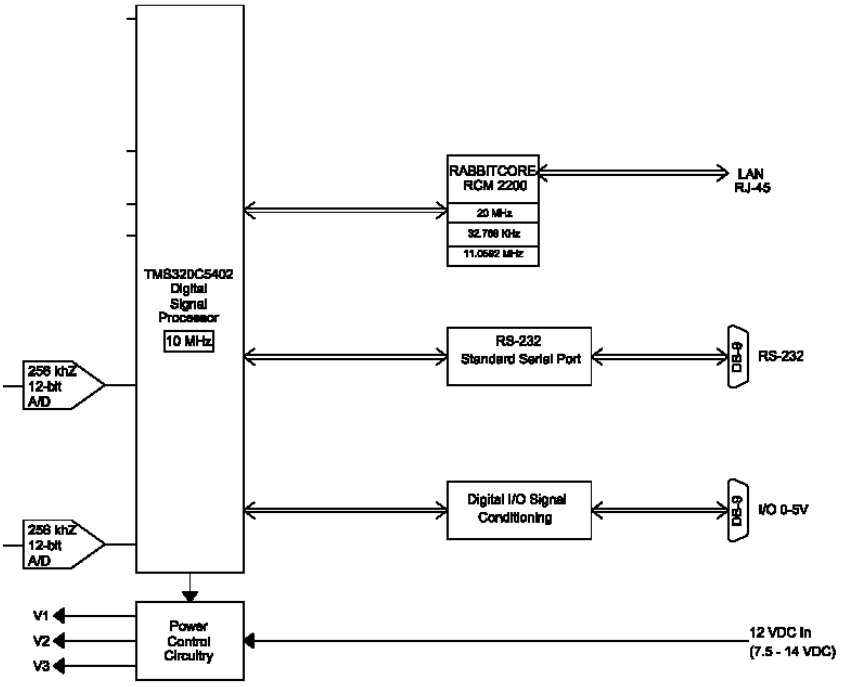
- Long range identification
- Vehicle-asset tracking
- Supply chain automation
- Time temperature monitoring
- Tamper detection (safe/secure supply chain)
- Security/ access systems
- Sensor monitoring
- Immobilizer / beeper / LED (can control outputs)
- Passive tag data storage for hierarchical asset tracking systems
- Location capability has been proven

## Reader Block Diagrams

### 2450 MHz Reader Front End




### 2450 MHz Reader Logic Blocks



# 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 (Tx), 1 receive (Rx)) 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

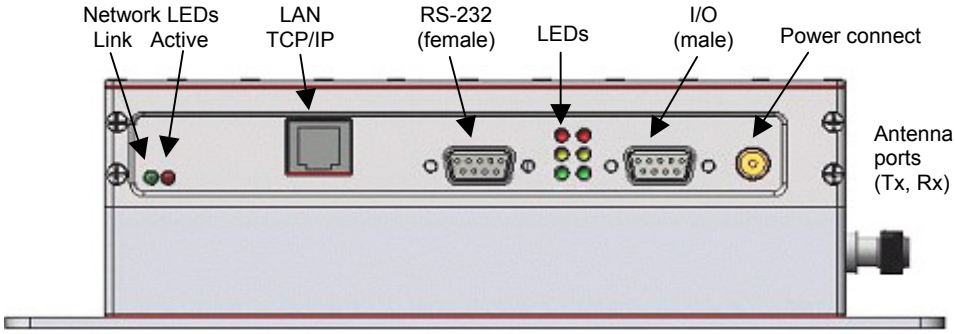
## Nanoscanner Reader Features

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:

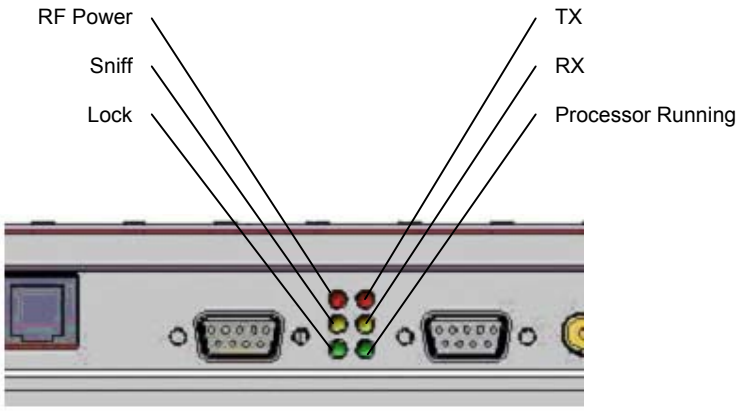
- Network LEDs (2)
- LAN TCP/IP port
- 9-pin D male I/O port
- Reader LEDs (6)
- 9-pin D female RS-232 serial port
- Power connector




*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:



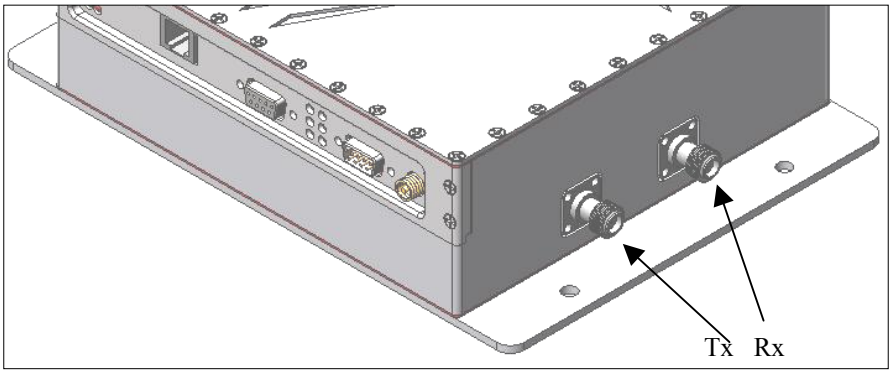

*Reader LED designations on I/O panel*

| Reader LEDs | | | | |
|---|---|---|---|---|
| **Left Column LEDs** | | | **Right Column LEDs** | |
| **Red** | **RF on** | | **Red** | **Comm TX**<br>Communications transmit to processor |
| **Yellow** | **Sniff**<br>Detect tag signal | | **Yellow** | **Comm RX**<br>Communications receive from processor |
| **Green** | **Lock**<br>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 connectors (reverse gender)*

Use the antenna marked Tx on the Tx connector and the antenna marked Rx on the Rx connector.

# System Assembly and Bench Test

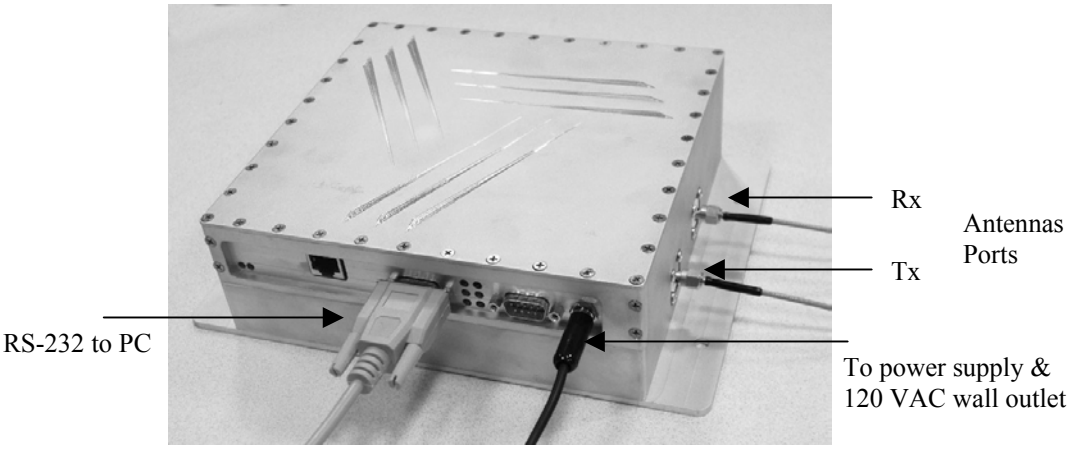
Assembling the Nanoscanner reader system is very easy.

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

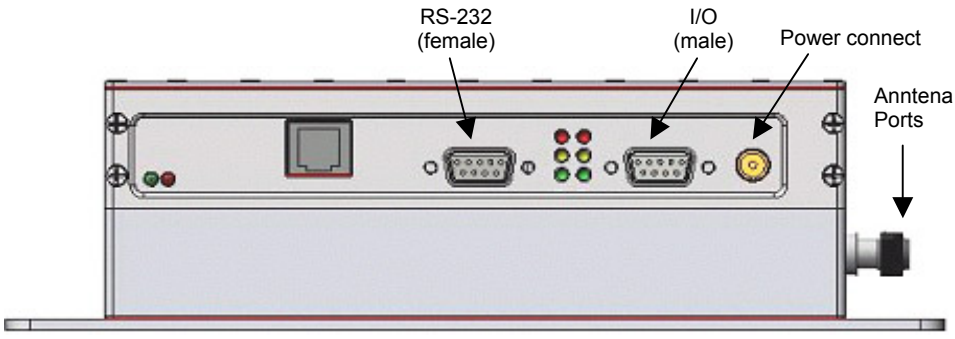
You will need two available 120 VAC wall outlets.

## 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.



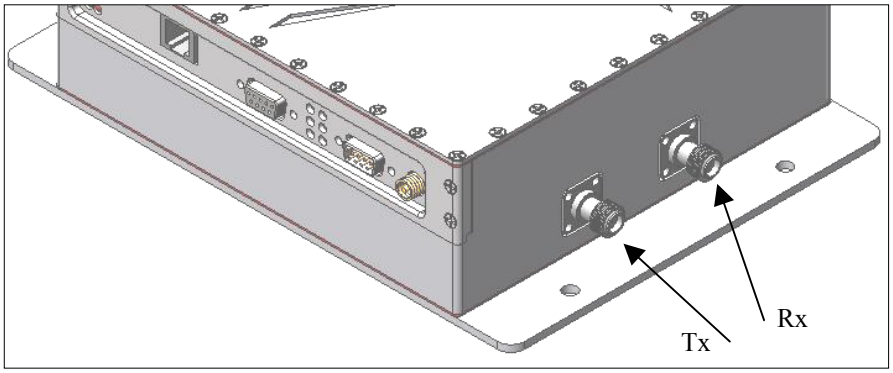

2. **Connect the RS-232 cable to the reader.**
   - Align the cable connector so that its shape and pins match the shape and holes of the DB-9 serial port.
   - Push the aligned connector into the port.
   - Finger-tighten the screws to secure the cable/connector to the reader.




*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 connectors.**
   - Connect the antenna marked Tx to the Tx connector of the reader and connect the antenna marked Rx on the Rx connector.
   - 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

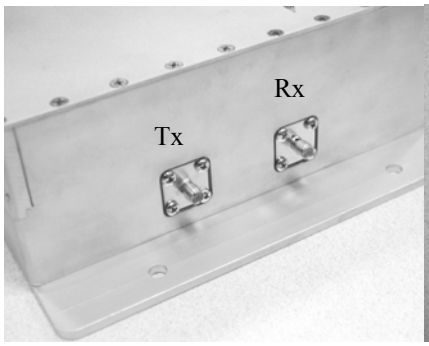
Installation involves all the same connection steps required for bench test. However, instead of situating equipment on a tabletop, the reader and antenna and their accessories will mounted in your application environment.

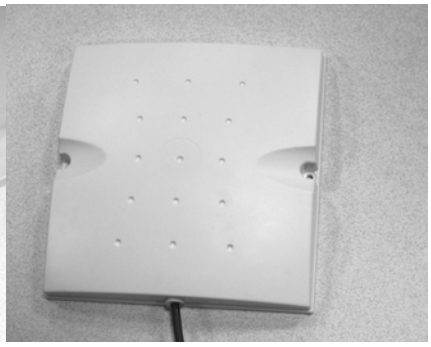
Antennas should be mounted at least ½ meter (1.5 ft) apart, situated at the average height at which tags are expected to be presented to the system.

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:*** *To meet FCC/Industry Canada RF Safety guidelines, 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. This device must not be co-located or operating in conjunction with any other antenna or transmitter. 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* for further information.

# CHAPTER 3
# Nanoscanner System Fundamentals

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

Specific instructions for setting up a reader are provided in the chapter *Reader-Host Communications Installation*.

Reader commands and their uses are covered in the chapter *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 1 / 915Mhz)</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 [ipAddress]" 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.

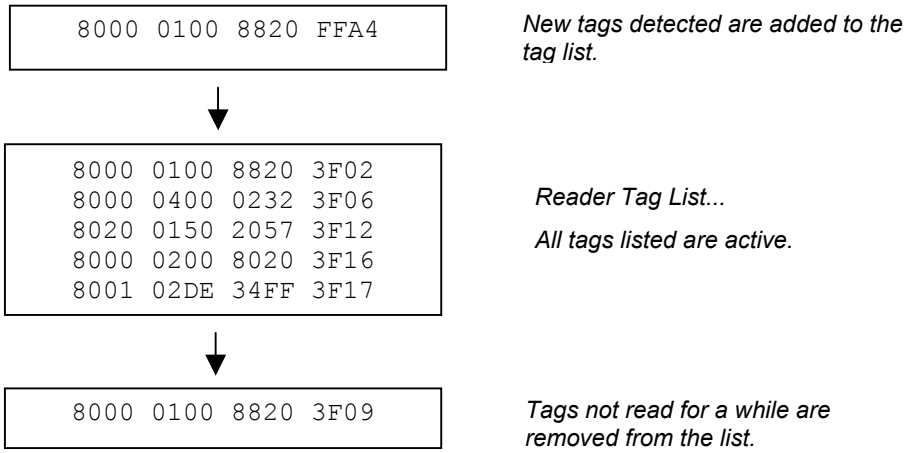
The Alien RFID Gateway application, also bundled with the development kit, uses the Java version of these libraries to build its active reader list on the main screen.

# 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.




*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 64-bit ID, followed by a 16 bit checksum (used to verify the ID was correctly 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 1000 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 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, CRC:97FC, Disc:2003/01/21 02:24:00, Count:1, Ant:0
Tag:1155 8B14 5661 D40B, 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</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 </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 can then optionally 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.)

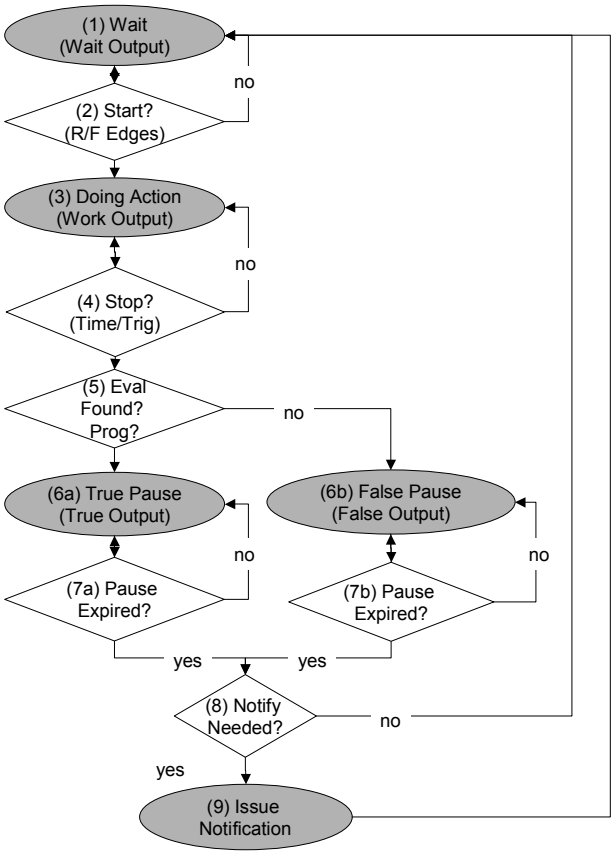
The user puts the reader into Autonomous Mode with the `AutoMode` command. `Set AutoMode = On` puts the Reader into Autonomous Mode. `Set AutoMode = Off` returns it to Interactive Mode.

**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

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 WITH 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 |
| TRUEFALSE | Send messages when the evaluation task of the autonomous state loop evaluates to true or false |

## 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<br>*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 |
| custom | Tag lists are sent out as plain text messages, each line being defined by the TagListCustomFormat specification |

- Text formatted tag lists take the form:

```
#Alien RFID Reader Auto Notification Message
#ReaderName: Spinner Reader
#ReaderType: Alien RFID Tag Reader (Class 1 / 915Mhz)
#IPAddress: 10.1.70.13
#CommandPort: 23
#Time: 2003/01/21 12:48:59
#Reason: TEST MESSAGE
Tag:1115 F268 81C3 C012, CRC:2483, Disc:2003/01/21 09:00:51, Count:1, Ant:0
Tag:0100 0100 0002 0709, CRC:8594, Disc:2003/01/21 11:00:10, Count:1, Ant:0
Tag:1054 A334 54E1 7409, 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 1 / 915Mhz)</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</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</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
# Tag Reading Fundamentals

This chapter provides an overview of the major tag reading concepts found in all Alien RFID systems.

A good understanding of this chapter is highly recommended to get the most of out this Nanoscanner system.

## Introduction

RFID tag reading is not just about getting the tag ID from a tag into the reader. There are different methods available to perform this basic operation, and different parameters and settings that can be altered to tweak the performance of this basic operation.

## Acquire Mode

The Acquire Mode defines the method used to read tags in the field. There are two distinct methods for reading tags, and the choice of one method over another depends on the application at hand.

The Acquire Mode is specified by issuing the '`Set AcquireMode`' command. It can take one of two values, '`inventory`' or '`global scroll`'.

#### GLOBAL SCROLL

Global Scroll is the most primitive of tag ID reading operations supported by the Alien Nanoscanner system. When a global scroll command is issued, the Nanoscanner sends a single command over the air to all and any tags. That command is simply a request for any tag to immediately send back its ID to the Nanoscanner.

The simplicity of this command is both its advantage and its downfall: The command is very quick to execute as it involves only one round trip between the reader and the tag. However because the command is so simple, problems will arise if there are more than one tag in the field. At this point, multiple tags will all receive the same command, and will all send back their ID to the reader at the same time. A case such as this makes it very difficult for the reader to discern individual IDs among the general noise. Typically one or two of the loudest or closest tags will be decoded, but the majority will not be discerned.

This is analogous to walking into a dark room full of people and shouting out the command "if anyone can hear me, shout your name back now". If there is one person in the room with you, you will be able to hear their name. If there are multiple people in the room, the results will be noise. Maybe you will be able to make out one or two names, but typically not more than that.

There are many applications where global scroll is the best tag reading method to use. These applications typically expect just one or two tags in the field of view at any one time, such as conveyor belt applications or toll-booth application. For these systems, global scroll outperforms a full inventory by a factor of 3 as far as individual read rates are concerned.

### INVENTORY

The inventory command is a full featured system for discerning the IDs of multiple tags in the field at the same time. This single high-level command transforms itself into a complex series of reader-tag interrogations, that eventually resolve themselves into a single list of tag IDs seen by the Nanoscanner. This method of interrogation and evaluation of multiple tags is known as an anti-collision search.

Continuing the analogy used in the global scroll description, the anti-collision sort works in the following way: You walk into a dark room full of people and instruct everyone to stand up. Then you start with the letter 'A' and tell anyone who's name begins with this letter to shout their name back. You may get zero replies, one reply or multiple noisy replies. If you can clearly make out any individual name from the noise, you shout back telling that person to sit down and be quite from now on. Next repeat the series of events, this time telling anyone who's name begins with 'AA' to shout back their name. If you can pick out one name, tell that person to sit down and be quite. You repeat this until no names are heard at all, each time adding a letter such as 'AB', 'AC'. When it gets to the point that there are no more names to be heard, you move on to the letter 'B' and repeat the series. By the time you've been through the letter 'Z', you should have been able to get everyone's name, and everyone should be sitting down. At this point the sort has been finished.

Obviously this sort algorithm is far more complex than the global scroll algorithm, requiring many more reader-tag instructions. However the Alien Nanoscanner considerably optimizes this basic sort method, and in doing so still provides a very fast and efficient sort algorithm.

### COMPATIBILITY CHART

The following chart shows which Alien systems support the different Acquire Modes.

| | 915 MHz Passive | 2450 MHz Passive | 2450 MHz Battery |
|---|---|---|---|
| Global Scroll | ✔ | ✔ | ✔ |
| Inventory | ✔ | ✔ | ✔ |

# Masks and Tag Memory Structure

Many commands aimed at Alien RFID tags require the setting of a mask, which directs the commands only at the tags who's ID matches the mask. This mechanism allows commands to be sent to one specific tag, a selective group of tags or the whole field of tags.

However to understand the use of masks, a basic understanding of tag memory structure is first required.

### CLASS I TAG MEMORY

Class I tags from Alien contain 96 bits of programmable memory, of which 64 bits are user-programmable. The remaining 32 bits are controlled by the reader to record state and checksum information inside the tag.

| | Checksum | | EPC Code (or User ID Code) | | | | | | | | Lock | PC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Bit | 0-7 | 8-15 | 16-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | 80-87 | 88-95 |

*Class I Tag Memory Structure*

Tag memory is address from left to right, where the leftmost byte is byte zero, and the leftmost bit is bit zero.

The 64 bit ID code (either a fully qualified EPC code or user-defined ID code) resides from bytes 2 to 9, or bits 16 to 79.

Bytes 0 and 1 contain a 2 byte checksum calculated over the 64 bits of tag ID only. The checksum is calculated and programmed into the tag automatically by the reader. This checksum is calculated using the CCITT-16 standard.

The Lock and Pass Code (PC) bytes stored at the end of tag memory are used to lock a tag and kill a locked tag. Each of these codes takes exactly one byte. The user can control the value of the pass code, passing it in as a parameter to the Lock command. The reader takes full control of the Lock byte, allowing it to flag the tag as either locked or unlocked.

(For further details on programming tag IDs and tag memory, please see the Tag Programming Guide).

### CLASS BPT TAGS

Class BPT tags from Alien support 96 bits of programmable ID memory. Unlike the Class I tag, all 96 bits are user-addressable and user-programmable. There are no pre-requisites for the content of this memory space.

| | EPC Code (or User ID Code) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Bit | 0-7 | 8-15 | 16-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | 80-87 | 88-95 |

*Class BPT Tag Memory Structure*

### MASK COMMAND FORMAT

The Mask command is a simple get and set pair, where the parameters comprise three parts:

- Bit Length of Mask, as a decimal number
- Bit Pointer of Mask, as a decimal number
- Array of Hex Bytes separated by white spaces

### ADDRESSING ALL TAGS

The simplest mask setting is one that addresses all tags in the field. This is specified with the command parameter of 'all', or can be specified using the three parameters method, where length = 0, pointer = 0, and data = 0. i.e.,

```
Set mask = all
```

Or

```
Set mask = 0, 0, 0
```

Issuing a command such as global scroll (i.e., set acquiremode=global scroll; get taglist) will cause all tags in the field of view to return their tag IDs to the reader. If there are multiple tags in the field, this may result in un-discernable noise.

### ADDRESSING A SINGLE TAG

The next simplest use of a mask is the exact singulation of a tag. By setting the mask to be the full tag ID of a known tag, the Nanoscanner will send out commands addressed to that tag only. No other tags will respond. This mode of operation is particularly useful for the battery tags that can have their memory or sensor interrogated.

For example, given that there is a known battery tag in the field with a tag ID of `'8000 0000 8001 0203 0300'`, the following mask setting can be used:

```
Set mask = 96, 0, 80 00 00 00 80 01 02 03 03 00
```

Subsequent commands to `get sensorvalue` will now be directed solely at this tag, and be answered only by this tag.

### ADDRESS A SUBSET OF TAGS

One of the more useful, but more complex applications of the mask command is to address a subset of tags in the field. This is achieved using partial masks.

For example, the following mask command can be issued to address only tag IDs that start with the numbers '8000 0040':

```
Set mask = 32, 0, 80 00 00 40
```

i.e., length = 32 bits, (4 x 8 bytes), starting at bit zero from left.

Subsequent commands that use a mask will now only be replied to by a tag that starts with this tag ID. This can be useful if for example the reader is scanning food items, but is only interested in finding a certain brand of breakfast cereal. By setting the mask to identify only the breakfast cereal tag IDs, any acquire command on the food items will only return the items of interest. This methodology works particularly well when combined with the EPC code strategy, where each product type and manufacture code use well defined memory codes that can be masked.

Another example is to search for all Class I tags whose last 3 bits of EPC code are set to one. The mask settings for this would be:

```
Set mask = 3, 77, 7
```

i.e., length = 3 bits, starting at bit 77, and matching value 7 (binary 111)

**NOTE:**
- Class I tag IDs start at bit 16 of tag memory
- Class BPT tag IDs start at bit 0 of tag memory

#### COMPATIBILITY CHART

The following chart shows which Alien systems support Masks with various commands.

| | 915 MHz Passive | 2450 MHz Passive | 2450 MHz Battery |
|---|---|---|---|
| Global Scroll | ✔ | ✔ | ✔ |
| Inventory | ✘[1] | ✘[1] | ✘[1] |
| | | | |
| Wake | ✔ | ✔ | ✔ |
| Sleep | ✔ | ✔ | ✔ |

1. Future releases of the Nanoscanner firmware will support Masked Inventory.

## Persistent Sleep and Wake

Tags have the ability to be put to sleep and awakened on command. Once tags have been put to sleep they will ignore any subsequent commands, even if addressed directly to them. The only command that these slept tags will respond to is wake, which will bring them back to life and make them respond to all commands again.

The Sleep and Wake commands can act together in a powerful way to help address multiple tags in the field.

By default the inventory and global scroll commands will read tags in the field, and leave them in an awake state. This means that the very next time an acquire action is made, the same tags will answer back to the reader, resulting in an identical tag list.

However it is possible to sleep tags are they are found. Both the inventory and global scroll modes support this action. In this scenario, as a tag is discovered by the reader, it is told to sleep. The very next time an acquire command is issued, the reader will scan the field of tags, but as they are all asleep, they will not answer and the tag list returned will be empty.

The effects of the sleep-as-found mode can be reverted at any time by issuing a Wake command. This will immediately wake up all tags in the field of view, making them ready for subsequent acquire commands.

This is a useful mode to use when dealing with very large numbers of tags in the field at once (>100 tags). Using these modes, the acquire command can discern as many tags as it can in one pass, leaving these tags asleep as it finds them. Then any subsequent acquire commands will now only be dealing with tags it missed in previous rounds, or tags that have entered the field since the last round. Thus a large population of tags can be sorted in smaller, more manageable rounds.

Wake, Sleep and Acquire commands can all be entered at the command line interface in interactive mode. However there are also two parameters that can be used to automate these functions:

#### ACQUIRESLEEP

The AcquireSleep command accepts either an `On` or `Off` parameter. If set to `On`, all subsequent acquire commands will sleep tags as they are found. If set to `Off`, all subsequent acquire commands will leave a tag awake once it has been read.

#### ACQUIREWAKECOUNT

The AcquireWakeCount is the partner parameter to the AcquireSleep count. AcquireWakeCount takes a single integer argument that determines after how many acquire commands should a Wake command be issued. If this is set to zero, Wake commands will never be automatically issued. If set to 10, a Wake command will be issued after every 10 acquire commands.

### SLEEP, WAKE AND MASKS

The Sleep and Wake commands always work with the current Mask setting. Therefore it is possible to Sleep a subset of tags before performing an acquire, or to Sleep all tags, then Wake a subset before acquire. Combining Sleep, Wake, Masks and Acquire Modes offers up many interesting possibilities for tag reading that will virtually address all problems in the field.

### COMPATIBILITY CHART

The following chart shows which Alien systems support Persistent Sleep and Wake commands.

| | 915 MHz Passive | 2450 MHz Passive | 2450 MHz Battery |
|---|---|---|---|
| Wake | ✗[1] | ✗[1] | ✔ |
| Sleep | ✗[1] | ✗[1] | ✔ |

1. Future releases of Class I tags from Alien Technology will support Persistent Sleep and Wake (expected Summer 2003)

# CHAPTER 5
# 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.

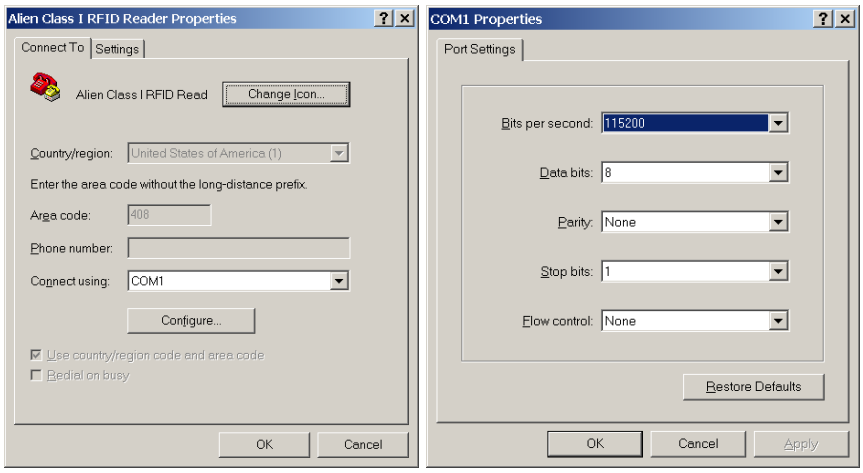
3. Launch the desired serial communications program (such as HyperTerminal which is supplied with Windows 98 and 2000).

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

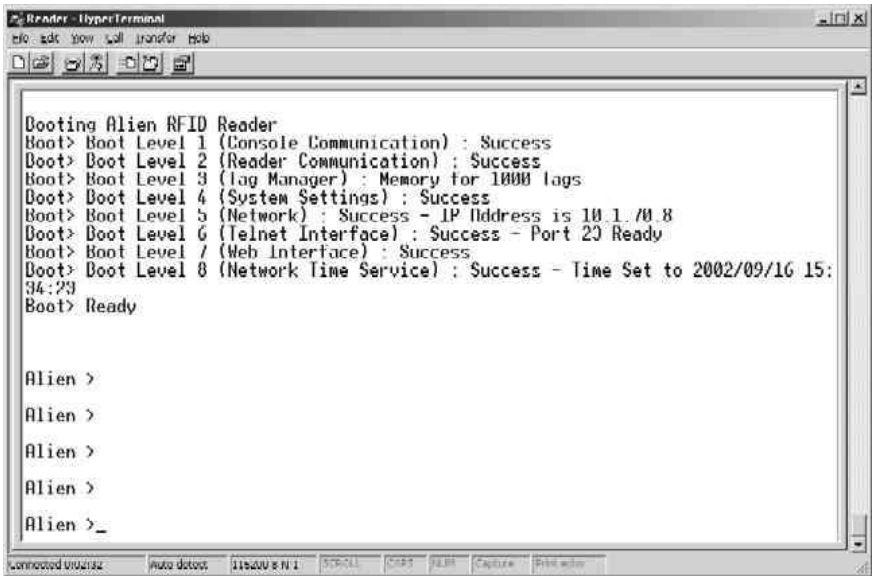
   - Baud Rate: 115200
   - Data Bits: 8
   - Parity: None
   - Stop Bits: 1
   - Flow Control: None

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 the chapter entitled *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:

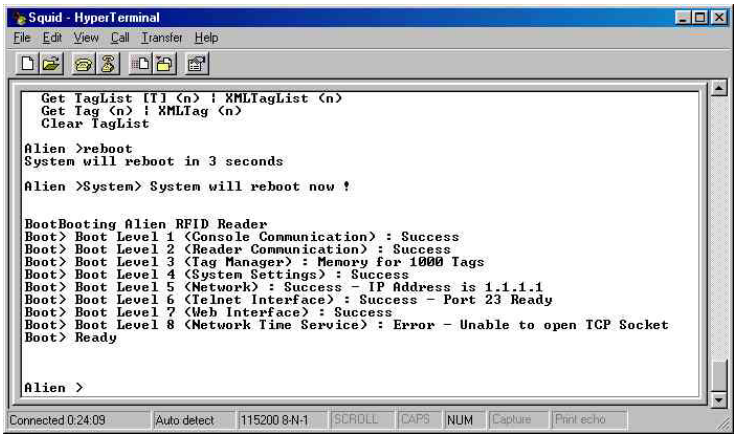
   IPaddress
   Netmask (or sub-netmask)
   Gateway
   DNS

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.

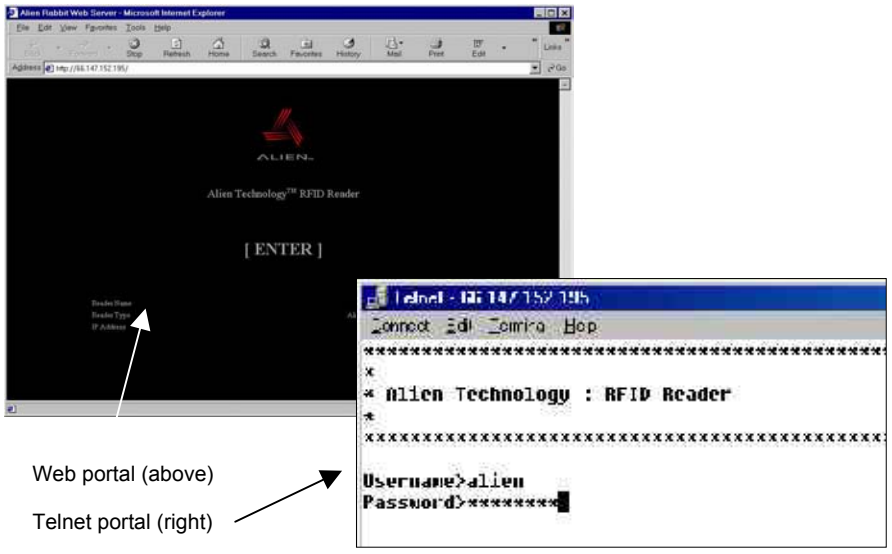



***To verify your network connection to the reader:***

10. Launch a browser.

11. Enter the reader’s assigned IP address into the web page location bar.

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




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, *Reader-Host Protocol*.

# CHAPTER 6
# 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 the chapters entitled: *Nanoscanner System Fundamentals* and *Tag Reading Fundamentals*.

For instructions on setting up reader operation via a host computer, see the chapter entitled *Reader-Host Communications Installation*.

## Reader Operation Overview

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

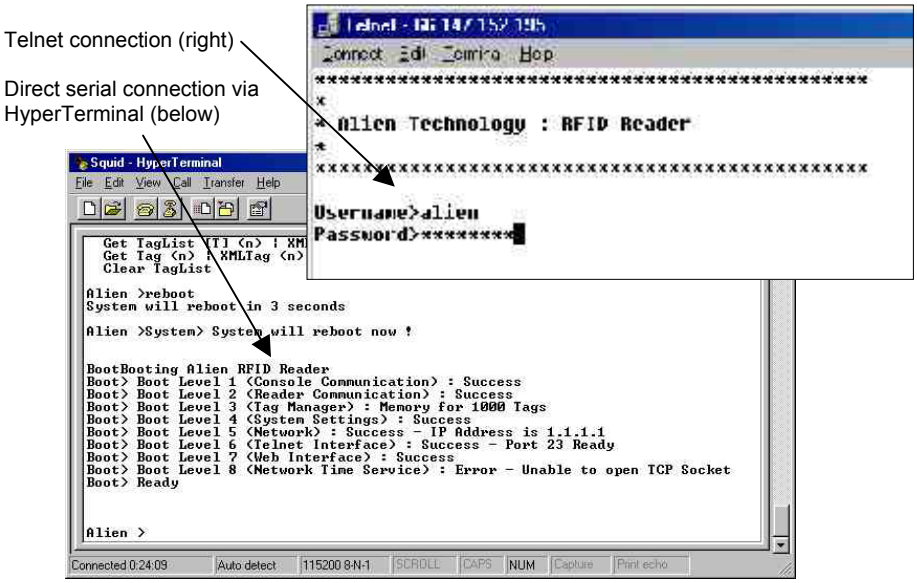
- Text-based command line operation (via direct serial or Telnet connection)
- Web-based HTML operation

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 Exceptions:***

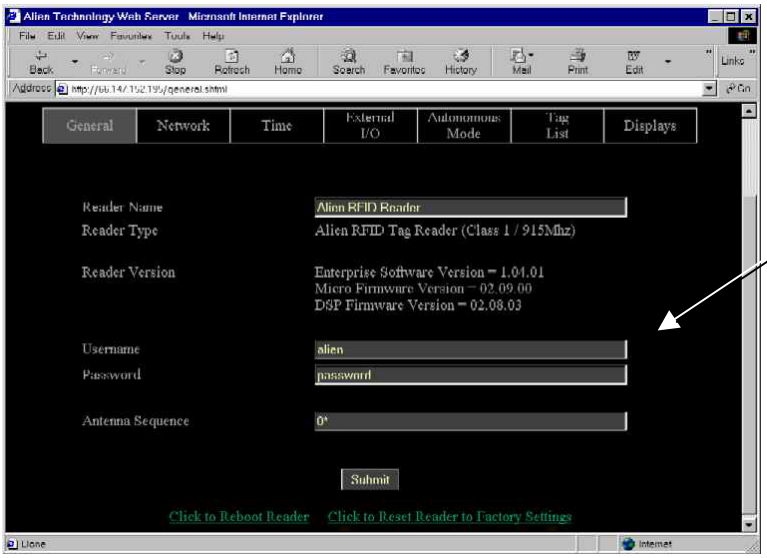
- *In Telnet operation you must issue the command "Q" to quit the session.*
- *Accessing reader controls via Telnet requires an authorized user name and password (both of which can be changed via the General command set).*

## 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 insensitive, 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 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<br>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<br>Set Username | Get and Set the Username used for the Network based access control. |
| Get Password<br>Set Password | Get and Set the Password used for the Network based access control. |
| Get AntennaSequence<br>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<br>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<br>Set IPAddress | Set and Get the network ID (IP Address) of the reader. If DHCP is enabled this will be set automatically. |
| Get Gateway<br>Set Gateway | Set and Get the network gateway. If DHCP is enabled this will be set automatically. |
| Get Netmask<br>Set Netmask | Set and Get the subnet mask. If DHCP is enabled this will be set automatically. |
| Get DNS<br>Set DNS | Set and Get the domain name server. If DHCP is enabled this will be set automatically. |
| Get HeartbeatPort<br>Set HeartbeatPort | The reader periodically sends out heartbeat messages to the network. The port over which this is done can configured. |
| Get HeartbeatTime<br>Set HeartbeatTime | Set and Get the time interval, in seconds, between successive heartbeats. |
| Get CommandPort<br>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<br>Set Time | Get and Set the real time clock on the reader in Local time. |
| Get TimeZone<br>Set TimeZone | Get and Set the time zone offset from UTC for the real time clock. |
| Get TimeServer<br>Set TimeServer | Get and Set the location of a network time server. |

### EXTERNAL IO COMMANDS

| Command | Description |
|---|---|
| Get ExternalOutput<br>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<br>Set AcquireMode | Specify how the Nanoscanner reads tags. |
| Get AcquireSleep<br>Set AcquireSleep | On or Off setting that determines whether tags are slept as they are read |
| Get AcquireWakeCount<br>Set AcquireWakeCount | Specify how often to issue a Wake command to all tags in the field |
| Set Mask<br>Get Mask | Get and Set the current mask as an array of bytes. |
| Get PersistTime<br>Set PersistTime | Get and Set the persistence time for tags in the tag list. |
| Get TagList (n) | Get the current list of active tags from the reader. |
| Get TagListFormat<br>Set TagListFormat | Set and Get the format for tag lists. |
| Get TagListCustomFormat<br>Set TagListCustomFormat | Specify a custom format for text based tag lists. |
| Clear TagList | Clear the list of active tags on the reader. |
| Wake | Wake tags addressed by the Mask settings |
| Sleep | Sleep tags addressed by the Mask settings |

### AUTONOMOUS MODE COMMANDS

| Command | Description |
|---|---|
| Get AutoMode<br>Set AutoMode | Switch auto mode on and off. |
| Get AutoWaitOutput<br>Set AutoWaitOutput | Specify the value of the output pins while in wait mode. |

| | |
|---|---|
| Get AutoStartTrigger<br>Get AutoStartTrigger | Get and Set the trigger that sends the auto mode state into working state. |
| Get AutoWorkOutput<br>Set AutoWorkOutput | Specify the value of the output pins while in work mode. |
| Get AutoAction<br>Set AutoAction | Get and Set the action to perform in auto mode. |
| Get AutoStopTrigger<br>Set AutoStopTrigger | Set and Get the external trigger that will move the auto mode state from work mode to evaluate mode. |
| Get AutoStopTimer<br>Set AutoStopTimer | Set and Get the timer that will move the auto mode state from work mode to evaluate mode. |
| Get AutoTrueOutput<br>Set AutoTrueOutput | Specify the value of the output pins when the auto mode evaluation returns a True condition. |
| Get AutoTruePause<br>Set AutoTruePause | Set and Get the pause time after the auto mode evaluation returns a True condition. |
| Get AutoFalseOutput<br>Set AutoFalseOutput | Specify the value of the output pins when the auto mode evaluation returns a False condition. |
| Get AutoFalsePause<br>Set AutoFalsePause | Set and Get the pause time after the auto mode evaluation returns a False condition. |
| Get AutoModeStatus | Get the current status of auto mode. |
| AutoModeReset | Reset all automode values to their default states. |
| AutoModeTriggerNow | Force a trigger event to occur if AutoStartTrigger is waiting for a trigger. |

### NOTIFY MODE COMMANDS

| Command | Description |
|---|---|
| Get NotifyMode<br>Set NotifyMode | Switch notify mode on and off. |
| Get NotifyFormat<br>Set NotifyFormat | Get and Set the format for tag lists pushed out in notify mode. |
| Get NotifyAddress<br>Set NotifyAddress | Get and Set the address to push tag lists to. |
| Get NotifyTime<br>Set NotifyTime | Get and Set the time interval for automatically pushing tag lists. |
| Get NotifyTrigger<br>Set NotifyTrigger | Get and Set the trigger for pushing tag lists. |
| Get MailServer<br>Set MailServer | Set and Get an SMTP mail server. This is only required if notification email messages are sent out. |
| Get MailFrom<br>Set MailFrom | Set and Get the email address of the Nanoscanner. |
| 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 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<br>Micro Firmware Version = 02.04.18<br>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 antenna ports 0 and 1.*

- **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

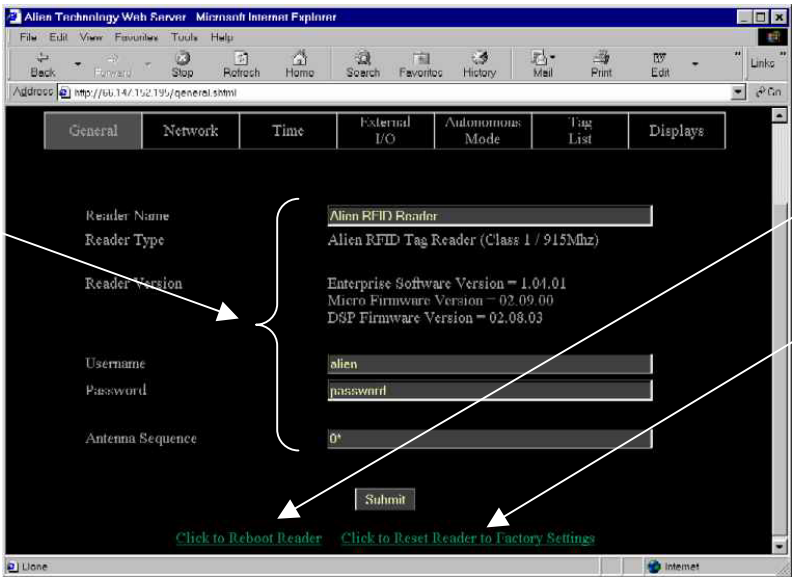
The FactorySettings command will reset all settings in the reader to their default values.

| 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

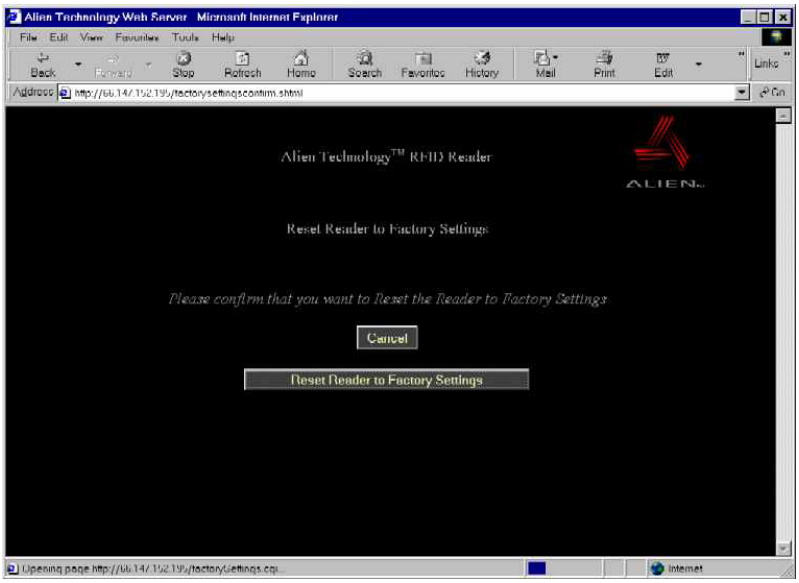
### COMMANDS/OPERATIONS VIA WEB GENERAL TAB

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.

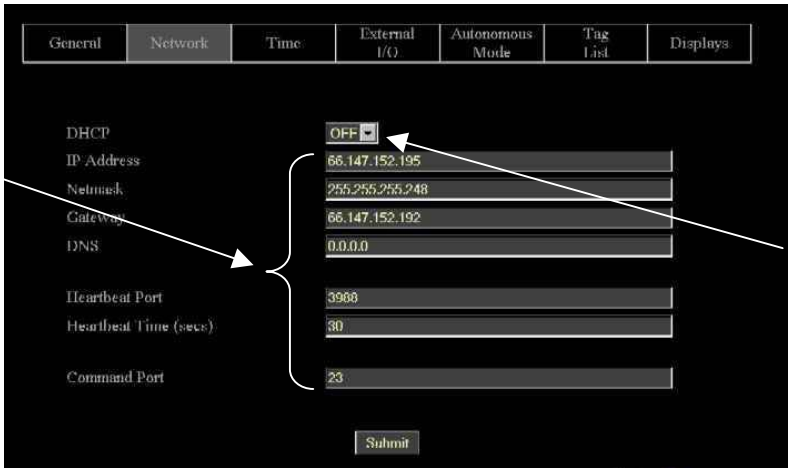
*NOTE: Changes made with this command will take effect immediately.*

| 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

## Time Commands – Text Based

The time at which tags are read by a reader is particularly important for many applications. For this reason, the reader has three time commands to ensure that the onboard real-time clock is always set accurately.

**GET TIME**
**SET TIME**

These commands allow the current time to be assigned to or retrieved from the reader.

- Times used by this command are always specified in local time, as defined by the TimeZone command.
- Times are always specified by the format YYYY/MM/DD hh:mm:ss.

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

| Example | |
|---|---|
| Command | >Get Time |
| Response | >Time = 2002/6/3 9:23:01 |
| | >Set Time = 2002/6/3 19:23:01 |
| | >Time = 2002/6/3 19:23:01 |

**GET TIMEZONE**
**SET TIMEZONE**

These commands allow the current time zone to be assigned to or retrieved from the reader. The time zone specifies the number of hours that must be added to or subtracted from UTC (Coordinated Universal Time; also known as GMT or Zulu) to determine a local time reference.

For example, to convert from UTC to Pacific Standard Time, set the TimeZone to –8. To convert from UTC to Pacific Daylight Time, set the TimeZone to –7.

- The default setting for this command is -7 hours (Pacific Daylight Time) because PDT is UTC time *minus 7 hours*.
- For more information about time zones, servers and UTC, refer to the Website listed under the Get/Set TimeServer command.

The TimeZone parameter is only useful if the TimeServer is used to automatically set the system clock. In this case, the TimeServer always retrieves the time in UTC format and will need to be offset to reflect local time using this parameter.

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

| Example | |
|---|---|
| Command<br>Response | >Get TimeZone<br>>TimeZone = -8 |
| | >Set TimeZone = 3<br>>TimeZone = 3 |

**GET TIMESERVER**
**SET TIMESERVER**

The reader uses the Internet to accurately set its internal clock every time it is rebooted. The protocol it uses is called the Daytime Protocol (RFC-867) which typically returns the time in UTC format.

In order to use this feature, a TimeServer must be specified. This is the network address of a machine that is constantly running the Daytime Protocol. In the US there are a number of machines owned and operated by the Government explicitly providing the time and date to Internet users.

- By default the reader is configured to connect to one of these machines on boot-up to get the current time.
- For a more in-depth description of this server, and a list of other publicly accessible Daytime Protocol Servers, see: http://www.boulder.nist.gov/timefreq/service/its.htm
- The default setting for this command is 132.163.4.101, a primary NIST network time server. Some alternative time servers are:

  time-a.nist.gov / 129.6.15.28

  time-b.nist.gov / 129.6.15.29

  time.nist.gov / 192.43.244.18

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

| Example | |
|---|---|
| Command<br>Response | >Get TimeServer<br>>TimeServer = 129.6.15.28 |
| | >Set TimeServer = 129.6.15.28<br>>TimeServer = 129.6.15.28 |

The TimeServer is only used once when the reader is booted up. A message in the boot sequence (sent out to the serial console) indicates success or failure of this option.

For example, a successful boot sequence will report the following messages to the serial console:

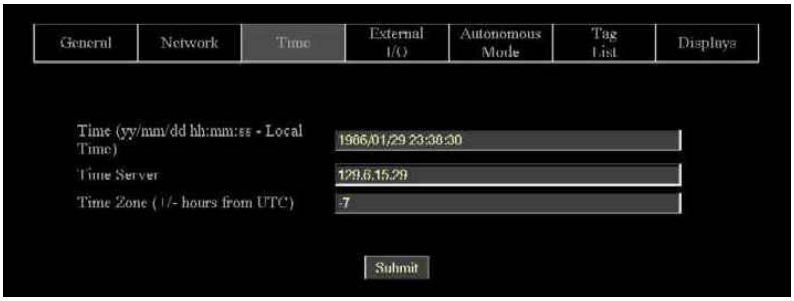
```
Booting Alien RFID Reader
Boot> Boot Level 1 (Console Communication) : Success
Boot> Boot Level 2 (Reader Communication) : Success
Boot> Boot Level 3 (Tag Manager) : Memory for 1000 Tags
```

```
Boot> Boot Level 4 (System Settings) : Success
Boot> Boot Level 5 (Network) : Success - IP Address is 10.1.60.4
Boot> Boot Level 6 (Telnet Interface) : Success - Port 23 Ready
Boot> Boot Level 7 (Web Interface) : Success
Boot> Boot Level 8 (Network Time Service) : Success - Time Set to
2002/08/23 16:50:24
Boot> Ready
```

## Time Commands – Web Based

Time commands are issued via the Web page to set up and access reader time parameters.

Web view Time tab covers all Get and Set time commands.




### COMMANDS/OPERATIONS VIA WEB TIME TAB

Command equivalents found on the Web-based “Time” tab are:

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

## External I/O Commands

These commands allow you to configure and retrieve current data regarding the reader's external output functions.

**SET EXTERNALOUTPUT**
**GET EXTERNALOUTPUT**

The reader controls two external output pins, which can subsequently be used to control external devices such a doors/gates, security lights. etc. Please refer to Chapter 1, Specifications section in this document for pinout diagrams.

With this command you can set the external output pin values. The command takes a single parameter that represents the bit mask settings of the external pins.

- Bit 0 represents the state of pin 0, and Bit 1 represents the state of pin 1.

  For example, to set pin 1 to high and pin 0 on low, use the bit mask of $10_{binary}$ which translates to $2_{decimal}$

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

| Example | |
|---|---|
| Command | >Set ExternalOuput = 2 |
| Response | >ExternalOutput = 2 |
| Command | >Get ExternalOuput |
| Response | >ExternalOutput = 2 |

**GET EXTERNALINPUT**

The reader also monitors two external input pins, which can subsequently be controlled by external proximity detectors and other input devices such as "magic-eyes" and magnetic switches. This command allows these external input pin values to be obtained. Please refer to Chapter 1, Specifications section in this document for pinout diagrams.

- The command returns a single byte result that represents the bit mask settings of the external pins. Bit 0 represents the state of pin 0, and Bit 1 represents the state of pin 1.

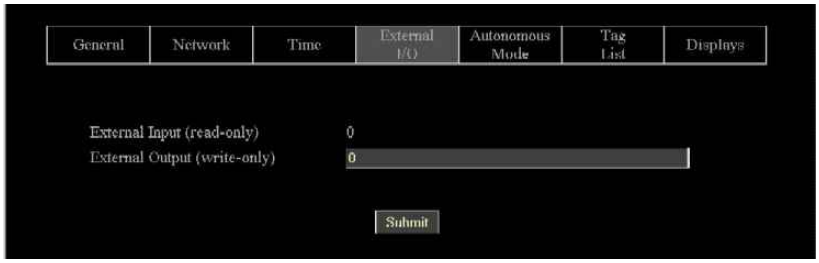
*NOTE: Changes made with this command will take effect immediately.*

| Example | |
|---|---|
| Command | >Get ExternalInput |
| Response | >ExternalInput = 2 (i.e., binary 10) |

## External I/O Commands – Web Based

External I/O commands are issued via the Web page to set up and access external input and output parameters.

Web view I/O tab covers all Get and Set External I/O commands.




### COMMANDS/OPERATIONS ON WEB EXTERNAL I/O TAB

Command equivalents found on the Web-based “External I/O” tab are:

- Get | Set ExternalOutput
- Get ExternalInput

## Tag List Commands – Command Line

Tag list commands allow you to retrieve immediate listings of tags that have been read and saved by the reader, and to assign and retrieve tag list functional parameters.

*NOTE: Web versions of these operations are shown in the next section.*

**GET TAGLIST (N)**

You can retrieve the reader's stored tag list either a single time (Get TagList) or multiple times (Get TagList n).

- The maximum number of tags that can be stored in the tag list is 1000.

Using the Get TagList to retrieve the stored list only once:

- **If the reader is currently in interactive mode**, the reader will immediately perform a full tag search (read and report) and display its current internal tag list. The reply will be a multi-line command with each line listing an active tag.

  If the tag list is empty, the message "(No Tags)" will be returned.

- **If the reader is in Autonomous mode**, the reader will display its current internal tag list only.

Using the Get TagList with an optional integer 'n' instructs the command to be repeated 'n' times before a combined result is returned.

The format of the data returned by this command is specified using the Set TagListFormat command, described below.

| Example | |
|---|---|
| Command | Get TagList |
| Response | Tag: 0002 0030 A233 0400, CRC: B340, Disc: 2002/03/23 15:36:33, Count: 4, Ant: 0<br>Tag: 8080 AAAB ECF0 0000, CRC: 3021, Disc: 2002/03/22 12:26:01, Count: 3, Ant: 1 |
| Command | Get TagList |
| Response | (No Tags) |

**SET TAGLISTFORMAT**
**GET TAGLISTFORMAT**

The Get and Set TagListFormat commands specify the formatting of tag lists. The command itself takes a text string as its argument, and can be one of the following:

| TagListFormat | Description |
|---|---|
| text | Tag lists displayed as plain text messages, one tag ID per line. |
| xml | Tag lists are displayed in XML text format |
| custom | Tag lists are displayed in the format described by TagListCustomFormat. |

- Text formatted tag lists take the following form:

```
Tag:1115 F268 81C3 C012, CRC:2483, Disc:2003/01/21 09:00:51, Count:1, Ant:0
Tag:0100 0100 0002 0709, CRC:8594, Disc:2003/01/21 11:00:10, Count:1, Ant:0
Tag:1054 A334 54E1 7409, CRC:2083, Disc:2003/01/21 11:50:03, Count:1, Ant:0
```

- XML Formatted tag lists take the form:

```
<Alien-RFID-Tag-List>
<Alien-RFID-Tag>
  <TagID>0102 0304 0506 0709</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</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>
```

In all cases the following information is reported per tag:

- TagID: The 64 bit tag ID.
- CRC: The checksum built into the tag that guarantees that the tagID was read correctly.
- Disc: The time the tag was first read by the reader in the current session.
- Count: The number of times the tag has been read in the current session.
- Ant: The antenna port number that the tag was LAST seen at.

| Example | |
|---|---|
| Command | Set TagListFormat = XML |
| Response | TagListFormat = XML |
| Command | Get TagListFormat |
| Response | TagListFormat = Text |

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

**SET TAGLISTCUSTOMFORMAT**
**GET TAGLISTCUSTOMFORMAT**

The Get and Set TagListCustomFormat allows a customized tag list to be defined. Once the format has been defined it can be applied by issuing the command 'set taglistFormat = custom'

The tagListCustomFormat command takes a single text line argument that defines how each tag should be represented on-screen. This argument can be made up of a mixture of text and tokens, where the tokens are defined in the table below.

When the Nanoscanner is required to print a taglist, the tokens in the custom format are replaced with their runtime values.

| Tokens | Description |
|---|---|
| %i | Tag ID with a white space between each pair of bytes i.e., 8000 00FE 8010 2AB7 |
| %k | Tag ID with no spaces between i.e., 800000FE80102AB7 |
| %d | Discovery date of tag, in format YY/MM/DD |
| %t | Discovery time of tag, in format hh:mm:ss |
| %a | Antenna the tag was last seen at |
| %c | Checksum (CRC) of the tag ID (see programming guide for more details on the checksum format) |
| %r | Read Count of tags, i.e., how many times the tag has been read |

| Example | |
|---|---|
| Command | Set TagListCustomFormat = Here is a tag %i |
| Response | TagListFormat = Here is a tag %i |
| Get TagList | Here is a tag 8000 0000 0000 0808<br>Here is a tag 102F ED3D 0303 0001 |
| Command | Set TagListCustomFormat = Tag %k, read %r times from antenna %a |
| Response | TagListFormat = = Tag %k, read %r times from antenna %a |
| Get TagList | Tag 8000000000000808, read 3 times from antenna 0<br>Tag 102FED3D03030001, read 120 times from antenna 1 |

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

**SET ACQUIREMODE**
**GET ACQUIREMODE**

Whenever the reader is called upon to read a tag it does so using the current AcquireMode. Currently the allowable modes are as follows:

| AcquireMode | Description |
|---|---|
| Inventory | Perform full inventory of multiple tags. |
| Global Scroll | Perform fast search for single tag. |

The default setting is Inventory. For a detailed description of the different modes, please refer to the earlier chapter entitled '*Tag Reading Fundamentals'*

- Inventory
  The Inventory acquire mode performs a full anti-collision search on tags in the reader's field of view. This method will locate and distinguish multiple tags in front of the reader at the same time.

- Global Scroll
  The Global Scroll acquire mode instructs the reader to read a single tag repeatedly. This is a very fast tag reading method which is most effective when only one tag at a time is expected to be within reader range, as in conveyor belt applications. Under such circumstances, the performance for single tag reading is considerably faster than repeatedly doing a full tag search using the Inventory mode.

  *NOTE: If multiple tags are in range of the reader when this mode is used, the reader will either select one of the tags (usually the "strongest'" or "loudest") to read and report it, or will read none of the tags.*

| Example | |
|---|---|
| Command<br>Response | Set AcquireMode = Global Scroll<br>>AcquireMode = Global Scroll |
| Command<br>Response | Set AcquireMode = Inventory<br>>AcquireMode = Inventory |

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

**SET ACQUIRESLEEP**
**GET ACQUIRESLEEP**

AcquireSleep is an On or Off parameter.

If AcquireSleep is set to On, any tags read by auto mode or interactive mode will be put to sleep as they are found. Subsequent reads of the tag field will return no more tags, until Wake commands are issued to the tags.

If AcquireSleep is set to Off, tags will be left awake once they have been read. Thus repeated reads will return the same tag IDs.

| Example | |
|---|---|
| Command<br>Response | Set AcquireSleep = on<br>>AcquireSleep = ON |
| Command<br>Response | Set AcquireSleep = off<br>>AcquireSleep = OFF |

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

**SET ACQUIREWAKECOUNT**
**GET ACQUIREWAKECOUNT**

AcquireWakeCount takes a single integer parameter.

If AcquireWakeCount is greater than zero, it specifies after how many Acquire events a Wake command should be issued.

For example, is AcquireWakeCount is set to 10, a Wake command will be issued after every 10 acquire commands (either global scrolls or inventories).

If AcquireWakeCount is set to zero or less, no Wake commands will be issued.
.

| Example | |
|---|---|
| Command<br>Response | Set AcquireWakeCount = 0<br>>AcquireWakeCount = 0 |
| Command<br>Response | Set AcquireWakeCount = 10<br>>AcquireWakeCount = 10 |

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

**GET MASK**
**SET MASK**

The Get and Set Mask commands will control the current mask that the reader uses. Masks are important in both addressing tags and interrogating them. For a detailed description of Masks, please refer to the earlier chapter entitled '*Tag Reading Fundamentals*'

The Set Mask command takes three parameters:

- Bit Length of Mask, as a decimal number
- Bit Pointer of Mask, as a decimal number
- Array of Hex Bytes separated by white spaces

Note: Class I tags IDs start at bit 16, not bit 0. The first 16 bits of a Class I tag are used to store the checksum for the tag.

The Get Mask command takes no parameters but returns the three parameters described above.

**Note:**
- Setting the mask to 'All' will address all tags currently in the RF field. i.e., "set mask= all'

| Example | |
|---|---|
| Command<br>Response | >Set Mask = all<br>>Mask (BitLen, BitPtr, XX XX) = All Tags |
| Command<br>Response | >Set Mask = 8, 0, 3<br>>Mask (BitLen, BitPtr, XX XX) = 8, 0, 3 |
| Command<br>Response | >Set Mask = 16, 0, 00 03<br>>Mask (BitLen, BitPtr, XX XX) = 16, 0, 00 03 |
| Command<br>Response | >Get Mask<br>>Mask (BitLen, BitPtr, XX XX) = 16, 0, 00 03 |

#### CLEAR TAGLIST

The Clear TagList command instructs the reader to immediately clear its internal tag list.

| Example | |
|---|---|
| Command<br>Response | >Clear TagList<br>>Tag List has been reset! |

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

#### GET PERSISTTIME
#### SET PERSISTTIME

The PersistTime specifies the length of time a tag's data will remain in the reader's internal list of active tags.

- Persist times are specified in seconds.
- The default setting is 10 seconds.
- Setting the persist time to a positive number (1-n) will establish a persist time of the desired number of seconds

- A zero persist time (0) will guarantee that tags are not stored in the tag list. However issuing a get taglist command in interactive mode will return any tags immediately found even though they won't be stored in the taglist.
- Setting the persist time to –1 will cause the history to build indefinitely until a get taglist command is issued; at this point the tag list is returned, and then immediately cleared.

The maximum number of tags that can be stored in the tag list is 1000. Once this tag limit is reached, error messages will be reported to the serial console, and no new tags will be added to the list until room is available.

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

| Example | |
|---|---|
| Command | >Get PersistTime |
| Response | >PersistTime=10 |
| Command | >Set PersistTime=300 |
| Response | >PersistTime=10 |

#### WAKE

The Wake command will request all tags in the field to wake up. This command is directed by the Mask settings, allowing all tags to be awakened or a subset only.

| Example | |
|---|---|
| Command | >Wake |
| Response | >Wake=OK |

#### SLEEP

The Sleep command will request all tags in the field to sleep. A sleeping tag will ignore any commands sent to it except the Wake command. This command is directed by the Mask settings, allowing all tags to be slept or a subset only.

| Example | |
|---|---|
| Command | >Sleep |
| Response | >Sleep=OK |

## Tag List Commands – Web Based

Tag List commands are issued via the Web page to set up and access tag information.

Allows you to:

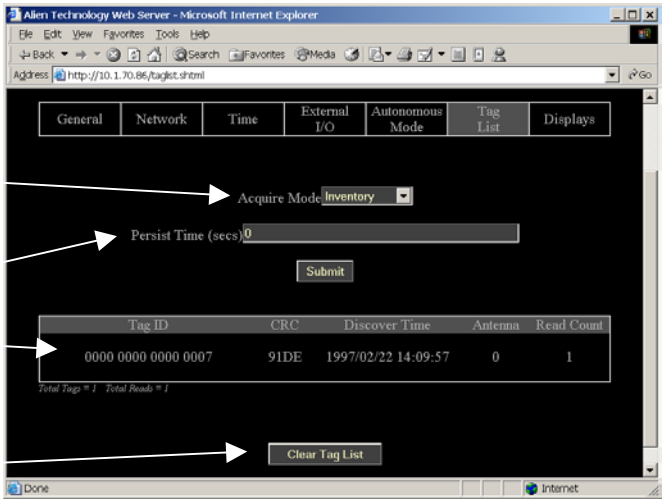
Get and Set Acquire Mode…

Get and Set Persist Time...

Display TagList...

and

Clear TagList.




Tag List displays:

- Tag ID
- CRC
- Discover time
- Reading Antenna
- Read count

### COMMANDS/OPERATIONS ON WEB TAG LIST TAB

*NOTE : Every time the Tag List page is loaded / refreshed, it is the equivalent of issuing a Get Taglist command to the reader. The results are displayed on the page.*

Command equivalents found on the Web-based “Tag List” tab are:

- Get | Set AcquireMode
- Get | Set PersistTime
- Get TagList(n)

  *Includes tag ID, crc, discover time, reading antenna and read count.*

- Clear Taglist

## Autonomous Mode Commands

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.

For a detailed description of the Automonous mode system please refer to Chapter 4 of this guide.

**SET AUTOMODE**
**GET AUTOMODE**

The AutoMode command turns on or off the automode.

- Valid command parameters are ON and OFF
- The default setting is OFF

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

| Example | |
|---|---|
| Command | >Get AutoMode |
| Response | >AutoMode=ON |
| Command | >Set AutoMode=on |
| Response | >AutoMode=ON |

**SET AUTOWAITOUTPUT**
**GET AUTOWAITOUTPUT**

The AutoWaitOutput specifies the output pin settings to effect while in the wait state of autonomous mode. The parameter is a bit mask for the two external output pins, where a '1' sets a pin to high, and a '0' sets a pin to low. Pin 1 is specified by bit one in the mask, and Pin 0 is specified by bit zero in the mask.

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

| Example | |
|---|---|
| Command | >Get AutoWaitOutput |
| Response | > AutoWaitOutput =0 |
| Command | >Set AutoWaitOutput =3 //Turn pins 0 and 1 to high |
| Response | > AutoWaitOutput =3 |

**SET AUTOSTARTTRIGGER**
**GET AUTOSTARTTRIGGER**

The AutoStartTrigger specifies the external input pins to monitor to cause the automode to jump from wait state to work state. Triggers can either be a pin going from low to high (rising edge) to high to low (falling edge). For each type of change, an integer bit mask must be provided to specify the pins to listen for changes on.

The command takes two parameters, a rising edge bit mask and a falling edge bit mask.

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

| Example | |
|---|---|
| Command | >Get AutoStartTrigger |
| Response | > AutoStartTrigger(rising, falling)= 0, 0 |
| Command | >Set AutoStartTrigger =3, 0 //Listen for rising edges on pins 0 and 1 |
| Response | > AutoStartTrigger (rising, falling)= 3, 0 |

**SET AUTOWORKOUTPUT**
**GET AUTOWORKOUTPUT**

The AutoWorkOutput specifies the output pin settings to effect while in the work state of autonomous mode. The parameter is a bit mask for the two external output pins, where a '1' sets a pin to high, and a '0' sets a pin to low. Pin 1 is specified by bit one in the mask, and Pin 0 is specified by bit zero in the mask.

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

| Example | |
|---|---|
| Command | >Get AutoWorkOutput |
| Response | > AutoWorkOutput =0 |
| Command | >Set AutoWorkOutput =3 //Turn pins 0 and 1 to high |
| Response | > AutoWorkOutput =3 |

**SET AUTOACTION**
**GET AUTOACTION**

The AutoAction command specifies the action to perform when running in the work mode of auto mode. This can be one of the following options:

| AutoAction | Description |
|---|---|
| None | Perform no action |
| Acquire | Perform an acquire action, as specified by the AcquireMode options. |

- The default setting is Acquire

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

| Example | |
|---|---|
| Command | >Get AutoAction |
| Response | > AutoAction = Acquire |
| Command | >Set AutoAction =Acquire |
| Response | > AutoAction = Acquire |

**SET AUTOSTOPTRIGGER**
**GET AUTOSTOPTRIGGER**

The AutoStopTrigger specifies the external input pins to monitor to cause the automode to jump from work state to evaluate state. Triggers can either be a pin going from low to high (rising edge) to high to low (falling edge). For each type of change, an integer bit mask must be provided to specify the pins to listen for changes on.

The command takes two parameters, a rising edge bit mask and a falling edge bit mask.

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

| Example | |
|---|---|
| Command | >Get AutoStopTrigger |
| Response | > AutoStopTrigger(rising, falling)= 0, 0 |
| Command | >Set AutoStopTrigger =3, 0 //Listen for rising edges on pins 0 and 1 |
| Response | > AutoStopTrigger (rising, falling)= 3, 0 |

**SET AUTOSTOPTIMER**
**GET AUTOSTOPTIMER**

The AutoStopTimer offers an alternative way to jump from work state to evaluate state. This is a time based jump, that will happen after the timer period specified by this command expires. The parameter is a single time period, specified in milliseconds.

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

| Example | |
|---|---|
| Command | >Get AutoStopTimer |
| Response | > AutoStopTrimer (ms) = 0 |
| Command | >Set AutoStopTimer =1000 //Acquire for 1sec then evaluate |
| Response | > AutoStopTimer (ms)= 1000 |

**SET AUTOTRUEOUTPUT**
**GET AUTOTRUEOUTPUT**

The AutoTrueOutput specifies the output pin settings to effect if the evaluate mode of autonomous mode evaluates to true. The parameter is a bit mask for the two external output pins, where a '1' sets a pin to high, and a '0' sets a pin to low. Pin 1 is specified by bit one in the mask, and Pin 0 is specified by bit zero in the mask.

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

| Example | |
|---|---|
| Command | >Get AutoTrueOutput |
| Response | > AutoTrueOutput =0 |
| Command | >Set AutoTrueOutput =3 //Turn pins 0 and 1 to high |
| Response | > AutoTrueOutput =3 |

**SET AUTOTRUEPAUSE**
**GET AUTOTRUEPAUSE**

The AutoTruePause specifies a millisecond pause to effect if the autonomous evaluation mode evaluates to true. This pause will occur after the AutoTrueOutput command has been processed.

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

| Example | |
|---|---|
| Command | >Get AutoTruePause |
| Response | > AutoTruePause (ms)=0 |
| Command | >Set AutoTruePause =500 //Pause for half a sec. |
| Response | > AutoTruePause = 500 |

**SET AUTOFALSEOUTPUT**
**GET AUTOFALSEOUTPUT**

The AutoFalseOutput specifies the output pin settings to effect if the evaluate mode of autonomous mode evaluates to false. The parameter is a bit mask for the two external output pins, where a '1' sets a pin to high, and a '0' sets a pin to

low. Pin 1 is specified by bit one in the mask, and Pin 0 is specified by bit zero in the mask.

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

| Example | |
|---|---|
| Command | >Get AutoFalseOutput |
| Response | > AutoFalseOutput =0 |
| Command | >Set AutoFalseOutput =3 //Turn pins 0 and 1 to high |
| Response | > AutoFalseOutput =3 |

**SET AUTOFALSEPAUSE**
**GET AUTOFALSEPAUSE**

The AutoFalsePause specifies a millisecond pause to effect if the autonomous evaluation mode evaluates to false. This pause will occur after the AutoFalseOutput command has been processed.

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

| Example | |
|---|---|
| Command | >Get AutoFalsePause |
| Response | > AutoFalsePause (ms)=0 |
| Command | >Set AutoFalsePause =500 //Pause for half a sec. |
| Response | > AutoFalsePause = 500 |

**GET AUTOMODESTATUS**

The Get AutoModeStatus command will return an integer representing the current state of the auto mode state machine.

Additionally the status may be followed by an asterisk character (*). If present it indicates that a complete auto mode cycle has occurred since the last get AutoModeStatus command was issued. Calling this method will always clear the * flag.

The following table details the different states returned:

| AutoModeStatus : States Returned | |
|---|---|
| 0 | Auto Mode is OFF |
| 10 | Auto Mode is initializing |
| 20 | Auto Mode is listening for a start trigger |
| 30 | Auto Mode is starting its Action |
| 40 | Auto Mode is processing its Action |
| 50 | Auto Mode is listening for a Stop condition |
| 60 | Auto Mode is entering its evaluation stage |
| 70 | Auto Mode is in its true or false pause stage |
| 80 | Auto Mode is in notify stage |

.

| Example | |
|---|---|
| Command | >Get AutoModeStatus |
| Response | > AutoModeStatus =0 //Auto Mode is off |
| Command | > Get AutoModeStatus |
| Response | > AutoModeStatus =30 * //Auto is starting its AutoAction<br>but the asterisk also indicates that a complete auto mode cycle has completed since we last enquired. |

#### AUTOMODERESET

The AutoModeReset command will reset all auto mode parameters to their default values, including setting the auto mode to off.

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

| Example | |
|---|---|
| Command | >AutoModeReset |
| Response | > All AutoMode settings have been reset ! |

#### AUTOMODETRIGGERNOW

The AutoModeTriggerNow command will emulate an external IO trigger event to effect auto mode. This command will only work if the Nanoscanner is already in auto mode and is waiting for a start trigger condition. At this point, issuing the AutoModeTriggerNow command will be identical to a real external trigger event, forcing the auto mode into its action cycle.

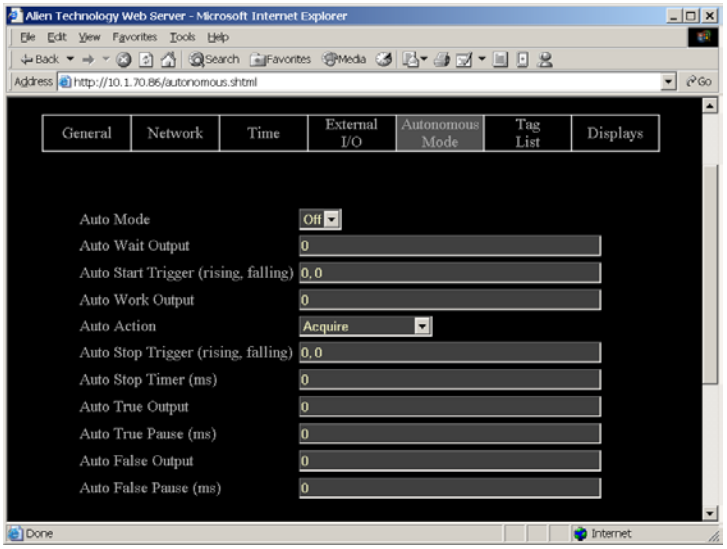
*NOTE: Changes made with this command will take effect immediately.*

| Example | |
|---|---|
| Command | >AutoModeTriggerNow |
| Response | > Auto Mode Triggering Now |

## Autonomous Mode Commands – Web Based

Autonomous Mode commands are issued via the Web page to set up and access autonomous mode parameters.

Web view Autonomous Mode tab covers all Get and Set autonomous mode commands.




### COMMANDS/OPERATIONS ON WEB AUTONOMOUS MODE TAB

Command equivalents found on the Web-based “Autonomous Mode” tab are:

- 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

## Notify Mode Commands

The Notify Mode commands are used to set up automated event notification when the reader is running in Auto Mode.

### SET NOTIFYMODE
### GET NOTIFYMODE

The NotifyMode command turns on or off the notify mode.

- Valid command parameters are ON and OFF
- The default setting is OFF

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

| Example | |
|---|---|
| Command | >Get NotifyMode |
| Response | > NotifyMode =ON |
| Command | >Set NotifyMode =on |
| Response | > NotifyMode =ON |

### GET NOTIFYADDRESS
### SET NOTIFYADDRESS

The Notify Address command pair specify where notification messages should be sent when they occur and how they should be sent. The form of the address determines the method of delivery.

Currently there are 3 delivery methods supported as shown in the table below:

| 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<br>*NOTE: the MailServer parameter must be configured for this to work. Optionally the MailFrom parameter can be used.* |
| 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. |

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

| Example | |
|---|---|
| Command | >Get NotifyAddress |
| Response | >NotifyAddress=10.1.0.12:4000 |
| Command | >Set NotifyAddress=user@msn.com |
| Response | >NotifyAddress=user@msn.com |

**GET NOTIFYTIME**
**SET NOTIFYTIME**

The Notify Time commands assign and retrieve the time interval for automatic tag list pushing to a listening machine.

- The time is specified in seconds.
- The minimum allowed time is 30 seconds.
- If set to zero or a negative number the time-based automatic notification is disabled.
- When set to a positive number of seconds, a standard notification message will be sent out each period.

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

| Example | |
|---|---|
| Command | >Get NotifyTime |
| Response | >NotifyTime=30 |
| Command | >Set NotifyTime=30 |
| Response | >NotifyTime=30 |

**GET NOTIFYTRIGGER**
**SET NOTIFYTRIGGER**

The NotifyTrigger commands specify and retrieve the event conditions (other than time-based) upon which a notification message is sent out to any listener.

Notify messages can be triggered under any of the following conditions:

| Trigger Name | Meaning |
|---|---|
| ADD | Send message when new tag is read and added to the TagList |
| REMOVE | Send message when a tag is removed from the TagList |
| CHANGE | Send message when a tag is either added to or removed from the TagList |
| 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 |

| | |
|---|---|
| TRUEFALSE | Send messages when the evaluation task of the autonomous state loop evaluates to true or false |

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

| Example | |
|---|---|
| Command | >Get NotifyTrigger |
| Response | >NotifyTrigger= REMOVE |
| Command | >Set NotifyTrigger=ADD |
| Response | >NotifyTrigger=ADD |

**GET NOTIFYFORMAT**
**SET NOTIFYFORMAT**

The NotifyFormat parameter specifies the format of any notification message.

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 in XML text format |
| custom | Tag lists are sent out as defined by the TagListCustomFormat command |

- Text formatted tag lists take the form:

```
#Alien RFID Reader Auto Notification Message
#ReaderName: Spinner Reader
#ReaderType: Alien RFID Tag Reader (Class 1 / 915Mhz)
#IPAddress: 10.1.70.13
#CommandPort: 23
#Time: 2003/01/21 12:48:59
#Reason: TEST MESSAGE
Tag:1115 F268 81C3 C012, CRC:2483, Disc:2003/01/21 09:00:51, Count:1, Ant:0
Tag:0100 0100 0002 0709, CRC:8594, Disc:2003/01/21 11:00:10, Count:1, Ant:0
Tag:1054 A334 54E1 7409, 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 1 / 915Mhz)</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</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</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>
```

**GET MAILSERVER**
**SET MAILSERVER**

The MailServer command pair allow you to define an SMTP (simple mail transfer protocol) mail server. This mail server is used only when automatic notification is configured (see Notify commands) and is set to use Mail as its delivery method.

*NOTE: Changes to this setting will take immediate effect.*

| Example | |
|---|---|
| Command | >Get MailServer |
| Response | >MailServer=12.34.56.78 |
| Command | >Set MailServer=45.224.124.34 |
| Response | >MailServer=45.224.124.34 |

**GET MAILFROM**
**SET MAILFROM**

The MailFrom command pair allow you to define the email address associated with the Nanoscanner. The emails sent out by the Nanoscanner will have this parameter set in the From: field of the email header.

*NOTE: Changes to this setting will take immediate effect.*

| Example |
|---|

| | |
|---|---|
| Command | >Get MailFrom |
| Response | >MailFrom = AlienRFIDReader |
| Command | >Set MailFrom = reader@mycompany.com |
| Response | MailFrom = reader@mycompany.com |

### NOTIFYNOW

The NotifyNow command instructs the reader to send out an immediate notification of its tag list to the address currently set by the NotifyAddress command.

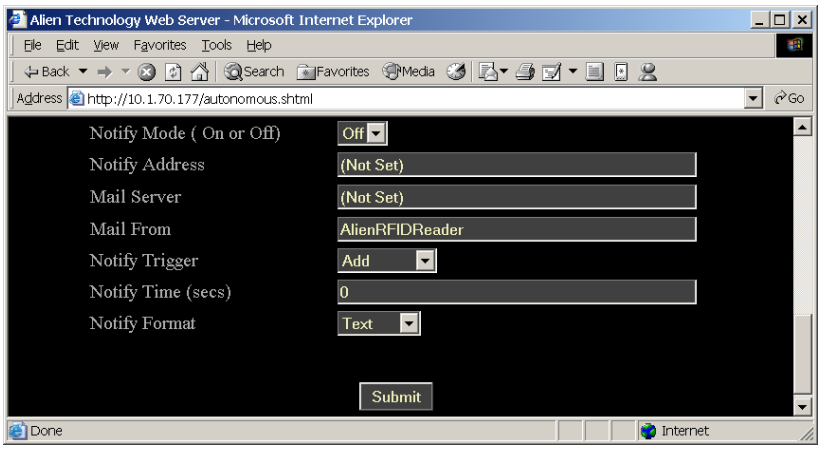
| Example | |
|---|---|
| *Where the reader is set to notify an internet address.* | |
| Command | >NotifyNow |
| Response | >Notification sent to 34.322.21.01:494 |
| *Where no NotifyAddress has been set.* | |
| Command | >NotifyNow |
| Response | >Notification Address not set |

## Notify Mode Commands – Web Based

Notify Mode commands are issued via the Web page to set up and access notify mode parameters. The commands are accessed at the bottom of the Autonomous Web Page section.

Web view Notify Mode tab covers all Get and Set notify mode commands.

This web page is located at the bottom of the Autonomous Mode web page.




### COMMANDS/OPERATIONS ON WEB AUTONOMOUS MODE TAB

Command equivalents found on the Web-based “Autonomous Mode” tab are:

- Get | Set NotifyMode
- Get | Set NotifyAddress
- Get | Set MailServer
- Get | Set MailFrom
- Get | Set NotifyTrigger
- Get | Set NotifyTime
- Get | Set NotifyFormat

# CHAPTER 7
# Reader⇔Host Protocol Extensions for Battery Powered Backscatter Tags

The Reader <–> Host protocol detailed in the previous chapter is a text-based communications protocol for configuring and operating the entire family of Alien Nanoscanner RFID readers. This chapter details extensions to this standard protocol that directly address the extended functionality of the Battery Powered Backscatter tags running at 2450Mhz.

## Introduction

The Battery Powered Backscatter readers fully support the Class I protocol as described in the previous chapter of this document. In addition to the basic Class I command set, these readers also support extra commands especially designed to address the enhanced functionality of the Battery Powered Backscatter tags. These extra commands fall into one of five categories:

### Masks
In order to address a single tag with any of the following commands, a suitable Mask must be set. Please see the description of the Mask command in the previous chapter of this document.

### Tags
The tag commands are used to explicitly communicate with a tag, to either interrogate its features and functionality, or its ID.

### Memory
The Battery Powered Backscatter tags can optionally support a read-write on-board memory typically in the range of 4K bytes to 16K bytes. The memory commands described in this document allow this tag memory to be read and written in discrete blocks via RF communication.

### Sensors
The Battery Powered Backscatter tags can optionally support the use of on-board sensors such as temperature or vibration sensors. The sensor commands can be used to interrogate and control the use of these on-board devices.

### Logging
If a tag is equipped with one or more sensors and on-board memory, they can be instructed to autonomously log data to tag memory even in the absence of an RF field. The logging commands are the interface to this functionality.

## Command List with Functions

### TAG COMMANDS

| Command | Description |
|---|---|
| Get TagID | Get the ID of a tag. |
| Get TagInfo | Get information about a tag. |
| Get TagVersion | Get the tag firmware version. |
| Get TagTime<br>Set TagTime | Get and Set the time and date on the tag's built in clock. |

### MEMORY COMMANDS

| Command | Description |
|---|---|
| Get Memory<br>Set Memory | Get and Set data from the tag memory. |
| Get MemoryPacketSize<br>Set MemoryPacketSize | Get and Set the size of the memory packets used in get and set memory commands. |
| Clear Memory | Clear the tag memory. |

### SENSOR COMMANDS

| Command | Description |
|---|---|
| Get SensorValue | Get the current value from a tag's sensor. |

### LOGGING COMMANDS

| Command | Description |
|---|---|
| Get LoggingMode<br>Set LoggingMode | Get and Set the automatic logging mode. |
| Get LoggingInterval<br>Set LoggingInterval | Set and Get the interval between automatic log recording events. |

# 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.*

## Tag Commands

These commands allow a unique tag (as specified by the mask commands) to be interrogated.

#### GET TAGID

Get TagID is used to return the ID of a unique tag specified by the mask commands. If no unique tag can be found (either the mask is incorrect or not specific enough to singulate a tag), the result will be “no tags”

| Example | |
|---|---|
| Command | >Get TagID |
| Response | >1010 2033 0330 3334 DE90 EE02 |
| Command | >Get TagID |
| Response | >No Tags |

#### GET TAGINFO

Get TagInfo command will return information about a single tag defined using the set mask command. The information returned will be a multi-line reply containing the following elements:

- Memory Size
- Sensor Type

**Note**: Please refer to the Nanoscanner Tag Guide for detailed descriptions of tag types.

| Example | |
|---|---|
| Command | >get taginfo |
| Response | Memory = 4 Kbytes |
| | Sensor = Dallas Semiconductor Temperature Sensor |

### GET TAGVERSION

Get TagVersion command will return information about a the firmware running on a tag.

| Example | |
|---|---|
| Command | >get tagversion |
| Response | Tag Firmware Version = 2.1.2 |

### GET TAGTIME
### SET TAGTIME

Each tag has an on-board real-time clock. The time represented by this clock can be obtained or set using these commands. Times are specified by the format: yy/mm/dd hh:mm:ss

The Set TagTime command can take one special parameter, ‘now’, which causes the reader to synchronize the tag’s clock with its own.

| Example | |
|---|---|
| Command<br>Response | >Set TagTime = 02/12/03 16:13:00<br>>TagTime = 02/12/03 16:13:00 |
| Command<br>Response | Set TagTime = now<br>>TagTime = 02/12/03 16:13:00 //Current reader clock setting |
| Command<br>Response | >Get TagTime<br>>TagTime = 02/12/03 16:13:00 |

## Memory Commands

Each tag may have on-board memory that can be used for arbitrary user data storage, or for holding sensor logging data. These commands allow this memory to be interrogated and programmed. As always, use the 'set mask' command to identify the unique tag to communicate with.

**SET MEMORY**
**GET MEMORY**

Set and Get Memory commands allow the direct manipulation and interrogation of the tag memory. The Get Memory command will return blocks of the tag memory, and the Set Memory command will write data to the tag memory.

Get Memory takes two parameters (length, address). Parameter one is the number of bytes to get expressed as a single decimal number. Parameter two is the start address of the memory to get, expressed as a single decimal number. The maximum number of bytes that this command will return is 4Kb, i.e., 4096 bytes. The results of the Get Memory command are multiple lines of ascii data, where each line of data will represent up to 16 hexadecimal bytes of memory. A line of data may include asterisk characters instead of expected data – this indicates that the request for a particular block of memory failed (usually RF communications failure). The data can usually be extracted by repeating the command after repositioning the tag.

Set Memory takes two parameters (address, data). Parameter one is the start address of the memory to set, expressed as a single decimal number. The second parameter is an ascii string of hex bytes, up to a total of `memoryPacketSize`. After the packet of data is written, it is read back for verification. If the data is verified the message "Memory@0000 = Written and Verified" will be output. If the data was not verified, the message "Error: Memory Written but not Verified" will be output.

**Note**: Memory is transferred to and from the tag in blocks of memory defined by the *memorypacketsize* command. The smaller the packet (i.e. 1 or 2 bytes) the smaller the transmission rate but also the smaller the error rate. Likewise the higher the packet size (i.e. 16 bytes) the higher the transmission rate but also the higher the error rate in a noisy environment.

**Note**: Please refer to the Nanoscanner Tag Guide for detailed descriptions of formatted tag memory. Because there are many different types of sensors attached to the Nanoscanner tags, the memory formatting may change due to the type of data being stored. All details can be found in this separate guide.

| Example | |
|---|---|
| Command<br>Response | >Get Memory = 20, 0<br>Memory@0000 = AF 00 A5 17 59 01 01 01 01 01 A5 0A 00 00 A5 80<br>Memory@0010 = 16 80 16 80 |
| Command<br>Response | >Set Memory = 0, 01 02 03 04 05 06 07 08 09 0A 0B<br>Memory@0000 = Written and Verified |

### SET MEMORYPACKETSIZE
### GET MEMORYPACKETSIZE

Set and Get MemoryPacketSize commands determine the number of bytes to use in each memory related transmission packet to and from the tag.

The smaller the packet (i.e. 1 or 2 bytes) the smaller the transmission rate but also the smaller the error rate. Likewise the higher the packet size (i.e. 16 bytes) the higher the transmission rate but also the higher the error rate in a noisy environment.

The default setting for this value is 16 bytes. The allowable range is 1 to 16 bytes.

| Example | |
|---|---|
| Command<br>Response | >Set MemoryPacketSize =4<br>MemoryPacketSize=4 |
| Command<br>Response | >Get MemoryPacketSize<br>MemoryPacketSize=16 |

### CLEAR MEMORY

Clear memory will completely erase the memory of a tag.

| Example | |
|---|---|
| Command<br>Response | >Clear Memory<br>Memory has been Cleared ! |

## Sensor Commands

The sensor commands deal exclusively with a tag's onboard sensor.

**GET SENSORVALUE**
Get SensorValue will return the sensor's current value. If the sensor was already switched off, this command will start the sensor before returning a value, which may take up to 1 second. Sensors will automatically be switched off two seconds after this command has been completed in order to preserve the battery life of the tag.

Typically the tag has no knowledge of the type of sensor attached to it. Consequently this command simply returns the raw number as returned by the sensor. No attempt is made to process this number into a humanly understandable form.

**Note**: Please refer to the Nanoscanner Tag Guide for detailed descriptions of to format of raw sensor values. Because there are many different types of sensors attached to the Nanoscanner tags, the format of the raw sensor values may change due to the type of data being acquired. All details can be found in this separate guide.

| Example | |
|---|---|
| Command | >Get SensorValue |
| Response | >SensorValue = 4539 |

## Logging Commands

These commands control the automatic logging of sensor data into the tags memory. Once set up, a tag can be removed from an RF field and still have sensor data logged periodically to memory. Bringing the tag back into an RF field will allow the memory to be retrieved and examined.

**GET LOGGINGMODE**
**SET LOGGINGMODE**

The automatic, time based logging of sensor data to a tag memory is controlled by setting the logging mode on the tag.

Setting a logging mode to OFF will turn off all automatic logging.
Setting a logging mode to ON will turn on the automatic logging as defined by the logging interval command. Turning on the logging mode like this will not erase the tag's memory; it will simply cause logged data to be appended to the current memory store. (Use the clear memory command to erase the memory before logging).

| Example | |
|---|---|
| Command | >Get LoggingMode |
| Response | >LoggingMode =Off |
| Command | >Set LoggingMode = On |
| Response | >LoggingMode =On |

**GET LOGGINGINTERVAL**
**SET LOGGINGINTERVAL**

When automatic logging is active, the tag will retrieve a value from the sensor and store it in tag memory on a periodic basis until the memory is full. At this point logging will cease. The periodicity of this logging is controlled by the logging interval parameter. This parameter is defined in terms of hours:mins:secs and defines the period between sensor logs.

**Note:** The minimum allowable logging interval is 1 minute.

**Note**: The tag will sleep while not in use, and then will wake up to take a sensor reading and then sleep again. This mode of operation ensures a long battery life.

The logging interval command takes three parameters, each separated by a colon, in the form hh:mm:ss.

| Example | |
|---|---|
| Command | >Get LoggingInterval |
| Response | >LoggingInterval = 00:01:00 |
| Command | >Set LoggingInterval = 03:21:00 |
| Response | >LoggingInterval = 03:21:00 |

# CHAPTER 8
# Web Based Application Examples

As part of the standard functionality of the Nanoscanner reader, the built-in web server is able to serve up a simple web based application example.

This application example can be found under the last tab on the Web pages, named “Applications.” Under this tab is a simple Applet running two applications that use reader commands. These provide an interactive environment for reading tags in the field.

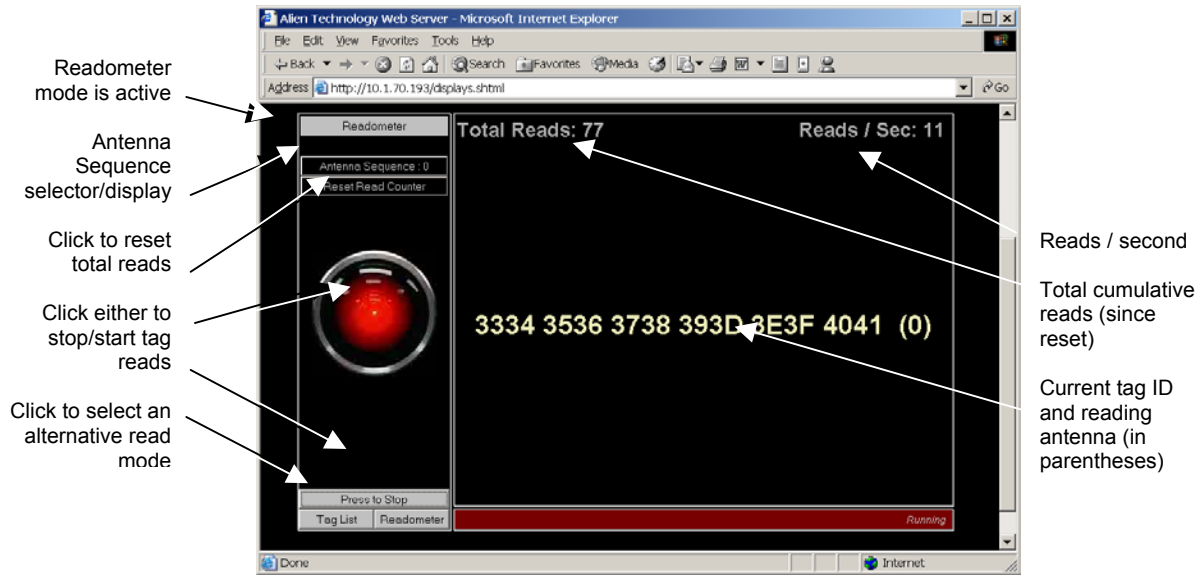
*NOTE: The Java Applets are all Java 1.1 compliant applets and will work in standard Netscape and Internet Explorer browsers.*

## Readometer

The “readometer” graphically displays a single tag and antenna information in real time.

This screen allows the user to:

- View a single tag (as returned by the Get TagList / Set AcquireMode= Global Scroll command) and the reading antenna
- View a cumulative and dynamic number of reads since starting or resetting this value
- View a dynamic Reads per Second value for the current tag
- Change the antenna sequence (see “General Commands”)
- Reset the Total Reads counter
- Stop/start the tag reading operation
- Switch to a different display mode

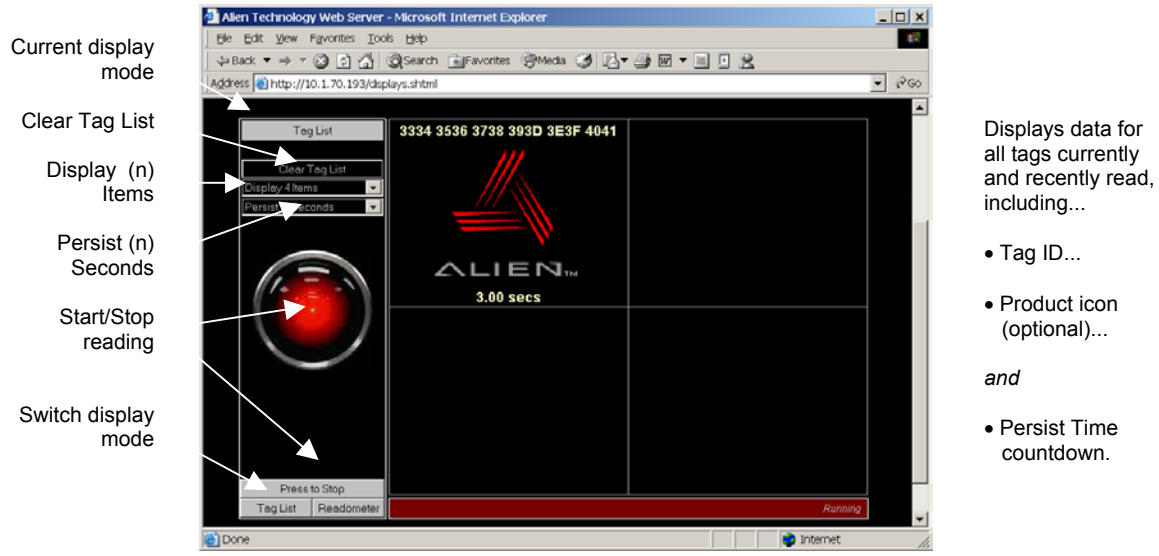


# Tag List

The Tag List applet provides a graphical view of the reader's current tag list.

This screen allows the user to:

- View tags that have been read and acquired by the reader most recently (typically using get tagList / set acquireMode = Inventory)
- View the Persist Time countdown for each tag after it is read
- Clear the tag list manually
- Change the number of cells in the display grid via pulldown menu
- Change the Persist Time via pulldown menu
- Start/stop tag reading
- Switch to a different tag display mode.



# Optimize Reader Settings

On each of the Tag List and Readometer screens is a small checkbox option entitled 'Optimize Reader Settings', which by default is checked (a tick mark is present).

When checked this tells the applet to optimize the reader settings *the next time* one of the two applications is started (i.e., the HAL eye turns to red). The following optimization settings are made to the reader depending on the application that is started:

## Readometer Settings

When the Readometer is started with the optimize option checked, the following commands are issued to the reader to put it into an optimized state for readometer readings.

- Set PersistTime = 0
- Set TagListFormat = Text
- AutoModeReset
- Set AcquireMode = Global Scroll

When running, the readometer performs repeated bursts of 'get taglist 25' followed by a 200 ms pause. The timing results displayed on the screen are calculated based on each 'get taglist 25' command. Thus for optimal timings, Global Scroll is used for the Acquire Mode.

The auto mode is reset, and left off; the readometer screen always works in foreground mode.

When the optimize option is turned off, only one command is issued to the reader when readometer is started:

- Set TagListFormat = Text

## Tag List Settings

When the Tag List is started with the optimize option checked, the following commands are issued to the reader to put it into an optimized state for tag list readings.

- Set PersistTime = -1
- Set TagListFormat = Text
- AutoModeReset
- Set AcquireMode = Inventory

When running, the application switches on auto mode, forcing the reader into autonomous acquisitions as fast as it can. The optimized acquisition mode is Inventory and the persist time is –1, telling the reader to build up a tag list until next interrogated. While the reader is building its tag list, the applet periodically

(~every 250ms) issues a 'get taglist' command, forcing the full tag list to be returned and the reader to reset its internal tag list.

When the optimize option is turned off, only one command is issued to the reader when the application is started:

- Set TagListFormat = Text

## Advanced Tag List Options

By turning off the optimization check box and running the tag list application, the reader can be set up manually to perform different actions:

#### RUNNING TAG LIST USING GLOBAL SCROLL AS THE ACQUIRE MODE

In some instances it is desirable to set the acquire mode to Global Scroll. By default, with the application optimize checkbox on, the application will set the reader into Inventory mode. However with the optimize checkbox off, the following manual settings can be made:

- Set AcquireMode = Global Scroll

The next time the application is started, it will run using the new settings.

#### RUNNING TAG LIST IN DUTY CYCLE MODE

In some instances it is desirable to run the reader in duty cycle mode, where instead of reading tags without a break, a timed pause is inserted into the read-cycle. By default, with the optimize checkbox on, the tag list application will set the reader into full time acquire mode. However with the optimize checkbox off, the following manual settings can be made:

- Set AutoStopTimer = 500
- Set AutoTruePause = 200
- Set AutoFalsePause = 200

The next time the tag list application is started, it will run using the new settings, forcing it into a cylce of reading tags for 500ms, followed by a 200ms pause regardless of whether tags were found or not. For further details on these commands and other autonomous mode options, please refer to the autonomous mode overview in this document.