Alien Technology

# Nanoscanner™

# Reader User Guide

ALIEN™

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Ron Gilbert
Alien Technology Corporation
18220 Butterfield Blvd.
Morgan Hill, CA 95037
Phone 408-782-3900
Fax 408-782-3910
www.alientechnology.com


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## FCC COMPLIANCE

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

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

## CAUTION

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


**Alien Technology**

# Nanoscanner™
# Reader User Guide

## Table of Contents

# CHAPTER 1

# Introduction

The *Nanoscanner Reader User Guide* provides basic instructions for installing and operating the Nanoscanner reader. It also includes an overview of RFID technology and covers the reader firmware protocol in detail.

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.

## Audience

For the purposes of this book, we assume the readers of the *Nanoscanner Reader 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
- External antenna and coaxial cable
- One RS-232 serial cable (for host computer)
- Power supply
- *Nanoscanner Reader User Guide*

### 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) Refer to the Nanoscanner Reader Developer's Guide for reader-host protocols.
- RFID Tags (AIDC Class 1 compliant)
- 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

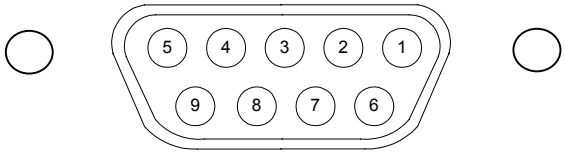
| | |
|---|---|
| **Name** | Nanoscanner Reader |
| **Part Number** | BHNPR001 |
| **Architecture** | Point-to-multipoint reader network |
| **Frequency** | 902.6 MHz – 927.4 MHz |
| **Hopping Channels** | 63 |
| **Channel Spacing** | 400 KHz |
| **Channel Dwell Time** | < 0.4 Seconds |
| **RF Transmitter** | < 30 dBm |
| **Modulation Method** | On Off Keying (OOK) |
| **20 db Modulation Bandwidth** | < 400 KHz |
| **RF Receiver** | 2 channels |
| **Power Consumption** | 25 Watts (120 VAC at 500 mW) |
| **Communications Interface** | RS-232, LAN TCPI/IP |
| **Inputs/Outputs** | 2 coax antenna, 8 logic I/O, comm ports, power |
| **Dimensions** | (L) 19 cm (7 in) x (W) 26 cm (10 in) x (D) 5 cm (2 in) |
| **Weight** | Approximately 1.8 kg (4 lb) |
| **Operating Temperature** | -40° C to +85° C (-40 °F to + 85°F) |

### NANOSCANNER READER EXTERNAL ANTENNA

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

### RS-232 PORT PINOUTS

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




| I/O Port Connector (Male DB-9M) | |
|---|---|
| Pin 1 | CTL0 |
| Pin 2 | CTL1 |
| Pin 3 | TRIG0 |
| Pin 4 | TRIG1 |
| Pin 5 | Ground |
| Pin 6 | $\overline{\text{CTL0}}$ |
| Pin 7 | $\overline{\text{CTL1}}$ |
| Pin 8 | $\overline{\text{TRIG0}}$ |
| Pin 9 | $\overline{\text{TRIG1}}$ |

### OTHER COMPONENTS

| | |
|---|---|
| **RS-232 Serial Cable** | DB-9 male/female serial |
| **Antenna Port 1 Plug** | Reverse thread 50 ohm terminator |

# CHAPTER 2

# RFID Overview

Radio-frequency identification (RFID) technology uses radio frequency signals to acquire data remotely from tags within read (or “interrogation”) range. The data is then used for a variety of purposes such as opening doors and gates, paying tolls or tracking equipment and materials.

Although RFID can be deployed in a number of frequency bands, the products referred to in this book operate exclusively in the UHF band, specifically, in the frequency band centered at 915 MHz (902-928 MHz).

This equipment—as well as many cordless telephones and other wireless devices—operates in this frequency band, which does not require its users to be licensed.

## RFID vs Barcodes

RFID is similar in some ways to barcode technology in that the tags or labels contain ID and other data readable by electronic equipment.

#### READ RANGE AND INTERFERENCE

An important advantage of RF over barcodes is that RF tags do not require “line of sight” to be read. That is—while a barcode must be scanned directly by a laser beam and cannot be read if something opaque stands between the reader/scanner and the label—RF tags can be read *through* a great many materials, including boxes and other radiolucent products.

The effective range of a laser-based barcode system is limited because with increased distance comes an increased chance of materials passing between the reader’s laser and the barcode label. Attempts in the past to use barcodes for tollway use or railcar identification, for example, failed because the vehicle speed—combined with the increased likelihood of rain, snow or debris interrupting the laser’s line-of-sight at the crucial moment of passage—rendered the technology very unreliable for these applications.

#### VISIBILITY OF PALLETS, CASES AND INDIVIDUAL ITEMS

In manufacturing, supply chain and retail/commercial applications, barcodes have been very effective for over 25 years. The line-of-sight and range limitations have been manageable for those environments where products or cases of products moved slowly past a reader at close distances.

Barcodes themselves can contain (and convey) information about manufacturer, product family and type, and perhaps even the specific

manufacturing lot. These capabilities have improved the speed and handling of products and materials around the world.

However, barcodes cannot identify a specific case of paper towels that is in the center of a pallet surrounded by other cases of towels. And barcodes cannot record the temperatures a perishable product has been exposed to and calculate a more realistic expiration date for that specific item.

Neither can barcode systems identify an individual carton of milk as it rolls down the checkout conveyor and alert the cashier that its contents may be spoiled. And barcodes cannot alert the merchant of products in the consumer's pocket that have not been paid for.

RFID systems have the potential to do all of these things; a laser-based barcode system cannot.

Although RFID is being developed initially for use in the supply side of many businesses (shipping, receiving, warehousing, stocking, inventory, etc.), this technology makes it not only possible, but realistic to one day track the movement of individual products throughout a retail store and to identify critical characteristics about the item.

For the near term, businesses will benefit from automatically logging shipments and receipts of products moving in and out through their loading docks. They will be able to track the movement of products within their own facilities to improve efficiency, and reduce theft and shrinkage.

### READ/WRITE TAG DATA

Barcode data is fixed the moment the label is printed. It can never be changed unless a new label is printed and attached. On the other hand, many RFID tags can be reprogrammed in the field to reflect current information such as storage location or date placed in service.

More sophisticated RFID tags can also record dynamic conditions (such as temperature or meter usage) as they change, then transfer the current conditions (or a record of conditions) to a reader upon request.

### THE RFID ADVANTAGE

In short, RFID raises the standard for automatic identification technology and allows it to perform more valuable functions than have been possible with barcodes.

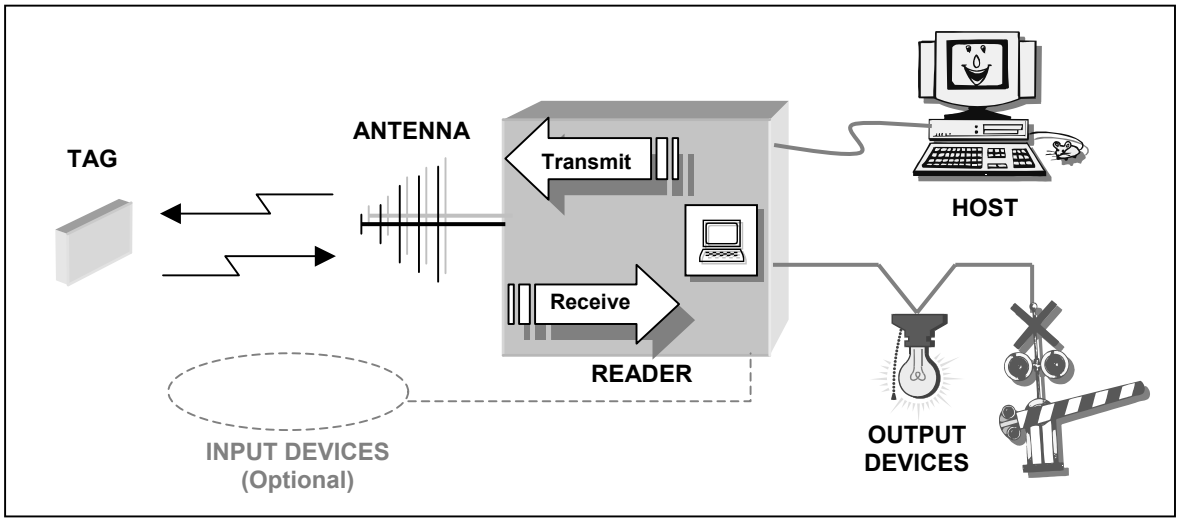
## RFID Components

Any RFID system needs certain basic components. These include:

- Transmitter
- Receiver
- Microprocessor

*Usually combined in a "reader" or "interrogator."*

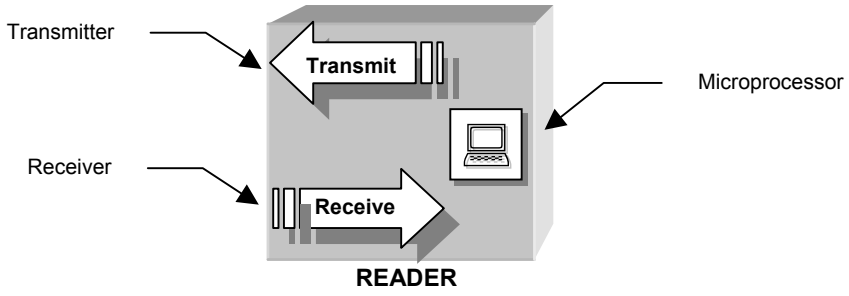
- Antenna(s)
- Tags
- Output device(s) and/or host computing device
- (Optional) input device(s)




*RFID system components*

### Reader or Interrogator

A reader may be referred to as an "interrogator" because it asks (or interrogates) tags for their ID information and any other data they may contain.




Because the transmitter and receiver functions are working together, the reader may also be referred to as a "transceiver."

No matter what it may be called, the reader typically contains a:

- transmitter,
- receiver, and
- microprocessor.

The reader unit also contains an antenna as part of the entire system (see below).

## Antenna(s)

The antenna broadcasts the RF signals generated inside the reader's transmitter into the immediate environment. The antenna also receives responses from tags within range.

In general, readers may use one or more antennas to detect and interrogate tags. For this system, however, only one antenna can be active at a time.

***CAUTION:*** *Reader antennas should be positioned so that personnel in the area may safely remain at least 23 cm (9 in) from the antenna's surface. See FCC OTE Bulletin 56 and 65 for further details.*

### HOW ACTUAL ANTENNAS LOOK

Although the antennas in our diagrams are often depicted like fish bones, it is unlikely you will see RFID antennas like this in the field.

**Reader Antennas.** Most reader antennas are housed in enclosures and will look like plain, shallow boxes. In some cases, the antenna may actually be contained inside the reader enclosure (which may also look like a plain box).

**Tag Antennas.** Tag antennas are often nothing more than etched or printed metallic patterns on a circuit board or thin film inside a small case or sandwiched between layers of a printed label.

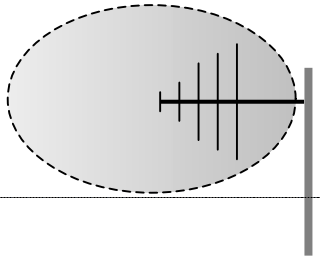
**TAG ANTENNA** **TAG CASE**

**READER ANTENNA**
**In enclosure**

### FOOTPRINT, POLARIZATION AND READ RANGE

Antennas have patterns or "footprints" that describe the area in which their energy is most effective. Although the word *footprint* suggests a two-dimensional area, the pattern actually exists in three dimensions and is more like a large, irregularly shaped balloon (think of an inflated surgical glove).

**ANTENNA & read range**



Although an antenna may manifest its energy in a certain pattern, how your system can use that energy depends on a great many factors including antenna characteristics, tag and reader characteristics, the nature of the items tagged, and the changing nature of the reading environment.

**Polarization.** Polarization of an antenna, expressed simply, means there is a preferred orientation of the tag to the reader antenna's energy field, which may optimize the system's ability to read tags, particularly under less than ideal conditions. *Under most normal conditions, and within the read range for the system, all functioning tags should be readable*. However, it may be possible to read tags well beyond the specified read range if they are oriented in the antenna's preferred direction. Keep in mind, however, that some systems may be designed to limit, rather than maximize, the read range and thus may use polarization to facilitate tag discrimination.

**Footprint Size and Read Range.** The size of the antenna footprint and the range at which a given tag may be read are affected, in various degrees, by such factors as the output power of the transmitter, the receiver sensitivity, the type of tag (and its own internal antenna) and the tag's position relative to the reader antenna. The reading environment also plays an important part in determining how far out and where, in relation to the antenna, tags can and cannot be read.

Because an antenna's pattern is often irregularly shaped, you may get a read at long range in one spot, then move the tag a few inches to one side and not be able to get the tag to read again until you have moved it several feet closer to the antenna.

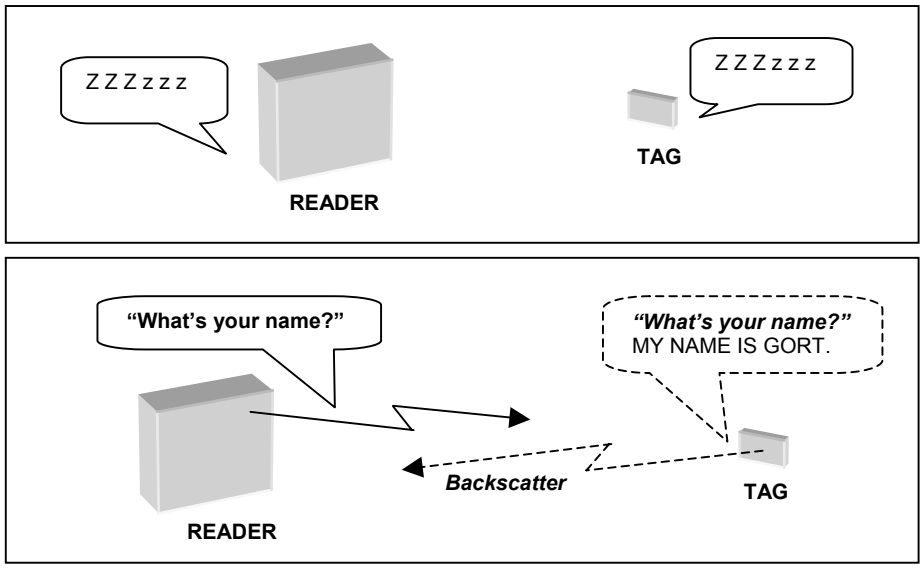
## Tags

RF tags are devices—similar in principle to barcodes or even name badges—that contain identification and other information that can be communicated to a reader from a distance. However, RF tags can contain much more information than a barcode, can be read at greater distances and under more challenging conditions, and in some cases can accept new data in the field.

### TAG-TO-READER COMMUNICATIONS

Tags are often classified as either "passive" or "active" to describe how they communicate with the reader. *Passive* means, simply, that the tag uses a modified form of the reader's own signal to send back its data. *Active* means the tag contains its own transmitter.

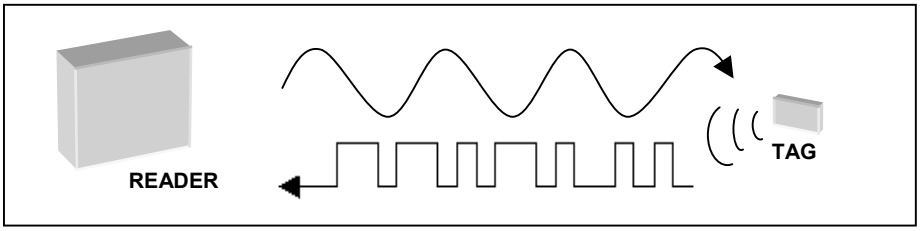
**(Passive) Backscatter Tags.** A passive tag uses a method called "modulated backscatter" to convey its data to the reader. Essentially, the tag reflects (or backscatters) the RF signal transmitted by the reader and embeds its unique ID and data by modulating that reflected signal.




*Passive tags reply by reflecting the reader's own RF signal, with unique tag data embedded in the modulated "backscatter."*

- **Modulated backscatter** is similar to sending messages between distant mountaintops by bouncing sunlight off mirrors using Morse Code patterns of on and off. In this scheme, communication is only possible when the light source is present.

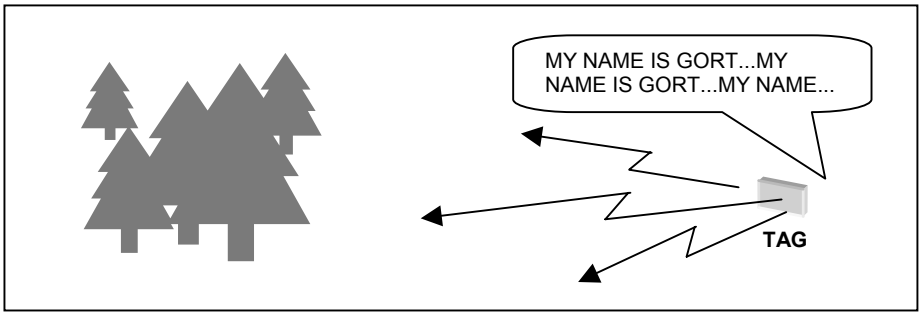
  The reader transmits a continuous-wave (CW) RF signal into the reading environment. When a tag appears in the area, it modulates, or breaks up, that CW signal into patterns of ones and zeroes that define the tag's digital data. Because it "speaks" essentially by reflecting the reader's "voice," a backscatter tag is physically incapable of communicating data outside the presence of a reader's signal.




*The reader transmits a continuous wave signal. The tag breaks up (modulates) that signal into patterns of ones and zeroes that convey its data to the reader.*

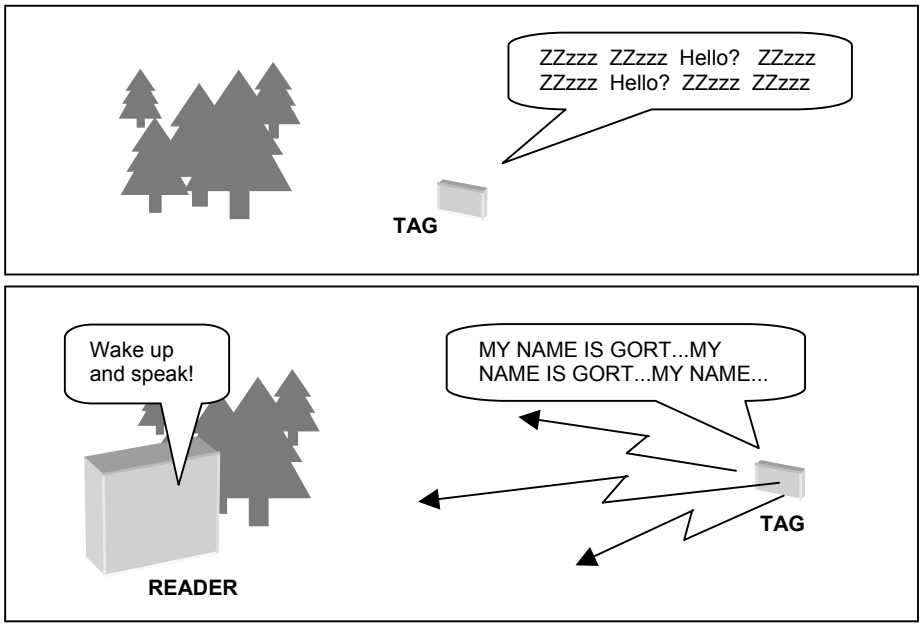
**(Active Tags) Transmitters and Transponders.** Active tags, unlike passive backscatter tags, contain their own transmitters, or tiny radio stations. Active tags may be considered to be either transmitters or transponders, though, to be precise, a transponder is always a transmitter tag, but not all transmitter tags are transponders, as you will see below.

- **Transmitters.** A transmitter tag can broadcast a message into the environment even if there is no reader active nearby to "hear" it. This tag is like a telephone can ring even when no one is home to answer it.




*Active tags (transmitters) contain their own little radio stations and can transmit messages even the absence of a reader.*

- **Transponders.** To conserve power, or to minimize RF noise pollution, some active/transmitter tags may be configured to "go to sleep" or enter a quiescent or lower-power state when not being interrogated. When a reader enters the area, it then transmits a signal to "wake up" all the tags in that area. Each tag thus only transmits in response to the reader's command. This type of active tag is called a "transmitter/responder" or "transponder."




*Active tags that are considered transponders (transmitter/responders) go into a quiescent or low power state ("sleep") until awakened by a reader.*

### CAUTIONS REGARDING TERMS AND EXPRESSIONS

The authors of this manual have chosen to use the simplest and most precise definitions of RFID terms to make the concepts as clear as possible throughout this text.

However, you should be aware of alternative definitions and uses of these same terms, which you may encounter elsewhere in the industry. To be sure of precise meaning, always clarify how these terms are being defined. The terms most often misused or used inconsistently are:

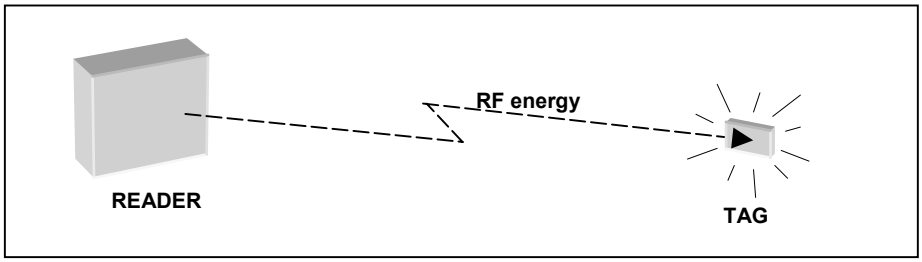
- Active/passive/semi-passive
- Transponder vs tag

**Active/Passive/Semi-Passive.** This book uses *active* and *passive* to describe whether a tag has a transmitter (active) or uses modulated backscatter to communicate with the reader (passive) as detailed in this section. However, many industry professionals refer to *active* and *passive* in terms of tag power, with *active* referring to battery power and *passive* referring to tags energized by the reader's RF signal (or "beam-powered"). In this scheme, a third term, *semi-passive*, is sometimes used to refer to tags that have a battery but which also use part of the RF signal's beam to energize their circuits for backscattering data to the reader. A third definition of *active* and *passive* may refer to whether or not a tag has an onboard processor.

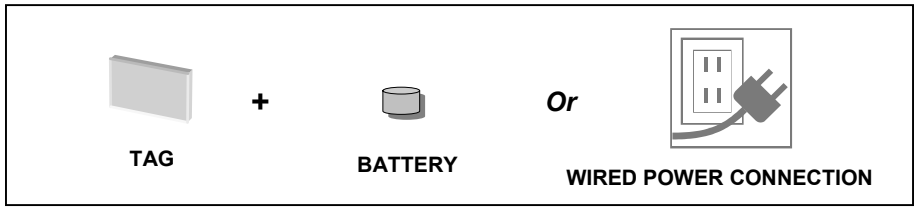
**Transponder vs Tag.** A growing trend in the industry is to refer to any RFID tag as a *transponder*. However, in the purest sense, while a transponder can be called a tag, not every tag is a transponder. Formed from the words *transmitter* and *responder*, the word *transponder* implies that the tag must first be an active transmitter, though it may be designed to respond and transmit only when a reader is nearby and sends the correct wake-up signal.

### TAG POWER

Tags can be powered either by the RF signal from a reader (RF "beam" powered) or by direct sources of energy such as batteries or wired power connections. A battery generally gives a tag more range and can allow it to perform independent functions.




*Beam-powered tags are powered exclusively by the energy in the RF signal transmitted by the reader.*




*Other tags receive power from batteries and, for special applications, may even be wired to a power source.*

Although beam power is used more often for passive tags, certain active tags are capable of storing energy from a reader's signal, then using that stored energy to actively transmit data.

Tags (whether passive or active) that perform functions in addition to providing their IDs (such as recording temperature or meter usage for later transmission to a reader) normally require some kind of augmenting power source.

### TAG RANGE

Tag range, like antenna range, depends on much more than just the characteristics of the tag. Reader power and sensitivity, antenna range and polarization, and the reading environment can all affect the range at which a given tag may be successfully read.

Certain attributes of the tag itself and its immediate surroundings also help determine a tag's full read range, including:

- Tag power source (battery-powered tags typically have greater range than those powered exclusively by the RF beam).
- Type of materials between and around the tag and the reader.
- Tag position relative to the antenna's preferred orientation.
- Relative tag speed (amount of time the tag is within read range, if either the tag or the reader is moving relative to the other).
- Amount and rate of data to be exchanged between tag and reader and the overhead involved in error correction and other quality processes.
- The tag antenna design.

Tags, like every other element in an overall system design, affect system performance and should be configured to optimize the specific applications they are to be used for.

### TAG MEMORY

Tags may have just enough memory to hold only the simplest of information, such as an ID code (little more than the amount of data on the average barcode label), or may have as much memory and processing power as a small computer. Tag memory may be read-only—or more accurately, write-once-read-many (WORM)—or read/write (R/W):

- **WORM or Read-only Memory.** Some tags are programmed once, either at the factory or by the user, then locked to prevent reprogramming. The data in these tags remains the same throughout the life of the tag.

- **Read/write Memory.** Read/write tags can be reprogrammed in the field, either by a dedicated programming device or by the reader itself. Some read/write tags can also record dynamic information such as temperature, usage, tilt and vibration, location, or date and time. When such a tag is read, it can also transmit its currently stored data to an authorized reader. The most sophisticated (transmitter) read/write tag

may, in fact, function as a wireless computer, able to interact with other tags and devices or link to the Internet.

**Memory vs. Power.** While tags with minimal memory capacity can easily function on the tiny bit of energy provided by the RF signal alone, higher tag memory and processing demands typically require the support of a battery or other type of power source.

#### INPUT/OUTPUT AND ONBOARD PROCESSING (OPTIONAL)

Certain tags can be configured to perform onboard processing functions and may be also have input/output (I/O) capabilities.

**Inputs and Outputs.** A tag may be connected to an input device, such as a temperature sensor, a meter, or a tamper/tilt detector. Such tags can receive data from the input device and then convey that data (either as a record of changes over time or as the current value) to the reader upon request. Outputs, on the other hand, allow a tag to activate an attached device such as a LED or emit an audible tone (to signal its presence) or can enable or disable connected devices. (For example, an attached tag could disable a computer or other equipment if removed from authorized premises.)

**Onboard Processing.** Tags with onboard processing capabilities can perform a variety of calculations or functions depending upon the tag's microprocessor and power source/consumption. Such tags might work in concert with an input device, for example, recording the temperature variations a perishable product has been exposed to over time, then calculating a more realistic expiration date based on that history.

## Host Computer and Input/Output Functions

In order to put the data acquired from a tag to practical use, the RFID system needs either a host computer to process that data or some kind of output function that responds to the tag data.

In many cases, both host computer and output functions are used in the RFID system.

#### HOST COMPUTER

Through a host computer, the RFID system can log and process tag transactions for a variety of purposes. For example:

- In a warehouse, a tag read can be associated with a location and time for the purposes of tracking objects and their movements.
- In an automated toll system, a tag read can trigger a debit from the tag owner's account.
- In an automated meter reading system, a tag read also includes gas or water usage data that can be forwarded to a customer billing system.

#### OUTPUT FUNCTIONS

The simplest RFID system may only react with specified outputs according to a set of rules programmed into the reader's microprocessor. For example:

- In access control applications, a tag read whose ID is on a list of authorized IDs can trigger the opening of a door or gate.
- In warehouse applications, reading the tag on a specific pallet can turn on a light, or ring a bell to indicate the desired case has been located.

#### INPUT FUNCTIONS (OPTIONAL)

An RFID system may also be designed to respond to certain input conditions. Readers are often configured to interface with input devices such as presence detectors. A presence detector can be used, for example, to power up a reader only when an object is within range so as to conserve energy or minimize the radio noise in a given environment.

## MIT, AIDC and the RFID (ePC) Initiative

The Auto ID Center (AIDC) at the Massachusetts Institute of Technology (MIT) is currently coordinating industry efforts to establish a new standard system for identifying objects using RFID. In place of barcodes and UPCs (universal product codes), objects would contain “ePCs” or electronic product code tags or labels.

The benefits of ePCs are the same, in many ways, as those for generic RFID in terms of its potential for increased range, ability to read through many materials, read/write functionality and discrete identification of individual objects.

The goal of the ePC initiative, however, goes beyond performance issues to embrace practical issues as well, such as cost, logistics and fostering healthy competition.

The final AIDC-endorsed standard will set price goals for products competing in the new ePC marketplace. Compliant products will be required to conform to certain configuration, interface and performance standards so that competing products will remain compatible with one another, giving users a range of suppliers from which to purchase their systems and ePC services.

The AIDC has defined four classes of RFID tags that will eventually address the various ePC performance and price requirements of the marketplace, as shown in the table below.

Alien Technology will have offerings in most of the AIDC classes plus special tag configurations outside the AIDC spec for other applications.

The first class of tags to be introduced under this initiative (AIDC Class 1) will be targeted primarily for use initially in manufacturing and supply-chain operations to track movement of pallets, cases, cartons and other larger units of product.

Once the technology has been integrated successfully into the supply side, it will be introduced for widespread implementation at the individual item level. Tests are currently being conducted to prove the efficacy of the RFID/ePC technology in reducing theft of items from point-of-sale (POS) displays.

## RFID and ePC Tag Classes

| ePC Tag Classes (AIDC and Alien) | | | | | | | |
|---|---|---|---|---|---|---|---|
| TAG TYPE➔ / ↓ TAG FEATURE | AIDC 1a | AIDC 1b | Alien Class 1 Emulator* | AIDC 2 | AIDC 3 | Alien Long Range | AIDC 4 |
| **Proposed common tag name** | ePCID 64 | ePCID 96 | ePCID emulator | ePCdata | ePCdata+ | Long-range data tag | CommTag |
| **1. Tag-to-reader communication mode** *B = Backscatter (passive) T = Transmitter (active)* | B | B | B | B | B | B | T |
| **2. Tag power** *Beam = RF beam powered Batt = battery or other power source* | Beam | Beam | Batt | Beam | Batt | Batt | Batt |
| **3a. Memory capacity (available to user)** | 64 bits | 96 bits | 64 bits | TBD | TBD | 1k byte | TBD |
| **4. Memory type** *WORM = Write-once, read-many RW = Read/write* | WORM | WORM | WORM | RW | RW | RW | RW |
| **5. Onboard processing capability** | -- | -- | -- | -- | Yes | Yes | Yes |
| **6. Range (optimal)** | 1 meter | 1 meter | 1 meter | 1 meter | <10 meters | 15-30 meters | >100 meters |
| **7. Cost range** | Lowest | Lowest | Medium | Low | Medium | Medium | High |
| **8. Wireless Interactivity** | -- | -- | -- | -- | -- | -- | Yes |
| **9. Market Introduction (est. timeframe)** | Oct 2002 | TBD | April 2002 | TBD | TBD | July 2002 | TBD |
| **10. Core functionality** | Simple product ID, similar to UPC on barcode | | | Product ID, R/W | Product ID, R/W, I/O w/battery for longer range and onboard processing | | Wireless communi-cations + ID |

**The emulator tag is an Alien long-range data tag whose performance has been modified to mimic the key attributes of Class 1 a and b tag performance.*

The tag classes shown in this table reflect the classes (1–4) established by the AIDC, along with two unique Alien tags.

This table cannot cover the vast range of RFID tags available today, but rather represents those specifically related to the AIDC initiative and the markets it addresses.

**Proposed Common Names.** These are suggested here to provide a short, yet descriptive, name by which users and the general public may easily refer to each of the broad tag categories.

- **ePCID** = lowest cost tags with read-only (or WORM) memory
- **ePCdata** = medium cost read/write tags with more memory (variations offer additional functions and increased range)
- **CommTag** = highest cost transmitter/interactive communicator tags

Each category may allow additional identifiers to be added to the core terms to indicate variations within the type (as in the designation “ePCdata+” for an ePCdata tag with a battery, or as in “ePCID 64” and “ePCID 96” indicating the differences in user ID memory size)

### CLASS 1 (EPCID TAGS)

Class 1 tags are most closely related to today’s barcode labels, thus they may be referred to as the simplest component of the system: the “ePCID” tag. They have a small amount of memory (the ePCID 64 has 64 bits versus the UPC-14 which has 42 bits), they will be extremely affordable (price goal is 5 cents), and can be made to fit most individual product packaging. Once programmed, their data will remain fixed, making them read-only tags. These tags will be powered by the reader’s RF beam exclusively.

### ALIEN’S CLASS 1 EPCID EMULATOR TAG

This specially-modified Alien tag is being used to simulate ePCID tag performance in interim tests of RFID viability for ePC and, specifically, supply chain applications. Although it contains a battery, which can potentially increase read range, this emulator tag has been tuned to the shorter range (~1 meter) specified for the ePCID tags. Only 96 bits of the tag’s available memory are used in this tag (64 bits for user ID), and its inherent capability for I/O functions has been disabled.

### CLASS 2 (EPC DATA TAGS)

Class 2 tags might logically be called “ePCdata” tags because they have the same basic functionality as the ePCID tags but with three times the memory (or more) and read/write data capability. This means new information can be written into these tags either though a reader at a checkpoint or through input devices connected directly to the tag. An ePCdata tag may, for example, be linked to a temperature sensor. These tags will cost somewhat more than the ePCID tags but will remain a low-cost choice for large-scale deployment.

### CLASS 3 (EPCDATA+ TAGS)

The Class 3, ePCdata+ tags offer significant capabilities beyond those of the basic ePCdata tag. The primary enhancement in these tags is their battery power. However, this simple feature gives these tags significantly improved range and memory and enables them to perform onboard processing. Battery-powered tags represent an increase in both tag size and cost (medium range).

### ALIEN LONG-RANGE TAGS

The Alien Long-range tag is very similar to the ePCdata+ tag (Class 3). The primary enhancements it offers over the Class 3 tag are increased range and more memory. This tag will be in the same price range as the ePCdat+ tag.

### CLASS 4 (COMMTAG)

The Class 4 tag is an entirely different breed of animal from all the other AIDC and Alien tags described previously. This tag is intended to have significant onboard processing capability along with the ability to transmit and wirelessly interact with the reader, other tags, and potentially, the Internet. Such a tag will be much more costly than any of the other tags, but can enable manufacturers and merchants to communicate directly with individual products. Such tags could, for example, alert consumers when a product's shelf life has been exceeded.

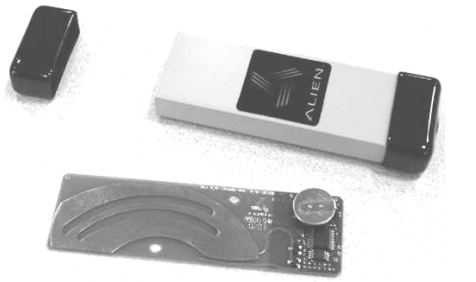
# CHAPTER 3
# Installation and Operation

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

## Tag Availability

For the purposes of this *Nanoscanner Reader User Guide*, it is assumed the tag you will be using is the Alien battery-powered backscatter tag in one of its two forms:

- The AIDC Class 1 emulator tag
- The long-range data tag




*Physical configuration of both the Alien Class 1 emulator and long-range data tag.*

#### CLASS 1 EMULATOR TAG

If you are involved in testing the AIDC specs or related applications, you may be using the Alien Class 1 emulator tag, which, as described earlier, is a modified version of the Alien long-range data tag whose range, data capacity and processing capabilities have been limited or disabled to mimic the Class 1 tag performance.

#### LONG-RANGE DATA TAG

As referenced on the “RFID and ePC Tag Classes” table, the Alien long-range data tag is similar to the Class 3, ePCdata+ tag. When the other tag classes have been implemented, this tag will represent an upgrade in both memory and range from the standard Class 3 ePCdata tag.

For the initial deployment of the Nanoscanner reader, this tag may be used effectively for numerous commercial applications including fleet management, automatic toll collection and an equipment tracking.

## Requirements

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

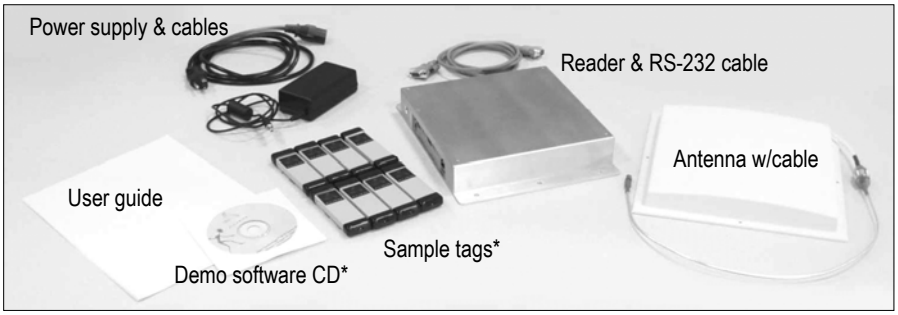
- PC running Windows 98 or higher, with CD-ROM drive (for demo system software) and one available RS-232 serial port.

- Standard 120 VAC power.
- Host software (either Alien's demo software or your own custom software). Refer to the *Nanoscanner Developer's Guide* for reader-host protocols.
- Tags (AIDC Class 1 compliant or Alien long-range data tags)
- Standard power cord (desired length) with grounded, 3-pronged plugs

## Receiving the Nanoscanner

Your Nanoscanner reader will be shipped with the items listed below. Please verify the contents of your received shipment before assembling.

- Nanoscanner reader
- Antenna with coaxial cable
- RS-232 reader-to-PC cable
- Reader power supply and cables (two sections: one attached, one detached)
- *Nanoscanner Reader User Guide*




*Components of the Nanoscanner Reader Demo System*

*If you have purchased a Nanoscanner Reader Demo System you will also receive:

- Demo system software CD
- Assortment of tags
- *Nanoscanner Reader Demo System User Guide*

### Reader Features

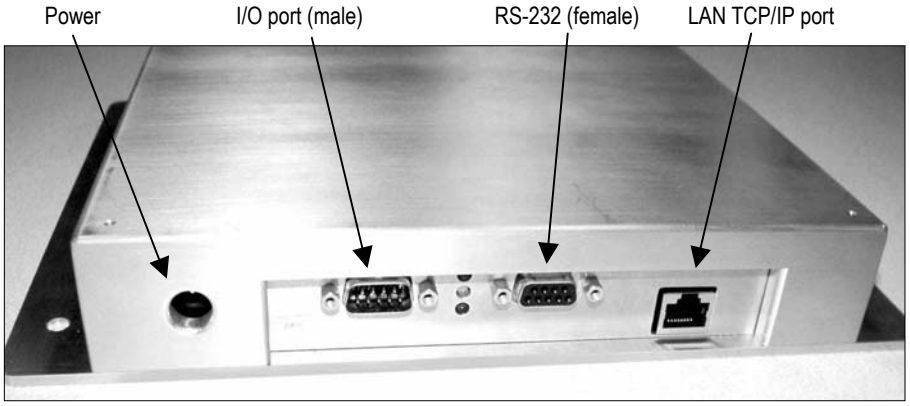
The Nanoscanner reader contains only two types of external user interface: connector ports and LEDs. One panel contains I/O connectors and LEDs. The opposite panel contains the antenna ports

#### I/O PANEL

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

- Power connector

- 9-pin D male I/O port
- 3 LEDs (Power/red, Sniff/yellow, Lock/green)
- 9-pin D female RS-232 serial port
- LAN TCP/IP port

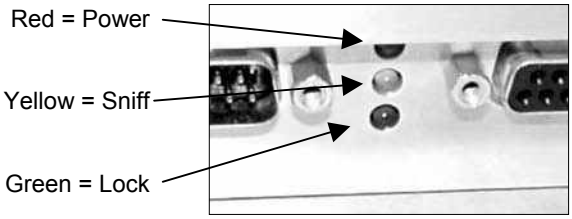



*Reader I/O panel*

### READER LEDS

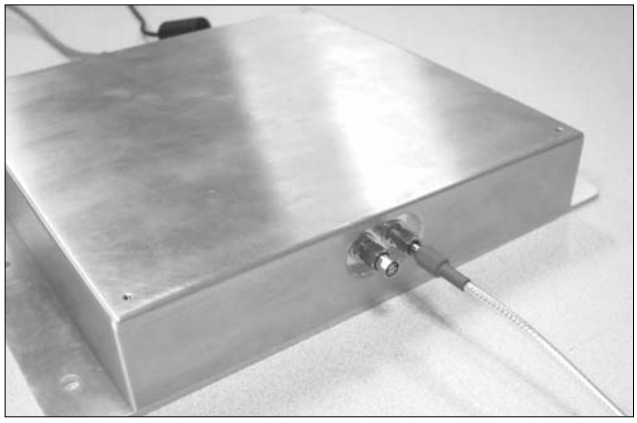
The LEDs provide external indication of three conditions:

- **Power (red).** Indicates power is applied to the reader.
- **Sniff (yellow).** Indicates tag signal has been detected, though it may not yet be strong enough to complete a transaction.
- **Lock (green).** Indicates a tag has been read.



### ANTENNA PANEL

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

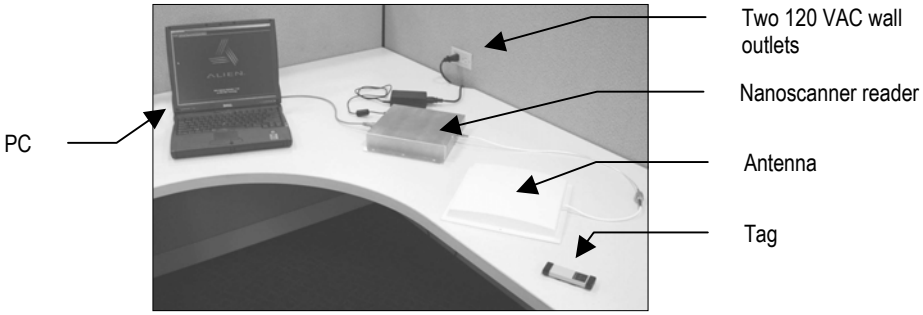


*Reader antenna ports*

***CAUTION:** If only one antenna is being used, the 50 ohm terminator cap must remain attached to the unused port on the left to prevent possible transmitter damage.*

## System Assembly and Bench Test

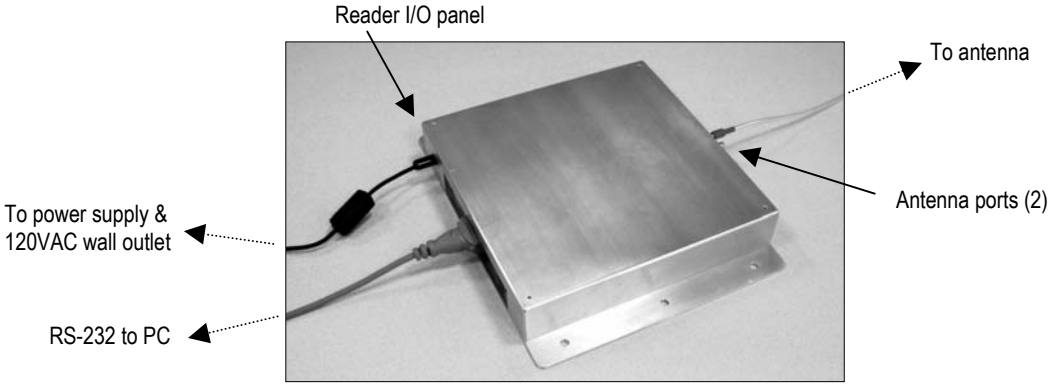
Assembling the Nanoscanner reader system is very easy. We recommend you set up the system and verify its operation in a bench test configuration (shown below) before installing it in a live application.




*Typical reader system benchtest set-up.*

### BenchTest 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.

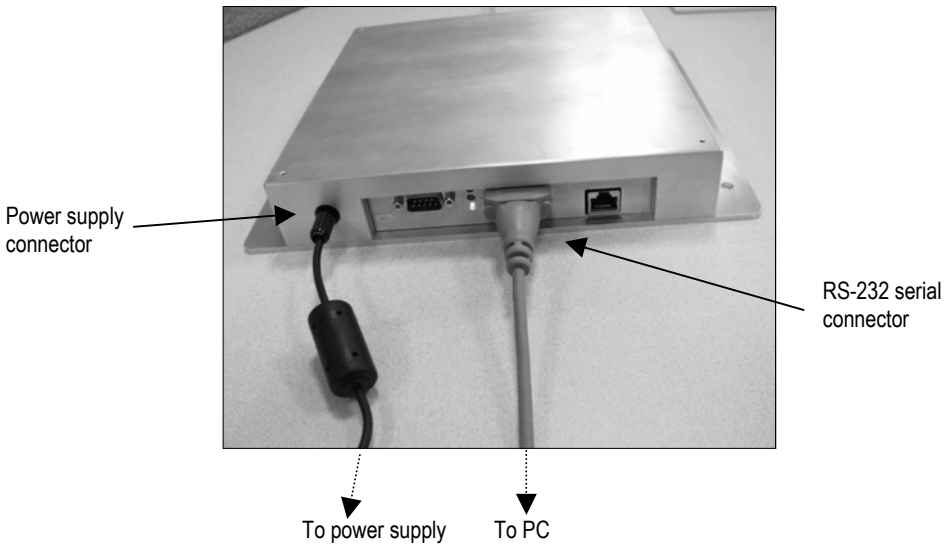



**2. Connect the RS-232 cable to the reader.**

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

- Push the aligned connector into the port.
- Finger-tighten the screws to secure the cable/connector to the reader.

**3. Connect the RS-232 cable to the serial port on the PC.**



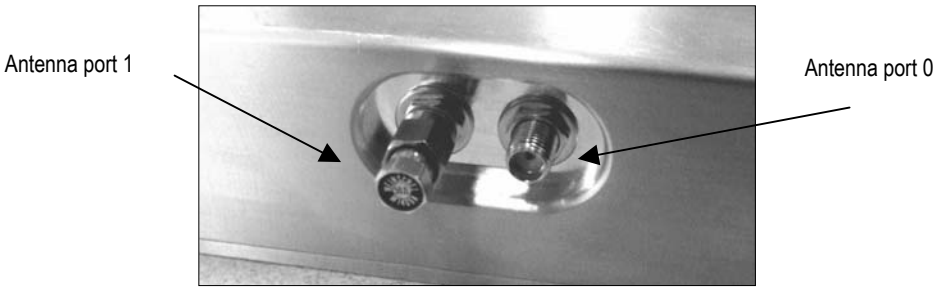

**4. Connect the power supply to the reader.**

- Using the thin cable attached to power supply, push the connector into the port until it is securely seated.

5. **Connect the coaxial cable to antenna port 0.**

   ***Caution:*** *For single antenna applications, you must use port 0, keeping the 50 ohm terminator cap on port 1 to prevent transmitter damage.*

   - Antenna port 0 is on the right if viewing reader with flange side down.
   - Align the coax cable's center pin and push into the port
   - Screw the fitting from the cable end onto the reader connector *counterclockwise* until finger tight to secure the cable to the reader.




*Reader antenna connector ports, showing unused port (port 1) on the left with terminator cap in place.*

   - If using two antennas, unscrew the 50 ohm terminator cap from the second port.
   - Stow the cap in a convenient location for future use as these are expensive items.
   - Connect the second antenna to the port and tighten fitting (counterclockwise)

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.

10. **Launch the desired host software application.**

    - You may use Alien's Nanoscanner demo system software or custom software developed per the reader-host protocol (see Chapter 3) for your specific application.

You are now ready to bench test the system.

## Bench Test Procedure

1. **Access an operational mode suitable for bench testing.**
   - Select a mode that will allow multiple consecutive reads of a single tag.
   - Refer to the applicable software application user guide for specific instructions.
2. **Position the reader to you can see the LEDs.**
   - You may also want to position the PC so you can view the monitor simultaneously for later tests.
3. **Move a tag slowly into the antenna's range.**
   - Begin with the tag well outside the expected range (~15-20 ft) and move it toward the antenna while observing the LEDs.
4. **Verify the Sniff LED illuminates when the tag approaches the read window.**
   - Sniff is the yellow LED.
5. **Verify the Lock LED illuminates when the tag is inside the read window.**
   - Lock is the green LED.
6. **Verify the host receives the tag data.**
   - Refer to indications specified in applicable user guide to verify the tag was read successfully.
7. **If bench test conditions are verified, proceed to installation.**

*NOTE: 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. We recommend you refer to the *Nanoscanner Reader Developer's Guide* for detailed system design information before permanently mounting your 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.

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

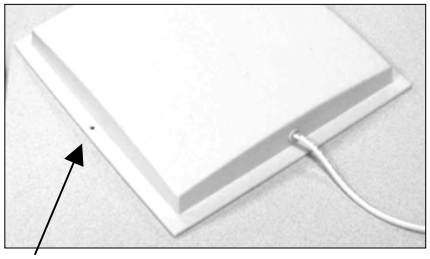
*Nanoscanner system configured for a single-antenna portal application. Shown here at a loading dock.*

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

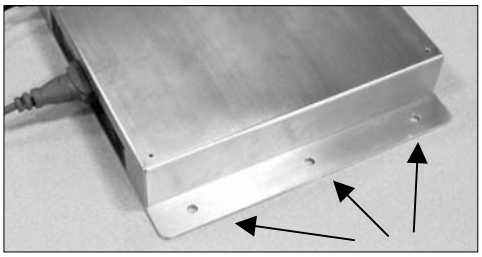
### Requirements

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
- (Optional) second antenna (if desired for additional coverage)
- 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.)



*Antenna mounting holes*



*Three mounting holes on either reader flange.*

## Installation Procedure

**1. Select mounting position for antenna(s).**

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

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

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

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

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

# System Operation

Because the Nanoscanner reader is operated autonomously according to programming from the host, there is little for the user to do in terms of direct operation of the reader.

### SOFTWARE DEVELOPERS

If you are a software developer, please refer to the next chapter, “Reader-Host Protocol,” for information relevant to creating software to enable reader-host communications and reader operation tailored to the desired application.

### SYSTEM USERS

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

# CHAPTER 4
# Reader⇔Enterprise Protocol

## Overview

The Reader<->Enterprise protocol is a text-based communications protocol for configuring and operating the Alien RFID Type I Reader for Enterprise Systems connectivity.

## Document Specifications

| Nanoscanner Reader<->Enterprise Protocol | |
|---|---|
| **Revision Date** | **June 24, 2002** |
| **Prepared By** | **Christopher I. Parkinson** |
| | **John M. Price** |

# Introduction

This document describes the programming interface that links the Alien RFID Type I Reader to the outside world.

## Reader Tag List

During normal operation of the reader, the device maintains an internal list of the tags that are *active*. Active tags are the ones 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.

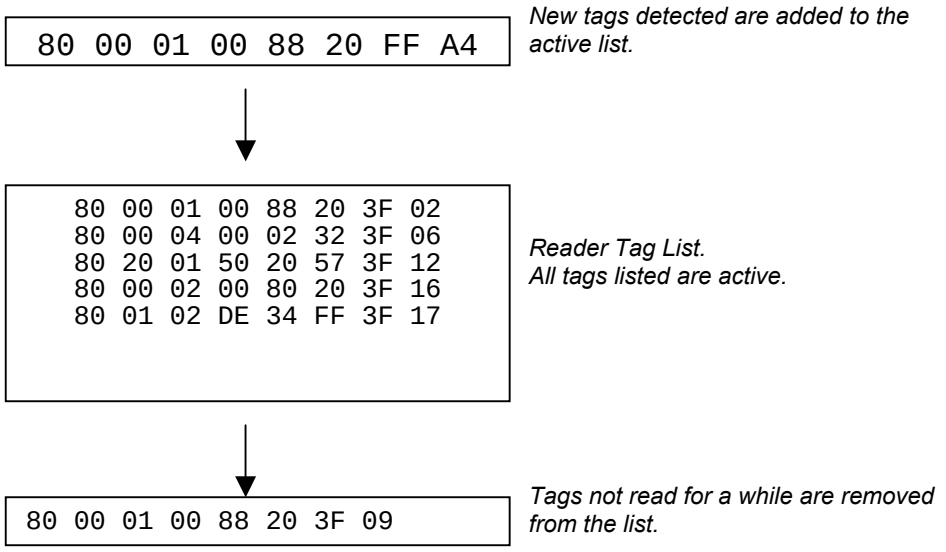



*Figure 1 – The Reader always has a concept of "what's out there", internally represented by the Reader Tag List*

## Persist Time

The persist time defines the duration between the time a tag was last read and the time it is removed from the Reader Tag List. Setting this value to a small time (~1 second) will cause the Reader 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.

# Communication Protocol

## Overview

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

- Serial Communication
- Network Communication
- Web Based Interaction

## Serial Communication

Commands can be issued to the Reader 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
Stop Bits : 1
Parity : None
Flow Control: None

## Network Communication

Commands can be issued to the Reader over the Internet or Intranet. The Reader is equipped with a standard Ethernet port allowing it to be physically connected to a network. By default the Reader will use DHCP to wake up and join a network. If DHCP is not available on the network, the Reader can be network configured via Serial communication.
By default the Reader will listen to incoming commands over port 23, the standard Telnet port.

## Web Based Communication

The Reader 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.

# Commands Introduction

## Overview

There are two distinct categories of Reader<->Enterprise command: those that are instantiated by the Enterprise host (Action commands), and those that instantiated by the Reader itself (Notify commands)

## Action Commands

Action commands are instantiated by an Enterprise system, which creates and issues a command to the Reader. The Reader always responds to these commands with an immediate reply. Action commands are used to configure the reader, to operate it and to interrogate the tag lists.

## Notify Commands

Notify commands are messages that are pushed out to the Enterprise by the Reader in response to some action. Once the Enterprise system has configured the Reader to push commands, the Reader is able to push tag lists out in response to some action or some time elapsing. This allows the Enterprise system to be notified on events, rather than constantly poll the reader for changes.

## Command Format

All commands between the Enterprise 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 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]

## General Commands

| Command | Description |
|---|---|
| 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 AntennaList<br>Set AntennaList | Get and Set the antenna port list the Reader should use. |
| Get Time<br>Set Time | Get and Set the real time clock on the Reader. |
| Reboot | Reboot the Reader. |

## 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 MailServer<br>Set MailServer | Set and Get an SMPT mail server. This is only required if notification email messages are sent out. |
| 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. |

## Enterprise Commands

| Command | Description |
|---|---|
| Get TagList | Get the current list of active tags the from Reader. |
| Clear TagList | Clear the list of active tags on the Reader. |
| Get PersistTime<br>Set PersistTime | Set and Get the Persist time |
| Get ReadTime<br>Set ReadTime | Set and Get the time interval between automated reads. |
| Get ReadTrigger<br>Set ReadTrigger | Set and Get the condition under which the automated reads can be triggered. |

### Notify Commands

| Command | Description |
|---|---|
| Get NotifyAddress<br>Set NotifyAddress | Get and Set the address to push tag lists to. |
| Set NotifyTime<br>Get NotifyTime | Get and Set the time interval for automatically pushing tag lists. |
| Set NotifyTrigger<br>Get NotifyTrigger | Get and Set the trigger for pushing tag lists. |

## General Commands

**GET READERNAME**
**SET READERNAME**

Description: The reader can have an arbitrary text name associated with it 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 | >OK |

**GET READERTYPE**

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

| Example | |
|---|---|
| Command | >Get ReaderType |
| Response | >ReaderType = Alien Passive Tag Reader Class 1 |

### GET READERVERSION

Description: The reader version text 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 | >Hardware Version = 1.0.02<br>Firmware Version = 1.0.01<br>Software Version = 1.1.22 |

### SET ANTENNALIST
### GET ANTENNALIST

Description: The reader can support the use of multiple antennae. This command allows the user to select which antenna port(s) to use. If the antenna is fixed, set this list to just one antenna number. Setting this list to more than one antenna number will cause the reader to cycle through the list on each successive tag read. Multiple antennae are specified by passing in a comma separated list as the argument. An asterisk (*) by a number indicates the current antenna in a list. The default value is 0. Currently antenna ports 0 and 1 are supported by this reader.

| Example | |
|---|---|
| Command | >Get AntennaList |
| Response | > AntennaList = 0* |
| | >Get AntennaList<br>> AntennaList = 0, 1* |
| | //Always use antenna 1<br>>Set AntennaList =1<br>>OK |
| | //Cycle between antenna 0 and antenna 1<br>>Set AntennaList =0, 1<br>>OK |

**GET TIME**
**GET TIME**

Description: These commands allow the current time to be obtained or set within the Reader. The primary purpose for having a real time clock is to timestamp the tags in the taglist so that their discovery time can be recorded.

Times are always specified by the format YYYY/MM/DD hh:mm:ss. Changes made with this command will require a reboot of the Reader to take effect.

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

**REBOOT**

Description: The reboot command will immediately cause the Reader to reboot itself.

| Example | |
|---|---|
| Command | >Reboot |
| Response | >OK : Rebooting Reader |

## Network Configuration Commands

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

Description: 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. Changes made with this command will require a reboot of the Reader to take effect.

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

| Example | |
|---|---|
| Command | >Get DHCP |
| Response | >DHCP=ON |
| Command | >Set DHCP=OFF |
| Response | >OK |

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

Description: If DHCP is not used for automatic configuration the Reader must be manually configured for use on a network. The IPAddress command pair allow the host's IP Address to be assigned and interrogated. Changes made with this command will require a reboot of the Reader to take effect.

| Example | |
|---|---|
| Command | >Get IPAddress |
| Response | >IPAddress =12.34.56.78 |
| Command | >Set IPAddress =34.55.33.12 |
| Response | >OK |

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

Description: 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 interrogated. Gateways must be specified as an IP. Changes made with this command will require a reboot of the Reader to take effect.

| Example | |
|---|---|
| Command | >Get Gateway |
| Response | >Gateway=34.56.78.90 |
| Command | >Set Gateway=12.56.23.01 |
| Response | >OK |

**GET NETMASK**
**SET NETMASK**

Description: 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 interrogated. Subnet masks must be specified as an IP. Changes made with this command will require a reboot of the Reader to take effect.

| Example | |
|---|---|
| Command | >Get Netmask |
| Response | >Netask=255.255.255.128 |
| Command | >Set Netmask=255.255.255.0 |
| Response | >OK |

**GET DNS**
**SET DNS**

Description: 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 interrogated. DNS Servers must be specified as an IP address. Changes made with this command will require a reboot of the Reader to take effect.

| Example | |
|---|---|
| Command | >Get DNS |
| Response | >DNS=12.34.56.78 |
| Command | >Set DNS=45.224.124.34 |
| Response | >OK |

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

Description: The MailServer command pair allow an SMTP mail server to be defined. This mail server is used only when automatic notification is configured (see Notify commands) and is set to use Mail as its delivery method. 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 | >OK |

**GET HEARTBEATPORT**
**SET HEARTBEATPORT**

Description: 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 actual port number that this packet is sent out to is configured using the HeartbeatPort command. 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.
Changes made with this command will take effect immediately.

The default setting for this command is 3988

The format of the UDP packet is a single text line containing three comma separated fields terminated with a NULL character:

ReaderName, ReaderType, ReaderCommandPort
i.e., “Loading Dock Reader A, Alien Class I Reader, 4002[0]”

| Example | |
|---|---|
| Command | >Get HeartbeatPort |
| Response | >HeartbeatPort=3004 |
| Command | >Set HeartbeatPort=10002 |
| Response | >OK |

**GET HEARTBEATTIME**
**SET HEARTBEATTIME**

Description: 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 specified and interrogated using this command. All intervals are specified in seconds. A setting of zero will suspend the output of any further heartbeats.

Changes made with this command will take effect immediately.

The default setting for this command is 30 seconds.

| Example | |
|---|---|
| Command | >Get HeartbeatTime |
| Response | >HeartbeatTime=30 |
| Command | >Set HeartbeatTime=60 |
| Response | >OK |

**GET COMMANDPORT**
**SET COMMANDPORT**

Description: The Reader can be configured and operated over the network using standard network sockets. The CommandPort settings are used to set and get the exact port number used by the Reader for this network connectivity.

Changes to this setting do not affect Serial communication and/or Web communication with the Reader. Changes made with this command will take effect immediately.

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

| Example | |
|---|---|
| Command | >Get CommandPort |
| Response | >CommandPort=23 |
| Command | >Set CommandPort=10004 |
| Response | >OK |

# Enterprise Commands

**GET TAGLIST**

Description: The get TagList command will retrieve the Reader's 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

Each tag is listed in the format:
TagID, DiscoverTime, ReadCount, Antenna

- TagID is the unique ID code carried by the tag
- Discover Time is the time that the tag was first added to the current tag list. It is formatted as YYYY/MM/DD hh:mm:ss (24 Hour clock)
- ReadCount is the number of time the tag has been read since Discover Time
- Antenna is the antenna port that the tag was first read from.

| Example | |
|---|---|
| Command | Get TagList |
| Response | Tag: 00 02 00 30 A2 33 04, Discover: 2002/03/23 15:36:33, Count: 4, Antenna: 0<br>Tag: 80 80 AA AB EC F0 00, Discover: 2002/03/22 12:26:01, Count: 3, Antenna: 1 |
| Command | Get TagList |
| Response | (No Tags) |

### CLEAR TAGLIST

Description: The clear taglist command will cause the Reader to immediately clear out its internal tag list.

| Example | |
|---|---|
| Command | >Clear TagList |
| Response | >OK |

### GET PERSISTTIME
### SET PERSISTTIME

Description: The persist time is used by the Reader to build up its internal list of active tags. Persist times are specified in seconds. Setting the persist time to a positive number (0-n) will effect an persist time of the desired number of seconds (a zero persist time will guarantee an empty tag list). Setting the persist time to a negative number (-1) will effect an infinite persist time. I.e., any tags read will continually be added to the tag list.
The maximum number of tags that can be stored in the tag list is 5000. Once this tag limit is reached, newer tags will replace the oldest ones in the list.

Changes made with this command will take effect immediately.

The default setting is 10 seconds.

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

**GET READTIME**
**SET READTIME**

Description: The read time specifies when and for how long the Reader attempts to read tags. The read time is set using two parameters, the sleep time followed by the read duration. Both parameters are specified in seconds. When set, the reader will repeat a cycle of sleeping for the specified sleep time, then waking up and reading for the specified read duration and then sleeping again. If the sleep time is set to zero or a negative number, the reader will remain constantly on. If the read duration is set to zero or a negative number the reader is switched off. If both are set to zero the reader will be switched off.

Changes made with this command will take effect immediately.
The default setting is always reading i.e., 0, 1

| Example | |
|---|---|
| Command<br>Response | >Get ReadTime<br>>ReadTime=3000, 6000 |
| Command<br>Response | >Set ReadTime=20, 10<br>>OK |

**GET READTRIGGER**
**SET READTRIGGER**

Description: The read trigger defines under what conditions, other than timed reads, a read is made.

Reads can be triggered under any of the following conditions, which can be added together for multiple trigger conditions. Each trigger condition is a trigger mode followed by a trigger parameter and a number of seconds to keep reading for after the trigger has been activated. Multiple trigger conditions are semicolon (;) separated options in the text line.

Changes made with this command will take effect immediately.

| Trigger Name | Meaning |
|---|---|
| ON_EXTERNAL_IO | Trigger a read if External IO is triggered. This parameter is followed immediately by a number indicating the External IO Trigger number to use. |

| Example | |
|---|---|
| Command | >Get ReadTrigger |
| Response | >ReadTrigger= ON_EXTERNAL_IO, 1, 20 |
| Command | >Set ReadTrigger= ON_EXTERNAL_IO, 1, 30 |
| Response | >OK |

# Notify Commands

**GET NOTIFYADDRESS**
**SET NOTIFYADDRESS**

Description: The notify address command pair specify where messages should be sent to when they arise and how they should be sent. The form of the address determines the method of delivery. Currently there are 3 delivery methods supported:

| NotifyAddress | Description |
|---|---|
| blank | Do not use automatic notification. |
| user@domain.com | Send a message via Email to the address specified. The address is specified in standard email form i.e., user@domain.com<br>Note that the MailServer parameter must be configured for this to work (see Network Commands) |
| 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. |

Changes made with this command will take effect immediately.

By default setting is OFF.

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

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

Description: The notify time defines the time interval for automatic tag list pushing to a listening machine. The time is specified in seconds. If set to zero or a negative number the time-based automatic notification is disabled. When set to a positive number of seconds, the complete tag list will be pushed out each period.

Changes made with this command will take effect immediately.

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

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

Description: The notify trigger defines under what conditions a message is pushed out to any listener. Notify commands can be triggered under any of the following conditions.

| Trigger Name | Meaning |
|---|---|
| ON_ADD | Push message when new tag is read and added to the TagList |
| ON_REMOVE | Push message when a tag is removed from the TagList |
| ON_CHANGE | Push message when a tag is either added or removed from the TagList |
| ON_EXTERNAL_IO | Push message when a read is triggered via the external IO pins |

Changes made with this command will take effect immediately.

| Example | |
|---|---|
| Command | >Get NotifyTrigger |
| Response | >NotifyTrigger= ON_REMOVE |
| Command | >Set NotifyTrigger=ON_ADD |
| Response | >OK |

### NOTIFY MESSAGE FORMAT

When either the Notify Trigger is activated or the Notify Time has elapsed a formatted message is sent to the listener specified by the Notify Address. The format of this message is always a multi-line response of trigger reason followed by a list of tags.

Notify Message Format:

#Alien RFID Reader Auto Notification
Reason
tagID, discoverTime, readCount, antenna
tagID, discoverTime, readCount, antenna

The following reasons are permissible

| Trigger Name | Meaning |
|---|---|
| ON_TIME | Message is pushed because NotifyTime seconds have elapsed and NotifyTime seconds is greater than zero. TagList to follow is complete taglist from Reader. |
| ON_ADD | Message is pushed because a Tag was added to the Reader tag list, and ON_ADD was set in the NotifyTrigger command. TagList to follow is list of added tags only. |
| ON_REMOVE | Message is pushed because a Tag was removed from the Reader tag list, and ON_REMOVE was set in the NotifyTrigger command. TagList to follow is list of removed tags only. |
| ON_CHANGE | Message is pushed because a Tag was either added to the Reader tag list or removed, and ON_CHANGE was set in the NotifyTrigger command. TagList to follow is complete taglist from Reader. |
| ON_EXTERNAL_IO | Message is pushed because an external IO pin was triggered and ON_EXTERNAL_IO was set in the NotifyTrigger command. TagList to follow is complete taglist from Reader |