

# 1422E Reader

## User Guide

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The AI1422E is the next generation of TransCore's on-board readers. The streamlined AI1422E incorporates the latest technology while maintaining the functionality of the original AI1422.

The AI1422E is available in three compliance options: FCC, ETSI, or CMIIT. The FCC compliant version is an ATA only 902.25-921.50 MHz fixed frequency reader. The ETSI compliant version is an ATA only 865.75-867.5 MHz frequency hopping reader. The CMIIT compliant version (P/N 10-1422-503) is an ATA only 902.625-924.375 MHz fixed frequency reader in 0.25MHz steps.



This guide provides on-site test procedures useful in troubleshooting, as well as AI1422E command codes and information on character translation. This information is intended for use by authorized TransCore AI1422E dealers, installers, and service personnel.

Information in this document is subject to change and does not represent a commitment on the part of TransCore, LP.

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**WARNING TO USERS IN THE UNITED STATES**  
**FEDERAL COMMUNICATIONS COMMISSION (FCC)**  
**LOCATION AND MONITORING SERVICE STATEMENT**  
**47 CFR §90.351**

**NOTE:** The user is required to obtain a Part 90 site license from the Federal Communications Commission (FCC) to operate this radio frequency identification (RFID) device in the United States. The FCC ID number is **FIH1422PT90V5**. Access the FCC website at [www.fcc.gov](http://www.fcc.gov) to obtain additional information concerning licensing requirements.

**NOTE:** Users in all countries should check with the appropriate local authorities for licensing requirements.

**FCC RADIO FREQUENCY INTERFERENCE STATEMENT**  
**47 CFR §15.105(A)**

**NOTE:** This equipment has been tested and found to comply with the limits for a 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 RF energy and may cause harmful interference to radio communications if not installed and used in accordance with the instruction manual. Operating this equipment in a residential area is likely to cause harmful interference, in which case, depending on the laws in effect, the user may be required to correct the interference at their own expense.

**NO UNAUTHORIZED MODIFICATIONS**  
**47 CFR §15.21**

**CAUTION**



***This equipment may not be modified, altered, or changed in any way without permission. Unauthorized modification may void the equipment authorization from the FCC and will void the warranty.***

**USE OF SHIELDED CABLES AND GROUNDING**  
**47 CFR §15.27(A)**

**NOTE:** Shielded cables and earth grounding the unit is recommended for this equipment to comply with FCC regulations.

**TRANSCORE, LP**  
**USA**

**AVERTISSEMENT À L'ATTENTION DES  
UTILISATEURS AUX ÉTATS-UNIS**  
**DÉCLARATION 47 CFR §90.351 (CODE DES  
RÈGLEMENTS FÉDÉRAUX) DE LA FEDERAL  
COMMUNICATIONS COMMISSION (FCC) SUR LES  
SERVICES DE LOCALISATION ET DE CONTRÔLE**

**REMARQUE** : L'utilisateur est tenu d'obtenir une licence d'utilisation sur site Partie 90 auprès de la Federal Communications Commission (FCC) afin de pouvoir utiliser ce dispositif RFID (radio-identification) aux États-Unis ou au Canada. Le numéro d'identification de la FCC est **FIH1422PT90V5**. Pour obtenir de plus amples informations concernant les exigences relatives aux licences, prière de consulter le site web de la FCC à [www.fcc.gov](http://www.fcc.gov).

**REMARQUE** : Il est recommandé à tous les utilisateurs, quel que soit leur pays, de consulter les autorités locales compétentes sur les exigences de licence.

**DÉCLARATION 47 CFR §15.105(A) DE LA FCC SUR  
LES INTERFÉRENCES DES FRÉQUENCES RADIO**

**REMARQUE** : Cet appareil a été testé et déclaré conforme à la catégorie d'un appareil numérique de classe A en accord avec la partie 15 des directives de la FCC. Ces normes visent à assurer une protection raisonnable contre les interférences nuisibles lorsque l'appareil est utilisé dans un environnement commercial. Cet appareil génère, utilise et peut émettre de l'énergie RF et peut être à l'origine d'interférences nuisibles aux communications radio s'il n'est pas installé et utilisé en suivant les directives du manuel d'instructions. Si cet appareil est utilisé dans une zone résidentielle, il est probable qu'il cause des interférences nuisibles. Dans ce cas, l'utilisateur pourrait être amené à remédier aux interférences à ses propres frais, selon les lois du pays en vigueur.

**AUCUNE MODIFICATION NON AUTORISÉE  
47 CFR §15.21**

**MISE EN GARDE** : IL EST INTERDIT DE MODIFIER, D'ALTÉRER OU D'APPORTER DES CHANGEMENTS À CET APPAREIL DE QUELQUE MANIÈRE QUE CE SOIT SANS AUTORISATION. TOUTE MODIFICATION NON AUTORISÉE PEUT ANNULER L'AUTORISATION D'UTILISATION ACCORDÉE PAR LA FCC ET ANNULERA LA GARANTIE.



**UTILISATION DE CÂBLES BLINDÉS ET MISE À LA TERRE  
47 CFR §15.27(A)**

**REMARQUE** : Il est recommandé d'utiliser des câbles blindés et une mise à la terre avec cet appareil afin de répondre aux réglementations de la FCC

**TRANSCORE, LP  
ÉTATS-UNIS**

## **WARNING TO USERS IN CANADA**

### **INDUSTRY CANADA (IC) INDUSTRY CANADA'S RADIO STANDARD SPECIFICATIONS (RSS-137) LOCATION AND MONITORING SERVICE IN THE BAND 902-928 MHZ SECTION 2.1**

**NOTE:** The user is required to obtain a license from Industry Canada (IC), to operate this radio frequency identification (RFID) device in Canada. The IC ID number is **1584A-1422R137V5**, access the IC website at [www.ic.gc.ca](http://www.ic.gc.ca) to obtain additional information concerning licensing requirements.

#### *Industry Canada (IC) Industry Canada's Radio Standard Specifications General Requirements (RSS-GEN) for Compliance of Radio Apparatus Statement Section 8.4*

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

- 1) This device may not cause interference; and
- 2) This device must accept any interference, including interference that may cause undesired operation of the device.

## **AVERTISSEMENT AUX UTILISATEURS AU CANADA**

### **INDUSTRIE CANADA (IC) INDUSTRIE CANADA RADIO STANDARD SPECIFICATIONS (CNR-137) EMPLACEMENT ET SERVICE DE SURVEILLANCE DANS LA BANDE 902-928 MHZ, SECTION 2.1**

**Remarque :** L'utilisateur est tenu d'obtenir une licence d'Industrie Canada (IC), afin d'exploiter ce dispositif d'identification par radiofréquence au Canada. Le numéro d'identification d'IC est **1584A-1422R137V5**. Pour obtenir de plus amples informations concernant les exigences relatives aux licences, prière de consulter le site web de d'IC à [www.ic.gc.ca](http://www.ic.gc.ca)

#### *Radio Standard Spécifications exigences générales Industrie Canada (IC) Industrie Canada (CNR-GEN) pour s'acquitter du Radio appareil déclaration article 8.4*

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- 1) l'appareil ne doit pas produire de brouillage, et
- 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**RADIO FREQUENCY HEALTH LIMITS FOR AI1422 READER  
USING AN EXTERNAL ANTENNA IN FREQUENCY BAND  
OF 902.25 TO 903.75 AND 910.00 TO 921.50 MHZ**

Several agencies (OSHA, FCC, IC) have environmental guidelines regulating maximum permissible exposure (MPE) or “safe” exposure levels that this product falls under. To ensure that proper safety guideline for the end users of this product, i.e. Occupational (Controlled) and General Population/ Public (Uncontrolled), the recommended levels for each of the agencies are presented in the next sections with TransCore’s recommendations for safety in the last section.

**OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION)**

OSHA (an agency of The United States of America) legislates in the Code of Federal Regulations (CFR) Title 29 Part 1910 Subpart G 1910.97 titled “Nonionizing radiation”, a maximum safe exposure limit of 10 milliwatts per square centimeter ( $mW/cm^2$ ) during any 0.1-hour period (i.e. 6 minutes). Using the frequency (in the middle of the band of operation of this equipment) of 915 MHz and the highest antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated to be 5 in (13 cm).

**FCC (FEDERAL COMMUNICATION COMMISSION)**

FCC (an agency of The United States of America) legislates in the Code of Federal Regulations (CFR) Title 47 Chapter I Subchapter A Part 1 Subpart I Section 1.1310 titled “Radio frequency radiation exposure limits” that the maximum permissible exposure (MPE) is the following:

***Occupational/Controlled Exposure***

*Power density = frequency (in MHz)/300  $mW/cm^2$  with an Averaging time of 6 Min*

***General Population/Uncontrolled Exposure***

*Power density = frequency (in MHz)/1500  $mW/cm^2$  with an Averaging time of 30 Min*

Using the frequency (in the middle of the band of operation of this equipment) of 915MHz and the highest antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated. The MPE minimum distances are 9.5 in (24 cm) for the Occupational/ Controlled environment, and 21 in (53 cm) for the General Population/Uncontrolled environment.

**INDUSTRY CANADA (INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT CANADA)**

Industry Canada (a Department of the Government of Canada) sets out the requirements in Radio Standards Specification RSS-102, Issue 5 guidelines, recommending a maximum safe power density in  $W/m^2$ . Thus, the maximum permissible exposure for general population/uncontrolled exposure at 915MHz is  $2.77 W/m^2$ . The average time is 6 minutes. The maximum permissible exposure (MPE) is the following:

### **Controlled Environment**

*Power density = 0.6455\*frequency (in MHz)<sup>0.5</sup> W/m<sup>2</sup> with a Reference Period time of 6 Min*

### **General Public/Uncontrolled Environment**

*Power density = 0.02619\*frequency (in MHz)<sup>0.6834</sup> W/m<sup>2</sup> with a Reference Period time of 6 Min*

Using the frequency (in the middle of the band of operation of this equipment) of 915MHz and the highest antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated. The MPE minimum distances are 11.8 in (30 cm) for the Controlled environment and 30.7 in (78 cm) for the General Public/Uncontrolled environment.

### **TransCore Recommendation on MPE (Maximum Permissible Exposure)**

The calculated power densities and MPE distance for each of the agencies respective to the environment is shown below.

<b>Occupational/Controlled Environment</b>				
<b>Agency</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>MPE minimum distance</b>		<b>Time (min)</b>
		<b>in</b>	<b>cm</b>	
OSHA	10	5	13	6
FCC	3.05	9.5	24	6
IC	1.95	11.8	30	6

<b>General Population/Public/Uncontrolled Environment</b>				
<b>Agency</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>MPE minimum distance</b>		<b>Time (min)</b>
		<b>in</b>	<b>cm</b>	
OSHA	10	5	13	6
FCC	0.61	21	53	30
IC	0.28	30.7	78	6

With the equipment installed and running at the maximum transmit power of 2.0W (33dBm), 0 dB transmit attenuation, using the highest gain antenna that the equipment is certified for, the recommendation for each of the operation environments is as follows:

- 1) The antenna should be installed at least 30.7 in (78 cm) from the General Population/Public i.e. Uncontrolled Environment.
- 2) Maintenance personnel (i.e. Occupational/Controlled Environment) must remain at least 11.8 in (30 cm) from the antenna and limit their time in the environment to 6 minutes when the system is operating.

**LIMITES D'EXPOSITION AUX RADIOFRÉQUENCES POUR LE LECTEUR AI1422  
UTILISANT UNE ANTENNE EXTERNE SUR LA BANDE  
DE FRÉQUENCES DE 902.25 À 903.75 ET DE 910.00 À 921.50 MHZ**

Plusieurs organismes (OSHA, FCC, IC) publient des directives environnementales qui recommandent des limites d'exposition maximale autorisée (normes MPE) ou des niveaux d'exposition « sûrs » auxquels cet appareil se conforme. Pour faire en sorte que chaque utilisateur final ait connaissance des directives de sécurité qui le concerne, que ce soit dans son travail (accès contrôlé) ou pour la population générale/le grand public (accès non contrôlé), TransCore présente les niveaux recommandés par chaque organisme dans ses recommandations sécuritaires détaillées dans la dernière section.

**OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION)**

Dans le Code des réglementations fédérales (CFR), Titre 29, Partie 1910, Sous-partie G 1910.97, intitulée « Nonionizing radiation » (Rayonnements non ionisants), l'OSHA (organisme américain) recommande un plafond d'exposition maximale de 10 milliwatts par centimètre carré (mW/cm<sup>2</sup>) pendant une période de 0,1 heure (soit 6 minutes). En utilisant la fréquence de 915 MHz (milieu de la bande de fréquences de cet appareil) et le gain d'antenne maximal pour lequel cet appareil a reçu une certification d'utilisation dans une installation finale, la distance minimale sécuritaire est de 13 cm (5 po).

**FCC (FEDERAL COMMUNICATION COMMISSION)**

Dans le Code des réglementations fédérales (CFR), Titre 47, Chapitre I, Sous-chapitre A, Partie 1, Sous-partie I, Section 1.1310 intitulée « Radiofrequency radiation exposure limits » (Limites d'exposition aux rayonnements de radiofréquence), la FCC (organisme américain) établit les limites d'exposition maximale autorisée (normes MPE) comme suit :

***Exposition professionnelle/contrôlée***

*Densité de puissance = fréquence (en MHz)/300 mW/cm<sup>2</sup> avec une durée moyenne de 6 min.*

***Exposition de la population générale/non contrôlée***

*Densité de puissance = fréquence (en MHz)/1500 mW/cm<sup>2</sup> avec une durée moyenne de 30 min.*

En utilisant la fréquence de 915 MHz (milieu de la bande de fréquences de cet appareil) et le gain d'antenne maximal pour lequel cet appareil a reçu une certification d'utilisation dans une installation finale, la distance minimale sécuritaire est la suivante : les distances MPE minimales sont de 24 cm (9,5 po) pour l'environnement professionnel/contrôlé et de 53 cm (21 po) pour la population générale/ environnement non contrôlé.



## **INDUSTRIE CANADA (INNOVATION, SCIENCES ET DÉVELOPPEMENT ÉCONOMIQUE CANADA)**

Le Cahier des charges sur les normes radioélectriques 102, 5<sup>e</sup> édition, d'Industrie Canada (un ministère du Gouvernement du Canada) établit des recommandations pour une densité de puissance maximale sécuritaire en W/m<sup>2</sup>. Ainsi, l'exposition maximale admissible pour la population générale/ non contrôlée à 915 MHz est calculée à 2,77 W/m<sup>2</sup>. La durée moyenne est de 6 minutes. Les limites d'exposition maximale autorisée (normes MPE) sont les suivantes :

### **Environnement contrôlé**

*Densité de puissance = 0,6455\*fréquence (en MHz)<sup>0,5</sup> W/m<sup>2</sup> avec une durée de référence de 6 min.*

### **Grand public/environnement non contrôlé**

*Densité de puissance = 0,02619\*fréquence (en MHz)<sup>0,6834</sup> W/m<sup>2</sup> avec une durée de référence de 6 min.*

En utilisant la fréquence de 915 MHz (milieu de la bande de fréquences de cet appareil) et le gain d'antenne maximal pour lequel cet appareil a reçu une certification d'utilisation dans une installation finale, la distance minimale sécuritaire est la suivante : les distances MPE minimales sont de 30 cm (11,8 po) pour l'environnement professionnel/contrôlé et de 78 cm (30,7 po) pour le grand public/ environnement non contrôlé.

### **Recommandations de TransCore sur les limites d'exposition maximale autorisée (normes MPE)**

Les densités de puissance et la distance MPE calculées par chaque organisme pour un environnement donné sont présentées ci dessous.

<b>Exposition professionnelle/environnement contrôlé</b>				
<b>Organisme</b>	<b>Densité de puissance (mW/ cm<sup>2</sup>)</b>	<b>Distance MPE minimale</b>		<b>Durée (en min.)</b>
		<b>po</b>	<b>cm</b>	
OSHA	10	5	13	6
FCC	3,05	9,5	24	6
IC	1,95	11,8	30	6

<b>Population générale/environnement non contrôlé</b>				
<b>Organisme</b>	<b>Densité de puissance (mW/ cm<sup>2</sup>)</b>	<b>Distance MPE minimale</b>		<b>Durée (en min.)</b>
		<b>po</b>	<b>cm</b>	
OSHA	10	5	13	6
FCC	0,61	21	53	30
IC	0,28	30,7	78	6

Avec l'appareil installé et fonctionnant à la puissance de transmission maximale de 2,0 W (33 dBm), 0 dB d'atténuation de transmission, et en utilisant le gain d'antenne maximal pour lequel l'appareil a reçu une certification, les recommandations pour chaque environnement d'exploitation sont les suivantes :

- 1) L'antenne devrait être installée à au moins 78 cm (30,7 po) de la population générale/du grand public, c'est-à-dire d'un environnement non contrôlé.
- 2) Le personnel d'entretien (c'est-à-dire dans un environnement professionnel/contrôlé) doit rester à au moins 30 cm (11,8 po) de l'antenne et limiter son temps d'exposition à 6 minutes lorsque l'appareil est en fonctionnement.

# Licensing Requirements

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To operate a radio frequency (RF) system in a given country, the user must first obtain permission from the regulatory agency that controls radio operations in that country. Most countries require type and safety approval, as well as licensing for RF transmitters. Users in all countries should check with the appropriate local authorities for licensing requirements.

## U.S. Licensing

This AI1422E Reader System requires an FCC Part 90 license to operate in the U.S. The authorized frequency bands in the U.S. are 902.25-903.75 and 910.00-921.50 MHz only if the reader does not modulate (i.e. ATA only). If the reader does modulate (SeGo) the frequency range is constricted to 911.75-919.75.

The user is responsible for filing the FCC license according to FCC regulations. Access the FCC Web site at <https://www.fcc.gov/licensing-databases/forms> or at <https://www.fcc.gov/licensing> to obtain additional information concerning licensing requirements.

An FCC license provides the user with the legal authorization to operate the RFID systems on the licensed frequencies at the site specified in the license. Only an authorized installer or service technician can set the frequency for the AI1422E Reader System to that specified in the FCC site license.

The FCC license also provides the user with protection and authorization to maintain the system should any other RFID be used in the licensed area after the AI1422E Reader System is installed.

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# Chapter 1 System Overview

The AI1422E Reader System is a microprocessor-controlled, single-antenna unit that uses a unique communications protocol to interface with vehicle identification (ID) equipment.

This reader system uses radio frequency (RF) energy to read data from tags. The AI1422E Reader System then decodes the tag ID information, validates the ID code, and transmits tag data directly to a host processor for real-time data processing and use.

Communications (terminal) programs usually do not provide adequate data processing capability. Your host computer software can be customized to provide the required capabilities.

The AI1422E Reader System consists of the AI1422E Reader, which consists of a reader and RF module, combined with a TransCore antenna, a TransCore tag, a host processor system, and a power source. **Figure 1** illustrates a typical reader system configuration.

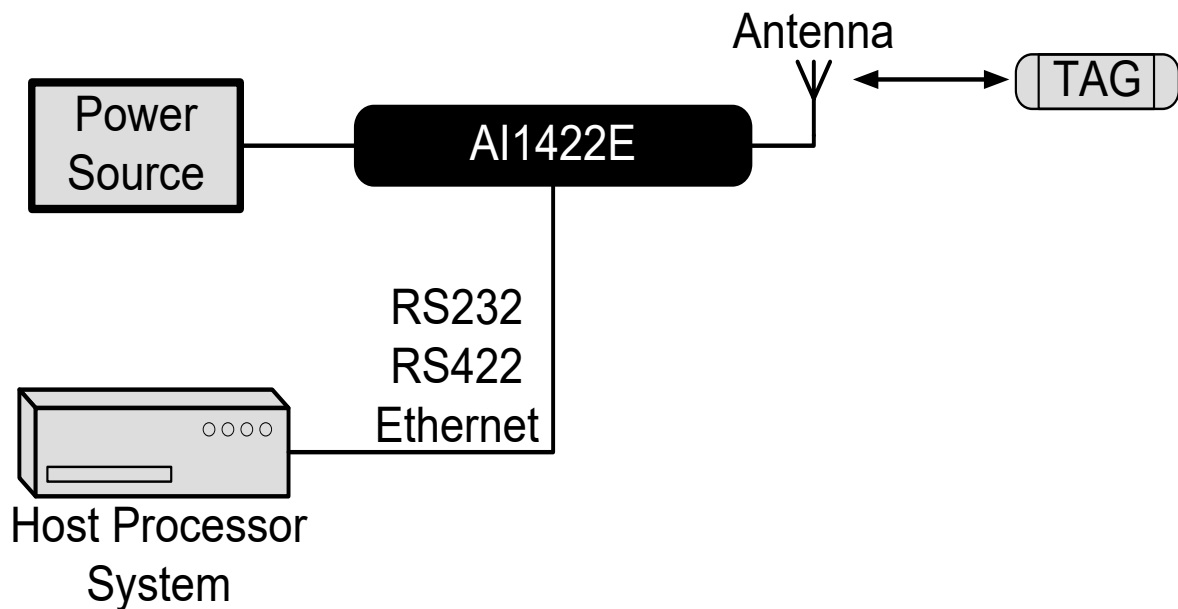


Figure 1 Typical Reader System Configuration

## AI1422E Models

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The AI1422E is available in three compliance options: FCC, ETSI, or CMIIT. The FCC compliant version (P/N 10-1422-500) is an ATA only 902-928 MHz fixed frequency reader. The ETSI compliant version (P/N 10-1422-800) is an ATA only 865.75-867.5 Mhz frequency hopping reader. The CMIIT compliant version (P/N 10-1422-503) is an ATA only 902.625-924.375 MHz fixed frequency reader in 0.25MHz steps.

### Transponder Interrogator

The transponder interrogator reads 60 bits half frame and 120 bits full frame of user-programmable data in the transponder.

The transponder interrogator is operated in a continuous read mode, and any tag entering its read field has its data automatically read and relayed to the host computer. In many applications this function is implemented by installing the reader on a vehicle with restricted movement, such as a rail car or monorail bus. The tags are embedded in the roadway at various locations in the vehicle's path. The data read from the tag allows the host computer to assess the vehicle's location and make any appropriate response to that information.

The transponder interrogator is an independent tag decoder that combines a reader and RF source to provide automatic identification and data storage within a single, compact unit. The transponder interrogator includes the following components:

- 19-inch rack-mount design (1U)
- RS232/RS422/Ethernet input/output (I/O) link
- Real-time clock
- Reader and RF module, combined in one unit

### Reader Power Regulation and Filtering

The AI1422E Reader System uses an input voltage ranging from 24 VDC to 110 VDC (12 VDC to 150 VDC Min/Max). The reader system incorporates a high-performance, DC-to-DC power supply that converts voltage in this range to 24 VDC. This voltage conversion is internal to the unit, and should be transparent to the end-user.

### Antenna

TransCore has multiple antennas for use with the AI1422E Reader, covering multiple applications such as heavy rail, light rail, European regions, and more. Contact TransCore for assistance with antenna selection.

## Tags (Transponders)

The AI1422E Reader System uses TransCore's half-frame and full-frame read-only tags. When selecting a tag for an application that requires the tag to be placed on the road bed, several design elements need to be kept in mind.

Beam-powered tags have a shorter footprint than battery or switch-powered tags, and thus the maximum top speed of the vehicle will be less, all other factors equal.

Battery tags have an inherently larger footprint, but the battery life limitation will require the operating company to replace the tags every 8 to 10 years. The presence of the battery and its reactive mass reduces the reliability of the tag, particularly when the tag is placed near high shock or vibration locations such as switches.

Switch-powered tags have RF characteristics similar to battery tags, but the tags derive power from the railway switch.

## Tag Mounting

All tags used with the AI1422E must be mounted on a flat metal plate. The internal antennas of these tags are tuned for the backplane of the tag to be in contact with a flat metal surface. This metal surface does not need to be extended beyond the outer dimensions of the tag, and having a larger metal surface will not affect the immediate performance of the tag.

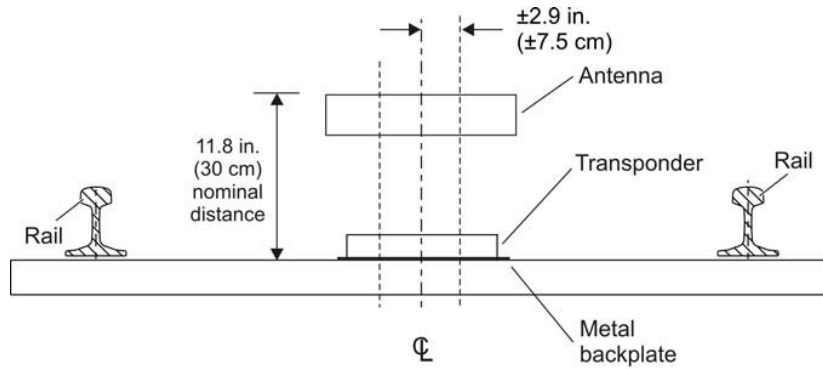
Metal located to the sides or above the tag can affect the tag's performance. Metal surfaces or objects should not be placed closer than 1 inch (2.5 cm) to the side edges of the tag to ensure that the tag's antenna tuning remains within design criteria. Metal placed above the tag can cause shadowing of the RF beam, both in the incident and return directions, and should be avoided. The only exception to this rule would be metal placed for the purpose of affecting the read range of the tag or footprint of the system, and the placement of such metal should be done with careful planning and testing to ensure proper system performance. With battery-powered tags, the arrangement of intentional metallic obstructions may be the best way to limit the broad footprint of these tags, as well as improve the repeatability of the TLS signal with respect to its absolute position relative to the tag. These tag mounting details are determined by the customer on the basis of each customer's overall system design and requirements. Keep in mind that metal placed too close in proximity to the tag will affect the tag's antenna tuning, and may unintentionally affect principal design parameters such as VSWR or the impedance match of single paths internal to the tag, to name a few examples.

## Antenna-to-Tag Centerline Alignment

For best performance, mount tags so that the centerline of the tags and the centerline of the reader antennas are within  $\pm 2.9$  inches ( $\pm 7.5$  cm) of each other ([Figure 2](#)).

## Antenna-to-Tag Distance

Many installations have been installed with a nominal 11.8 in (30 cm) distance from the backplane of the reader antenna to the back edge of the tag (Figure 2).



SD-0151

Figure 2 Antenna-to-Tag Centerline Tolerance

# Chapter 2 Interface Connections

The interface connectors are located on the AI422E Reader System front panel as shown in [Figure 3](#).

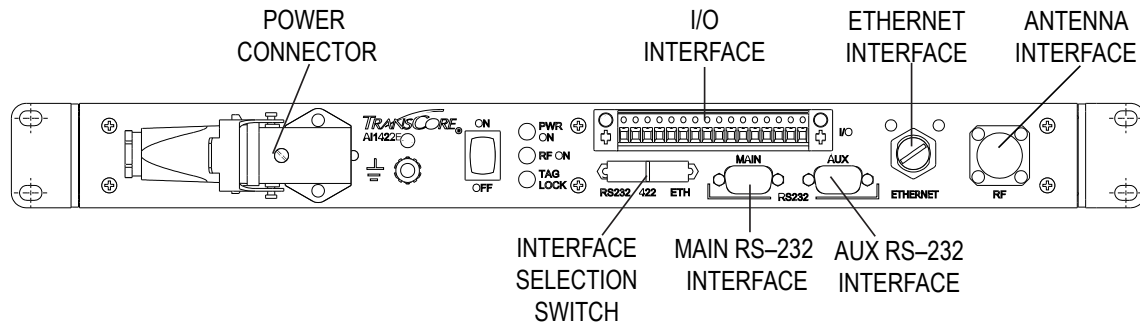


Figure 3 Front Panel of an AI422E Reader

## Antenna Interface

Attach the antenna cable directly to the antenna interface on the front panel of the AI422E Reader System. The antenna cable length depends on the installation.

## Ethernet (M12) Interface

The AI422E Reader incorporates a Lantronix® Ethernet to Serial conversion module, which is used to add full Ethernet compatibility into the reader. This module is located on the interface board internal to the reader, and is addressable through Lantronix host software. More details on this module can be found in [Figure 4 on page 2–6](#).

The Ethernet Interface utilizes a 4-pin, D-coded M12 connector (defined in IEC 61067-2-101 Amendment 1 as the Industrial Ethernet standard). This connector is pin-to-pin compatible with RJ45 10/100Mbps Ethernet.

[Figure 4](#) shows the connector pin designations.

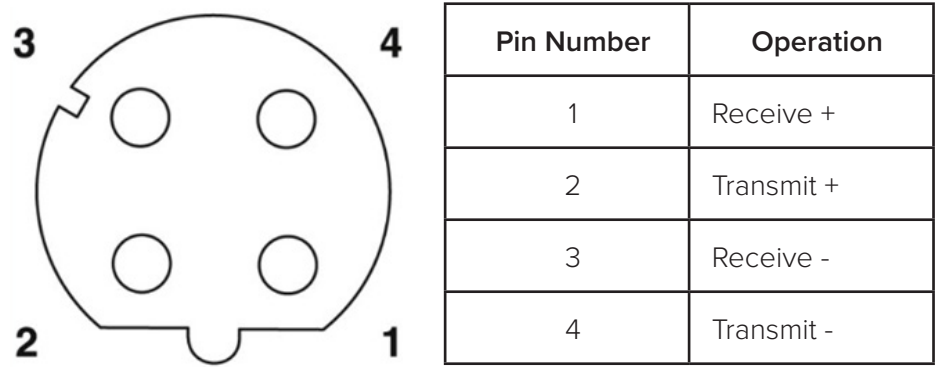


Figure 4 Pin Designations for M12 Connector

## I/O Interface

The customer I/O interface connector contains the tag lock, main power, RF Power outputs (solid state), trigger signals (solid state), and RS-422 (Figure 5). A mating connector for the customer I/O interface is supplied with each unit. This connector allows a screw terminal, point-to-point wiring interface.

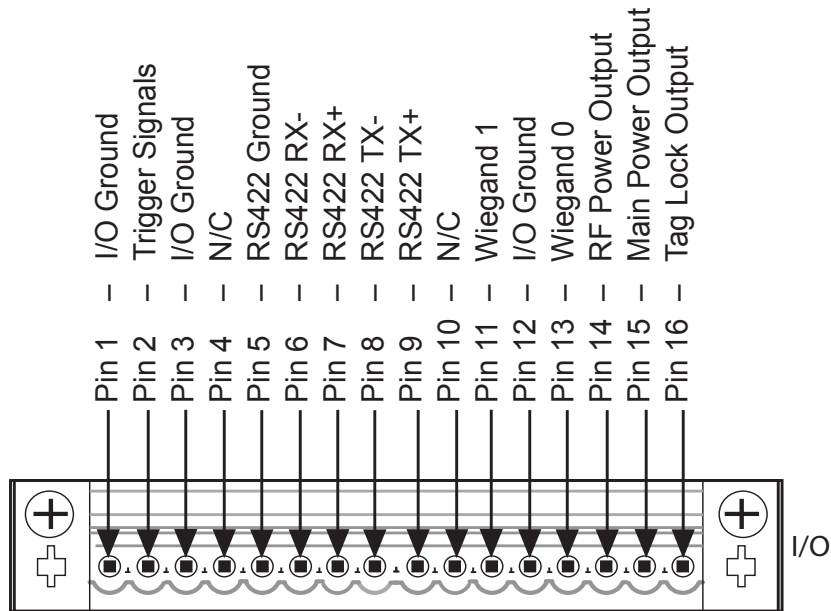


Figure 5 IO Interface Drawing

## Trigger Signals (Pin 2)

The trigger connection turns on the RF power when shorted to I/O ground and the AI1422E Reader System has been programmed with the RF Follows Trigger command (! 642).

## RS-422 Interface (Pins 5-9)

The RS-422 interface is a terminal block connector. In real-time mode, tag IDs are read and passed on to the host processor.

## RF Power Output (Pin 14)

The transistor-transistor logic (TTL) RF power LED goes active high when the reader system is configured for the RF power to be on and the ON/OFF switch is set to ON. The RF power signal may be connected to an LED for monitoring purposes.

The main power relay is referenced to  $5V_{iso}$  and I/O Ground.

## Main Power Output (Pin 15)

The TTL main power signal goes active high when the ON/OFF switch on the front panel is switched to ON. The main power signal may be connected to an LED for monitoring purposes.

The main power relay is referenced to  $5V_{iso}$  and I/O Ground.

## Tag Lock Output (Pin 16)

The TTL lock signal shows the presence of a tag. The lock signal goes active high when a valid tag is in the RF field of the antenna and may be connected to an LED for monitoring purposes.

The tag lock relay is referenced to  $5V_{iso}$  and I/O Ground. The falling edge of the tag lock signal can be increased by using a 10K ohm resistor.

## Power Connector

The power connector on the front panel of the AI1422E Reader System is a panel mount, right angle, EPIC® HA-3 style 3 pin plus ground rectangular connector.

## Interface Selection Switch

The AI1422E Reader incorporates a communications interface selection switch, which allows on-the-fly changes to the communications mode. This switch allows selecting the reader's receive communications interface. All communications interfaces are configured for simultaneous transmit, but only the interface selected by the switch is active for commands transmitted into the reader.

## Main RS–232 Interface

The main RS–232 interface is a standard DB–9 plug connector used with a host processor. In real-time mode, tag IDs are read and passed on to the host processor. Figure 6 illustrates the RS–232, DB–9 plug connector pin-outs.

## Aux RS–232 Interface

The auxiliary RS–232 interface is used as a backup monitoring system to the main RS–232 interface. The auxiliary interface monitors data from the transponder interrogator. The auxiliary RS–232 interface is a standard DB09 plug connector. This port is not wired to receive data and cannot accept commands.

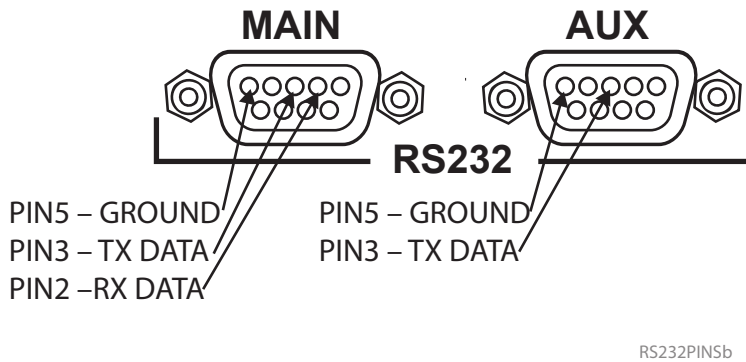


Figure 6 RS–232, DB–9 Interface Connector Pin-outs



# Chapter 3 Installation

## General

Equipment should be installed and serviced only by skilled, qualified personnel in restricted access locations.

## Mechanical

The AI1422E has a standard 1U sized hole pattern. For installation, use No. 10 rack US screws and torque to 25-30 in-lbs. For metric, use M6 screws and torque to 3-4 N-m. Refer to [Figure 7](#) for diagram and dimensions.

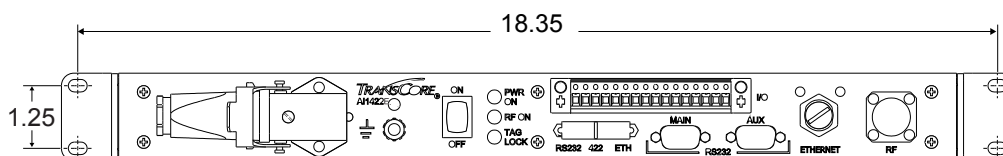


Figure 7 AI1422 Dimensions

## Electrical Power

### Assembling the Power Connector

This section describes the steps to assemble the power connector. Typically, the power source is located in the same cabinet with the AI1422E.

**NOTE:** The Power cable requires an 18 AWG stranded wire or larger, with a minimum insulation rating of 70C and 150V. Wire must meet EN 60950-1 or other applicable component standards.

An external 10A-rated overcurrent protection device is required in-line with positive terminal for proper system operation and protection. Device must meet EN60950-1 or applicable component standard(s).



**WARNING:** Ensure that the ON/OFF switch is in the OFF position and the PWR ON indicator is not illuminated before servicing the unit.

1. Unpack the unit from the shipping crate and locate the power connector on the front panel ([Figure 8](#)).



Figure 8 Power Connector

2. Unlatch the plug from the receptacle on the unit and remove it (Figure 9).



**Figure 9 Remove Plug from Receptacle**

3. Locate the set screw on the plug housing. Remove the screw and plug-insert from the housing (Figure 10).



**Figure 10 Remove Screw and Plug Insert**

4. Locate the tabs on the plug insert. Squeeze the tabs to remove the wire harness from the insert clip (Figure 11).



**Figure 11 Remove Wire Harness from Insert Clip**

5. Remove the cable gland assembly from the rear of plug (Figure 12).



**Figure 12 Cable Gland Assembly - Rear of Plug**

- Locate the wiring diagram label on the top panel of the 1422E and note the corresponding pin numbering on the plastic of the plug wire harness (Figure 13).



**Figure 13 Pin Numbering: Plug Wire Harness**

- Thread the +Vin and -Vin wires through the cable gland, housing, and insert assemblies (Figure 14).



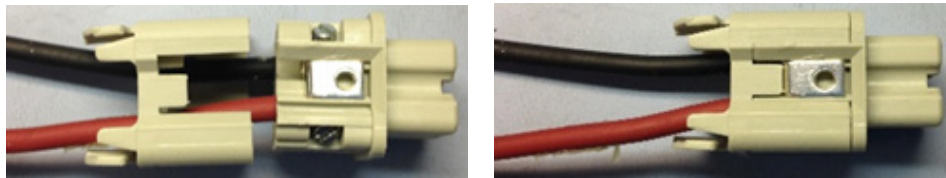
**Figure 14 Thread Wires Through Assembly**

- Loosen the wire retention screws on the wire harness. Insert the wires into their respective pins and tighten the retention screws to ensure wires cannot be removed (Figure 15).



**Figure 15 Thread Wires Through Assembly**

9. Insert the wire harness into the insert clip until the tabs click into place (Figure 16).



**Figure 16** Insert Wire Harness into Insert Clip

10. Place the insert back into the plug housing and tighten the set screw (Figure 17).



**Figure 17** Reassemble and Tighten Set Screw

*NOTE: If the set screw will not tighten, remove the insert and ensure the set screw is properly aligned with the hole on the plug housing.*

11. Insert the cable gland assembly back into the plug housing. Using a wrench, tighten the gland nut. Connect +Vin and -Vin to the power source (Figure 18).



**Figure 18** Reassemble Cable Gland Assembly

## Installing Wires into Connector



**WARNING:** Ensure that the ON/OFF switch is in OFF position and the PWR ON indicator is not illuminated before connecting/disconnecting from the power supply.

### Connecting power

1. Ensure that the ON/OFF switch is in the **OFF** position (Figure 19).



Figure 19 Power Switch

2. Reinstall the power connector. Press the latch firmly to ensure proper connection (Figure 20).



Figure 20 Reinstall Power Connector

3. Toggle the ON/OFF switch to the **ON** position and ensure the **PWR ON** indicator is illuminated (Figure 21).



Figure 21 Power the Unit to ON

## Disconnecting power

4. Toggle the ON/OFF switch to the **OFF** position and ensure that the **PWR ON** indicator is not illuminated (Refer to Figure 19).



Figure 22 Connector Latch

5. Unlatch the connector (Figure 22).



Figure 23 Remove Plug from Receptacle

6. Gently remove plug from receptacle (Figure 23).

## Protective Earth Ground Terminal



### CAUTION:

*For safety and proper operation, the 1422E must be properly fastened to a protective earth ground. The ground stud is located on the front panel of the 1422E between the power connector and ON/OFF switch (Figure 24).*



Figure 24 Location of Ground Stud

For proper grounding, refer to the diagram in [Figure 25](#).

*NOTE: Grounding cable should be 16 AWG or larger.*

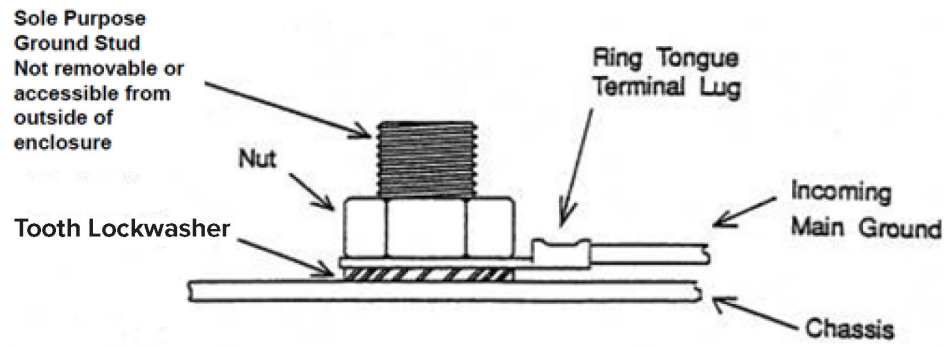


Figure 25 Proper Single Ground Screw Diagram

## Chapter 4 System Test Procedures

This chapter provides testing procedures that will help you fine-tune your reader system and test basic operation, measure radio frequency (RF) power, measure system noise, read tags, and monitor the system.

### Required Tools and Equipment

The following tools and equipment are required:

- 50-ohm, 5-watt (W) load (N-type connector)
- Personal computer (PC) with terminal emulator software
- Appropriate power source for your reader
- Digital multimeter
- Antenna, cable, and connectors

### Testing Basic Operation

To test the system operation, configure the reader system as follows:

1. Configure a terminal emulator (a PC using communications software) to 9600 baud, no parity, 8 data bits, and 1 stop bit (factory default settings for the reader).
2. Connect the emulator to the main RS-232 interface located on the front panel of the reader system. When using RS-232, a null modem is required.
3. Slide the Interface Selection switch on the front panel of the reader to **RS-232**. Refer to [“Figure 3 Front Panel of an AI1422E Reader” on page 2–5](#) to view a diagram of the front panel.
4. Toggle the ON/OFF switch located on the front panel of the reader system to **OFF**.
5. Connect a power source to pins 1 (+) and 3 (-) on the DC power input front panel connector (Figure 26).

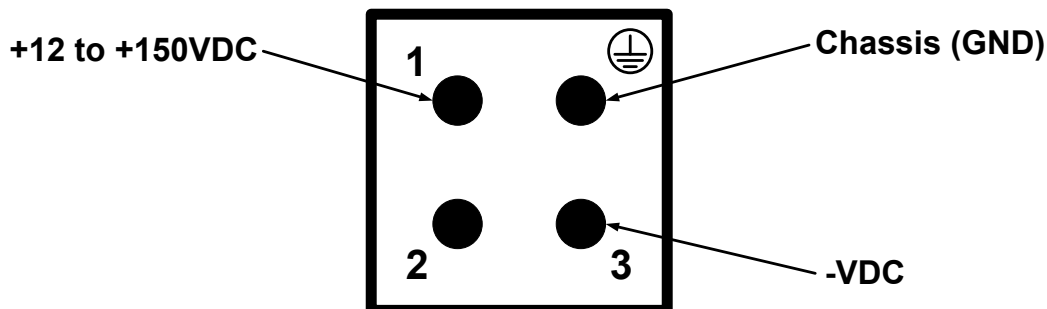


Figure 26 Power Source Connections



6. Toggle the ON/OFF switch located on the front panel of the reader system to **ON**.
7. Enter the command !01 or ~~CC (CC must be entered in upper case) and press **Enter**.

*Note: For information on entering command codes, refer to “Chapter 5 Communications Protocols” on page 5–19.*

8. Input !22 and press **Enter**. The time and date will be returned.

If the time and date are not received, check communications connections, cycle power, and repeat.

If the time and date are incorrect, use !20 and/or !21 to correct this information, then input the following commands:

!20hh:mm:ss	sets time
!21MM/DD/YY	sets date
!642	sets RF to follow the trigger
!41	enables transmission of all IDs

*Note: !41 command should be used in diagnostic mode only. Do not use in normal system operation.*

The reader will echo the command and reply !Done when the reply is properly executed. To enter back into normal operation mode after testing the tag, input the following commands:

!01	enters command mode
!40	disables transmission of all IDs
!00	enter data mode

## Reading the Tag

---

### To verify that the AI1422E Reader System is correctly reading tags:

1. Toggle the ON/OFF switch located on the front panel of the reader system to **OFF**.
2. Using your own cable, connect the laptop PC to the reader system at the main RS–232 interface.
3. Slide the **Interface Selection switch** on the front panel of the reader to RS–232.
4. Connect the antenna to the antenna interface on the front panel of the reader system.
5. Toggle the ON/OFF switch located on the front panel of the reader system to **ON**.
6. Connect a jumper between pins 3 (Ground) and 2 (Trigger Input) on the customer I/O interface to trigger the RF on (“Figure 5 IO Interface Drawing” on page 2–6).
7. Monitor the LEDs on the box and verify that the main power LED and the RF power LED are illuminated.
8. Position a programmed TransCore rail tag with a backplate within 2 to 3 feet (0.6 to 0.9 m) of the antenna. No other tag can be in this 2 to 3 foot (0.6 to 0.9 m) area during this test.

9. Verify that the lock LED is illuminated and that the PC is acquiring the tag data.

*Note: If the !41 command was issued prior to this test, the PC will be receiving a continuous stream of tag data. If the !41 command was not issued, the reader responds with only one response. The Lock LED remains illuminated as long as there is a tag in the field, but only one response is forthcoming unless the !41 command has been issued.*

10. Remove the tag from the antenna field. The PC should stop reading the tag data.
11. Disable the trigger by disconnecting the jumper.
12. Toggle the on/off switch located on the front panel of the reader system to **OFF**.

*Note: Repeat this test several times. Each time, the lock LED should be illuminated and the PC should be reporting the tag data.*

# Chapter 5 Communications Protocols

The AI1422E Reader supports the following communications protocols:

- Basic
- Error Correcting

The following protocol information provides reference information relevant to developing host software.

Communications are performed using the 7-bit ASCII code with optional parity, thus providing easy setup, testing, and diagnostics with standard ASCII terminals and serial printers. Parity must be enabled to achieve the specified undetected error rate.

Each message is framed within the start-of-message (som) and end-of-message (eom) characters so that the host computer can detect the beginning and end of each message. This convention is most important under marginal communications conditions during which the host may receive extraneous noise-induced characters between reader transmissions. In such instances, the host is capable of ignoring any messages that do not conform to the som–eom frame sequence.

Both data mode and command mode require a two-way message interchange when using ECP. This interchange is completed by the message recipient returning a message acknowledgment to the message sender.

With ECP, all transmissions require a message. If a message is not received, the sender will time out with the same effect as if it had received a negative acknowledgment (from the host) or an !Error message from the AI1422E Reader.

Software (XON/XOFF) flow control is optionally supported. Be careful in the use of XON/XOFF since noise-induced characters may be interpreted by the AI1422E Reader as the XOFF character, which would suspend reader output without information reaching the host computer. For more information refer to “[Table 25 Select RF Operating Frequency Commands \(FCC\)](#)” on page D–29.

*Note: TransCore recommends that XON/XOFF flow control be disabled while using ECP.*

## Basic Protocol

---

With basic protocol, messages sent to and from the AI1422E Reader and the host are transmitted without error checking. For each host transmission, the AI1422E Reader returns a !Done or !Error message to the host.

When the host computer is physically close to the AI1422E Reader and no sources of interference exist, the basic protocol provides reliable communications.

The host must be ready to receive reader-transmitted messages because in basic protocol the AI1422E Reader does not wait for the host to acknowledge a message before transmitting the next message. If necessary, the host may halt reader transmissions by using software or hardware. Refer to “[Chapter 6 Commands](#)” on page 6–21 for flow control information.

## Error Correcting Protocol

---

When the quality of data communications is imperative or may be suspect, you can invoke ECP to ensure the integrity of data transmitted between the AI1422E Reader and the host.

*Note: TransCore recommends that basic protocol (not ECP) be used when commands are entered manually at the keyboard.*

Wiegand output is automatically disabled when the reader is put into ECP mode.

Error correction is accomplished with the use of a cyclic redundancy check (CRC) value that is based on the message data. The originator (reader or host) calculates the CRC value of a message and includes it in the transmitted message.

The recipient (reader or host) also calculates a CRC value for the received message. If the transmitted message data is correct, the CRC value calculated by the recipient will agree with the CRC value calculated by the originator. If the CRC values do not agree, the recipient rejects the message.

Message sequence numbers are also included when using ECP. These sequence numbers are checked to determine if the message received has the correct sequence number; if not, the recipient rejects the message.

Since the seven-bit ASCII code is used and there are eight data bits per character, the eighth bit can optionally be used to support parity. Where parity is selected, the CRC value calculation includes the parity of each character in the calculation of the CRC value.

Parity is required to achieve the most reliable communications. If parity is enabled, both the AI1422E Reader and the host must issue a message if any received character has a parity error. However, the message must not be transmitted before receipt of the eom character. In this case, the AI1422E Reader will issue an `!Error` message, and the host computer will issue a negative acknowledgment message.

# Chapter 6 Commands

The AI1422E Reader is delivered from the factory with specified default settings that determine how the reader operates. Commands transmitted by the host computer can change the default settings and control additional features. The commands can be transmitted by manually entering the commands at the host keyboard if the host is in terminal emulation mode.

*Note: If you are using Wiegand mode, you must connect the PC or laptop to the AI1422E Reader using the RS–232 or RS–422 interface and a terminal emulation program to send commands to the reader. You can leave the Wiegand interface connected during this procedure.*

## Operating Modes

The AI1422E Reader has three modes of operation: Data Mode, Command Mode, and Download Mode. The software for the AI1422E Reader contains two separate programs — Boot and Application. The Boot program has control of the AI1422E Reader on startup and when operating in download mode. The Application program has control of the AI1422E Reader during a command mode operation and holds the application code. Together, they control the AI1422E Reader in the three modes of operation.

### Data Mode

The AI1422E Reader is in Data Mode on power-up. While in Data Mode, the AI1422E Reader sends all communications to the host computer as data messages, such as tag IDs and reports. Reports provide information on Input 0 and Input 1 status changes, a presence without tag report, and buffer overflow information. The host computer can send only four commands to the AI1422E Reader while in Data Mode (Table 1).

**Table 1 Data Mode Commands**

Data Mode Commands		
Type	Description	Command
Status Request	Causes the interrogator to respond with a message containing information indicating the rolling transponder seen count and the count of host error messages.	~~@@
Retransmit Request	Requests the interrogator to retransmit the last tag ID read. (BB must be entered in upper case).	~~BB
Enter Command Mode	Disables reading and reporting of tags and changes the reader from Data Mode to Command Mode. (CC must be entered in upper case). Refer to <a href="#">"Switch to Command Mode" on page 6–27</a> .	~~CC
Enter Command Mode	Disables reading and reporting of tags and changes the reader from Data Mode to Command Mode.	!01

There is no carriage return or line feed required for any of the ~~ commands. Commands !01 require a carriage return.

No Response is received with the ~~CC and !01 commands.

Note: The AI1422E Reader transmits ID codes to the host computer when the AI1422E Reader is in Data Mode. If the AI1422E Reader remains in Command Mode with tags passing through the read zone, no tag IDs are reported.

## Asynchronous Interrogator Data Message

The interrogator sends the transponder ID in 8-bit ASCII. The message format is as follows:

```
<7EH><7EH><01H><transponder count><transponder ID><CRC>
```

The interrogator transmits the most significant bit first. The CRC is calculated, starting with the most significant byte.

No Response is received with the ~~CC and !01 commands.

Table 2 presents the field descriptions.

**Table 2 Asynchronous Interrogator Tag Data Message Fields**

Field	Description	Hex	ASCII
Start of Message	These two bytes, along with the Message type byte, designate the start of the data message.	7E7E	~~
Message Type	An 01H indicates that this message is a tag data message.	01	SOH
Transponder Seen Count	After power-up, this 8-bit count begins with 01 and is updated each time a tag with a unique ID moves out of the RF field, then back into the RF field. This field is useful in determining whether a train has multiple tag reads of a given ID due to a change in the train's direction.	00 - FF	N/A
Transponder ID	The data that is programmed into the transponder. The data within the transponder is 6-bit ASCII but the interrogator translates this data into standard 8-bit ASCII.	Hex ID	ID
Cyclical Redundancy Check	An 8-bit cyclical redundancy check (CRC). Includes the Start of Header, the Seen Count and the Transponder ID. Refer to <a href="#">Appendix E on page E-33</a> for a description of the CRC algorithm. There is no carriage return or line feed for this message.	00 - FF	N/A

## Status Request

*Note: The Status Request should only be used when the train is stationary. Sending this command simultaneous to tags being read can create a condition whereby the interrogator will no longer report tags until power cycled.*

The Status Request command causes the interrogator to respond with a message containing information indicating the transponder seen count and host error messages.

The request command format is as follows:

```
<7EH><7EH><40H><CRC>
```

The response is

```
<7EH><7EH><02H><Transponder count><host  
computer messages-bad CRC><incomplete host message>  
<Reserved><Reserved><Reserved><CRC>
```

**Table 3 Status Request Message Fields**

Field	Description	Hex	ASCII
Start of Message	These two bytes designate the start of the data message.	7E7E	^^
Message Type	Sending a 40H indicates that this message is a status request.	40	@
Cyclical Redundancy Check	The 8-bit cyclical redundancy check (CRC) includes the Start of Message and Message Type. See <a href="#">Appendix E on page E-33</a> for a description of the CRC algorithm. This is a fixed value of 40 hexadecimal, for this command. There is no carriage return or line feed for this message.	40	@

Table 4 Status Response Message Fields

Field	Description	Hex	ASCII
Start of Message	These two bytes, along with the Message Type byte, designate the start of the data message.	7E7E	~~
Message Type	An 02H indicates that this message is a status response.	02	STX
Transponder Seen Count	The Transponder Seen Count is a single byte, hexadecimal field. At power-up, the interrogator initializes this Seen Count byte to 00. This value is incremented each time a tag with a unique ID moves out of the RF field, then back into the RF field. This field is useful in determining whether a train has multiple tag reads of a given ID due to a change in the train's direction.	00 - FF	N/A
Number of Messages from Host with Bad CRCs	At power-up, the interrogator initializes this byte with 00. It is incremented each time a message with a bad CRC is received from the Host.	00 - FF	N/A
Number of incomplete Host Messages	At power-up, the interrogator initializes this byte with 00. It is incremented each time an incomplete message is received from the Host.	00 - FF	N/A
Reserved	Reserved	0	NUL
Reserved	Reserved	0	NUL
Reserved	Reserved	0	NUL
Cyclical Redundancy Check	This field is a single byte (8-bits) cyclical redundancy check (CRC). Includes the Start of Message, Message Type, Transponder Seen Count, Number of Messages from Host with bad CRCs, and Number of Incomplete Host Messages. Refer to <a href="#">Appendix E on page E-33</a> for a description of the CRC algorithm. There is no carriage return or line feed for this message.	00 - FF	N/A

## Retransmit Request

*Note: The Retransmit Request should only be used when the train is stationary. Sending this command simultaneous to tags being read can create a condition whereby the interrogator will no longer report tags until power cycled.*

The Retransmit Request Command tells the transponder to retransmit the last tag ID. (BB must be entered in upper case).



The request command format is as follows:

```
<7EH><7EH><42H><CRC>
```

The response is

```
<7EH><7EH><01H><transponder count><transponder ID><CRC>
```

**Table 5 Retransmit Request Message Fields**

Field	Description	Hex	ASCII
Start of Message	These two bytes, along with the Message Type byte, designate the start of the data message.	7E7E	~
Message Type	Sending a 42H indicates that this message is a retransmit request.A	42	B
Cyclical Redundancy Check	An 8-bit cyclical redundancy check (CRC) Includes the Start of Message and Message Type. Refer to <a href="#">Appendix D on page D-11</a> for a description of the CRC algorithm. This is a fixed value of 42 hexadecimal, for this command. There is no carriage return or line feed for this message.	42	B

**Table 6 Retransmit Response Message Fields**

Field	Description	Hex	ASCII
Start of Message	These two bytes, along with the Message Type byte, designate the start of the data message.	7E7E	~
Message Type	An 01H indicates that this message is a tag data message.	01	SOH
Transponder Seen Count	After power-up, this 8-bit count begins with 01 and is updated each time a tag with a unique ID moves out of the RF field, then back into the RF field. This field is useful in determining whether a train has multiple tag reads of a given ID due to a change in the train's direction.	00 - FF	N/A
Transponder ID	The data that is programmed into the transponder. The data within the transponder is 6-bit ASCII but the interrogator translates this data into standard 8-bit ASCII.	Hex ID	ID
Cyclical Redundancy Check	An 8-bit cyclical redundancy check (CRC). Includes the Start of Message, Message Type, Seen Count and Transponder ID. Refer to <a href="#">Appendix E on page E-33</a> for a description of the CRC algorithm. There is no carriage return or line feed for this message.	00 - FF	N/A

## Command Mode

While the AI1422E Reader is in Command Mode, the host computer sends commands to the AI1422E Reader that can be used to control the operation and configuration of the reader. After the AI1422E Reader receives a command, it transmits a command response message. Typically, the command message contains `!Done`, `!Error`, or data relating specifically to the command request. These messages may be of variable length since some commands require information as part of the message.

Communications can be lost if the host computer attempts to send certain commands under marginal communications conditions. For example, if the host computer transmits the command request to change the baud rate and the AI1422E Reader properly receives the request and transmits the `!Done` message, one of the two following conditions may occur:

1. If the host computer receives the `!Done` message, then both the host and the AI1422E Reader switch to the new baud rate, and communications are maintained.

*Note: In many applications, the host must be set to the new baud rate as it will not change automatically. The AI1422E Reader changes the baud rate immediately after issuing the `!Done` message.*

2. If the host does not receive the `!Done` message transmitted by the AI1422E Reader, the host assumes that the command was not properly sent and does not switch to the new baud rate, causing a loss of communications.



### CAUTION

***The host computer should not attempt to change communications parameters or protocols during marginal communications conditions; otherwise, a loss of communications can result.***

## Download Mode

In Download Mode, the AI1422E Reader allows the host to download new software.

While in Download Mode, the reader communications port parameters are fixed at the following factory-default settings: 9800 baud, 8 data bits, 1 stop bit, no parity, software flow control (XON/XOFF), basic protocol.

While in Download Mode, the AI1422E Reader turns RF off, does not process tags, and does not echo host commands.

## Command List

---

Reader commands are divided into groups based on primary function. The following sections provide information about each command in command number order. Refer to [Appendix E on page E-33](#) for listings of commands in both numerical and alphabetical order.

In the Command Quick Reference list, the symbols `<` and `>` represent variable message data. These symbols are not part of the message syntax. Hex digits (0–9, A–F) in either uppercase or lowercase characters may be used in data strings and for hex digits A–F.

## Reader Mode Control

Group 0 commands control reader mode. The mode determines whether the reader is transmitting data to or receiving data from a host computer or terminal.

### 00/662 Switch to Data Mode (Factory Default)

**!00** Switches the reader to Data Mode, which allows the reader to transmit tag data (ID codes) to the host. In addition to switching the reader to Data Mode, command **!00** automatically saves to non-volatile memory (NVRAM) any user parameters that had been changed during the command mode session. The reader enters Data Mode on power up.

The command **!662** is present for backward compatibility with previous generation AI1422 readers.



#### CAUTION

**To save user parameter changes to NVRAM, you must send command !00/!662 before powering down the reader.**

### Switch to Command Mode

While operating in Data Mode, the reader accepts the following commands:

**!01** switch to Command Mode

Reader response: No Response

**~~CC** switches the reader to Command Mode, which allows the reader to accept commands from a host or terminal. While in Command Mode, the reader turns RF off and does not acquire tags.

Reader response: No Response

## Communications Port Control

Group 1 commands configure the parameters used by the AI1422E Reader to communicate with a host computer or terminal. These commands set baud rate, stop bits, parity, and end-of-line delay.

## 100N Select Baud Rate

!100N selects the reader baud rate. *The factory-default setting is 9600 baud.* The N variable specifies the baud rate shown in [Table 7](#).

Reader response: !Done

**Table 7 Select Baud Rate Commands**

Command	Baud Rate Selected
1002	1200
1003	2400
1004	4800
<b>1005</b>	<b>9600 (factory default)</b>
1006	19.2 K
1007	38.4 K



### CAUTION

*If ECP is enabled, ensure that the ECP timeout is sufficient for the new baud rate. Refer to “525 Display Communications Protocol Status” on page 6–36.*

## 101N Select Stop Bits

!101N selects the number of stop bits for reader character transmission. *The factory default setting is 1 stop bit.* The N variable specifies the number of stop bits as indicated in [Table 8](#).

Reader response: !Done

**Table 8 Select Stop Bits Commands**

Command	Stop Bits Selected
<b>1010</b>	<b>1 (factory default)</b>
1011	2

## 102N Select Parity

!102N selects the reader parity setting. The factory-default setting is parity disabled. The N variable specifies parity as shown in [Table 9](#).

Reader response: !Done

**Table 9 Select Parity Commands**

Command	Data Bits	Parity Selected
<b>1020</b>	<b>8</b>	<b><i>Disable parity (factory default)</i></b>
1021	7	Select even parity
1022	7	Select odd parity

## Real-time Clock

---

Group 2 commands control the real-time clock which maintains the AI1422E internal time and date. This time and date can be appended to IDs, error messages, and sensor input reports.

### 20 Set Time

!20 sets the time. Enter the time in the proper format: two-digit decimal entries with no spaces between characters and using colons as delimiters. The entry format is as follows:

!20HH:MM:SS or !20HH:MM:SS:hh

where

HH represents hours (00 to 23).

MM represents minutes (00 to 59).

SS represents seconds (00 to 59).

hh represents hundredths of a second (00 to 99).

:

is the time delimiter.

If hundredths of a second is not specified, the reader sets the hundredths register to 00.

Reader response: !Done

## 21 Set Date

!21 sets the date. Enter the date in the proper format: two-digit decimal entries with no spaces between characters and using forward slashes “/” as delimiters. Ensure when entering the “/” character that you do not use the one on the number pad, as it prints the characters Esc+O+Q and not the “/” character.

The entry format is as follows:

21MM/DD/YY

where

MM	represents the month (01 to 12).
DD	represents the day (01 to 31).
YY	represents the last two digits of the year (00 to 99).
/	is the date delimiter.

Reader response: !Done

## 22 Display Time and Date

!22 displays the reader’s current time and date. One space separates the time and the date output.

Reader response: HH:MM:SS .hh MM/DD/YY

where

HH	represents hours.
MM	represents minutes.
SS	represents seconds.
hh	represents hundredths of seconds.
:	is the time delimiter.
MM	represents the month.
DD	represents the day.
YY	represents the last two digits of the year.
/	is the date delimiter.

# ID Filtering

---

Group 4 commands set criteria for filtering (buffering or discarding) ID codes. These commands are useful for eliminating duplicate ID codes and selecting the type of tags read by the AI1422E Reader.

## 40 Disable Transmission All ID Codes

!40 instructs the reader to reinstate the previous uniqueness checks.

Reader response: !Done

## 41 Transmit All ID Codes

!41 instructs the reader to transmit all IDs without regard for uniqueness. This command can be useful when mapping the footprint or performing diagnostics.

After diagnostics are complete, you may want to reinstate the uniqueness check using command !410N Select Unique ID Code Criteria, or by using !40 to set reader back to its original setting.

Reader response: !Done

## 410N Select Unique ID Code Criteria (Anti-passback Feature)

!410N instructs the reader to buffer and transmit ID codes according to the following test: an ID is read if previously decoded IDs have changed value at least  $N+1$  times since the new ID was last received. IDs that do not pass the test are not read. **The factory-default setting is command !4100, which selects a separation of one ID.** Variable  $N$  specifies ID separation as shown in Table 10.

Table 10 Unique ID Code Criteria

Command	Uniqueness Criteria
<b>4100</b>	<b><i>Separation of 1 ID (factory default)</i></b>
4101	Separation of 2 IDs
4102	Separation of 3 IDs
4103	Separation of 4 IDs

Each time the reader receives a tag ID, it compares the ID with the contents of a comparison register. This register contains the following four items:

- Item 1 Most recently acquired ID
- Item 2 Second-most recently acquired ID
- Item 3 Third-most recently acquired ID
- Item 4 Fourth-most recently acquired ID

When the uniqueness filter is set to separation of one ID, the newly acquired ID is transmitted only if it is different from the first item. Separation of two IDs allows transmission if the new ID is different from Items 1 and 2 in the comparison register.

Separation of three and four IDs transmit the new ID only if it is different from the first three and the first four items, respectively.

*Note: A new ID can fail the filter test and not be transmitted; however, it remains stored in the comparison register.*

The uniqueness test's time limit is set by Command !441. If an ID is buffered, it will not be accepted again unless it arrives at the reader more than the programmed time interval from the previous arrival or until the receipt of one or more other IDs reset the uniqueness.

Reader response: !Done

## 420N Select Valid ID Code Criteria

!420N directs the reader to validate an ID received only after it has been obtained a specified number of times in sequence. Values for N are 0 through 3 (Table 11). The factory setting is one acquisition (N = 0).

The validation procedure is executed before the unique ID test (Select Unique ID Code Criteria [!410N] commands). IDs that do not pass the validation test are not reported.

For example, command !4203 specifies that the same ID must be obtained from the RF module 4 times in succession before it is considered for the uniqueness test. This feature is useful in installations where RF reflections may cause a single tag to be read multiple times or where an occasional ID might be read from fringe areas.

**Table 11 Select Valid Code Commands and Frames**

Command	Valid Code Frames
<b>4200</b>	<b>1 (Factory default)</b>
4201	2
4202	3
4203	4

## 440 Reset Uniqueness

!440 causes the ID filtering process set by Select Unique ID Code Criteria (!410N) to restart. It is used in conjunction with the Variable Timeout (!44N) commands. This command provides a method to end all uniqueness timers.

## 44N Set Uniqueness Timeout

!44N Places a time limit on the uniqueness criterion set by Select Unique ID Code Criteria (!410N). The parameter N sets the number of minutes on the timeout clock. The factory setting is two minutes (N=1).

### Command Timeout Clock

**!441 2 minutes (factory setting)**

!442 15 seconds

!443 30 seconds

Entering these commands effectively expires the timeout clock, which erases all current IDs in the comparison register. In effect, the first ID that is acquired after the clock expires always appears to be new and is stored. Newly acquired IDs are only tested against IDs that are registered after the clock resets.

The timeout clock is continually reset (does not expire) as long as the reader receives the same tag ID. For example, assume that the timeout clock is set for 2 minutes and there is a rail car parked on a siding in front of the reader. Without this continual reset



feature, the rail car's ID would be reported every 2 minutes (each time the timeout clock expired).

#### 450 Disable Wiegand Mode (Factory Default)

!450 is a default set in the factory to disable Wiegand mode.

Reader response: !Done

#### 451 Enable Wiegand Mode

!451 enables Wiegand mode, which allows the reader to transmit data in a format that emulates the output of a magnetic card reader.

In Wiegand mode, the reader transmits Wiegand-formatted tag data through the Wiegand interface and ASCII data (the reader accepts reader commands and responds) through the serial port interface. The reader outputs data from Wiegand-programmed tags via the Wiegand interface. Tags that are not Wiegand-formatted are not transmitted through the Wiegand interface or the serial port when in Wiegand mode, although the tag lock relay is activated on any tag acquired.

Reader response: !Done

#### 452 Disable Tag Translation Mode (Factory Default)

!452 disables tag translation mode. Incoming full-frame tags will be directly converted to ASCII. They will not be translated from Association of American Railroads (AAR) and American Trucking Associations (ATA) format to ASCII.

Reader message: !Done

#### 453 Enable Tag Translation Mode

!453 enables the translation of tags in AAR and ATA formats. Specific data fields, such as owner ID and car number, will be extracted from these tags, translated according to AAR or ATA standards, and converted to ASCII. Tags that are not programmed in AAR or ATA format will be directly converted to ASCII. The reader will not attempt to translate data from half-frame or dual-frame tags.

Reader message: !Done

#### 480 Disable ATA

!480 Disables the reader from reading ATA protocol tags.

#### 481 Enable ATA

!481 enables the reader to read ATA protocol data from tags.

## Reader Status

---

Group 5 commands provide status reports on the parameters and operation of the reader.

### 505 Display Software Version

!505 displays the reader model number, software version information, and assigned serial number.

Reader response:

```
Model E4 Series Ver X.XX SNSSSSSS
```

where

X.XX Version Number

SSSSSS Serial number of the unit, skipping the fourth character printed on the reader product label

### 506 Display Hardware Configuration Information

!506 displays hardware configuration information stored in the reader memory by the user. Hardware configuration information is empty by default until you set the information to any 20 character ASCII string desired using command !696S...S.

Reader response: An ASCII string from 1 to 20 characters in length

### 510 Display RF Transceiver FPGA Version

!510 displays RF FPGA VER = XX.XX

### 511 Display RF Transceiver I Filter Chip Version

!511 displays FIL IC I VER = XX.XX

### 512 Display RF Transceiver Q Filter Chip Version

!512 displays FIL IC Q VER = XX.XX

### 513 Display DSP Board Actel Version

!513 displays DSP FPGA VER = XX.XX

### 520 Display Power Fail Bit

!520 displays the value of the reader power fail bit. The power fail bit changes from 0 to 1 when power to the reader is interrupted. To reset the bit, use command !63 Reset Reader or command !65 Reset Power Fail Bit. On initial power-up, the host should transmit one of these two commands to clear the power fail bit.

Reader message:

```
PWRB P<0 to 1>R0
```

where

P0	No power failure detected
P1	Power failure detected
R0	Not applicable to AI1422E Reader

## 521 Display Reader ID Number

!521 displays the reader ID that is sent in the auxiliary data field.

Reader message: RDID xx

where

xx = 01 to FF (hexadecimal)

## 522 Display Communications Port Parameters

!522 displays the selected communications port parameters, including the baud rate (!100N), the number of stop bits (!101N), the parity scheme (!102N), and the end-of-line delay.

Reader message: MAIN B<2 to 7> S<0 to 1> P<0 to 2> D0

where

B2	1200 baud
B3	2400 baud
B4	4800 baud
<b>B5</b>	<b>9600 baud (factory default)</b>
B6	19.2 kbps
B7	38.4 kbps
<b>S0</b>	<b>one stop bit (factory default)</b>
S1	two stop bits
<b>P0</b>	<b>no parity (factory default)</b>
P1	even parity
P2	odd parity
D0	00 ms end-of-line delay (fixed)

One space is required between each value. For example, if factory default settings are assigned, the reader message is

MAIN B5 S0 P0 D0

indicating 9600 baud, one stop bit, no parity, and 0 ms end-of-line delay.

*Note: The information transmitted in response to command !522 applies to data and command mode operation only. While operating in download mode, default communications parameters are always used.*

## 524 Display Appended Information Status

!524 displays the information being appended to the reader transmissions.

!31N appends information. Append time and date are not available to the AI1422E Reader.

Reader message: IDAP T<0> D<0> X<0 to 1>

where

- T0 Time not appended
- T1 Time appended (not valid for the AI1422E Reader)
- D0 Date not appended
- D1 Date appended (not valid for the AI1422E Reader)
- X0 *Auxiliary information not appended (factory default)***
- X1 Auxiliary information appended

One space is required between each value. For example, if factory-default settings are assigned, the reader response is

IDAP T0 D0 X0

indicating time, date, and auxiliary information not appended.

## 525 Display Communications Protocol Status

!525 displays the status of command !61N Selected Communications Protocol, Selected Mode of Flow Control, and command !612NN ECP Timeout.

Reader response: ECPS P<0 to 2> T<01 to FF> X<0 to 2> S0

where

- P0 *Basic protocol enabled (factory default)***
- P1 ECP enabled
- Txx ECP timeout where xx = 01 to FE (hexadecimal) Timeout (ms) = 50 \* xx. If xx = FF, timeout disabled
- X0 Flow control disabled
- X1 *Software flow control enabled (factory default)***
- S0 start of message character is !

For example, if factory default settings are assigned, the reader message is:

ECPS P0 TFE X1 S0

which means basic protocol enabled, an ECP timeout of 254 (12,700 ms, 12.7 sec), software flow control enabled, and start of message character is !.

## 527 Display RF Status Legacy

!527 displays the current status of the RF module. The reader response indicates whether RF is controlled externally by the host, set by command !640N RF Control, or internally by input set by command !641. Command !528 also displays the current RF status and the uniqueness timeout.

FCC Reader message: RFST C<0 to 1> O<0 to 1> T<1 to 3> Fxxx Rxx Gxx Axx Ixx

ETSI Reader message: RFST C<0 to 1> O<0 to 1> T<1 to 3>

where

C0	RF controlled by host
<b>C1</b>	<b>RF controlled by presence sensor on Trigger Input (factory default)</b>
O0	RF off
O1	RF on
T1	Uniqueness timeout of two minutes
T2	Uniqueness timeout of 15 seconds
T3	Uniqueness timeout of 30 seconds
Fxx	RF output frequency.
Rxx	Tag decoder range (distance) for ATA tags, xx = 00 to 1F hexadecimal range value
Gxx*	Tag decoder range (distance) for eGo and eGo Plus tags xx= 00 to 1F hexadecimal range value
Axx	RF power attenuation, where 00 is maximum output power and 0A is minimum output power (10 dB less than maximum power).
Ixx*	IAG RF power attenuation, where 00 is maximum output power and 06 is minimum output power* (6 dB less than maximum power).

## 528 Display RF Status (ETSI Compliant Readers Only)

*Note: If this command is sent to an FCC Compliant reader, it will mirror the !527 command except for Frequency, which will report as F00.*

!528 displays the current status of the RF module. The reader response indicates whether RF is controlled externally by the host, set by command !640N RF Control, or internally by input set by command !641. Command !528 also displays the current RF status and the uniqueness timeout.

Reader message: RFST C<0 to 1> O<0 to 1> T<1 to 3> Fxx Rxx Gxx Axx Ixx

where

C0	RF controlled by host
<b>C1</b>	<b>RF controlled by presence sensor on Trigger Input (factory default)</b>
O0	RF off
O1	RF on

---

\* Not applicable for the AI1422E

T1	Uniqueness timeout of two minutes
T2	Uniqueness timeout of 15 seconds
T3	Uniqueness timeout of 30 seconds
Fxx	RF Output Frequency. Frequency is hopping and not programmable. It will always report as Fxx.
Rxx	Tag decoder range (distance) for ATA tags, xx = 00 to 1F hexadecimal range value
Gxx**	Tag decoder range (distance) for eGo and eGo Plus tags xx= 00 to 1F hexadecimal range value
Axx	RF power attenuation, where 00 is maximum output power and 0A is minimum output power (10 dB less than maximum power).

*Note: If using an ETSI AI1422E, the default RF power attenuation will be A03.*

Ixx**	IAG RF power attenuation, where 00 is maximum output power and 06 is minimum output power (6 dB less than maximum power). For example, if factory default settings are assigned, the reader message is RFST C1 00 T1 Fxx R1F G1F A00 I04 which means that RF is enabled by presence sensor on input 0, RF signal off, uniqueness timeout of two minutes, maximum range for ATA tags, maximum range for eGo and eGo Plus tags, full RF power, and IAG power set at 4 dB attenuation.
-------	---

## 529 Display Presence Input Status

!529 displays the parameters associated with presence detection and RF control. The reader's message indicates if presence without tag reports are enabled/ disabled (!690N Select Presence without Tag Report Option), if input inversion is enabled/ disabled (!694N Select Input Inversion Option), and the minimum presence true period (always true). The reader's message also reports the selected RF timeout (!693N Select RF Timeout Period) and the selected means of RF-off control (!692N Select RF Control Algorithm). If presence without tag reports is enabled (!6901 Enable Presence without Tag Reports), the reader transmits a report if a presence is detected without the subsequent acquisition of a valid tag.

*Note: RF timeout values vary depending on the operative tag read mode and the type of tag in the read field. All times are approximate.*

---

\*\* Not applicable for the AI1422E

Reader message: PRST P<0 to 1> D0 A<0 to 2> T<0 to F> I<0 to 1>

where

<b>P0</b>	<b>Presence without tag reports disabled (factory default)</b>
P1	Presence without tag reports enabled
D0	Minimum presence true period of 0 ms (fixed)
A0	RF off on timeout only
A1	RF off on timeout or tag
<b>A2</b>	<b>RF off on timeout or presence condition false (factory default)</b>
T0	RF timeout of 0 ms (always expired)
T1	4 ms
T2	8 ms
T3	12 ms
T4	20 ms
T5	24 ms
T6	32 ms
T7	48 ms
T8	60 ms
T9	92 ms
TA	152 ms
TB	300 ms
TC	452 ms
TD	600 ms
TE	752 ms
<b>TF</b>	<b>RF timeout infinite, never expires (factory default)</b>
<b>I0</b>	<b>input inversion disabled (factory default)</b>
I1	input inversion enabled

For example, if factory default settings are assigned, the reader message is

```
PRST P0 D0 A2 TF I0
```

which means that presence without tag reports is disabled, minimum presence true period is 0, RF off control on timeout or presence false, infinite RF timeout, and input inversion disabled.

### 530 Display RF0 Filter Status

!530 displays the parameter set for the RF input, including the selected unique ID code criteria (!410N Select Unique ID Code Criteria) and the valid ID code criteria (see “410N Select Unique ID Code Criteria (Anti-passback Feature)” on page 6–31).

Reader message: RF0S U<0, 4> V<0 to 3>

where

U0	Disable transmit all IDs
U4	Any tag ID separation
V0	Valid ID code criteria of one acquisition
V1	Valid ID code criteria of two acquisitions
V2	Valid ID code criteria of three acquisitions
V3	Valid ID code criteria of four acquisitions

For example, if factory default settings are assigned, the reader message is

RF0S U0 V0

which means separation of one ID for uniqueness filtering and a valid ID code criteria of one acquisition.

### 532 Display Wiegand Mode Status

!532 displays the Wiegand mode status as either enabled or disabled.

Reader message: TOF <0 to 1>

where

0	Wiegand mode disabled
1	Wiegand mode enabled

### 533 Display Wiegand Retransmit Interval

!533 displays the Wiegand retransmit interval. This interval specifies the delay in seconds before the reader retransmits Wiegand data for a tag still in the read zone. The factory default is 1 second.

Reader message: WTI <01 to FF>

where

01 to FF = seconds (1–255) in hexadecimal.

*Note: The actual value of the Wiegand retransmit interval may vary depending on the operative tag read mode and the type of tag in the read field.*

For example, 10 = 16 seconds and FF = 255 seconds. The retransmit interval in ATA tag read mode is about twice these values.



### 534 Display Tag Translation Mode Status

!534 displays tag translation mode status, enabled or disabled. If tag translation mode is enabled, incoming full-frame tags in AAR or ATA format are translated according to ISO standards. Refer to [“452 Disable Tag Translation Mode \(Factory Default\)” on page 6–33](#) for more information.

Reader message: TT <0 to 1>

where

0	tag translation mode disabled
1	tag translation mode enabled

### 537 Display Echo Status

!537 displays echo mode status. In basic protocol (!610 Select Basic Protocol), the reader may be configured to enable (!6171 Enable Echo Mode) or disable (!6170 Disable Echo Mode) the echo of received commands. Refer to [“6170 Disable Echo Mode \(Factory Default\)” on page 6–43](#) and [“6171 Enable Echo Mode” on page 6–44](#) for more information.

Reader message: ECHO <0 to 1>

where

0	Echo status disabled
1	Echo status enabled

### 540 Display Flash Checksum

!540 displays the flash memory checksum.

Reader message: PCKS I0000 Exxxx

where

0000	Not applicable to the AI1422E Reader
xxxx	Represents the four-byte ASCII representation of the flash memory checksum

### 543 Display Boot Checksum

!543 displays the boot ROM checksum.

Reader message: BCKS xxxx

where

xxxx	represents the four-byte ASCII representation of the boot ROM checksum.
------	---

## 570 Display Tag Protocols

!570 displays the currently selected tag protocol.

Reader response: ATA:<E,D> eGo:<D SeGo:D> IAG:D> EPC: D> Sort:<D TMM0

where

E	Enabled
D	Disabled
TMM0	Fixed

## 577 Report Buffered Handshakes

!577 reports the buffered handshakes.

Reader message: XX

where

XX	the number of handshakes
----	--------------------------

# Reader Control Functions

---

Group 6 commands set reader control functions such as reader ID, communication protocol, output pulse, and RF control.

## 60NN Set Reader ID Number

!60NN sets the reader ID that will be sent in the auxiliary data field (command !311). Uppercase or lowercase characters are allowed for NN; for example, hex digits A through F or a through f

where

NN = 00 to FF (hex for 0 to 255, **factory default = 00**).

Reader response: !Done

## 610 Select Basic Communication Protocol (Factory Default)

!610 enables the basic communications protocol.

Reader response !Done

## 611 Select Error Correcting Protocol

!611 enables the error correcting protocol. For more details on Error Correcting Protocol, contact TransCore technical support.

Reader response: !Done

## 612NN Select Error Correcting Protocol Timeout

!612 NN selects the timeout interval for ECP. This timeout applies to the transmission of tag, report, and error messages and to the receipt of host commands. The transmit timeout is initiated immediately after the end-of-message sequence CR/ LF is transmitted. If the

host does not acknowledge the message within the specified interval, the reader times out and retransmits the message.

The receive timeout is initiated upon receipt of the start-of-message character (!). If the end-of-message character (CR) is not received within the specified interval, the reader discards the partially received message and resets its receiver.

Uppercase or lowercase characters are allowed for NN; for example, hex digits A through F or a through f.

The value for NN specifies the timeout interval as follows:

ms	50 * NN for NN = 01 to FE (1–254)
<b>FE</b>	<b>Factory default (12,700 ms or 12.7 seconds)</b>
FF	Disables the ECP timeout

Reader response: !Done



### CAUTION

*Ensure that the ECP timeout is sufficient for a given baud rate.*

## 614N Select Software Flow Control Option

!614N

selects the Software Flow Control option for reader-to-host communications. The factory default setting is software flow control (XON/XOFF) enabled. During data mode and command mode operation, the following Software Flow Control options are available. The N variable specifies Software Flow Control as shown in [Table 12](#).

**Table 12 Software Flow Control Commands**

Command	Software Flow Control Option	Response
6140	Disable flow control	!Done
<b>6141</b>	<b>Enable software flow control</b>	<b>!Done</b>

If the reader is configured for software flow control (XON/XOFF), it stops transmitting if it receives an XOFF character (host software Command 13H). It does not resume transmitting until it receives an XON character (host software Command 11H).

*Note: TransCore recommends that XON/XOFF Software Flow Control be disabled while using the ECP.*

## 6170 Disable Echo Mode (Factory Default)

!6170

disables the reader's echo of received host commands. If operating in basic protocol, the reader echoes by default. As the reader receives a host command, it echoes each character of the command. Once the entire command has been received and processed, the reader transmits its response. If echoing is disabled with command !6170, the reader does not echo the command, but only transmits its response. The reader never echoes while in ECP or download mode operation.

Reader response: !Done

**CAUTION:**

*Echo does not disable echo for Legacy AI1422 commands. For a list of these commands, refer to “Legacy Commands” on page D–13.*

## 6171 Enable Echo Mode

!6171 enables the reader to echo received host commands. Command !6170 disables echo mode.

Reader response: !Done

## 63 Reset Reader

!63 resets the power fail bit, clears all buffers, resets tag uniqueness, turns off both output lines, transmits the sign-on message, and returns to the Data Mode.

*Note: This command does not reset any other configuration parameters or have any command response.*

## 64N RF Control

!64N directly controls the RF module. The N value controls the RF power as shown in [Table 13](#).

!640 disables RF-by-input control command !642 Select RF-by-Input Control.

Reader response: !Done

**Table 13 RF Control Commands**

Command	RF Power
640	Turns off RF
641	Turns on RF

## 642 Select RF-by-Input Control (Factory Default)

!642 configures the reader for RF-by-input control. The reader automatically turns on RF when it detects a presence through sense0 (trigger input). The reader turns off RF according to the selected RF control algorithm (!692N Select RF Control Algorithm).

Reader response: !Done

## 643NN Select ATA Operating Range (Distance)

!643 NN selects the read range for ATA tags where NN is a hexadecimal value from 00 to 1F; the range increases with increasing NN value. The range can be adjusted for 32 discrete values where 00 is the shortest range and 1F is the longest range. **The default range value is 1F.**

Reader response: !Done

## 644NN Set RF Attenuation

!644NN sets the attenuation control for the output RF power where NN is a hexadecimal value from 00 to 0A. Settings for attenuation are 1.0 dB increments over a range of 10 dB of attenuation from the maximum power setting of 33 dBm at full power to a minimum power level of 26 dBm.

*Note: If using an ETSI AI1422E, the default RF power attenuation will be A03 and will not accept a lower attenuation.*

The Set RF Attenuation command NN variables and corresponding attenuation settings are shown in Table 14.

**Table 14 RF Attenuation Command Variables**

Variable (NN)	Attenuation Setting (dB)
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
0A	10

Reader response: !Done

## 647XXX Select RF Operating Frequency (Used only for FCC Part 90 and CMIIT Units)

!647XXX sets the reader RF from 860 to 930 MHz in 250 kHz steps, where XXX is a hexadecimal value from 000 to 118. After the reader's frequency is set, the value is stored in non-volatile RAM (NVRAM). This value is not altered by power-down.

For the CMIIT model, frequency range from 920.625 to 924.375 MHz in 250 KHz steps where XXX is a hexadecimal value from 4C5 to 4E3.

If the NVRAM becomes corrupted, the correct operating frequency cannot be guaranteed. In this circumstance, the RF section shuts down and the reader sends an `Error06` message to the host. Until the frequency is reset using command !647XXX, the unit displays the same error message every time it is powered up or if an attempt is made to enable the RF by host or by external sensor.

Note: Frequency does not have a factory default and must be programmed by the end user.

Refer to “Table 25 Select RF Operating Frequency Commands (FCC)” on page D–29 for a list of FCC commands.

Refer to “Table 26 Select RF Operating Frequency Commands (CMIIT)” on page D–31 for a list of CMIIT commands.

Reader response: !Done



**CAUTION:**

**An ETSI AI1422E does not require a frequency configuration. Do not attempt to change the frequency of an ETSI AI1422E.**

### 65 Reset Power Fail Bit

!65 resets the power fail bit to 0. The bit changes from 0 to 1 when power is restored to the reader. Upon reader power-up, the host transmits either command !65 or !63 Reset Reader to properly initialize this bit. The current state of the power fail bit may be displayed. Refer to “520 Display Power Fail Bit” on page 6–34 for more information.

Reader response: !Done

### 66F Load Default Operating Parameters

!66F loads all the factory default operating parameters except RF operating frequency. Refer to “Table 21 AI1422E Default Configuration Settings” on page D–11 for a listing of the defaults.

Reader response: !663  
!Done

### 690N Select Presence Without Tag Report Option

!690N enables or disables the presence without tag report option. If the presence without tag reporting option is enabled using command !6901, input reports are transmitted when a tag presence is detected without the subsequent acquisition of a valid tag. The value for N specifies the reports as shown in Table 15.

Reader response: !Done

**Table 15 Presence Without Tag Report Commands**

Command	Report Option
6900	<i>Disable presence without tag reports (factory default)</i>
6901	Enable presence without tag reports

### 692N Select RF Control Algorithm

!692N selects the algorithm for turning off RF power when RF-by-input control is enabled using command !641 Select RF-by-Input Control.

The values for N specify the RF control algorithms as shown in Table 16.

Table 16 RF Control Algorithm Commands

Command	RF Power Off
6920	On timeout only
6921	Timeout or tag ID acquired
<b>6922</b>	<b><i>Timeout or presence false (factory default)</i></b>

- !6920 turns off RF power based on the timeout established by command !693N Set RF Timeout Period.
- !6921 allows RF power to be turned off either after the timeout period or upon acquisition of a valid tag ID, whichever occurs first. The reader turns off the RF immediately following the acquisition of a valid tag, whether or not it is unique. This control algorithm may be used in Wiegand mode to ensure that the tag data is transmitted once and only once per presence on both serial and Wiegand ports.
- !6922 turns off RF power either after the timeout period or upon the presence false condition, whichever occurs first.

Reader response: !Done

### 693N Select RF Timeout Period

- !693N selects the RF timeout period used by command !692N Select RF Control Algorithm. Values for N range from 0 through F.
- !693F disables the RF timeout.
- Uppercase or lowercase characters are allowed for N; for example, hex digits A through F or a through f. The commands and corresponding timeouts are shown in [Table 17](#).

Table 17 Timeout Period Values

Command	Timeout (ms)
6930	0 (always expired)
6931	4
6932	8
6933	12
6934	20
6935	24
6936	32
6937	48
6938	60

Table 17 Timeout Period Values

Command	Timeout (ms)
6939	92
693A	152
693B	300
693C	452
693D	600
693E	752
<b>693F</b>	<b><i>Infinite (never expires, factory default)</i></b>

Reader response: !Done or !Error

The reader returns an Error message if a valid hexadecimal digit is not substituted for N in command !693N.

### 695S...S Set Serial Number

!695 assigns the reader serial number according to the format:

695SSSSSS

where

SSSSSS is the serial number.

The serial number may contain as many as six uppercase or lowercase ASCII alphanumeric characters.

Reader response: !Done

*Note: The factory-assigned serial number of the reader contains seven characters. However, to maintain backward compatibility, the reader software allows only six characters to be entered. When setting the serial number, skip the fourth (middle) character of the seven-character number shown on the reader product label.*

*Once assigned, the serial number is preserved during power-down and the loading of default parameters.*

### 696S...S Store Hardware Configuration String

Command !696S...S stores hardware configuration information into reader memory.

The hardware configuration string is assigned according to the following format:

696S...S

where

S...S is the hardware configuration string that may contain as many as 20 uppercase or lowercase ASCII alphanumeric characters.



Reader response: !Done

*Note: Once assigned, configuration information is preserved during power-down and the loading of default parameters.*

## Auxiliary Reader Control

Group 8 commands provide control of reader functions, such as the sense input lines.

### 830 Disable Automatic Periodic RF Status Report (Factory Default)

!830 is a default set in the factory to disable the automatic periodic RF status report.

Reader response: !Done

### 831 Enable Automatic Periodic RF Status Report

!831 enables the automatic periodic RF status report. This function sends out a periodic RF status report if no other message (a tag read) is sent from the reader for a period of time. This message is the same message that would be sent in response to the !528 Display RF Status command. Enabling this function is helpful in some sites where there may not be much tag activity, and the user wants an automatic way to ensure the communication channel with the reader is still intact. With this function enabled, the host system will get a message from the reader at least every three minutes.

Reader response: !Done

### 856 – Disable 3-character mode (factory default)

!856 disables 3-character mode. Incoming tag data will be reported in standard 10-character mode.

Reader response: !Done

### 857 – Enable 3 char mode

!857 enables 3-character mode. Incoming tag data will be reported in 3-character mode to emulate legacy AI1422 3-character models.

Reader response: !Done

# Chapter 7 Troubleshooting and Maintenance

This section lists routine diagnostic procedures for troubleshooting an improperly working reader system and maintenance procedures to keep the AI1422E Reader System operating correctly.

## Required Tools and Equipment

---

The following tools and equipment are required:

- 50-ohm, 5-watt (W) load (N-type connector)
- Personal computer (PC) with terminal emulator software
- Appropriate power source for your reader
- Digital multimeter
- Loopback DB09 Connector
- Antenna and cable
- Slot head screwdriver

## Troubleshooting

---

### Loopback Mode

It is possible to reset the AI1422E Reader to default by looping back the TX from the RS232 into the RX via a short wire. Installing a loopback will cause the reader to reset its settings to factory default, which is extremely useful during troubleshooting. The procedure for resetting the reader is below.

1. Power down the AI1422E reader by toggling the main power switch to the **OFF** position.
2. Slide the Interface Selection switch on the front panel of the reader to **RS232**.
3. Install a loopback connector to the MAIN RS232 port.
4. Apply power to the AI1422E reader by toggling the main power switch to the **ON** position.
5. Wait 30 seconds for the reader to complete the factory reset.
6. Power down the AI1422E reader by toggling the main power switch to the **OFF** position.
7. The reader should now be configured for factory default settings.

## Failure Modes

### No Communication

To determine if there is a problem in the communications hardware, the following two commands should be repeated together for testing purposes:

```
!01      escape to diagnostic mode
!22      display time and date
```

If functioning properly, the time and date will be displayed after the second command, which means that the reader is communicating. If the reader is not functioning properly, then perform the following checks.

- Verify that the AI1422E Reader System has adequate power. It should have 24 VDC  $\pm$ 0.5 VDC.
- Verify that the main power switch is on.
- Verify that the main power light-emitting diode (LED) is illuminated.
- Verify that you are using a null modem cable connection.
- Verify that the Interface Selection switch on the front panel of the reader is set to the correct interface.
- Verify that the baud rate is set correctly. If an incorrect baud rate is suspected, select and send each baud rate in turn, using the `!100X Baud Rate Select` command, and wait for a response.

### Unit Will Not Read Tags

The suggestions listed here assume that the user has already verified proper serial communications. If RF POWER LED is illuminated, the indication is that the AI1422E is querying for tags. If the LOCK LED is illuminated, the indication is that the reader system is retrieving tag data. If neither of the LED indicators are illuminated, check the following items:

- Verify that the antenna connection is good.
- Verify that the antenna cable is in good condition.
- Verify that a single, known valid tag, properly polarized, is in the antenna field.
- Verify that the trigger remains activated and the unit power is on.
- Verify that a tag is being alternated with another tag containing different data to avoid uniqueness filtering.

## Error Messages

The AI1422E Reader transmits an error message if a command received from the host is not a recognized command or if information supplied with the command is not correct. The reader sends this message to diagnostic commands if the reader fails the specified test.

Table 18 contains a list of error messages.

**Table 18 Error Messages**

Error Message	Description	Corrective Action
Error06	NVRAM parameters have been lost. The AI1422E Reader will not function properly because the RF section is shut off until the frequency is reset.	Reset the frequency using command ! 647XXX
Error07	The RF phase locked loop (PLL) has lost lock and is unable to operate at its intended frequency. RF output is disabled while the AI1422E Reader attempts to reset the PLL.	Reset the frequency using command ! 647XXX
Error08	The RF PLL has successfully regained lock and has been reset to its proper operating frequency. The RF section is returned to its state prior to losing lock (enabled/disabled). Error08 will only be issued after Error07 has been issued.	No action necessary; the previous error has been corrected.
Error11	The operator is attempting to use an Intellitag-based tag in Wiegand mode while the AI1422E Reader is in ID-only mode, thus Wiegand compatibility issues.	Enable eATA mode using command ! 489 if Wiegand operation is needed and the tags are programmed with Wiegand data.
ErrorRF1	Warning message that the RF board did not return an update acknowledge signal	If the reader indicates a single ErrorRF1 event and recovers from the error, no corrective action is required. You may want to track this error message if it should occur again. If the reader indicates repeated ErrorRF1 warning messages then return the reader to the factory.

Table 18 Error Messages

Error Message	Description	Corrective Action
ErrorRF2	Warning message that the RF module did not return an INIT DONE signal	If the reader indicates a single <code>ErrorRF2</code> event and recovers from the error, no corrective action is required. You may want to track this error message if it should occur again. If the reader indicates repeated <code>ErrorRF2</code> warning messages then return the reader to the factory.
ErrorRF3	Warning message of unexpected status read, including status byte, from RF module	If the reader indicates a single <code>ErrorRF3</code> event and recovers from the error, no corrective action is required. You may want to track this error message if it should occur again. If the reader indicates repeated <code>ErrorRF3</code> warning messages then return the reader to the factory.

## AI1422E Reader Repair

The AI1422E Reader is designed for whole-unit replacement and is manufactured with surface-mounted components. It requires sophisticated testing and repair equipment. All testing and repairs are performed at TransCore's factory. Please contact TransCore to obtain a Return Materials Authorization (RMA) for returning the reader.

## Technical Support

Authorized dealers and distributors are responsible for the direct support of all customers. Authorized dealers and distributors needing support can contact TransCore Technical Support. Please be prepared to answer a series of questions that are designed to direct you to the best TransCore support resource available. These questions will relate to symptoms, configuration, model, and tags used.

*Note: End users and facility operators contacting Technical Support will be referred to the dealer responsible for the system sale.*

# Appendix A Character Conversion

Table 19 lists the TransCore 6-bit-per-character conversion from the standard ASCII character set.

**Table 19 TransCore 6-Bit-Per-Character Conversion**

spc	000000	6	010110	L	101100
!	000001	7	010111	M	101101
"	000010	8	011000	N	101110
#	000011	9	011001	O	101111
\$	000100	:	011010	P	110000
%	000101	;	011011	Q	110001
&	000110	<	011100	R	110010
'	000111	=	011101	S	110011
(	001000	>	011110	T	110100
)	001001	?	011111	U	110101
*	001010	@	100000	V	110110
+	001011	A	100001	W	110111
,	001100	B	100010	X	111000
-	001101	C	100011	Y	111001
.	001110	D	100100	Z	111010
/	001111	E	100101	[	111011
0	010000	F	100110	\	111100
1	010001	G	100111	]	111101
2	010010	H	101000	^	111110
3	010011	I	101001	_	111111
4	010100	J	101010		
5	010101	K	101011		

# Appendix B Technical Specifications

Table 20 lists the specifications of the AI1422E Reader System.

**Table 20 AI1422E Reader System Specifications**

Specification	Description
<b>Size</b>	19.0 x 1.75 x 9.0 in (48.3 x 4.4x 22.9 cm)
<b>Weight</b>	5.0 lb (2.27 kg)
<b>Operating temperature</b>	-40°F to +158°F (-40°C to +70°C)
<b>Power requirement</b>	24V to 110VDC, 25 watts maximum
<b>Available frequency range</b>	902–928 MHz (FCC) 860-870 MHz (ETSI)
<b>Approved frequency range for Federal Communications Commission and Industry Canada</b>	902.25–903.75 MHz and 910.00–921.50 MHz
<b>Receiver sensitivity</b>	-60 dBm
<b>Transmitter RF power</b>	33 dBm (2W)
<b>Communications port</b>	RS–232, 1200 to 38,400 baud RS–422, 1200 to 38,400 baud Ethernet, 10/100 Mbps
<b>Other features</b>	Real-time clock Front Panel Ground Stud

Figure 27 gives the mechanical dimensions of the AI1422E Reader.

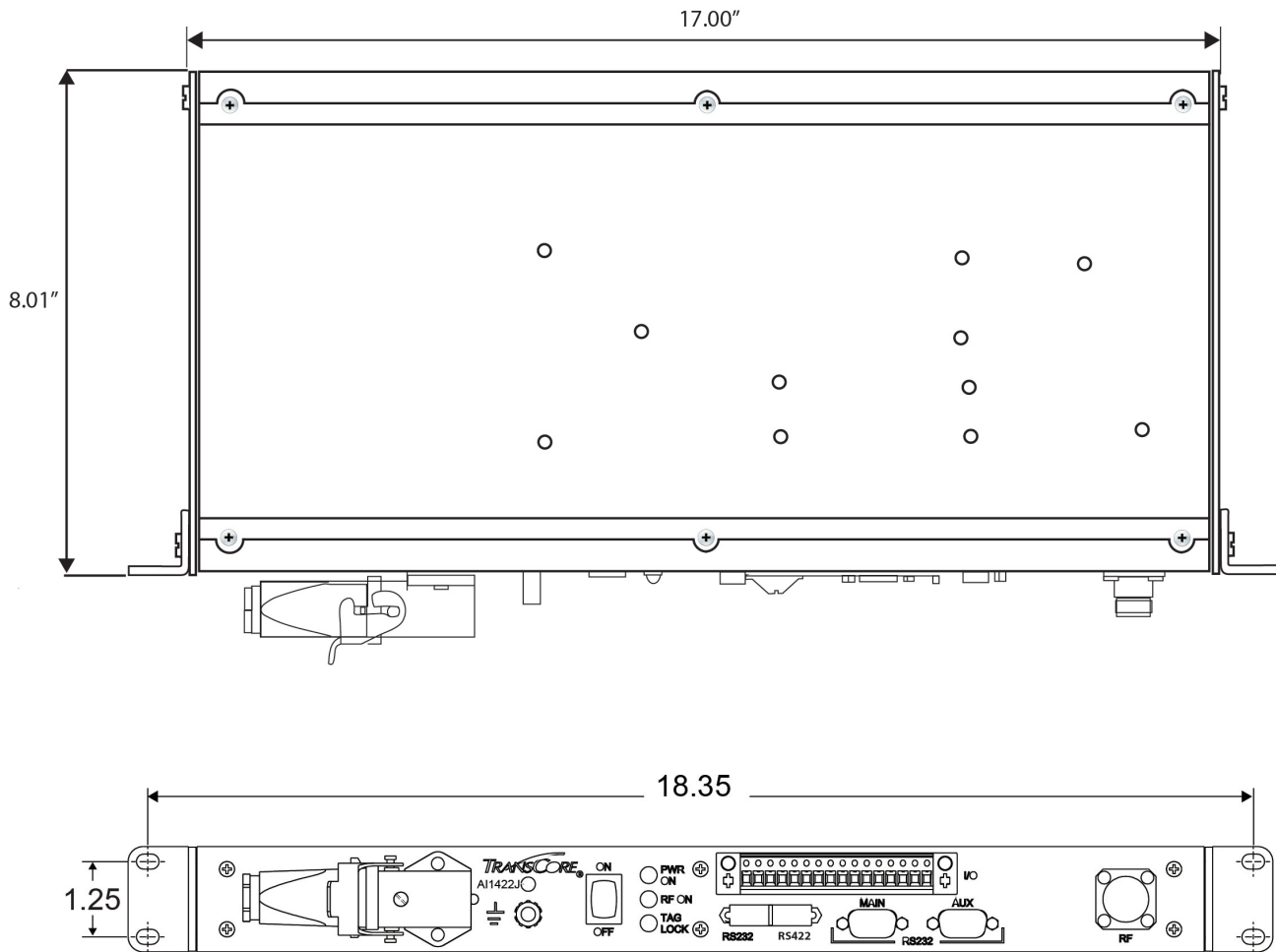


Figure 27 AI1422E Reader Mechanical Dimensions



## Appendix C Lantronix® Ethernet Module

The AI1422E incorporates an Embedded Ethernet to Serial server from Lantronix. In order to configure the Ethernet to Serial server, Lantronix software is required. The user guide for the Lantronix XPort® Direct + Embedded Serial-to-Ethernet server can be found at [www.lantronix.com/wp-content/uploads/pdf/XPort-Direct-Plus\\_UG.pdf](http://www.lantronix.com/wp-content/uploads/pdf/XPort-Direct-Plus_UG.pdf).

The easiest way to connect to the AI1422E is by using the Lantronix CPR (Com Port Redirector) software, which will allow connecting directly to the AI1422E through the Ethernet Interface from a Windows computer. The Lantronix CPR software and documentation is located at [www.lantronix.com/support](http://www.lantronix.com/support).

Contact Lantronix with questions:

Embedded Device: Lantronix XPort Direct + Embedded Serial-to-Ethernet

Lantronix Technical Support

Hours: 6:00am – 5:00pm Pacific Time

Mon. – Fri. (excluding holidays)

Tel: (800) 422-7044 (US Only)

Tel: (949) 453-7198

## Interface through Ethernet Port

To interface through the Ethernet port of the AI1442E, connect via the M12 Ethernet port (Use an M12 to RJ45 adapter if required). A static IP address will need to be assigned to your local host if directly connected or the reader may be attached to your network.

### Setting up Local Host

1. Install the stand-alone **DeviceInstaller** (Figure 28). This is needed to know the IP address of the Ethernet to serial converter.

Product	Comment
<a href="#">Stand-alone DeviceInstaller Setup application for Windows (91 MB) - ZIP Archive</a>	No internet access required to install

Figure 28 Install the Stand-alone DeviceInstaller

2. Once installed, launch **DeviceInstaller** (Figure 29) from the **Start** menu.

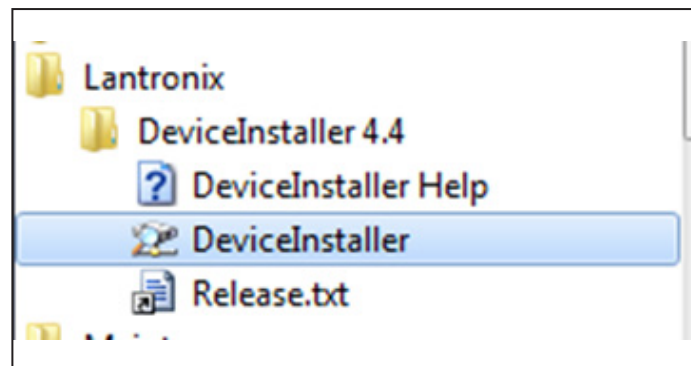


Figure 29 Launch DeviceInstaller from the Start Menu

3. If connecting directly to the computer's Ethernet port, go to the computer's network setting and change the IP address and Subnet mask of the network interface controller (NIC) card you are connecting to as shown in [Figure 30](#).

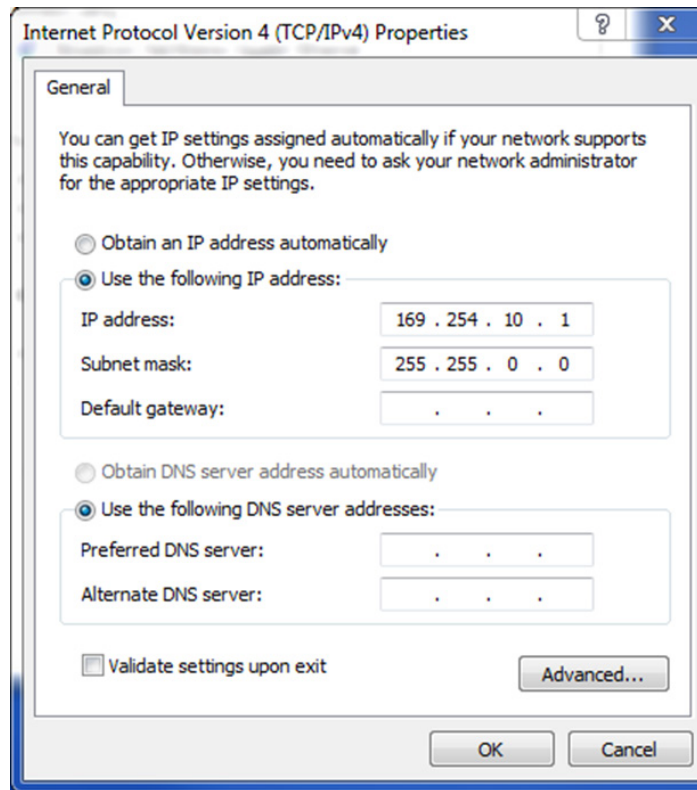


Figure 30 Change IP Address and Subnet Mask of NIC Card.

4. If the computer has multiple NIC cards, you might see a prompt similar to the prompt shown in [Figure 31](#). Select **Yes**.

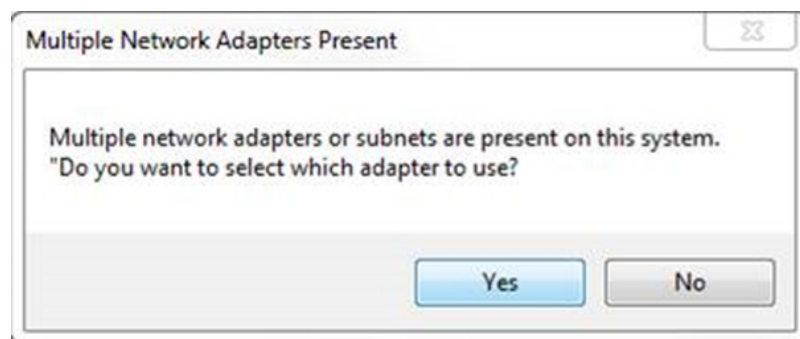


Figure 31 Prompt if Computer has Multiple NIC cards

- Choose the desired adapter and then select **OK**. If you are connecting directly to your computer's Ethernet port, choose the network adapter with the **169.254.10.1** address. If you are connecting to your corporate network, choose the **Local Area Connection**. The selection can be changed at any time through the **Options** menu. Refer to [Figure 32](#).



Figure 32 NIC Card Options Screen

- If you are not connecting through a network, configure the IP Address and the Subnet mask as described in Step 3.
- If prompted to check for updates, select **No** ([Figure 33](#)).

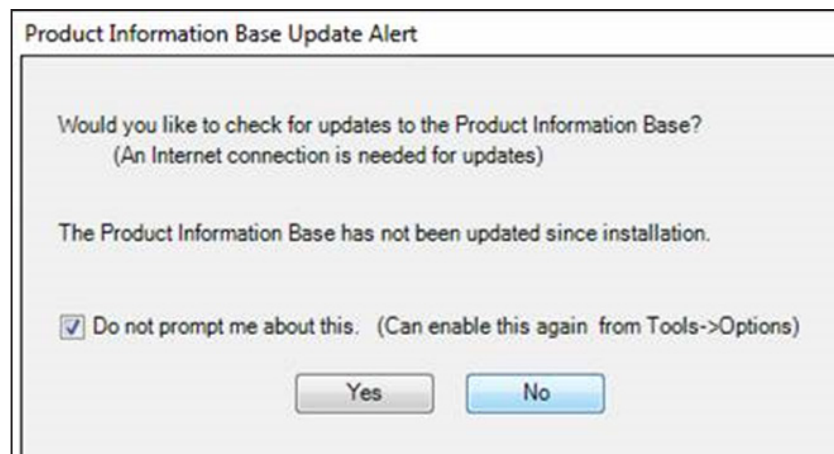


Figure 33 Check for Updates Prompt

8. If a firewall is present, disable it to allow access (Figure 34).

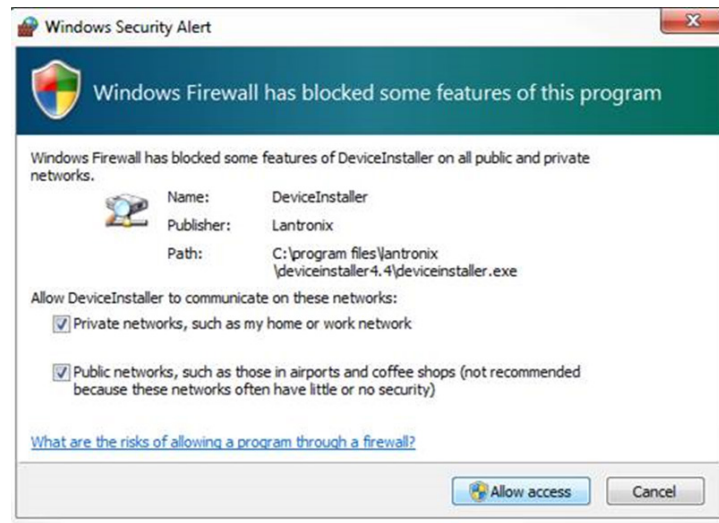


Figure 34 Disable Firewall to Allow Access

## Finding IP address of Reader

1. From the Lantronix DeviceInstaller right-click on the connection you choose and hit refresh (Figure 35).

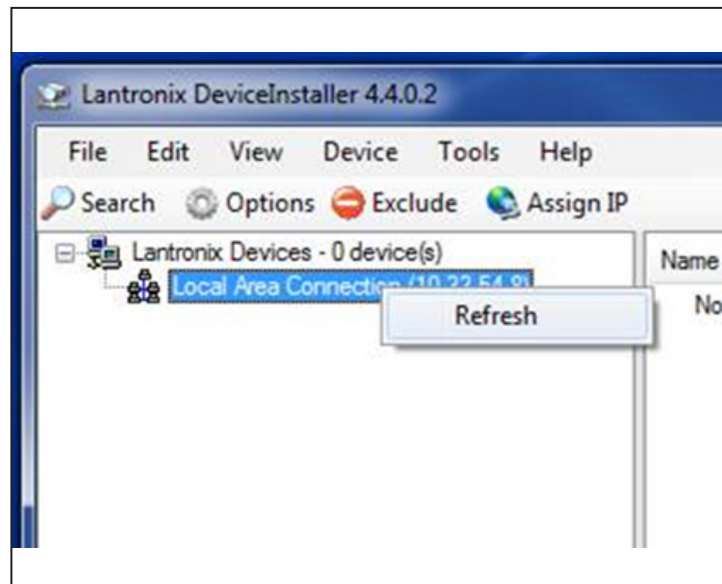


Figure 35 Lantronix DeviceInstaller Menu

- The Xport Direct+ device will populate on the right side of the window (Figure 36).



Figure 36 Finding the IP address of a Reader

- Use the IP address to configure your terminal emulator Connection (Ex: PuTTY). Use Telnet and Port 10001 (Figure 37).

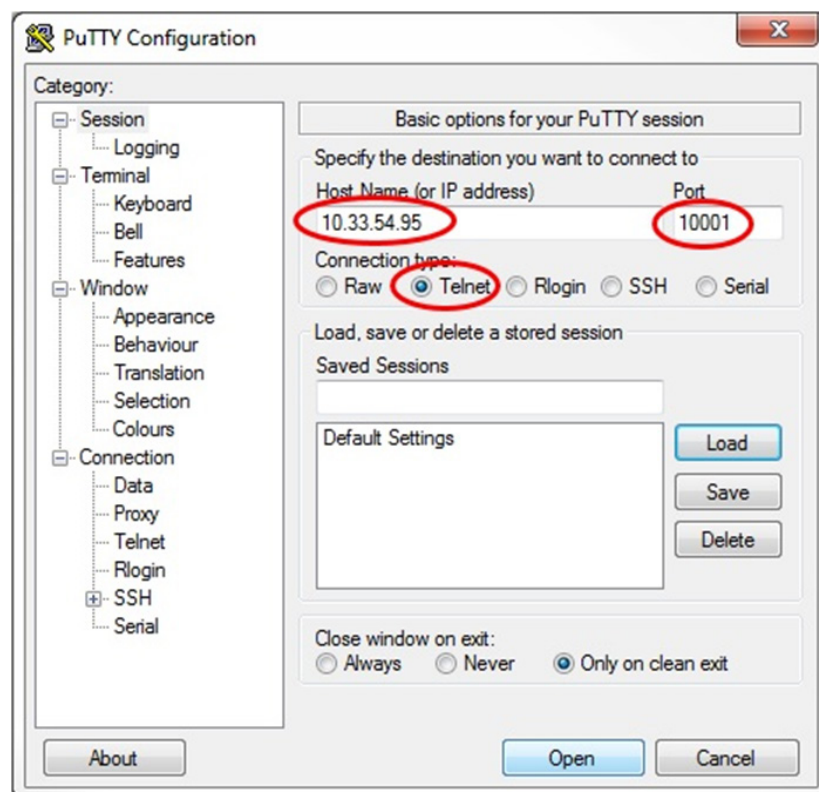


Figure 37 PuTTY Configuration Screen

4. The opened connection is similar to a serial connection.
5. Ignore the local echo of the typed characters, if using PuTTY (Figure 38).

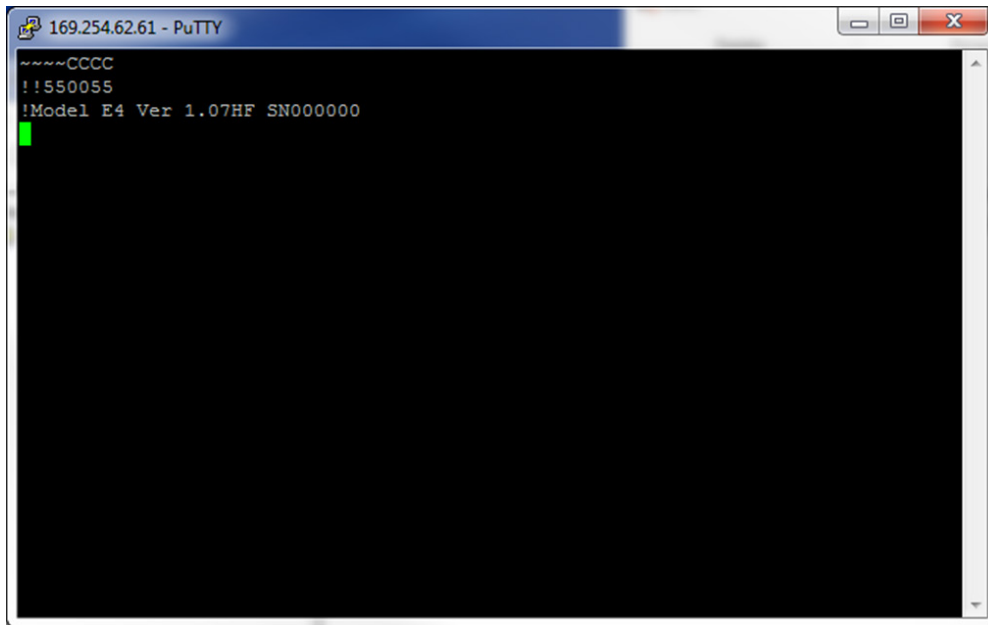


Figure 38 PuTTY Connection Screen

# Appendix D Command Quick Reference

## Command Quick Reference

This appendix lists the default configuration settings for the AI1422E and its commands. Commands are listed both numerically and alphabetically.

## Command Syntax

The command numbers consist of from 2 to 4 hex digits. The letters *N* or *S* may follow a command number. The letter *N* indicates that part of the command number is variable. The letter *S* indicates the requirement for an alphanumeric data string that is to be included immediately following the command number. Hex digits (0–9, A–F) in either uppercase or lowercase characters may be used in data strings and for hex digits A–F.

**Table 21** lists factory default settings. **Table 23** lists all of the commands available to users in numerical order. **Table 24** lists the same commands in alphabetical order by command name.

## Factory Default Settings

**Note:** **Table 21** lists the factory default settings for the AI1422E.

**Table 21 AI1422E Default Configuration Settings**

Parameter	Setting	Command
Operating mode	Data	00
Baud rate	9600	1005
Stop bits	1	1010
Parity	None	1020
Unique ID code criteria	Separation of 1 ID	4100
Valid ID code criteria	Acquisition of 1 ID	4200
Wiegand Mode	Disable	450
Uniqueness time-out	2 minutes	441
Tag translation mode	Disabled	452
Reader ID number	00	6000
Communications protocol	Basic	610
Error protocol (ECP) timeout	12.7 sec	612FE
Echo mode	Disabled	6170
RF-by-input control	Enabled By Sense	6421
ATA operating range (distance)	Maximum	6431F



Table 21 AI1422E Default Configuration Settings

Parameter	Setting	Command
RF attenuation	Full power(10-1422-5XX/10-1422-8XX)	64400/64403
Presence without tag reports	Disabled	6900
RF-off control	Timeout or no presence	6922
RF timeout	Never true	693F
Serial number	SSSSSS	695
Store hardware configuration	Hardware configuration not known	696
Automatic periodic RF status report	Disabled	830
3-character mode	Disabled	856

*NOTE: Frequency doesn't have a factory default and must be programmed by the end user.*

## Legacy Commands

Legacy AI1422 commands will echo after a carriage return with echo off enabled. This emulates how the legacy AI1422 performed. Refer to [Table 22](#).

**Table 22 Legacy Commands**

Command	Function	Echo On Response	Echo Off Response
^^CC	Enter Diagnostic Mode (CC must be upper case)	^^CC	(no response)
!100x	baud rate select where: 1002 = 1200 baud 1003 = 2400 baud 1004 = 4800 baud 1005 = 9600 baud 1006 = 19200 baud	!100x !Done	!Done
!20HH:MM:SS	Set the time in the real-time clock	!20HH:MM:SS !Done	!20HH:MM:SS !Done
!21MM/DD/YY	Set the date in the real-time clock	!21MM/DD/YY !Done	!21MM/DD/YY !Done
!22	Display Time and date	!22 !HH:MM:SS.hh MM/DD/YY	!22 !HH:MM:SS.hh MM/DD/YY
!40	Disable transmit all tag ID codes	!40 !Done	!40 !Done
!41	Transmit all tag ID codes	!41 !Done	!41 !Done
!505	Report firmware version number	!505 !Model E4 Ver x.xxHFb2 SNXXXXXX	!505 !Model E4 Ver x.xxHFb2 SNXXXXXX
!521	report number of handshakes	!521 !RDID XX	!!RDID XX
!640	Disable RF	!640 !Done	640 !Done
!641	Enable RF	!641 !Done	!641 !Done
!642	RF on by sense input	!642 !Done	!642 !Done
!662	Exit Diagnostic Mode	!662 !Done	!662 !Done

## Numerical Command List

The following conventions are used in [Table 23](#):

- Items in ***bold italics*** identify factory default settings.
- Only the command-related data portion of the reader message is shown.

Refer to “[Chapter 5 Communications Protocols](#)” on [page 5–19](#) for the complete syntax of commands and messages.

**Table 23 AI1422E Commands Listed Numerically**

Number	Command Name	Reader Message
<b>00</b>	<b><i>Switch to data mode</i></b>	<b><i>!Done</i></b>
01	Switch to command mode	
1002	Set baud rate = 1200 baud	!Done
1003	Set baud rate = 2400 baud	!Done
1004	Set baud rate = 4800 baud	!Done
<b>1005</b>	<b><i>Set baud rate = 9600 baud</i></b>	<b><i>!Done</i></b>
1006	Set baud rate = 19.2 K baud	!Done
1007	Set baud rate = 38.4 K baud	!Done
<b>1010</b>	<b><i>Use one stop bit</i></b>	<b><i>!Done</i></b>
1011	Use two stop bits	!Done
<b>1020</b>	<b><i>Disable parity</i></b>	<b><i>!Done</i></b>
1021	Select even parity	!Done
1022	Select odd parity	!Done
20	Set time	!Done
21	Set date	!Done
22	Display time and date	HH:MM:SS.hh MM/DD/YY
40	Disable Transmission All IDs	!Done
41	Transmit all IDs	!Done
<b>4100</b>	<b><i>Select one ID separation</i></b>	<b><i>!Done</i></b>
4101	Select two ID separation	!Done
4102	Select three ID separation	!Done
4103	Select four ID separation	!Done
<b>4200</b>	<b><i>Select 1 valid ID code</i></b>	<b><i>!Done</i></b>
4201	Select 2 valid ID codes	!Done

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
4202	Select 3 valid ID codes	!Done
4203	Select 4 valid ID codes	!Done
440	Reset uniqueness	!Done
441	Set uniqueness time-out to 2 minutes	<b>!Done</b>
442	Set uniqueness time-out to 15 seconds	!Done
443	Set uniqueness time-out to 30 seconds	!Done
<b>450</b>	<b>Disable Wiegand Mode</b>	<b>!Done</b>
451	Enable Wiegand Mode	!Done
452	Disable tag translation mode	<b>!Done</b>
453	Enable tag translation mode	!Done
480	Disable ATA	!Done if AI1422E model supports this tag protocol. !Error if tag protocol is unsupported.
481	Enable ATA	!Done if AI1422E model supports this tag protocol. !Error if tag protocol is unsupported.
505	Display version	Model [E4] Ver [version no.] SN [serial no.]
506	Display hardware configuration information	S...S S...S = ASCII string (maximum length of 20 characters)
510	Display RF Transceiver FPGA Version	RF FPGA VER = XX.XX
511	Display RF Transceiver I Filter Chip Version	FIL IC I VER = XX.XX
512	Display RF Transceiver Q Filter Chip Version	FIL IC Q VER = XX.XX
513	Display DSP Board Actel Version	DSP FPGA VER = XX.XX
520	Display power fail bit	PWRB Px R0 P0 = no power fail has occurred P1 = power fail has occurred R0 = not applicable to the AI1422E

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
521	Display reader ID number	RDID xx xx = 00–FF
522	Display comm port parameters	MAIN Bx Sx Px D0 B2 = 1200 B3 = 2400 B4 = 4800 B5 = 9600 B6 = 19.2 B7 = 38.4 S0 = one stop bit S1 = two stop bits P0 = no parity P1 = even P2 = odd D0 = EOL delay of 0 ms
524	Display appended info status	IDAP T0 D0 Xx T0 = time not appended T1 = time appended D0 = date not appended D1 = date appended X0 = aux info not appended X1 = aux info appended
525	Display comm protocol	ECPS Px Txx Xx S0 P0 = basic P1 = ECP Txx = ECP timeout ms = 50 * xx FF = disabled ECP timeout X0 = no flow control X1 = software flow control S0 = som character is #

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
527	Display RF status	<p>RFST Cx Ox Tx Fxxx Rxx Gxx Axx I04  C0 = RF controlled by host  C1 = RF-by-presence sensor  O0 = RF off  O1 = RF on  T1 = uniqueness timeout of 2 min  T2 = uniqueness timeout of 15 sec  T3 = uniqueness timeout of 30 sec  Fxxx = RF output frequency, xxx = 000 to 118  Rxx = Tag decoder range (distance) for ATA tags, 00 to 1F hexadecimal range value  Gxx = Tag decoder range (distance) for eGo Plus Tags, 00 to 1F hexadecimal range value  Axx = RF power attenuation, 00 max to 0A min (10 dB less than max)  I04 = fixed</p> <p><i>Note: If you enter RF settings using command !642NN, the display command for RF output frequency, F is "Fxx" and indicates use of the backward-compatible frequency entry method.</i></p> <p><i>Note: On ETSI readers:</i></p> <p><b>!527</b>  <b>!RFST Cx Ox Tx</b>  to get the rest of the response, enter  <b>!528</b>  <b>!RFST C0 O1 T1 Fxx Rxx Gxx A03 I04</b></p> <p><i>The frequency on an ETSI reader is fixed and will always display as "Fxx" attenuation is also fixed at A03</i></p>
528	RF Status (ETSI compliant only)	<p><b>!RFST C0 O1 T1 Fxx Rxx Gxx A03 I04</b></p> <p>The frequency on an ETSI reader is fixed and will always display as "Fxx" attenuation is also fixed at A03</p>

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
529	Display presence input status	PRST Px D0 Ax Tx lx P0 = disable presence w/o tag reports P1 = enable presence w/o tag reports D0 = min presence true period of 0 ms A0 = RF off on timeout A1 = RF off on timeout or tag A2 = RF off on timeout or no presence T0 = RF timeout of 0 ms (always expired) T1 = RF timeout of 4 ms T2 = RF timeout of 8 ms T3 = RF timeout of 12 ms T4 = RF timeout of 20 ms T5 = RF timeout of 24 ms T6 = RF timeout of 32 ms T7 = RF timeout of 48 ms T8 = RF timeout of 60 ms T9 = RF timeout of 92 ms TA = RF timeout of 152 ms TB = RF timeout of 300 ms TC = RF timeout of 452 ms TD = RF timeout of 600 ms TE = RF timeout of 752 ms <b>TF = RF timeout infinite, never expires (factory default)</b> <b>IO = Input inversion disabled (factory default)</b> I1 = Input inversion enabled
530	Display RFO filter status	RFOS Ux V0 <b>U0 = disable transmit all IDs (factory default)</b> U4 = any tag ID separation <b>V0 = valid ID code criteria of one acquisition (factory default)</b> V1 = valid ID code criteria of two acquisitions V2 = valid ID code criteria of three acquisitions V3 = valid ID code criteria of four acquisitions
532	Display Wiegand Mode Status	TOF <0 to 1>

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
533	Display Wiegand Retransmit Interval	WTI <01 to FF>
534	Display tag translation mode status	TT <0 to 1> 0 = tag translation mode disabled 1 = tag translation mode enabled
537	Display echo status	ECHO <0 to 1> <b>0 = disabled (factory default)</b> 1 = enabled
540	Display flash checksum	PCKS I0000 Exxxx xxxx = 4-byte ASCII checksum
543	Display boot checksum	BCKS xxxx xxxx = 4-byte ASCII checksum
570	Display operating mode status	ATA:<E, D> eGo:D SeGo:D IAG:D EPC:D sort:D. AI1422E can only do ATA, eGo/ SeGo sort not applicable E = Enabled D = Disabled
577	Report buffered handshakes	XX = number of handshakes
60NN	Set reader ID number NN = 00–FF (00 = factory default)	!Done
<b>610</b>	<b>Select basic protocol</b>	<b>!Done</b>
611	Select ECP protocol	!Done
612NN	Set ECP timeout NN = 01–FE (1–255) timeout = 50 ms * NN (if NN = FF, timeout is disabled)	!Done
6140	Disable flow control	!Done
<b>6141</b>	<b>Enable software flow control</b>	<b>!Done</b>
<b>6170</b>	<b>Disable echo</b>	<b>!Done</b>
6171	Enable echo	!Done
63	Reset reader	
640	Turn off RF	!Done
641	Turn on RF	!Done
<b>642</b>	<b>Select RF-by-input control</b>	<b>!Done</b>



Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
642NN	Select RF operating frequency	!Done
643NN	Set ATA operating range (distance) NN = 00 (shortest) to 1F (longest) <b>1F = default</b>	!Done
644NN	Set RF attenuation NN = 00 to 0A	!Done
647XXX	Select RF operating frequency from 860 to 930 in 250 kHz steps XXX = 000 - 118 (hexadecimal) Frequency can not be set on ETSI readers	!Done
65	Reset power fail bit	!Done
66F	Load default operating parameters (except RF operating frequency)	!663 !Done
662	Exits Command Mode.	!Done
<b>6900</b>	<b>Disable presence without tag reports</b>	<b>!Done</b>
6901	Enable presence without tag reports	!Done
6920	Turn RF off on timeout	!Done
6921	Turn RF off on timeout/tag	!Done
<b>6922</b>	<b>Turn RF off on timeout/no presence</b>	<b>!Done</b>
693N	Set RF timeout N = 0–F (in milliseconds) (always expired, 4,8,12,20,24, 32,48,60,92,152, 300,452, 600,752, infinite)	!Done
<b>693F</b>	<b>Set RF timeout = infinite</b>	<b>!Done</b>
<b>695S...S</b>	<b>Set serial number S...S = ASCII string (maximum length of 6 characters)</b>	<b>!Done</b>

Table 23 AI1422E Commands Listed Numerically

Number	Command Name	Reader Message
<b>696S...S</b>	<b>Store hardware configuration string</b> <i>S...S = ASCII string (maximum length of 20 characters)</i>	<b>!Done</b>
<b>830</b>	<b>Disable automatic periodic RF status report</b>	<b>!Done</b>
831	Enable automatic periodic RF status report	!Done
<b>856</b>	<b>Disable 3-character mode</b>	<b>!Done</b>
857	Enable 3-character mode	!Done

## Alphabetical Command List

The following conventions are used in:

- Items in ***bold italics*** identify factory default settings.
- Only the command-related data portion of the reader message is shown.

Refer to [Table 22 on page D–66](#) for the complete syntax of commands and messages.

**Table 24 AI1422E Commands Listed Alphabetically**

Command Name	Code	Reader Message
<b><i>Disable 3-character mode</i></b>	<b><i>856</i></b>	<b><i>!Done</i></b>
Disable ATA	480	!Done if AI1422E model supports this tag protocol. !Error if tag protocol is unsupported.
<b><i>Automatic periodic RF status report disable</i></b>	<b><i>830</i></b>	<b><i>!Done</i></b>
<b><i>Disable echo</i></b>	<b><i>6170</i></b>	<b><i>!Done</i></b>
Disable flow control	6140	!Done
<b><i>Disable parity</i></b>	<b><i>1020</i></b>	<b><i>!Done</i></b>
<b><i>Disable presence without tag reports</i></b>	<b><i>6900</i></b>	<b><i>!Done</i></b>
Disable tag translation mode	452	!Done
Disable Transmission All IDs	40	!Done
Disable Wiegand Mode	450	!Done
Display appended info status	524	IDAP T0 D0 Xx P0 = basic P1 = ECP Txx = ECP timeout ms = 50 * xx FF = disabled ECP timeout X0 = no flow control X1 = software flow control S0 = som character is #
Display boot checksum	543	BCKS xxxx xxxx = 4-byte ASCII checksum

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Display comm port parameters	522	MAIN Bx Sx Px D0 B2 = 1200 B3 = 2400 B4 = 4800 B5 = 9600 B6 = 19.2 B7 = 38.4 S0 = one stop bit S1 = two stop bits P0 = no parity P1 = even P2 = odd D0 = EOL delay of 0 ms
Display comm protocol	525	ECPS Px Txx Xx S0 P0 = basic P1 = ECP Txx = ECP timeout ms = 50 * xx FF = disabled ECP timeout X0 = no flow control X1 = software flow control S0 = som character is #
Display DSP Board Actel Version	513	DSP FPGA VER = XX.XX
Display echo status	537	ECHO <0 to 1) <b>0 = disabled (factory default)</b> 1 = enabled
Display flash checksum	540	PCKS I0000 Exxxx xxxx = 4-byte ASCII checksum
Display hardware configuration information	506	S...S S...S = ASCII string (maximum length of 20 characters)
Display operating mode status	570	ATA:<E, D> eGo:D SeGo:D IAG:D EPC:D sort:D. AI1422E can only do ATA, eGo/ SeGo sort not applicable
Display power fail bit	520	PWRB Px R0 P0 = no power fail has occurred P1 = power fail has occurred R0 = not applicable to the AI1422E

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Display presence input status	529	PRST Px D0 Ax Tx lx P0 = disable presence w/o tag reports P1 = enable presence w/o tag reports D0 = min presence true period of 0 ms A0 = RF off on timeout A1 = RF off on timeout or tag A2 = RF off on timeout or no presence T0: RF timeout of 0 ms (always expired) T1: RF timeout of 4 ms T2: RF timeout of 8 ms T3: RF timeout of 12 ms T4: RF timeout of 20 ms T5: RF timeout of 24 ms T6: RF timeout of 32 ms T7: RF timeout of 48 ms T8: RF timeout of 60 ms T9: RF timeout of 92 ms TA: RF timeout of 152 ms TB: RF timeout of 300 ms TC: RF timeout of 452 ms TD: RF timeout of 600 ms TE: RF timeout of 752 ms TF: RF timeout infinite, never expires (factory default) IO = Input inversion disabled (factory default) I1 = Input inversion enabled
Display reader ID number	521	RDID xx xx = 00–FF

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Display RF status	527	<p>RFST Cx Ox Tx Fxxx Rxx Gxx Axx I04  C0 = RF controlled by host  C1 = RF-by-presence sensor  O0 = RF off  O1 = RF on  T1 = uniqueness timeout of 2 min  T2 = uniqueness timeout of 15 sec  T3 = uniqueness timeout of 30 sec  Fxxx = RF output frequency, xxx = 000 to 118  Rxx = Tag decoder range (distance) for ATA tags, 00 to 1F hexadecimal range value  Gxx = Tag decoder range (distance) for eGo Plus Tags, 00 to 1F hexadecimal range value  Axx = RF power attenuation, 00 max to 0A min (10 dB less than max)  I04 = fixed</p> <p><i>Note: If you enter RF settings using command !642NN, the display command for RF output frequency, F is "Fxx" and indicates use of the backward-compatible frequency entry method.</i></p> <p><i>Note: On ETSI readers:</i></p> <p><b>!527</b>  <b>!RFST Cx Ox Tx</b>  to get the rest of the response, enter  <b>!528</b>  <b>!RFST C0 O1 T1 Fxx Rxx Gxx A03 I04</b>  The frequency on an ETSI reader is fixed and will always display as "Fxx" attenuation is also fixed at A03</p>
Display RF Transceiver FPGA Version	510	RF FPGA VER = XX.XX
Display RF Transceiver I Filter Chip Version	511	FIL IC I VER = XX.XX
Display RF Transceiver Q Filter Chip Version	512	FIL IC Q VER = XX.XX

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Display RF0 filter status	530	RF0S Ux V0 <b>U0 = disable transmit all IDs (factory default)</b> U4 = any tag ID separation <b>V0 = valid ID code criteria of one acquisition (factory default)</b> V1 = valid ID code criteria of two acquisitions V2 = valid ID code criteria of three acquisitions V3 = valid ID code criteria of four acquisitions
Display tag translation mode status	534	TT <0 to 1> 0 = tag translation mode disabled 1 = tag translation mode enabled
Display time and date	22	HH:MM:SS.hh MM/DD/YY
Display version	505	Model [E4] Ver [version no.] SN [serial no.]
Display Wiegand Mode Status	532	TOF <0 to 1>
Display Wiegand Retransmit Interval	533	WTI <01 to FF>
Enable 3-character mode	857	!Done
Enable ATA	481	!Done if AI1422E model supports this tag protocol. !Error if tag protocol is unsupported.
Enable automatic periodic RF status report	831	!Done
<b>Enable echo</b>	<b>6171</b>	<b>!Done</b>
Enable presence without tag reports	6901	!Done
<b>Enable software flow control</b>	<b>6141</b>	<b>!Done</b>
Enable tag translation mode	453	!Done
Enable Wiegand Mode	451	!Done
Exits Command Mode.	662	!Done

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Load default operating parameters (except RF operating frequency)	66F	!663
Report buffered handshakes	577	XX = number of handshakes
Reset power fail bit	65	!Done
Reset reader	63	
Reset uniqueness	440	!Done
RF Status (ETSI Compliant Only)	528	!RFST C0 O1 T1 Fxx Rxx Gxx A03 I04 The frequency on an ETSI reader is fixed and will always display as “Fxx” attenuation is also fixed at A03
<b>Select 1 valid ID code</b>	<b>4200</b>	<b>!Done</b>
Select 2 valid ID codes	4201	!Done
Select 3 valid ID codes	4202	!Done
Select 4 valid ID codes	4203	!Done
<b>Select Basic protocol</b>	<b>610</b>	<b>!Done</b>
Select ECP protocol	611	!Done
Select even parity	1021	!Done
Select four ID separation	4103	!Done
Select odd parity	1022	!Done
<b>Select one ID separation</b>	<b>4100</b>	<b>!Done</b>
Select RF operating frequency	642NN	!Done
Select RF operating frequency from 860 to 930 in 250 kHz steps	647XXX	
<b>Select RF-by-input control</b>	<b>642</b>	<b>!Done</b>
Select three ID separation	4102	!Done
Select two ID separation	4101	!Done
Set ATA operating range (distance) NN = 00 (shortest) to <b>1F (longest)</b>	643NN	!Done
Set baud rate = 1200 baud set	1002	!Done
Set baud rate = 2400 baud set	1003	!Done
Set baud rate = 4800 baud set	1004	!Done
<b>Set baud rate = 9600 baud set</b>	<b>1005</b>	<b>!Done</b>



Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
Set baud rate = 19.2 K baud set	1006	!Done
Set baud rate = 38.4 K baud set	1007	!Done
Set date	21	!Done
Set ECP timeout NN = 01–FE (1–255) timeout = 50 ms * NN (if NN = FF, timeout is disabled)	612NN	!Done
Set reader ID number NN = 00–FF	60NN	!Done
Set RF attenuation NN = 00 to 0A)	644NN	!Done
Set RF timeout N = 0–F (in milliseconds) (always expired, 4,8,12,20,24, 32,48,60,92,152, 300,452, 600,752, infinite)	693N	!Done
<b>Set RF timeout = infinite</b>	<b>693F</b>	<b>!Done</b>
<b>Set serial number</b>	<b>695S...S</b>	<b>!Done</b>
Set time	20	!Done
Set uniqueness time-out to 15 seconds	442	!Done
Set uniqueness time-out to 2 minutes	441	!Done
Set uniqueness time-out to 30 seconds	443	!Done
<b>Store hardware configuration string</b>	<b>696S...S</b>	<b>!Done</b>
Switch to command mode	01	
<b>Switch to data mode</b>	<b>00</b>	<b>!Done</b>
Transmit all IDs	41	!Done
Turn off RF	640	!Done
Turn on RF	641	!Done
Turn RF off on timeout	6920	!Done
<b>Turn RF off on timeout/no presence</b>	<b>6922</b>	<b>!Done</b>
Turn RF off on timeout/tag	6921	!Done

Table 24 AI1422E Commands Listed Alphabetically

Command Name	Code	Reader Message
<i>Use one stop bit</i>	<b>1010</b>	<b>!Done</b>
Use two stop bits	1011	!Done

Table 25 Select RF Operating Frequency Commands (FCC)

Command	RF Frequency (MHz)
6470A9	902.25
6470AA	902.5
6470AB	902.75
6470AC	903
6470AD	903.25
6470AE	903.5
6470AF	903.75
6470C8	910
6470C9	910.25
6470CA	910.5
6470CB	910.75
6470CC	911
6470CD	911.25
6470CE	911.5
6470CF	911.75
6470D0	912
6470D1	912.25
6470D2	912.5
6470D3	912.75
6470D4	913
6470D5	913.25
6470D6	913.5

**Table 25 Select RF Operating Frequency Commands (FCC)**

<b>Command</b>	<b>RF Frequency (MHz)</b>
6470D7	913.75
6470D8	914
6470D9	914.25
6470DA	914.5
6470DB	914.75
6470DC	915
6470DD	915.25
6470DE	915.5
6470DF	915.75
6470E0	916
6470E1	916.25
6470E2	916.5
6470E3	916.75
6470E4	917
6470E5	917.25
6470E6	917.5
6470E7	917.75
6470E8	918
6470E9	918.25
6470EA	918.5
6470EB	918.75
6470EC	919
6470ED	919.25
6470EE	919.5
6470EF	919.75
6470F0	920
6470F1	920.25

**Table 25 Select RF Operating Frequency Commands (FCC)**

Command	RF Frequency (MHz)
6470F2	920.5
6470F3	920.75
6470F4	921
6470F5	921.25
6470F6	921.5

**Table 26 Select RF Operating Frequency Commands (CMIIT)**

Command	RF Frequency (MHz)
6474C5	920.625
6474C6	920.75
6474C7	920.875
6474C8	921
6474C9	921.125
6474CA	921.25
6474CB	921.375
6474CC	921.5
6474CD	921.625
6474CE	921.75
6474CF	921.875
6474D0	922
6474D1	922.125
6474D2	922.25
6474D3	922.375
6474D4	922.5
6474D5	922.625
6474D6	922.75
6474D7	922.875

**Table 26 Select RF Operating Frequency Commands (CMIIT)**

<b>Command</b>	<b>RF Frequency (MHz)</b>
6474D8	923
6474D9	923.125
6474DA	923.25
6474DB	923.375
6474DC	923.5
6474DD	923.625
6474DE	923.75
6474DF	923.875
6474E0	924
6474E1	924.125
6474E2	924.25
6474E3	924.375

## Appendix E Cyclic Redundancy Check

The cyclic redundancy check (CRC) is calculated, starting with the most significant byte.

The algorithm for the CRC used in the Interrogator is detailed here.

```

unsigned char generateCrc(unsigned char newByte, unsigned char newCrc)
{
    int i;
    unsigned char carryOld = 0;
    unsigned char carryNew = 0;

    for (i = 8; i > 0; i--)+
    {
;           Following 3 stmnts imitate "rotate left
           through carry" of data byte

        carryNew = (newByte >> 7); Shift Right 7, (high bit remains)
        newByte <<= 1;           Left shift by 1
        newByte |= carryOld;     Or the carry bit (previous high bit) into new-
                                Byte low bit
;
        carryOld = carryNew;     put carryNew into carryOld
;
;           Following 3 stmnts imitate "rotate left
           through carry" of CRC
        carryNew = (newCrc >> 7); Get high bit of CRC, put into carryNew
        newCrc <<= 1;           Make room for carry bit in low order of newCRC
        newCrc |= carryOld;     Or the carry bit into newCRC
        carryOld = carryNew;     Save the high order bit of CRC

        if (carryNew) newCrc ^= 0x85; If carryNew non-zero, XOR newCRC with 0x85
                                polynomial
    }

    return newCrc;
}

int main(void)
{
    int i, j;

```

```

unsigned char newStr[5][12] =
{
    {0x01, 0x21, 'T', 'E', 'S', 'T', ' ', 'T', 'A', 'G', ' ', '1'},
    {0x01, 0x01, 'T', 'E', 'S', 'T', ' ', 'T', 'A', 'G', ' ', '1'},
    {0x01, 0x23, 'T', 'E', 'S', 'T', ' ', 'T', 'A', 'G', ' ', '1'},
    {0x01, 0x24, 'R', 'I', 'C', 'H', 'A', 'R', 'D', ' ', '0', '2'},
    {0x01, 0x22, 'R', 'I', 'C', 'H', 'A', 'R', 'D', ' ', '0', '2'}
};
unsigned char newCrc = 0x00;

for (j = 0; j < 5; j++)
{
    for (i = 0; i < sizeof(newStr[j]); i++)
    {
        newCrc = generateCrc(newStr[j][i], newCrc);
        printf("0x%02X (%c)\n", newStr[j][i], newStr[j][i]);
    }
    printf("crc: 0x%02X (%c)\n", newCrc, newCrc);
    printf("\n");

    newCrc = 0x00;
}

}

;Computed CRCs for the previous examples
;          string 1 CRC = 0xAC
;          string 2 CRC = 0xC1
;          string 3 CRC = 0x70
;          string 4 CRC = 0x34
;          string 5 CRC = 0xD5

```



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