

1422E Reader

User Guide

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The AI1422E Reader User Guide provides information necessary for interfacing the AI1422E Reader System to a host computer system.



Purpose of This Guide

This user guide provides information for interfacing the AI1422E Reader System with a host computer system. This guide provides on-site test procedures useful in troubleshooting any problems encountered after installation. Command codes, which allow the user to configure the reader system for communicating with the host computer, are discussed as is ASCII character conversion to TransCore 6-bit character codes.

Intended Audience

The intended audience for the *AI1422E Reader User Guide* are skilled personnel (including trained engineers and technicians). These people are involved in the design, specification, and installation of AI1422E Reader Systems.

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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 FIHA1422E. Access the FCC website at 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 FIHA11422E. 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.

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-AI1422E, access the IC website at 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-AI1422E. 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.

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/cm²) 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 8in (20cm).

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 “Radiofrequency radiation exposure limits” that the maximum permissible exposure (MPE) is the following:

Occupational/Controlled Exposure

Power density = frequency(in MHz)/300 mW/cm² with an Averaging time of 6 Min

General Population/Uncontrolled Exposure

Power density = frequency(in MHz)/1500 mW/cm² 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 14in (36cm) for the Occupational/ Controlled environment, and 31.5in (80.5cm) 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/m². Thus, the maximum permissible exposure for general population/uncontrolled exposure at 915MHz is 2.77 W/m². The average time is 6 minutes. The maximum permissible exposure (MPE) is the following:

Controlled Environment

*Power density = 0.6455*frequency(in MHz)^{0.5} W/m² with a Reference Period time of 6 Min*

General Public/Uncontrolled Environment

*Power density = 0.02619*frequency(in MHz)^{0.6834} W/m² 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 18in (45cm) for the Controlled environment and 47in (120cm) 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.

Occupational/Controlled Environment				
Agency	Power Density (mW/cm ²)	MPE minimum distance		Time (min)
		in	cm	
OSHA	10	8	20	6
FCC	3.05	14	36	6
IC	1.95	18	45	6

General Population/Public/Uncontrolled Environment				
Agency	Power Density (mW/cm ²)	MPE minimum distance		Time (min)
		in	cm	
OSHA	10	8	20	6
FCC	0.61	31.5	80	30
IC	0.28	47	120	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 47in (120cm) from the General Population/ Public i.e. Uncontrolled Environment.
- 2) Maintenance personnel (i.e. Occupational/Controlled Environment) must remain at least 18in (45cm) 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/cm²) 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 20 cm (8 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/cm² avec une durée moyenne de 6 min.

Exposition de la population générale/non contrôlée

Densité de puissance = fréquence (en MHz)/1500 mW/cm² 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 36 cm (14 po) pour l'environnement professionnel/contrôlé et de 80,5 cm (31,5 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^e édition, d'Industrie Canada (un ministère du Gouvernement du Canada) établit des recommandations pour une densité de puissance maximale sécuritaire en W/m². Ainsi, l'exposition maximale admissible pour la population générale/non contrôlée à 915 MHz est calculée à 2,77 W/m². 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)^{0,5} W/m² avec une durée de référence de 6 min.*

Grand public/environnement non contrôlé

*Densité de puissance = 0,02619*fréquence (en MHz)^{0,6834} W/m² 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 45 cm (18 po) pour l'environnement professionnel/contrôlé et de 120 cm (47 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.

Exposition professionnelle/environnement contrôlé				
Organisme	Densité de puissance (mW/cm ²)	Distance MPE minimale		Durée (en min.)
		po	cm	
OSHA	10	8	20	6
FCC	3,05	14	36	6
IC	1,95	18	45	6
Population générale/environnement non contrôlé				
Organisme	Densité de puissance (mW/cm ²)	Distance MPE minimale		Durée (en min.)
		po	cm	
OSHA	10	8	20	6
FCC	0,61	31,5	80	30
IC	0,28	47	120	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 120 cm (47 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 45 cm (18 po) de l'antenne et limiter son temps d'exposition à 6 minutes lorsque l'appareil est en fonctionnement.

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Before You Begin

Before You Begin

Guide Topics

This chapter presents an overview of the AI1422 Reader User Guide. [Table 1–1](#) describes the contents of each chapter.



Table 1–1 Overview of Contents

Chapter 1 – Before You Begin	Describes the purpose, intended audience, guide topics, related documentation, document conventions, and licensing requirements
Chapter 2 – System Overview	Provides an overview of the AI1422E Reader System’s features, options, supported tag descriptions and tag mounting primer, and accessories
Chapter 3 – Interface Connections	Describes the AI1422E Reader System interface connectors and identifies their primary functions
Chapter 4 – Installation Instructions	Describes installation of the AI1422E Reader System
Chapter 5 – System Test Procedures	Provides testing procedures that the user can use to fine-tune the AI1422E Reader System
Chapter 6 – Communications Protocols	Describes the communications protocols for the AI1422E Reader
Chapter 7 – Command Codes	Discusses the host-transmitted commands that are used to control the AI1422E Reader configuration and operation
Chapter 8 – Troubleshooting and Maintenance	Provides troubleshooting indications and maintenance procedures that are used to keep the AI1422E Reader System operating
Appendix A – Character Conversion	Provides TransCore 6-bit-per-character conversions from the standard ASCII character set
Appendix B – Technical Specifications	Provides the product specifications
Appendix C – Lantronix® Tech Support	Provides information on the Lantronix Ethernet Module Configuration.

Typographical Conventions

Table 1–2 lists the conventions used in this manual.

Table 1–2 Conventions used in this manual

Convention	Indication
	This procedure might cause harm to the equipment and/or the user.
	Concerns about a procedure
Code	Code, including keywords and variables within text and as separate paragraphs, and user-defined program elements within text appear in courier typeface.
Dialog Box Title	Title of a dialog box as it appears on screen
Function	Start with the characters, G4, and are in mixed case with no underscores, and include parentheses after the name, as in G4FunctionName().
Menu Item	Appears on a menu. Capitalization follows the interface.
<i>Note</i>	Auxiliary information that further clarifies the current discussion. These important points require the user's attention. The paragraph is in italics and the word Note is boldface.
NUL	Zero-value ASCII character or a zero-value byte
NULL	Zero-value pointers. Null-terminated string refers to strings of printable ASCII characters with a zero-value byte placed in memory directly after the last printable character of the string.

Licensing Requirements

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 to 904 MHz and 909.75 to 921.75 MHz.

The user is responsible for filing the FCC license according to FCC regulations. Access the FCC Web site at www.fcc.gov/Forms/Form601/601.html or at wireless.fcc.gov/index.htm?job=online_filing 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.

System Overview

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 2-1](#) illustrates a typical reader system configuration.

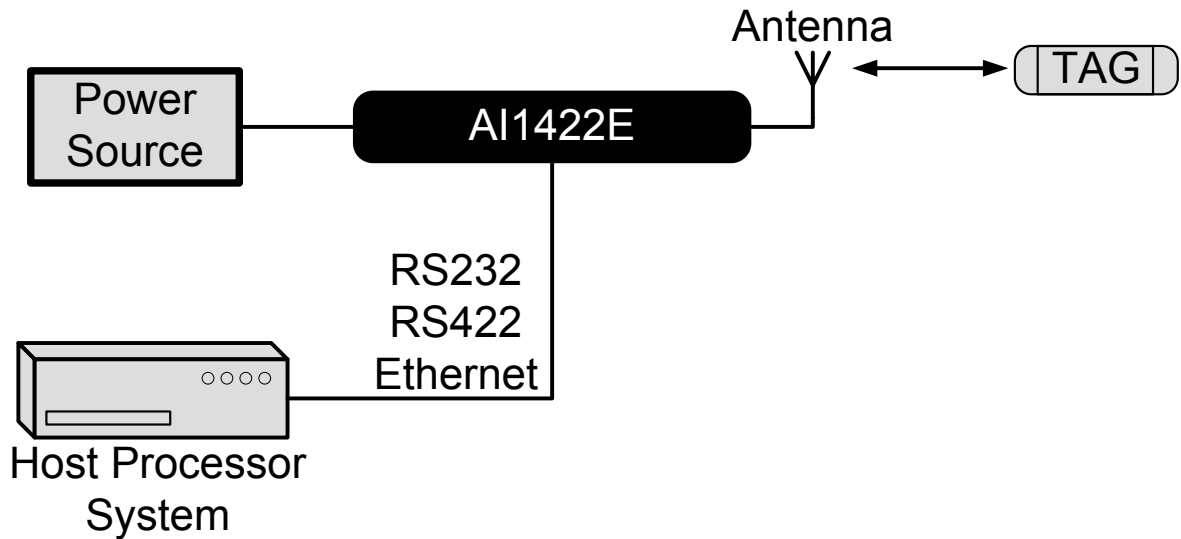


Figure 2-1 Typical Reader System Configuration

Transponder Interrogator

The transponder interrogator reads 60/120 bits 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 railcar or monorail bus. The tags are imbedded 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 reader system uses an input voltage ranging from 12VDC to 150V DC. The AI1422E Reader System incorporates a high-performance, DC-to-DC power supply that converts voltage in this range to 24VDC. 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.

Transponders (Tags)

The AI1422E Reader System can use TransCore's half-frame or 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. The beam powered tags will have a shorter footprint than a battery or switch powered tag, and thus the maximum top speed of the vehicle will be less, all other factors equal. However, although the battery tag has an inherently longer footprint, the battery life limitation will require the operating company to replace the tags every 8 to 10 years. Additionally, 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.

For practical purposes, the switch powered tags have RF characteristics similar to battery tags, and the tags are powered by inductive power derived from railway switch power.

Tag Mounting

All of the 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.

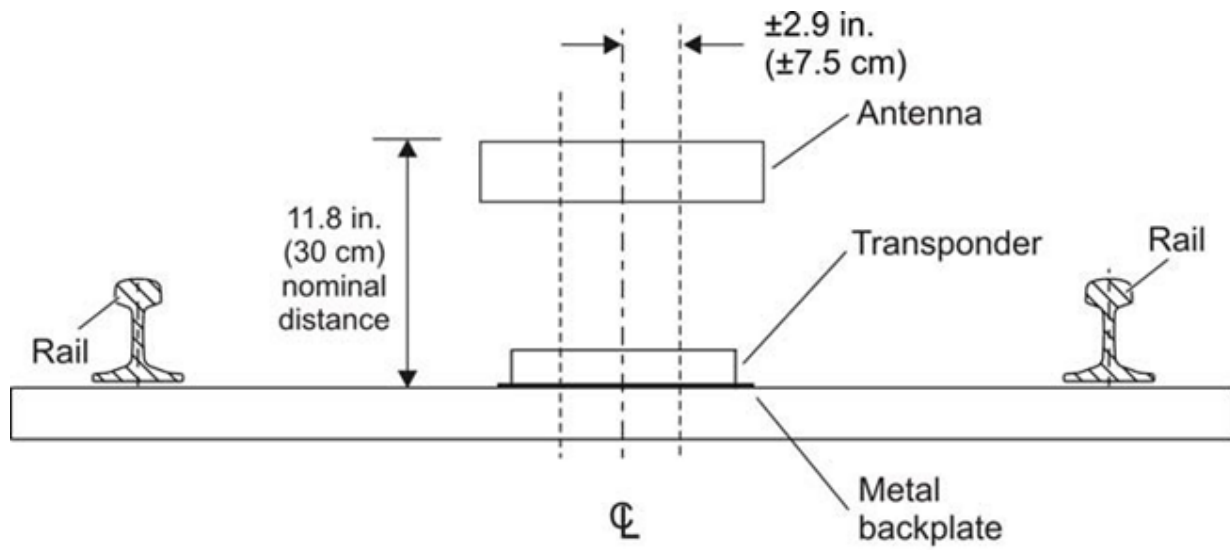
Metal located in the immediate vicinity of the tag, that is, to the sides of the tag or above the tag, can affect the tag's performance. Metal surfaces or objects should not be placed closer than 1 inch (2.5 cm) to the side edges of the tag to ensure that the tag's antenna tuning remains within design 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 effecting 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 would need to be made 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 ± 2.9 inches (± 7.5 cm) of each other (Figure 2-2).

Antenna-to-tag Distance

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



SD-0151

Figure 2-2 Antenna-to-Tag Centerline Tolerance

Interface Connections

Description of AI1422E Reader System

Because the AI1422E Reader System combines a reader and radio frequency (RF) module into a single unit, you must connect the following items to the system: the external DC power, the customer input/output (I/O), the selected communications interfaces, and the antenna. These interface connectors are located on the AI1422E Reader System front panel as shown in [Figure 3–1](#).

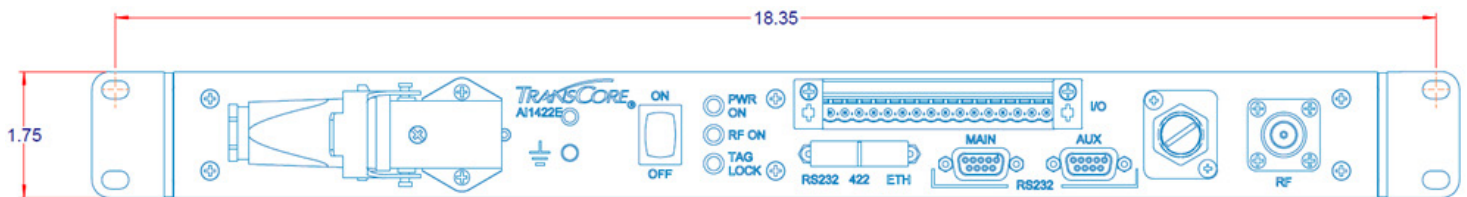


Figure 3–1 Sample Front Panel of an AI1422E Reader

Antenna Interface

Attach the antenna cable directly to the antenna interface on the front panel of the AI1422E Reader System. The antenna cable length depends on the installation.

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 DE09 plug connector used with a host processor. In real-time mode, tag IDs are read and passed on to the host processor. [Figure 3–2](#) illustrates the RS–232, DE09 plug connector pin-outs.

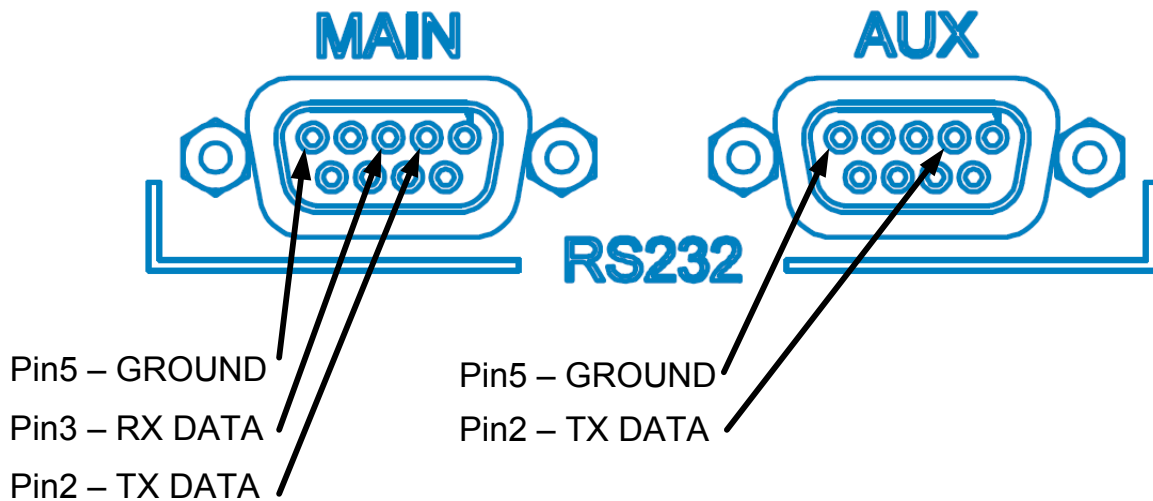


Figure 3–2 RS-232, DE09 Interface Connector Pin-outs

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 DE09 plug connector. This port is not wired to receive data and cannot accept commands.

RS–422 Interface

The RS–422 interface is a terminal block connector, occupying pins 5-9 of the Customer I/O Interface. In real-time mode, tag IDs are read and passed on to the host processor.

Ethernet (M12) Interface

The AI1422E 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 [“Appendix C” on page C-1](#)

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.

Customer I/O Interface

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 3–3](#) shows the pin-outs on the customer I/O interface connector.

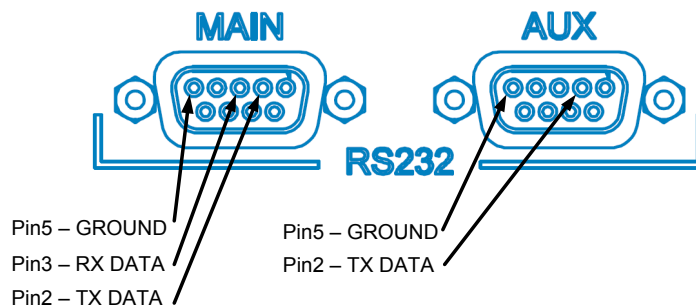


Figure 3–3 Customer I/O Interface Pin-outs

The customer I/O interface connector contains the lock, main power, RF solid state outputs, the trigger signals (solid state), and RS422 ([Figure 3–3](#)).

Tag Lock Output

The transistor-transistor-logic (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 5Viso and I/O Ground.

Main Power Output

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 5Viso and I/O Ground.

RF Power Output

The 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.

Trigger Signals

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).

Power Connection

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

Installation Instructions

General

Equipment should be installed/serviced by skilled, qualified personnel only. Equipment should be installed in RESTRICTED ACCESS LOCATIONS only.

Mechanical

Dimensioned mounting hole drawing (metric & in)

General info on screws, torque, etc.

Electrical

Power

Assembling the Power Connector



WARNING: Ensure ON/OFF switch is in “OFF” position and “PWR ON” LED is not illuminated before servicing unit.

1. Unpack unit from shipping crate and locate the power connector on the front panel.



2. Unlatch plug from receptacle on unit and remove.



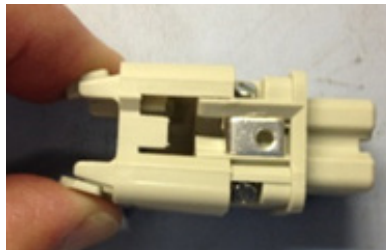
3. Locate set screw on the plug housing.



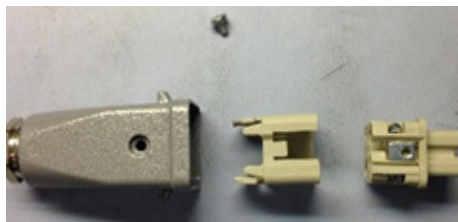
- Remove screw and plug insert from plug housing.



- Locate tabs on plug insert.



- Squeeze tabs to remove wire harness from insert clip.



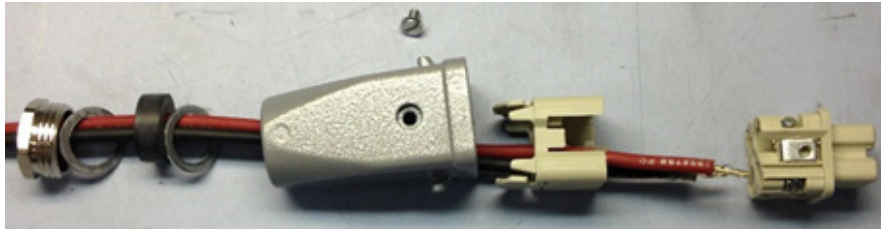
- Remove cable gland assembly from rear of plug



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



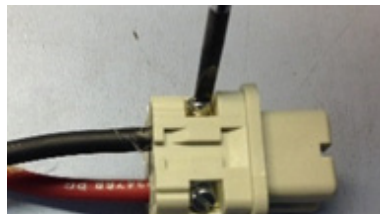
9. Thread +Vin and -Vin wires through cable gland, housing, and insert assemblies.



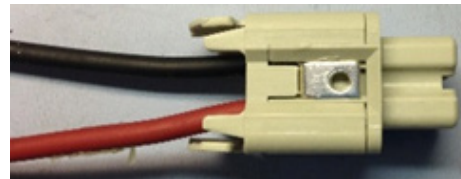
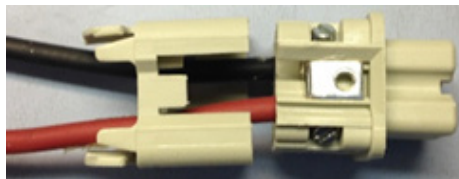
NOTE: Power cable requires 18 AWG stranded wire or larger, with a minimum insulation rating of 70C and 150V. Wire must meet EN 60950-1 or other applicable component standards.

NOTE: External 10A-rated fast-acting fuse required in-line with positive terminal for proper system operation and protection. Fuse must meet EN60950-1 or applicable component standard(s).

10. Loosen wire retention screws on wire harness, insert wires into their respective pins, and tighten retention screws to ensure wires cannot be removed



11. Insert wire harness into insert clip until the tabs click into place



12. Place insert back into plug housing and tighten set screw.



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

13. Insert cable gland assembly back into plug housing.



14. Using a wrench, tighten gland nut.



15. Connect +Vin and -Vin to power source.

NOTE: Unit MUST be installed as close to power source as possible

Installing Wires into Connector



WARNING: Ensure ON/OFF switch is in “OFF” position and “PWR ON” LED is not illuminated before connecting/disconnecting from power supply.

Connecting power

1. Ensure ON/OFF switch in “OFF” position



2. Insert plug into receptacle.



3. Latch firmly to ensure proper connection.



4. Switch ON/OFF switch to "ON" position and ensure "PWR ON" LED is illuminated.



Disconnecting power

1. Switch ON/OFF switch in “OFF” position and ensure “PWR ON” LED is not illuminated.



2. Unlatch connector



3. Gently remove plug from receptacle.

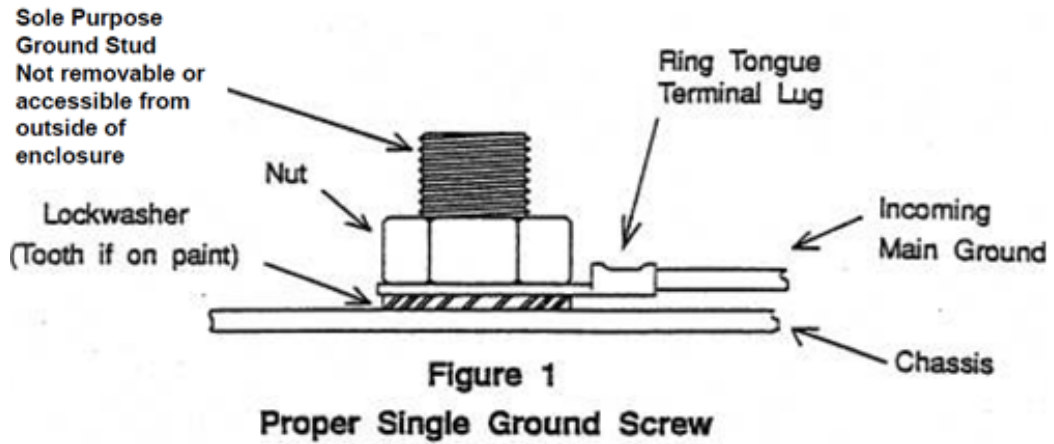


Protective Earth Ground Terminal

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.



For proper grounding, refer to the diagram below:



NOTE: Grounding cable should be 16 AWG or larger

System Test Procedures

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.
3. Slide the Interface Selection switch on the front panel of the reader to **RS232**.
4. Switch 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 5-1).

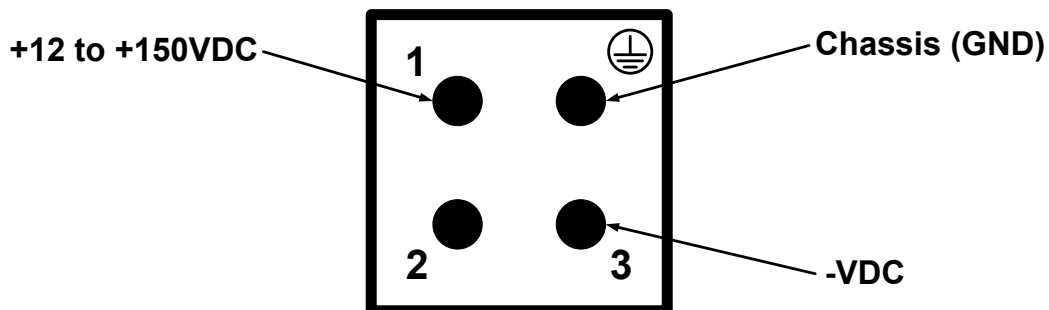


Figure 5-1 Power Source Connections

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

Note: For information on entering command codes, refer to “Communications Protocols” on page 6-2.

Type `!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 type the following commands:

```
!20hh:mm:ss sets time
!21MM/DD/YY sets date
!642 sets RF to follow the trigger
!41 enables tag reporting
```

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

The entered command and `!Done` response will be returned after each properly executed command.

Reading the Tag

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

1. Switch 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 RS232 interface.
3. Slide the **Interface Selection** switch on the front panel of the reader to RS232.
4. Connect the antenna to the antenna interface on the front panel of the reader system.
5. Set the ON/OFF switch located on the front panel of the reader system to **on**.
6. Connect a jumper between pins 14 (ground) and 15 (trigger) on the customer I/O interface to trigger the RF on (“[Figure 3–3 Customer I/O Interface Pin-outs](#)” on page 3-4).
7. Monitor the LEDs on the box and verify that the main power LED and the RF power LED are lit.
8. Position a programmed TransCore half-frame 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 lit 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 lit 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. Set 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 lit and the PC should be reporting the tag data.

Communications Protocols

Communications Protocols

The AI1422E Reader supports the following communications protocols:

- Basic
- Error correcting protocol (ECP)
- Data inquiry

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 acknowledgement 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 [“525 Display Communications Protocol Status” on page 7-17](#).

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 [“Command Codes” on page 7-2](#) 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.

Data Inquiry Protocol

Data inquiry protocol is a basic protocol option that allows the host to control transmission of reader tag data. The selection of data inquiry protocol affects data mode operation.

As the AI1422E Reader acquires tags, it buffers them but does not transmit them. Instead, the host must poll the AI1422E Reader for each tag by sending a CTRL-E character (hex 5 digit). The AI1422E Reader transmits one message (tag ID or report data) for each CTRL-E it receives until the buffer is empty.

Each tag request message sent by the host consists only of the CTRL-E character; no som or eom characters are sent. AI1422E Reader data transmission (tag ID and report data) format is the same as for basic protocol.

Selection of data inquiry protocol does not affect command mode

Command Codes

Command Codes

This chapter discusses the host-transmitted commands that are used to control the AI1422E Reader configuration and operation.

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 data mode and 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 the data mode upon power-up. While in the data mode, the AI1422E Reader sends all communications as data messages, such as tag IDs and reports, to the host computer. Reports provide information on input status changes (input0 and input1), a presence without tag report, and buffer overflow information. The host computer can send only two commands to the AI1422E Reader while in data mode:

- Command !01 Switch To Command Mode changes the AI1422E Reader from the data mode to the command mode. Refer to [“01/~~CC Switch to Command Mode” on page 7-4](#)

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 the command mode with tags passing through the read zone, all tag IDs are not reported.

Command Mode

While the AI1422E Reader is in the 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 `Error`, `Done`, 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:

- 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.

Note: The AI1422E Reader changes the baud rate immediately after issuing the Done message.

- However, 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: 38400 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 D](#) for listings of commands in numerical and alphabetical order.

In the following text, 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 — Command Group 0

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)

Command !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, and is not recommended for use.



Caution

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

While operating in data mode, the reader accepts the following commands:

- Command !01 Switch to Command Mode

Reader response:

Done

01/^^CC Switch to Command Mode

Command !01 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:

Done

Communications Port Control — Command Group 1

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

Command !100N selects the reader baud rate. The factory-default setting is 9600 baud. The N variable specifies the baud rate shown in [Table 7-1](#).

Table 7–1 Select Baud Rate Commands

Command	Baud Rate Selected
1002	1200
1003	2400
1004	4800
1005	9600 (factory default)
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 7-17

Reader response:

Done

101N Select Stop Bits

Command !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 7–2](#).

Table 7–2 Select Stop Bits Commands

Command	Stop Bits Selected
1010	1 (factory default)
1011	2

Reader response:

Done

102N Select Parity

Command !102N selects the reader parity setting. The factory-default setting is parity disabled. The N variable specifies parity as shown in [Table 7–3](#).

Table 7–3 Select Parity Commands

Command	Data Bits	Parity Selected
1020	8	Disable parity (factory default)
1021	7	Select even parity
1022	7	Select odd parity

Reader response:

Done

Command Group 2

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. An internal battery supports the clock, so time and date are preserved if main power is lost.

20 Set Time

Command !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

Command !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. 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

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

Reader message:

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.

Append Information — Command Group 3

Group 3 commands append useful information to reader transmissions, such as IDs, error messages, and sensor input reports. Auxiliary information such as reader number, antenna number (or manual entry code), number of times the previous tag was read, and sensor input status can be appended to the ID using the Group 3 commands.

30N Append Time and Date Selection

Command !30N selects the option of appending the time and date to transmitted IDs,

error messages, presence without tag reports, and input status change reports. The factory default setting is time and date appended (command !302).

The reader returns an `ERROR` message if its tag buffer contains data. The reset reader command !63 may be transmitted to clear the buffer; however, tag ID data will not be reported. If this is unacceptable, allow the buffer to empty before re-issuing append time and date command !30N. Append Time and Date commands are shown in [Table 7–4](#).

Table 7–4 Append Time and Date Commands

Command	Append Option
300	No time and date appended
302	Time and date appended (factory default)

The reader transmits messages with time and date appended as follows. One space separates the time from the date.

```
<string>&<HH:MM:SS.hh MM/DD/YY>
```

where

string is a tag ID, error message, or report.

& separates <string> from the time and date.

HH:MM:SS is the time delimiter.

MM/DD/YY is the date delimiter.

Reader response:

Done

31N Append Auxiliary Information Selection

Command !31N selects the option of appending auxiliary information to transmitted IDs, presence-without-tag reports, and input status change reports. Auxiliary information is not appended to error messages. The factory-default setting is no auxiliary information appended. The N variable specifies whether or not auxiliary information is to be appended. Append Auxiliary Information commands are shown in [Table 7–5](#).

Table 7–5 Append Auxiliary Information Commands

Command	Append Option
310	No auxiliary information appended (factory default)
311	Auxiliary information appended

The reader transmits messages with auxiliary information appended as:

```
<message data>%<xx-y-zz-q>
```

where

- % separates the auxiliary information and signals the host computer that auxiliary information is appended.
- xx reader ID. Value can be set with command !60NN.
- auxiliary information delimiter
- y antenna number. Value fixed at 0.
- zz number of reads (00 to FF hexadecimal) of the previous tag
- q current status of input0 and input1 (0 to 3). Refer to [“525 Display Communications Protocol Status” on page 7-17](#). These values are inverted if input inversion is enabled with command 6941.

Reader response:

Done

!320 Disable EAC Page Append (Factory Default)

Command !320 is a factory-set default that disables the EAC (embedded application code) page append.

Reader response:

Done

!321 Enable EAC Page Append

Note: This functionality was added to the Encompass® 2 Reader to handle a special unique customer requirement, and is retained in the AI1422E Reader for full backward compatibility.

Command !321 selects the option to append an additional predefined 8 bytes of data to be read from an eGo® or eGo Plus tag when the reader is in ID only mode (i.e., not eATA) and multitag sort is enabled. The additional bytes that are read from the tag are in locations 10 through 17.

The reader transmits the message with EAC page append as follows:

The EAC append data occurs before time and date append data and AUX append data if they are enabled.

```
<tag ID>&<EAC page data>
```

Reader response:

Done

ID Filtering — Command Group 4

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

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

Reader response:

Done

41 Transmit All ID Codes

Command !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)

Command !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 7–6](#).

Table 7–6 Unique ID Code Criteria

Command	Uniqueness Criteria
4100	Separation of 1 ID (factory default)
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 two 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

Command !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 7-7). The factory setting is one acquisition (N = 0).

Table 7-7 Select Valid Code Commands and Frames

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

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

440 Reset Uniqueness

Command 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

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 railcar parked on a siding in front of the reader. Without this continual reset feature, the railcar's ID would be reported every 2 minutes (each time the timeout clock expired).

450 Disable Wiegand Mode (Factory Default)

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

Reader response:

Done

451 Enable Wiegand Mode

Command `!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)

Command `!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

Command `!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

454 Disable Multi-tag Sort (Factory Default)

Command !454 is a default set in the factory to disable the multi-tag sort function.

Reader response:

Done

455 Enable Multi-tag Sort

Command !455 enables the multi-tag sort function that allows the reader to identify unique tags within a group of Intellitag-based tags. Multi-tag sort allows full operation of the tags and reader to be carried out with a limited number of tags in the presence of the reader.

Reader response:

Done

Note: Enabling the multi-tag sort function adversely affects the vehicle speed at which tags may be read. If there is only one Intellitag-based tag in the vehicles of the target population, multi-tag sort should be disabled.

456 Enable eGo Plus Tag Initialization During Multi-tag Sort (Factory Default)

Command !456 enables the reader to send the eGo Plus Tag initialize command as part of the multi-tag sort function. When the reader sends the eGo Plus Tag initialize command, all tags in the RF field reenter the sort process.

Reader response:

Done

457 Disable eGo Plus Tag Initialization During Multi-tag Sort

Command !457 disables the reader from sending the eGo Plus Tag initialize command as part of the multi-tag sort function. Any eGo Plus Tags already identified by the reader during the sort process will not be re-identified as long as they remain powered in the RF field. The reader will only identify new tags that come into the RF field or tags that do not remain powered in the RF field.

Reader response:

Done

480 Disable ATA

Command !480 disables the reader from reading ATA protocol tags.

481 Enable ATA

Command !481 enables the reader to read ATA protocol data from tags if the reader is programmed to read this tag protocol.

482 Disable eGo

Command !482 disables the reader from reading protocol eGo data from tags.

483 Enable eGo

Command !483 enables the reader to read factory-programmed eGo data from tags if the reader is programmed to read this tag protocol.

484 Disable SeGo

Command !484 disables the reader from reading SeGo protocol data from tags.

485 Enable SeGo

Command !485 enables the reader to read SeGo protocol data from tags if the reader is programmed to read this tag protocol.

486 Disable IAG

Command !486 disables the reader from reading IAG protocol data from tags.

487 Enable IAG

Command !487 enables the reader to read IAG protocol data from tags if the reader is programmed to read this tag protocol.

488 Disable eATA

Command !488 disables the reader from reading factory-programmed eATA data from tags.

489 Enable eATA

Command !489 enables the reader to read factory-programmed eATA data from eGo Plus or eGo tags. This option must be enabled to obtain Wiegand data from eGo Plus or eGo tags.

490 Disable Alternate Group Select (Factory Default)

Command !496 disables the alternate group select function that allows the reader to distinguish tags meeting specific criteria pre-programmed into the tags.

Reader response:

Done

Reader Status — Command Group 5

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

505 Display Software Version

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

Reader message:

```
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

Command !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

Command !510 displays RF FPGA VER = XX.XX

511 Display RF Transceiver I Filter Chip Version

Command !511 displays FIL IC I VER = XX.XX

512 Display RF Transceiver Q Filter Chip Version

Command !512 displays FIL IC Q VER = XX.XX

513 Display DSP Board Actel Version

Command !513 displays DSP FPGA VER = XX.XX

520 Display Power Fail Bit

Command !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

Command !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

Command !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
- B5 9600 baud (factory default)
- B6 19.2 kbps
- B7 38.4 kbps
- S0 one stop bit (factory default)
- S1 two stop bits
- P0 no parity (factory default)
- 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

Command !524 displays the information being appended to the reader transmissions. Command !31N appends information. Append time and date are not available to the AI1422E Reader.

Reader message:

where

IDAP T<0> D<0> X<0 to 1>

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

Command !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)

7-20 TransCore Proprietary

P1 ECP enabled

P2 data inquiry protocol 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 !.

526 Display I/O Status

Command !526 displays the current input/output (I/O) status. The reader message indicates whether outputs are being controlled externally by the host through command !620N Output Control or internally through command !621 Predefined Output Mode. It also displays the current status of two outputs, two inputs, and the selected output pulse duration that is set by command !67N.

Reader response:

IOST C<0 to 1> O<0 to 3> I<0 to 3> D<0 to F>

where

C0	Host controls outputs
C1	Predefined output mode
O0	Both outputs off
O1	Output0 on
O2	Output1 on
O3	Both outputs on
I0	Both inputs false
I1	Input0 true
I2	Input1 true
I3	Both inputs true
D0	4 ms output pulse duration
D1	8 ms output pulse duration
D2	12 ms output pulse duration
D3	16 ms output pulse duration
D4	20 ms output pulse duration
D5	24 ms output pulse duration
D6	32 ms output pulse duration
D7	40 ms output pulse duration
D8	48 ms output pulse duration
D9	60 ms output pulse duration
DA	76 ms output pulse duration
DB	152 ms output pulse duration
DC	228 ms output pulse duration (factory default)
DD	300 ms output pulse duration
DE	376 ms output pulse duration
DF	752 ms output pulse duration

Note: The first character of the output pulse duration value is alpha; the second character is numeric.

Table 7–8 shows the output0 and output1 open/closed conditions for the output status displays.

Table 7–8 Open/Closed Conditions for Output Status

Output Status	Output0 Wire Pair		Output1 Wire Pair	
	Orange/Black	Brown/Black	White/Black	Green/Black
O0	Closed	Open	Closed	Open
O1	Open	Closed	Closed	Open
O2	Closed	Open	Open	Closed
O3	Open	Closed	Open	Closed

Table 7–9 shows the output0 and output1 open/closed conditions for the output status displays for readers in IAG applications.

Table 7–9 Open/Closed Conditions for Output Status (IAG Applications)

Output Status	Output0 Wire Pair		Output1 Wire Pair	
	Orange Jumper to Black of Brown/Black	Brown/Black	White Jumper to Black of Green/Black	Green/Black
O0	Closed	Open	Closed	Open
O1	Open	Closed	Closed	Open
O2	Closed	Open	Open	Closed
O3	Open	Closed	Open	Closed

Table 7–10 shows the input0 and input1 open/closed conditions for the input status displays.

Table 7–10 Open/Closed Conditions for Input Status

Input Status	Input0 Wire Pair	Input1 Wire Pair
	Green/Red	Blue/Black
I0	Open	Open
I1	Closed	Open
I2	Open	Closed
I3	Closed	Closed

527 Display RF Status

Command !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 !527 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> Fxxx Rxx Gxx Axx Ixx
```

where

C0	RF controlled by host
C1	RF controlled by presence sensor on input0, the red/green pair (factory default)
O0	RF off
O1	RF on
T1	Uniqueness timeout of two minutes
T2	Uniqueness timeout of 15 seconds
T3	Uniqueness timeout of 30 seconds
Fxxx	Fixed
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 06 is minimum output power (6 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)

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

```
RFST C1 O0 T1 Fxx R1F G1F A00 I04
```

which means that RF is enabled by presence sensor on input0, 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

Command !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.

Reader message:

```
PRST P<0 to 1> D0 A<0 to 2> T<0 to F> I<0 to 1>
```

where

P0	Presence without tag reports disabled (factory default)
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
A2	RF off on timeout or presence condition false (factory default)
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
TF	RF timeout infinite, never expires (factory default)
I0	input inversion disabled (factory default)
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

Command !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 !420N Select Valid ID Code Criteria).

Reader message:

```
RF0S U<0 to 4> V<0 to 3>
```

where

- U0 One ID separation (factory default)
- U1 Two ID separations
- U2 Three ID separations
- U3 Four ID separations
- U4 Transmit all IDs
- 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

Command !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

Command !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

Command !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 7-12](#) for more information.

Reader message:

TT <0 to 1>

where

0 tag translation mode disabled

1 tag translation mode enabled

537 Display Echo Status

Command !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” on page 7-26](#) and [“6171 Enable Echo Mode \(Factory Default\)” on page 7-26](#) for more information.

Reader message:

ECHO <0 to 1>

where

0 Echo status disabled

1 Echo status enabled (factory default)

540 Display Flash Checksum

Command !540 displays the flash memory checksum.

Reader message:

```
PCKS I0000 Exxxxx
```

where

0000 Not applicable to the AI1422E Reader

xxxx Represents the four-byte ASCII representation of the flash memory checksum

543 Display Boot Checksum

Command !543 displays the boot ROM checksum.

Reader message:

```
BCKS xxxx
```

where

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

549 Display User-Programmable Group Select Equals (GSE) Filter Data

Command !549 queries the reader for the user-programmable GSE filter data programmed in the reader using command !697. The response data is formatted similar to the data in the configuration command.

For example, if the command string shown in command !697 (refer to “[697 Set User-Programmable Group Select Equals \(GSE\) Filter](#)” on page 7-36) was sent to a given reader, the response to the !549 query command would be:

```
!A4 0A 0005014202024133
```

The reader response contains all the data fields repeated in the same sequence as displayed in the User-Programmable GSE configuration command.

560 Request Sensor Status Change

Command !560 displays the sensor status change reporting. Status change reporting may be disabled by command !82N Select Input Status Change Report Option.

Reader message:

where

```
SSTC E<0 to 1>M<0 to 3>
```

E0 Input status change reports disabled (factory default)

E1 Input status change reports enabled

M0 Reporting disabled (factory default)

M1 Changes on input0 reported

M2 Changes on input1 reported

M3 Changes on either input reported

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

```
SSTC E0 M0
```

which means that input status change reports are disabled on both input0 and input1.

570 Display Tag Protocols

Command !570 displays the currently selected tag protocol. Reader response:

```
ATA:<E, D> eGo:<I, F, D> SeGo:<I, F, D> IAG:<E, D> Sort:<E, D>
TMM0
```

where

I	ID (64 bits)
E	Enabled
F	Full transaction (eATA)
D	Disabled

TMM0 Fixed

577 Report Buffered Handshakes

Command !577 reports the buffered handshakes.

Reader message:

```
XX
```

where

XX is number of handshakes

!582 Display Synchronization Values

Command !582 displays the synchronization values, which are typically used to alleviate interference issues in dense populations of Interagency Group (IAG) readers.

The values are set with commands !648NN and !649NN. Reader Response:

```
SYNC T<00 to FF> H<00 to 0A>
```

Where T is the number of milliseconds (ms) before the reader sends a synchronization pulse to all other readers on the RS-485 bus and H is the number of milliseconds that the reader holds off starting IAG tag protocol once it receives the synchronization pulse.

Reader Control Functions — Command Group 6

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

60NN Set Reader ID Number

Command !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

though 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)

Command !610 enables the basic communications protocol.

Reader response:

Done

611 Select Error Correcting Protocol

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

Reader response:

Done

613 Enable Data Inquiry Protocol

Command !613 enable the data inquiry protocol. Refer to [“Data Inquiry Protocol” on page 6-3](#).

Reader response:

Done

6170 Disable Echo Mode

Command !6170 disables the reader’s echo of received host commands. If operating in basic protocol or data inquiry 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

6171 Enable Echo Mode (Factory Default)

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

Reader response:

Done

620N Set Output Control

Command !620N provides direct control of two output lines that may be used to operate external hardware, such as gates or traffic lights. The value for N specifies the output status requested as shown in [Table 7–11](#). Receipt of any !620N command automatically disables command !621 Predefined Output Control.

Table 7–11 Output Control Commands

Command	Output Control Option
6200	Turn off both output ports (factory default)
6201	Turn off output1, Turn on output0
6202	Turn off output0, Turn on output1
6203	Turn on both output ports

Reader response:

Done



Caution

The RF ON Indicator and RF Active Output on the I/O Connector are driven through Output0. Utilizing this command will disable the Indicator. **621 Select Predefined Output Control (Factory Default)**

Command !621 configures the reader for predefined output mode. In this mode, output0 drives the RF Active LED, and output1 is automatically asserted upon receipt of a valid unique tag ID. The output line remains asserted for the time specified by output pulse duration (!67N Set Output Pulse Duration). Any direct control command (!620N Output Control) automatically disables the predefined output mode.

Note: In Wiegand mode operation, output1 is not controlled by a pre-defined output mode.

Reader response:

Done

63 Reset Reader

Command !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

Command !64N directly controls the RF module. The N value controls the RF power as shown in [Table 7–12](#).

Table 7–12 RF Control Commands

Command	RF Power
640	Turns off RF
641	Turns on RF

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

Reader response:

Done

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

Command !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)

Command !643NN 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

Command !644NN sets the attenuation control for the output RF power where NN is a hexadecimal value from 03 to 0A. Settings for attenuation are 1.0 dB increments over a range of 7 dB of attenuation from the maximum power setting of 25 dBm at 3-dB attenuation to a minimum power level of 18 dBm.

The Set RF Attenuation command NN variables and corresponding attenuation settings are shown in [Table 7–13](#).

Table 7–13 RF Attenuation Command Variables

Variable (NN)	Attenuation Setting (dB)
03	3
04	4
05	5

06	6
07	7
08	8
09	9
0A	10

Reader response:

Done

645NN Set eGo and eGo Plus Operating Range (Distance)

Command !645NN sets the read range for eGo and eGo Plus 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

646XX Set IAG RF Attenuation

Command !646XX sets the IAG attenuation control for the output RF power where XX is a hexadecimal value from 00 to 06. Setting 00 (0 dB) is the maximum power setting and 06 (6 dB) is the minimum power setting. The default attenuation value is 04.

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

Command #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.

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.

The commands to set the RF operating frequency are presented in [Table 7–14](#)

Table 7–14 Select RF Operating Frequency Commands

Command	RF Frequency (MHz)
647000	860.00
.	.
.	.
.	.
6470CF	911.75
6470D0	912.00
6470D1	912.25
6470D2	912.50
6470D3	912.75
6470D4	913.00
.	.
.	.
.	.
6470EA	918.50
6470EB	918.75
6470EC	919.00
6470ED	919.25
6470EE	919.50
6470EF	919.75
.	.
.	.
.	.
657113	928.75
647114	929.00

Command	RF Frequency (MHz)
647115	929.25
647116	929.50
647117	929.75
647118	930.00

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

Command !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. “520 Display Power Fail Bit” on page 7-15 for more information.

Reader response:

Done

66F Load Default Operating Parameters

Command !66F loads all the factory default operating parameters except RF operating frequency. Refer to Table 8-2, AI1422E Reader Default Configuration Settings for a listing of the defaults.

Reader response:

Done All parameters loaded OK

Error A parameter load failed

67N Set Output Pulse Duration

Command !67N sets the output pulse duration for the command !621 Predefined Output Control. This command specifies the length of time that output line(s) will be asserted upon receipt of a valid and unique tag ID. The factory default setting is 228 ms. The variable N specifies an output pulse duration of 48 ms to 752 ms.

Uppercase or lowercase characters are allowed for N; for example, hex digits A through F or a through f. The command numbers and corresponding output pulse durations are shown in Table 7-15.

Table 7–15 Output Pulse Duration Commands

Command	Duration
670	4
671	8
672	12
673	16
674	20
675	24
676	32
677	40
678	48
679	60
67A	76
67B	152
67C	228 (factory default)
67D	300
67E	376
67F	752

Additional IDs may be acquired during the selected output pulse duration; however, the timing restarts upon each successive ID acquisition. This command should be used with discretion. For example, when the tag acquisition interval is short compared to the selected pulse duration, distinct pulses may not be generated.

Reader response:

Done or Error

690N Select Presence Without Tag Report Option

Command !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 7–16](#)

Table 7–16 Presence Without Tag Report Commands

Command	Report Option
6900	Disable presence without tag reports (factory default)
6901	Enable presence without tag reports

Reader response:

Done

Refer to “[Basic Protocol and ECP Format](#)” on page 6-5 for message format information.

692N Select RF Control Algorithm

Command !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 7-18.

Table 7–17 RF Control Algorithm Commands

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

Command !6920 turns off RF power based on the timeout established by command !693N Set RF Timeout Period.

Command !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.

Command !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

Command !693N selects the RF timeout period used by command !692N Select RF Control Algorithm. Values for N range from 0 through F.

Command !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 7–18](#).

Table 7–18 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
6939	92
693A	152
693B	300
693C	452
693D	600
693E	752
693F	Infinite (never expires, factory default)

Reader response:

Done or Error

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

694N Select Input Inversion Option

Command !694N enables or disables input inversion. When inversion is enabled, an open circuit input is interpreted as a closed circuit, and a closed circuit input is interpreted as an open circuit. This feature allows greater flexibility in the attachment of external equipment to the reader inputs. For example, some proximity sensors indicate presence with an open circuit. In this instance, command !6941 can enable input inversion so that an open circuit input indicates a presence. The values for N represent the two inversion options as shown in [Table 7–19](#).

Table 7–19 Input Inversion Options

Command	Options
6940	Disable input inversion (factory default)
6941	Enable input inversion

Reader response:

Done

695S...S Set Serial Number

Command !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.

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.

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

Reader response:

Done

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.

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

Reader response:

Done

697 Set User-Programmable Group Select Equals (GSE) Filter

Command !697 assigns the user-programmable GSE filter.

The command string is assigned according to the following format:

```
697 MM AA DDDDDDDDDDDDDDDDD
```

where

- MM = The tag uses this mask to determine which of the eight Comparison Data bytes are to be compared for the Group Select filter.
- AA = This field is used by the tag to determine the start address in the tag memory for the comparison data.
- DD...DD = Comparison Data: an 8-byte field (16 characters) used by the tag as the comparison data for the Group Select filter. The tag compares the data in this field to data in tag memory beginning at the Start Address to determine if the tag will respond to a reader Group Select request. Only the bytes having the corresponding bit set in the GSE Mask is used for this comparison.

As an example, to configure a reader to have only tags with data in byte locations 10, 12, and 15 (decimal) with hexadecimal values “00,” “01,” and “02,” the following command is used:

```
!697 A4 0A 0005014202024133
```

To understand how the data is interpreted, it is necessary to break down the GSE Mask field, A4, into binary:

```
A4 = 1010 0100
```

This mask equates to the tag comparing the first, third, and sixth bytes of the Comparison Data to data in the tag beginning at address location 0A (10 decimal).

The Comparison Data field is broken down in bytes with the bytes corresponding to the mask underlined in bold (for clarification):

```
Address: 0A 0B 0C 0D 0E 0F 10 11
```

```
Data: 00 05 01 42 02 02 41 33
```

where

0A (10 decimal) must be equal to “00” hexadecimal, the first byte in the Comparison Data field

0C (12 decimal) must be equal to “01” hexadecimal, the third byte in the Comparison Data field

0F (15 decimal) must be equal to “02” hexadecimal, the sixth byte in the Comparison Data field

Reader response:

```
Done
```

Auxiliary Reader Control — Command Group 8

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

82N Select Input Status Change Report Option

Command !82N selects the input lines to be monitored to report any change in input status. The enabled input lines are monitored for any changes in the logic states. If a change is detected, the reader generates an input status change message and treats it as a tag ID. If the auxiliary information option is enabled, the input status field displays the current input values. The value for N specifies the report options as shown in [Table 7–20](#).

Table 7–20 Input Status Change Report Options

Command	Report Option
820	Disable status change reports (factory default)
821	Report change on input0
822	Report change on input1
823	Report changes on input0 and input1

Reader response:

Done

830 Disable Automatic Periodic RF Status Report (Factory Default)

Command !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

Command !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 !527 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

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 DE09 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.

13. Power down the AI1422E reader by switching the main power switch to the 'OFF' position.
14. Slide the Interface Selection switch on the front panel of the reader to RS232.
15. Install a loopback connector to the MAIN RS232 port.
16. Apply power to the AI1422E reader by switching the main power switch to the 'ON' position.
17. Wait 30 seconds for the reader to complete the factory reset.
18. Power down the AI1422E reader by switching the main power switch to the 'OFF' position.

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.

- Does the AI1422E Reader System have adequate power? If not, ensure reader has 24V DC \pm 0.5V DC.
- Is the main power switch on? If not, switch it on.
- Is the main power switch light-emitting diode (LED) lit? If not, turn on power switch.
- Are you using a null modem cable connection? If not, switch to a null modem connection.
- Is the Interface Selection switch on the front panel of the reader set to the correct interface? If not, slide the switch to the correct interface.
- Have you set the correct baud rate? 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 lit, the indication is that the AI1422E is querying for tags. If the LOCK LED, , is lit, the indication is that the reader system is retrieving tag data. If either LED is not lit, then 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 being alternated with a tag containing different data to avoid uniqueness filtering.

Unit Will Not Retain Settings

If the unit will not retain information, such as time and date stamp or baud rate between power cycles, the internal battery backup has failed and the unit must be returned for repair. Contact TransCore at the telephone number listed **at the front of this user guide**

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 8–21 contains a list of error messages.

Table 8–21 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 RF frequency. Refer to “Radio Frequency” on page 8-15 for instructions.
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.

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 ErrorRF2 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 ErrorRF2 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 ErrorRF3 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 ErrorRF3 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 Technical

Support at (505) 856-8007. 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.

A

Character Conversion

Appendix A

Character Conversion

Table A-1 lists the TransCore 6-bit-per-character conversion from the standard ASCII character set.

Table A–22 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		

Technical Specifications

Appendix B

Technical Specifications

Table B-1 lists the specifications of the AI1422E Reader System.

Figure B–1 AI1422E Reader System Specifications

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

Figure B-1 gives the mechanical dimensions of the AI1422E Reader.

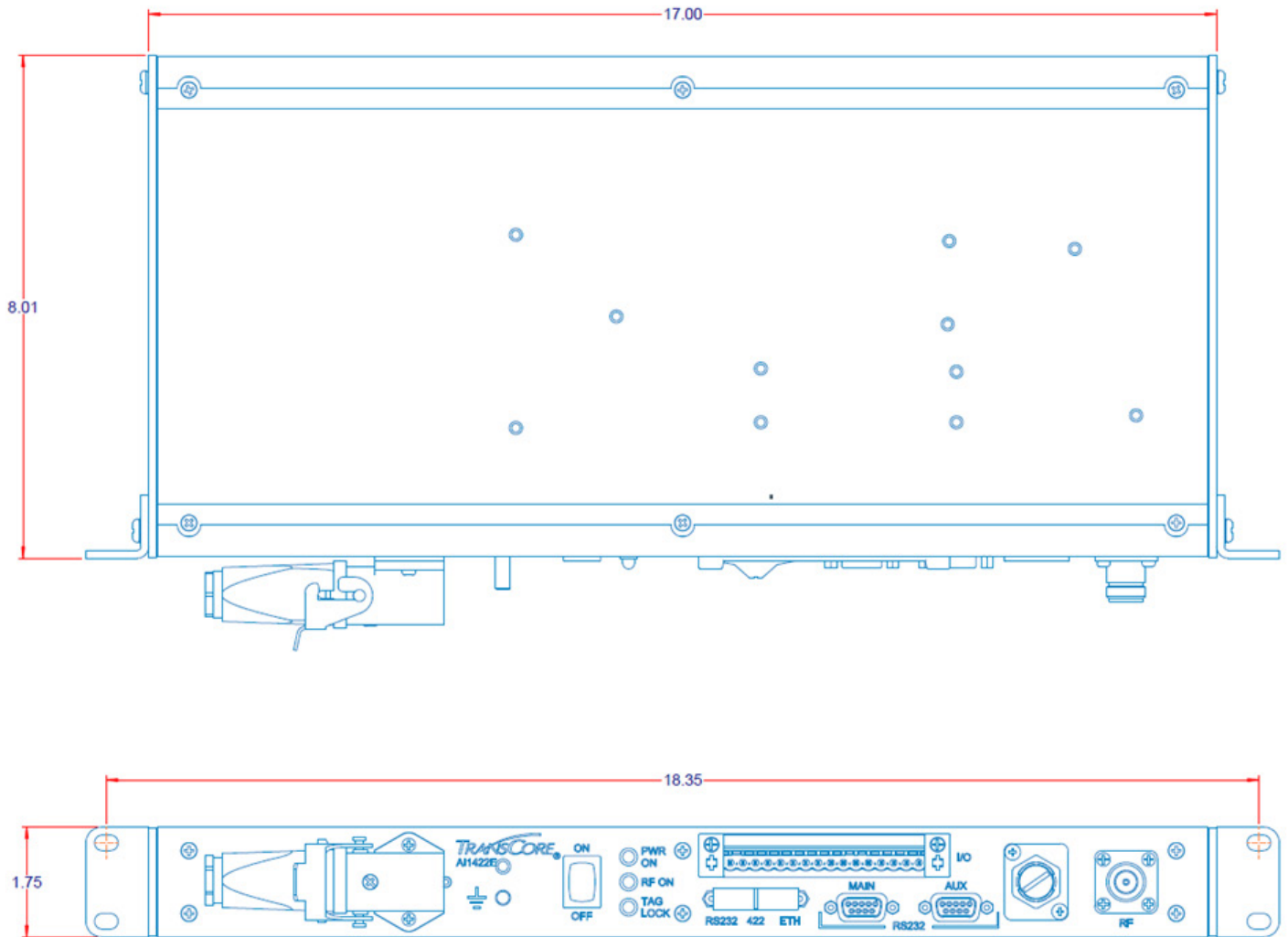


Figure B-1 AI1422E Reader Mechanical Dimensions

Lantronix[®] Ethernet Module Configuration

Appendix C

Lantronix® Ethernet Module Configuration

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.

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 can be found at http://ltxfaq.custhelp.com/app/answers/detail/a_id/928 and documentation of this software can be found in the Lantronix® CPR Quick Start Guide, located at www.lantronix.com/wp-content/uploads/pdf/Com-Port-Redirector_QS.pdf

Other methods of communicating through the Lantronix® module exist. 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

