# Encompass® 4-S
## Quick Start Guide

TransCore's Encompass® 4-S family of fully integrated wireless radio frequency identification (RFID) readers are designed for use in parking, security access, electronic vehicle registration (EVR), traffic management, and low-speed electronic toll collection applications.

This quick start guide is intended for use by authorized TransCore Encompass series dealers, installers, and service personnel, and provides information for site design, reader placement, testing, installation, and troubleshooting.



# TRANSCORE®
Trusted Transportation Solutions

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

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**WARNING TO USERS IN THE UNITED STATES**

**FEDERAL COMMUNICATIONS COMMISSION (FCC)**
**LOCATION AND MONITORING SERVICE STATEMENT**
**47 CFR §90.351**

**NOTE:** The user is required to obtain a Part 90 site license from the Federal Communications Commission (FCC) to operate this radio frequency identification (RFID) device in the United States. The FCC ID number is FIHE4SPT90V5. 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 FIHE4SPT90V5. 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 IC: 1584A-E4SRSS137V5, 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 IC: 1584A-E4SRSS137V5. 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 ENCOMPASS 4 READER
USING AN EXTERNAL ANTENNA IN FREQUENCY BAND
OF 902.25 TO 903.75 AND 910.00 TO 921.50 MHZ**

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

### *OSHA (Occupational Safety and Health Administration)*

OSHA (an agency of The United States of America) legislates in the Code of Federal Regulations (CFR) Title 29 Part 1910 Subpart G 1910.97 titled "Nonionizing radiation", a maximum safe exposure limit of 10 milliwatts per square centimeter ($mW/cm^2$) during any 0.1-hour period (i.e. 6 minutes). Using the frequency (in the middle of the band of operation of this equipment) of 915 MHz and the highest antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated to be 8.3 in (21 cm).

### *FCC (Federal Communication Commission)*

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

### *Occupational/Controlled Exposure*

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

### *General Population/Uncontrolled Exposure*

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

Using the frequency (in the middle of the band of operation of this equipment) of 915MHz and the highest antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated. The MPE minimum distances are 15 in (38 cm) for the Occupational/ Controlled environment, and 33 in (84 cm) for the General Population/Uncontrolled environment.

### *Industry Canada (Innovation, Science and Economic Development Canada)*

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

*Controlled Environment*

*Power density = 0.6455\*frequency (in MHz)$^{0.5}$ W/m$^2$ with a Reference Period time of 6 Min*

*General Public/Uncontrolled Environment*

*Power density = 0.02619\*frequency (in MHz)$^{0.6834}$ W/m$^2$ 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 18.5 in (47 cm) for the Controlled environment and 48.8 in (124 cm) for the General Public/Uncontrolled environment.

*TransCore Recommendation on MPE (Maximum Permissible Exposure)*

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

| Occupational/Controlled Environment | | | | |
|---|---|---|---|---|
| Agency | Power Density (mW/cm$^2$) | MPE minimum distance | | Time (min) |
| | | in | cm | |
| OSHA | 10 | 8.3 | 21 | 6 |
| FCC | 3.05 | 15 | 38 | 6 |
| IC | 1.95 | 18.5 | 47 | 6 |

| General Population/Public/Uncontrolled Environment | | | | |
|---|---|---|---|---|
| Agency | Power Density (mW/cm$^2$) | MPE minimum distance | | Time (min) |
| | | In | cm | |
| OSHA | 10 | 8.3 | 21 | 6 |
| FCC | 0.61 | 33 | 84 | 30 |
| IC | 0.28 | 48.8 | 124 | 6 |

With the equipment installed and running at the maximum transmit power of 2.11 W (33.24 dBm), 0dB 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 49 in (124 cm) from the General Population/ Public i.e. Uncontrolled Environment.

2) Maintenance personnel (i.e. Occupational/Controlled Environment) must remain at least 19 in (47 cm) from the antenna and limit their time in the environment to 6 minutes when the system is operating.

**LIMITES D'EXPOSITION AUX RADIOFRÉQUENCES POUR LE LECTEUR ENCOMPASS 4
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 21 cm (8,3 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 38 cm (15 po) pour l'environnement professionnel/contrôlé et de 84 cm (33 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, 5e 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 47 cm (18,5 po) pour l'environnement professionnel/contrôlé et de 124 cm (48.8 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/cm2) | Distance MPE minimale | | Durée (en min.) |
| | | po | cm | |
| OSHA | 10 | 8,3 | 21 | 6 |
| FCC | 3,05 | 15 | 38 | 6 |
| IC | 1,95 | 18,5 | 47 | 6 |

| Population générale/environnement non contrôlé | | | | |
|---|---|---|---|---|
| Organisme | Densité de puissance (mW/cm2) | Distance MPE minimale | | Durée (en min.) |
| | | po | cm | |
| OSHA | 10 | 8,3 | 21 | 6 |
| FCC | 0,61 | 33 | 84 | 30 |
| IC | 0,28 | 48,8 | 124 | 6 |

Avec l'appareil installé et fonctionnant à la puissance de transmission maximale de 2,11 W (33,24 dBm), 0dB 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 124 cm (49 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 47 cm (19 po) de l'antenne et limiter son temps d'exposition à 6 minutes lorsque l'appareil est en fonctionnement.

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# Site Licensing

Encompass® 4-S Readers radiate more than 3 milliwatts of RF power, and must be licensed under Federal Communications Commission (FCC) Section 90.239. An FCC license provides the user with the legal authorization to operate the Encompass 4-S Reader on the licensed frequencies at the site specified in the license. The FCC license also provides the user with protection and authorization to maintain the system should any other RFID product be used in the licensed area after the Encompass 4-S Reader equipment is installed.

The site owner must complete and file Form 601, FCC Application for Wireless Telecommunications Bureau Radio Service Authorization. Forms are available online at the FCC Internet site https://www.fcc.gov/licensing-databases/forms.

The authorized frequency band for this product in the United States is 911.75 to 919.75 MHz. Only an authorized installer or service technician should set the RF frequency of the Encompass 4-S Reader to the frequency specified in the FCC site license.

# Designing the Site Plan

Design the site plan before ordering equipment and installing the Encompass 4-S Reader. If the site configuration differs significantly from the recommendations in this guide, contact TransCore Sales Support.

## Determine the Reader and Tag Combination

The Encompass 4-S Reader is capable of reading the following protocols and formats:
- TransCore Super eGo® (SeGo)
- eGo (ISO 18000-6B)
- ATA/AAR/ISO 10374
- IAG (Interagency Group)
- Wiegand

Table 1 lists the Encompass 4-S Reader models and features.

Table 1  Encompass 4-S Reader Features

| Reader Model* | Protocol(s) | Wiegand | Internal Antenna | Communication | |
|---|---|---|---|---|---|
| | | | | RS-232 | RS-422 |
| 10-400y-S08 | ATA | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S01 | SeGo | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S19 | IAG | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S02 | ATA/SeGo | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S10 | ATA/IAG | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S04 | SeGo/IAG | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S09 | eGo/ATA | ✓ | ✓ | ✓ | ✓ |
| 10-400y-S03 | eGo/SeGo | ✓ | ✓ | ✓ | ✓ |

*y = 2 (RS-232) or y = 4 (RS422)

# Reader Placement

Encompass 4-S Readers may be mounted on a pole at the side of the lane (side-fire), or on a gantry or surface extending over the center of the lane (overhead). The reader should be located in a place where it is not likely to be bumped out of alignment. Readers should not directly face each other or be positioned back-to-back.

For a pole mount installation, readers should be installed as high as possible so that the reader can be pointed down to control the read zone and minimize interference in the adjacent lane.

# Tag Placement on Vehicle

Most TransCore RFID tags should be mounted in the center of the windshield to the right of the rear-view mirror post. Refer to the installation instructions for your specific tag for more information on tag placement.

# Site Layout, Lane Type, and Traffic Flow

Become familiar with the configuration of the site and its proximity to other sites. Determine what the lane types will be, and identify any equipment that will be used, such as ticket machines or proximity readers.

The number of readers that will be required depends on the number of lanes at the site, how they are grouped, and total entry and exit points. Measure lane widths and the distance between adjacent lanes, taking into account any island/barrier width. TransCore recommends a lane width of 12 feet or less, with the distance between the readers at least 12 feet or more.

# Interfaces to External Equipment

For effective lane layout and transaction framing, the maximum distance from the entry loop to the reader should be about 8 feet. The distance from the reader to the gate arm should be 3 to 4 feet before the gate. Refer to

The readers are typically configured to be loop-activated (on by presence). Readers may be alternatively set to have RF on continuously. The choice depends on traffic volume and possible interaction with the other in-lane components.

# Electrical and Communications Requirements

The Encompass 4-S Reader requires 16-20VAC, 47-63HZ, or 16-28VDC for proper operation. Contact TransCore Sales Support for a list of recommended transformers and cable lengths.

The reader is available in RS–232 or RS–422 models. Maximum distance for RS–232 (3-wire serial) is 50 feet at 9600 baud. Maximum distance for RS–422 (4-wire differential signal) is 4000 feet at 9600 baud. The baud rate can be adjusted to accommodate noisy environments.

# Interface Cable

The Encompass 4-S Reader uses a single 26-pin (13 twisted pair) cable to interface with power, I/O, and communications signals. The reader cable can be directly connected to external devices or routed to other components via an external junction box. Refer to Figure 1 to see an example of the interface cable wire pairs and socket.
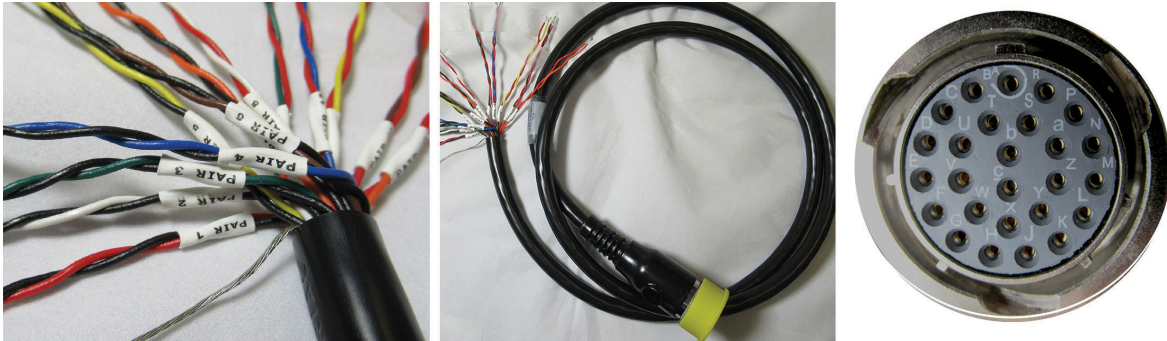


**Figure 1 Interface Cable**

Table 2 describes each wire pair color and pin designation.

**Table 2 Interface Cable Wire Pair Key**

| Pair Number | Pin | Color | Description |
|---|---|---|---|
| 1 | A | Black | TX232, RX422+, IF_ 485- |
| | B | Red | RX232, RX422-, IF_ 485+ |
| 11 | C | Yellow | RTS, GND (RS485) |
| | D | Red | CTS, DEF L (RS485) |
| 10 | E | Blue | WIEGAND 0 |
| | F | Red | WIEGAND 1 |
| 13 | G | Orange | 18V |
| | H | Red | 18V RETURN |
| 12 | J | Brown | 18V |
| | K | Red | 18V RETURN |
| 8 | L | White | LOCK |
| | M | Red | LOCK RETURN |
| 9 | N | Green | SENSE 0 |
| | P | Red | SENSE 0 RETURN |
| 4 | R | Blue | SENSE 1 |
| | S | Black | SENSE 1 RETURN |
| 6 | T | Black | OUT 0 COMMON |
| | U | Brown | OUT 0 NORMALLY OPEN |

Table 2  Interface Cable Wire Pair Key

| Pair Number | Pin | Color | Description |
|---|---|---|---|
| 7 | V | Black | OUT 0 COMMON |
| | W | Orange | OUT 0 NORMALLY CLOSED |
| 3 | X | Black | OUT 1 COMMON |
| | Y | Green | OUT 1 NORMALLY OPEN |
| 2 | Z | Black | OUT 1 COMMON |
| | a | White | OUT 1 NORMALLY CLOSED |
| 5 | b | Yellow | GROUND |
| | c | Black | GROUND |

# Pre-Installation Testing

## Bench Test the Reader

Bench test the reader using the following equipment:
- Audible circuit tester (buzzer) or volt meter with continuity tester
- Compatible power/communications cable
- PC using a terminal emulation program such as Tera Term or PuTTY.

## Connect Hardware

1. For AC powered units, connect the power wires from the cable to the transformer. Select Pair 12 (Brown/Red) and Pair 13 (Orange/Red) using the colors from each wire pair to connect the cable as described in Table 3. Do not apply power to the transformer at this time.

   *Note: AC transformer must be TransCore's 76-1670-005 or equivalent.*

| Input Voltage | Output Voltage | Rated Current | No Load Voltage |
|---|---|---|---|
| 120 VAC 60 Hz | AC 18.0 V ± 5% | 2700 mA | AC 21.0 V Max |

Table 3  Power Connections

| Pair Number | Colored Wire Pair | Use These Colors | Connect to Transformer Terminal Strip |
|---|---|---|---|
| 12 | Brown/Red | Orange and Brown | L1 (16 to 20V AC) |
| 13 | Orange/Red | Red and Red | L2 (16 to 20V AC) |
| Earth Ground | Shielded Drain Wire | Isolated | Separate from any other RF |

2. Connect the leads from the audible tester to the red and white pair of wires (Pair #8) from the power/communications cable.

3. For RS–232 units, refer to Table 4 for wiring instructions. For RS–422 units, refer to Table 5.

4. Connect the communications cable to the appropriate terminal on the host computer.

**Table 4  RS–232 Interface**

| Pair Number | Colored Wire Pair | Use This Color | Connect to Host DB9 Pin | Connect to Host DB25 Pin |
|---|---|---|---|---|
| 1 | Red/Black | Black | Pin 2 (RXD) | Pin 3 (RXD) |
| | | Red | Pin 3 (TXD) | Pin 2 (TXD) |
| 5 | Yellow/Black | Yellow | Pin 5 (GND) | Pin 7 (GND) |
| | | Black | Do not connect | |

**Table 5  RS–422 Interface**

| Pair Number | Colored Wire Pair | Use This Color | Connect to Host Signal |
|---|---|---|---|
| 11 | Yellow/Red | Yellow | Receive (+) |
| | | Red | Receive (-) |
| 1 | Red/Black | Black | Transmit (+) |
| | | Red | Transmit (-) |
| 5 | Yellow/Black | Yellow | Signal Ground |

## Correct Reader Grounding

Ground the reader following the recommended grounding shown in Figure 2.
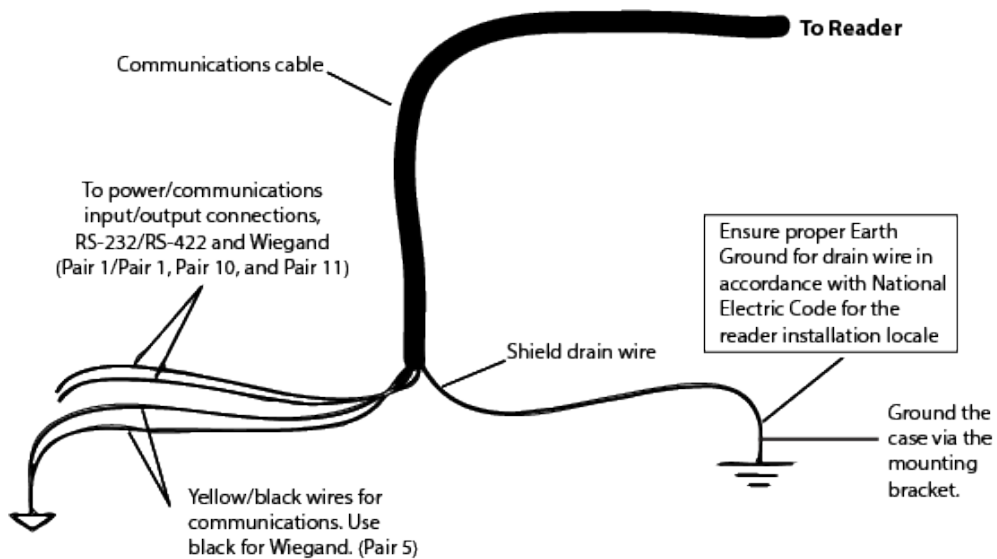


**Figure 2  Recommended Reader Grounding**

# Set up the Terminal Emulation Application

1. Launch the terminal emulation application.

2. In the dialog boxes choose the com port to which the communications interface is attached and set the properties as follows:
   - Bits per second: 9600 baud
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None

# Power the Reader

1. Ensure circular connector is connected to the reader. The connector is keyed, and should only be able to be plugged in one way.

2. Once the reader has been powered up, a sign-on message will appear. If startup is successful, the sign-on message appears as follows:

   Model E4 Series [software version] SNYYYYYY
   [Copyright notice]

   Where YYYYYY is the serial number of the Encompass 4-S Reader unit being used.

# Configure for Wiegand Operation

When using a Wiegand interface, configure the reader for Wiegand operation using the commands in Table 6. Connect the Wiegand interface wires including the Black of the Yellow/Black pair for signal ground, as shown in Table 7. If not using Wiegand tags, move to the next step, "Read Test Tags".

Table 6  Wiegand Testing Command Example

| Enter | Reader Response | What It Does |
|---|---|---|
| #01 | #Done | Switches reader to command mode |
| #489 | #Done | Sets operational mode to read eATA data from eGo Plus or eGo tags |
| #451 | #Done | Switches reader to Wiegand mode |
| #6401 | #Done | Turns RF ON |
| #00 | #Done | Returns reader to data mode and saves settings to NVM |

Table 7  Wiegand Interface

| Pair Number | Colored Wire Pair | Use This Color | Connect to Data Wire of Wiegand Controller |
|---|---|---|---|
| 10 | Blue/Red | Blue | Data0 |
| | | Red | Data1 |
| 5 | Yellow/Black | Black | Ground |
| | | Yellow | Do not connect |

For further information, refer to TransCore document 16-0088-001, Wiegand Translator Guide.

# Read Test Tags

Hold a tag in front of the reader to determine if the data is read out on the computer screen or on the Wiegand interface.

The commands listed in Table 8 return the reader to factory defaults.

**Table 8  Return to Factory Default Commands**

| Enter | Reader Response | What It Does |
|---|---|---|
| #01 | #Done | Switches reader to command mode and turns RF OFF |
| #66F | #Done | Loads all factory default operating parameters except operating frequency |
| #00 | #Done | Returns reader to data mode and turns RF ON, if enabled |

Table 9 provides commands that can be used for testing the reader. The #40 command causes the reader to transmit the Tag data continuously and command #6401 will cause the reader to transmit RF continuously.

**Table 9  Testing Commands**

| Enter | Reader Response | What It Does |
|---|---|---|
| #01 | #Done | Switches reader to command mode and turns RF OFF |
| #481 | #Done | Sets operational mode to read ATA tags |
| #40 | #Done | Transmits all tag IDs without regard for uniqueness |
| #6401 | #Done | Turns RF ON |
| #00 | #Done | Returns reader to data mode and turns RF ON, if enabled |

# Frequency Plan

The Encompass 4-S Reader FCC-approved frequency band is 911.75 to 919.75 MHz. This relatively narrow frequency band requires careful planning to maintain the desired 2 MHz frequency separation between adjacent readers.

If readers are spread out within a facility (readers ½ mile or so apart) and loops are used, then frequencies may be reused. Figure 3 shows frequency separation for 4 lanes.
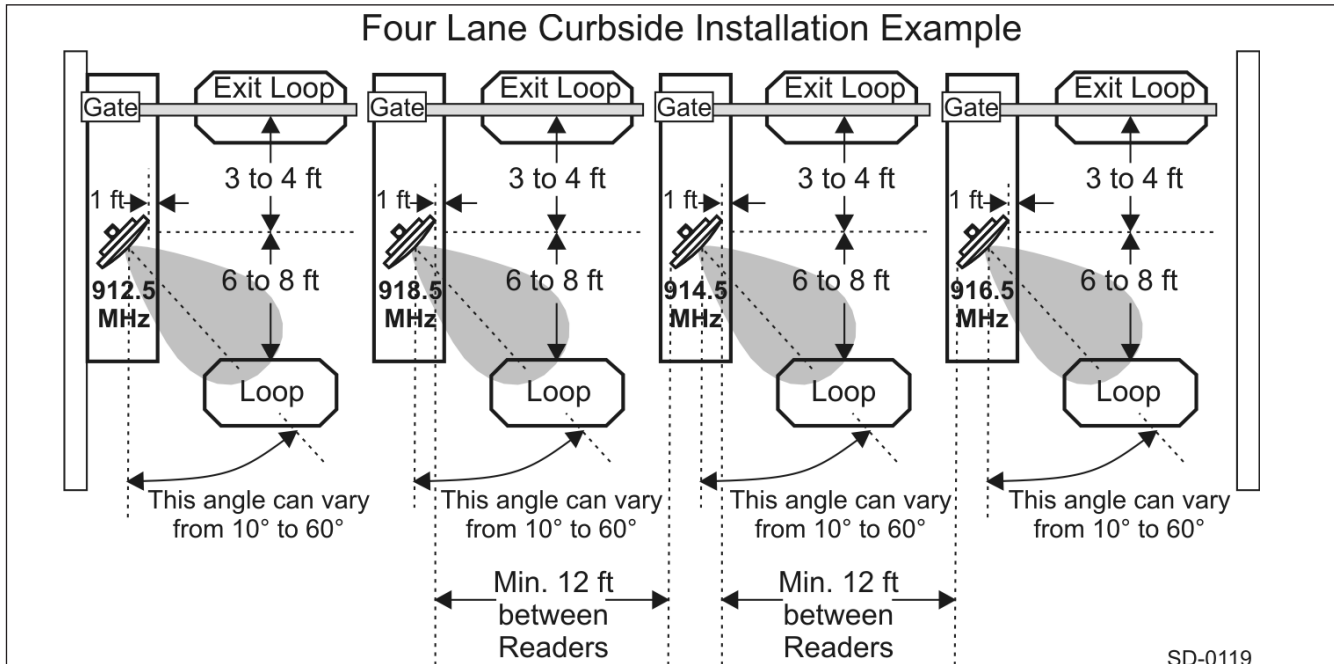


**Figure 3 Frequency Separation for Four Lanes**

Table 10 shows an example of the frequency settings for up to 14 lanes, along with the two different commands that can be used to set the reader operating frequency. Command #642NN is backward compatible to older readers including the Encompass 2 reader, and provides a 0.5MHz resolution. Command #647XXX provides a 0.25MHz resolution for setting the reader frequency. Either command may be used to set the reader frequency. Note that the response to Command #527 (Display RF Parameters) will include either two or three hexadecimal characters, depending on which command was last used to set the reader frequency.

**Table 10 Reader Frequencies Staggered for 14 Lanes**

| Lane | Reader Frequency | #642 | #647 | Lane | Reader Frequency | #642 | #647 |
|------|------------------|------|------|------|------------------|------|------|
| 1 | 912.50 | 15 | 0D2 | 2 | 915.00 | 1A | 0DC |
| 3 | 917.50 | 1F | 0E6 | 4 | 913.50 | 17 | 0D6 |
| 5 | 916.00 | 1C | 0E0 | 6 | 918.50 | 21 | 0EA |
| 7 | 914.50 | 19 | 0DA | 8 | 917.00 | 1E | 0E4 |
| 9 | 913.00 | 16 | 0D4 | 10 | 915.50 | 1B | 0DE |
| 11 | 918.00 | 20 | 0E8 | 12 | 914.00 | 18 | 0D8 |
| 13 | 916.50 | 1D | 0E2 | 14 | 919.00 | 22 | 0EC |

# Installation at the Site

Complete pre-installation testing before installing the reader on site.

## Before Starting Installation

Confirm the following:

- All construction is complete and electrical and communications cables are of the appropriate length and in place.
- A watertight junction box with terminal strip is present.
- A dedicated power supply of the appropriate voltage is present.
- Placement of the readers follows the site plan.
- The readers are in the correct positions: side-fire or overhead.

The Encompass 4-S reader has a weep hole located on the bottom left side to allow moisture to escape. The reader should always be positioned so that the side with the weep hole is lower than the top. For overhead mounting, the reader angle should be at least 10° (Figure 4).

Typically, readers (or antennas) are installed either on the side of the lane, pointing into the lane (side-fire) or directly over the lane, pointed downward (center-fire or overhead).

Top

Minimum 10° angle

Top

Weep Hole

HS-0119B

Weep Hole
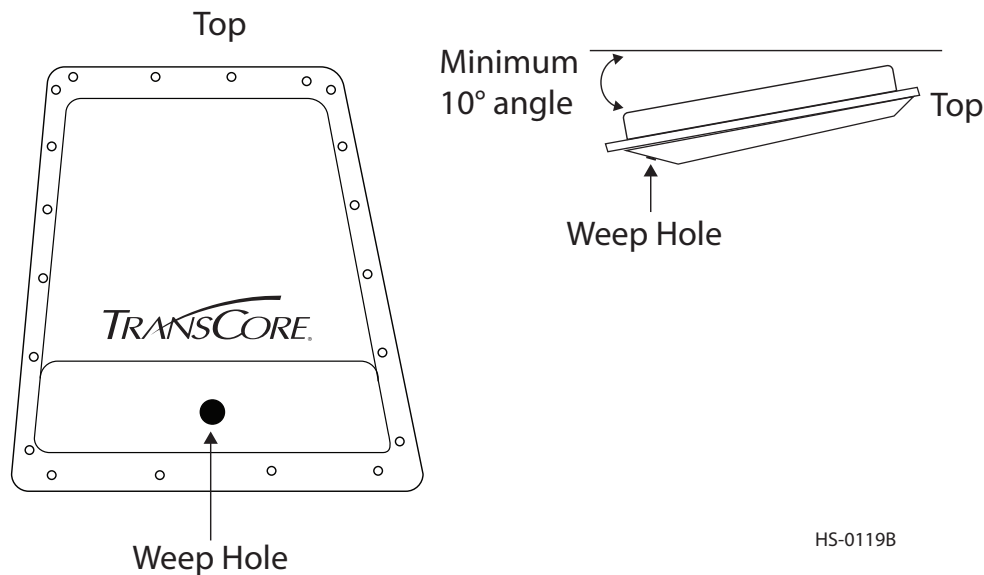
**Figure 4 Correct Orientation of Reader**

Overhead installations are typically used in parking garages and other areas where an overhead mounting surface already exists. These readers are normally set to 10° down-tilt.

Side-fire installations are commonly used when the lanes are out in the open and the installation of a pole is sufficient to mount a reader.

# Mount Reader on Round Pole or Flat Surface

Proper reader angle may require both up-down and right-left adjustment. Ensure that the correct wall-mount or pole-mount bracket is used in the reader installation.

**⚠ CAUTION:**

**CAUTION**

*For reliable reader operation, ensure that the reader is connected to Earth Ground. Also connect the housing, via the mounting bracket, to Earth Ground.*

*Connect the cable shield of the communications cable to Earth Ground. TransCore strongly recommends following the National Electric Code for lightning protection for the locale where the Encompass 4-S Reader is installed. Refer to* "Figure 2 Recommended Reader Grounding" on page 16.

## Connect All Wiring

1. Connect all wiring as described in "Pre-Installation Testing" on page 15 using the "RS–232 Wiring Diagram" on page 23 as a guide or the "RS-422 Wiring Diagram" on page 24 as a guide.

   *NOTE: Use a watertight junction box that meets applicable local and national building codes for connecting power and communications wiring. The junction box houses the transformer, terminal strip for power, and the communications connections. TransCore recommends a NEMA Type-4 junction box with a back mounting panel. The junction box must meet all environmental specs of the housed electronics, including the transformer specs.*

2. Connect the sense input and sense output circuits using Table 11 as a guide.

3. Start the terminal emulation application. Refer to "Pre-Installation Testing" on page 15.

**⚠ CAUTION:**

**CAUTION** *Do not ground the input power supply.*

**Table 11  Sense Input/Output Cabling Assignments**

| Pair Number | Pair | Pin | Color | Signal | Description | Typical Function |
|---|---|---|---|---|---|---|
| 5 | Yellow/Black | b | Yellow | GND | Logic ground | Signal ground used with RS–232, RS–422, and Wiegand |
| | | c | Black | GND | Logic ground | Signal ground used with RS–232, RS–422, and Wiegand |
| 10 | Blue/Red | E | Blue | WGND0 | Wiegand data0 | Parking/access control |
| | | F | Red | WGND1 | Wiegand data1 | Parking/access control |
| 8 | White/Red | L | White | Lock | Tag lock output, active-closed | Testing/maintenance |
| | | M | Red | Lock_RTN | Tag lock return | Testing/maintenance |

**Table 11  Sense Input/Output Cabling Assignments**

| Pair Number | Pair | Pin | Color | Signal | Description | Typical Function |
|---|---|---|---|---|---|---|
| 9 | Green/Red | N | Green | Sense Input0 | Sense Input0 (loop) | Loop and presence detection |
| | | P | Red | Sense Input0_ RTN | Sense Input0 return; not isolated from signal ground | Loop and presence detection |
| 4 | Blue/Black | R | Blue | Sense Input1 | Sense Input1 | General-purpose sense input, not used for detecting presence |
| | | S | Black | Sense Input1_ RTN | Sense Input1 return; not isolated from signal ground | General-purpose sense input, not used for detecting presence |
| 6 | Brown/Black | T | Black | Sense Output0_ COM | Sense Output0 (tag detect), common terminal | Switched output to control gate |
| | | U | Brown | Sense Output0_ NO | Sense Output0 normally open terminal | Switched output to control gate |
| 7 | Orange/ Black | V | Black | Sense Output0_ COM | Sense Output0 (tag detect output), common terminal | Switched sense output for any external control (light, gate, buzzer, etc.) |
| | | W | Orange | Sense Output0_ NC | Sense Output0 normally closed terminal | Switched sense output for any external control (light, gate, buzzer, etc.) |
| 3 | Green/Black | X | Black | Sense Output1_ COM | Sense Output1, common terminal | Switched sense output |
| | | Y | Green | Sense Output1_ NO | Sense Output1 normally open terminal | Switched sense output |
| 2 | White/ Black | Z | Black | Sense Output1_ COM | Sense Output1, common terminal | Switched sense output |
| | | a | White | Sense Output1_ NC | Sense Output1 normally closed terminal | Switched sense output |

## Wiring Diagram for an Encompass® 4-S (RS–232) Unit

| Terminal Block | | Twisted Pairs | Encompass 4-S Connector |
|---|---|---|---|
| RS–232 | RxD, Pin2 for DB9 or Pin3 for DB25 | 1 | Black (Black/Red Pair) TxD | A |
| | TxD, Pin3 for DB9 or Pin2 for DB25 | 2 | Red (Black/Red Pair) RxD | B |
| | SIG GND, Pin5 for DB9 or Pin7 for DB25 | 3 | Yellow (Yellow/Black Pair) Signal Ground | b |
| | | 4 | Black (Yellow/Black Pair) Signal Ground | C |
| 18V AC Transformer L1 | Red (Black/Red) to Reader Rápido Transformer | 5 (NC) | Red / Orange/Brown / Orange | H / G |
| L2 | Black (Black/Red) to Reader Rápido Transformer | 6 | | |
| | | 7 | Red / Red/Red / Brown | K / J |
| Dry Contact ext. gate relay | Low Current, Pulsed Relay (C) Closure Output | 8 (NC) | Black (Black/Brown Pair), Form C (C) | T |
| | Low Current, Pulsed Relay (NO) Closure Output | 9 | Black (Black/Brown Pair), Form C (NO) | U |
| | | 10 | | |
| Audible alarm (Buzzer w/ Battery) | To Plus (+) side of 9V Battery | 11 (NC) | White (White/Red Pair), Tag Lock Output | L |
| | To Plus (+) side of 6-12V DC Buzzer | 12 | Red (White/Red Pair), Tag Lock Output Return | M |
| | | 13 | | |
| Gate Controller with Wiegand Input | Connection to Wiegand device (DATA0) | 14 (NC) | Blue (Blue/Red Pair), DATA0 for Wiegand | b |
| | Connection to Wiegand device (DATA1) | 15 | Red (Blue/Red Pair), DATA1 for Wiegand | E |
| | Connection to Wiegand device (SIG GND) | 16 | | F |
| Loop Detector | | 17 | Green (Green/Red Pair), Presence detect | N |
| | | 18 | Red (Green/Red Pair), Presence detect | P |
| | | 19 | | |

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**Figure 5 RS–232 Wiring Diagram**

**Wiring Diagram for an Encompass® 4-S (RS-422) Unit**

Encompass 4-S Connector

Twisted Pairs

Terminal Block

RS–232

P1

P2

12V AC
PWR RTN

LDM422 Converter

| | | |
|---|---|---|
| Pin3 for DB9 or Pin2 for DB25 | TD | RD |
| Pin 2 for DB9 or Pin3 for DB25 | | |
| Pin5 for DB9 or Pin7 for DB25 | GND | |

RDA¹ Receive (–) — Red (Yellow/Red Pair) Tx (–) — 1 — D

RD B¹ Receive (+) — Yellow (Yellow/Red Pair) Tx (+) — 2 — C

TD A, Transmit (–) — Red (Red/Black Pair) Rx (–) — 3 — B

TD B, Transmit (+) — Black (Red/Black Pair) Rx (+) — 4 — A

SIG GND — 5 (NC) — Red — H

Red (Black/Red) to Reader Rápido Transformer — Orange/Brown — 6 — Orange — G

Black (Black/Red) to Reader Rápido Transformer — 7 — Red — K

18V AC Transformer — L1 / L2

Red/Red — 8 (NC) — Brown — J

Low Current, Pulsed Relay (C) Closure Output — Black (Black/Brown Pair), Form C (C) — 9 — T

Low Current, Pulsed Relay (NO) Closure Output — Black (Black/Brown Pair), Form C (NO) — 10 — U

Dry Contact ext. gate relay

To Plus (+) side of 9V Battery — White (White/Red Pair), Tag Lock Output (Dry Contact) — 11 (NC)

To Plus (+) side of 6-12V DC Buzzer — Red (White/Red Pair), Tag Lock Output Return — 12 — L

Audible alarm (Buzzer w/ Battery) — Yellow (Yellow/Black Pair) SIG GND for RS–422 — 13 — M

Connection to Wiegand device (SIG GND) — Black (Yellow/Black Pair), SIG GND for Wiegand — 14 — b

Connection to Wiegand device (DATA0) — Blue (Blue/Red Pair), DATA0 for Wiegand — 15 — c

Connection to Wiegand device (DATA1) — Red (Blue/Red Pair), DATA1 for Wiegand — 16 — E

Gate Controller with Wiegand Input — 17 — F

Green (Green/Red Pair), Presence detect — 18 — N

Loop Detector — Red (Green/Red Pair), Presence detect — 19 — P

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**Figure 6  RS-422 Wiring Diagram**

## Apply Power

Apply power and verify the reader sign-on message appears on the terminal emulator application laptop/computer.

## Reader Set Up

1. Use reader commands to query status and set up the reader.

2. Make sure that each reader is set up to the appropriate settings.

3. Adjust reader angle and power to optimize read zone for each reader.

4. Check for interference from each reader or the environment, using a portable field spectrum analyzer if one is available.

   *Note: If using Wiegand tags, configure the reader for Wiegand operation and connect the Wiegand interface. Refer to* "Configure for Wiegand Operation" on page 17.

5. Disconnect the computer and connect the reader to back end devices. Recheck read zone and for interference between readers.

6. System-test the reader to verify that the gate opens when a valid tag is read.

7. Once all in lane testing is complete, perform a system test using tagged vehicles passing through numerous lanes. The tag reads are sent to the gate controller back end system for validation.

# Reader Commands

Table 12 provides the commands frequently used in testing, setting up, and tuning the Encompass 4-S Reader.

**NOTE:** *An #*Error *response from the reader indicates that the command was entered incorrectly.*

Table 12  Frequently Used Reader Commands

| Enter | Reader Response | What It Does |
|-------|-----------------|--------------|
| #00 | #Done | Returns reader to data mode |
| #01 | #Done | Switches to command mode |
| #40 | #Done | Transmits all tag IDs without regard for uniqueness |
| **#450** | #Done | **Disable Wiegand mode (Default**) |
| #451 | #Done | Enable Wiegand mode, Refer to #532 |
| **#454** | #Done | **Disable Multitag Sort (Default)** |
| #455 | #Done | Enable multi-tag sort |
| #46NN | #Done | Set Wiegand retransmit interval in seconds<br>NN = 01–FF Hex **(01 Default)** Refer to#533 |

Table 12  Frequently Used Reader Commands

| Enter | Reader Response | What It Does |
|---|---|---|
| #48N | #Done | Select tag mode<br>N = 0–9<br>0 = disable ATA<br>1 = enable ATA<br>2 = disable eGo<br>3 = enable eGo<br>4 = disable SeGo<br>5 = enable SeGo<br>6 = disable IAG<br>7 = enable IAG<br>8 = disable eATA<br>9 = enable eATA<br>NOTE: Encompass 4-S Reader will only have tag protocols specific to the model ordered.<br><br>NOTE: Refer to Commands #838 and #839 |
| #505 | #Model [model]<br>Ver [version no.] SN [serial no.] | Display firmware version |

**Table 12  Frequently Used Reader Commands**

| Enter | Reader Response | What It Does |
|---|---|---|
| #527 | #RFST Cx Ox T1 Fxx Rxx Gxx Axx Ixx<br><br>C0 = RF controlled by host, Refer to #6400, #6401<br><br>C1 = RF-by-input control, Refer to #641<br><br>O0 = RF off, Refer to #6400<br><br>O1 = RF on, Refer to #6401<br><br>T1 = uniqueness timeout of 2 min, Refer to #441<br><br>Fxx = RF output frequency 00 to 34, (Refer to #642NN, #647XXX<br><br>Rxx = ATA RF output range, 00 to 1F (**Default = 1F = max range**), Refer to #643NN<br><br>Gxx = eATA SeGo/eGo range control, 00 to 1F<br><br>(**Default =1F = max range) ,** Refer to #645NN<br><br>Axx = RF power attenuation, 00 to 0A (**Default = 00 = Max Power**), Refer to #644NN<br><br>Ixx (IAG Attenuation) = 00-0F (**04 Default**) 00=Max Power, Refer to #646NN | Display RF status |
| #532 | #TOF <0 to 1>, Refer to #450, #451<br><br>0 = Wiegand disabled<br>1 = Wiegand enabled | Display Wiegand mode status |
| #533 | #WTI <01 to FF><br>seconds (1-255) in hex, Refer to #46NN | Display Wiegand retransmit interval |

**Table 12  Frequently Used Reader Commands**

| Enter | Reader Response | What It Does |
|---|---|---|
| #570 | #ATA:_ eGo: _ SeGo: _ IAG:_ EPC:_SORT: _TMM:_ <br> I = SeGo ID (64 bits) <br> E = enabled <br> F = full transaction <br> D = disabled <br><br> Refer to commands #480 – #489, 838 and #839 | Display reader protocols |
| #63 | #Model [model] <br> Ver [version no.] SN [serial no.] <br> Copyright [date] <br> TransCore | Reset reader equivalent to cycling power. Does not affect operating parameter settings |
| #6400 | #Done | Turn RF off |
| #6401 | #Done | Turn RF on |
| **#641** | #Done | **Select RF-by-input control (Default)** |
| #642NN (00 – FF) | #Done | Set RF operating frequency, 0.5 MHz resolution: **915MHz = #6421A (Default).** Refer to Table 10. |
| #643NN (00-1F) | #Done | Set operating range for ATA protocol (distance): (00 to 1F Hex) **1F = max range (Default)** |
| #644NN (00 – 0A) Hex | #Done | Set RF attenuation in 1.0 dB increments; 0 to 10 dB, 00=max power for max range |
| #645NN | #Done | Set operating range for eGo and SeGo protocols |
| #646xx (00 – 0F) Hex | #Done | where xx = 00 to 0F (hex) <br><br> Set IAG Attenuation. Allows control of the read zone for IAG tags. Does not affect the performance of other tag types. 00=max power for max range (**04 Default**) |
| #647xxx | #Done | Set RF operating frequency, 0.25 MHz Resolution, **#6470DC = 915MHz (Default).** Refer to Table 10. |
| #66F | #Done | Load default operating parameters (does not affect RF operating frequency) |

# Troubleshooting

## Communications problems between the reader and back-end host

These problems may be caused by incorrectly wiring the communications cable, using the wrong cable, having a too-long cable run, or incorrectly setting communications parameters between host and reader.

**Cable run for RS–232 exceeds 50 feet in length**

Fifty feet exceeds the maximum length for RS–232 interface. The interface should be converted to RS 422, wireless modem, fiber optic, or Wiegand.

**RF is not on**

The technician must verify that RF is on by presence or by using the command #6401 for RF ON Continuously. Command #527 may be used to verify RF status (O1).

**Improper grounding**

Cable shielding should be connected to Earth Ground to prevent damage from lightning or power surges.

**Mixed tag population**

In a mixed tag population, multiple tags in the same vehicle must be separated by at least 2 inches, preferably more.

**Reader not programmed correctly**

The technician must verify that all parameters are set appropriately for the reader location. Command #527 may be used to verify reader parameters. If using Wiegand, the technician can use commands #532 and #533 to verify Wiegand status.

**Readers pointed toward each other**

Configure the site plan so that readers are not aimed directly facing one another or in immediate proximity back-to-back. Refer to Figure 3.

**Tag presentation**

Check the installation instructions for the specific tag to ensure that tags are properly mounted in the location determined by the reader placement.

**Tag-to-reader polarization**

Tag polarization must match reader polarization. Both tags and readers should be installed horizontally.

## When performing a quick test of the Encompass 4-S Reader, the buzz box does not buzz.

Check all the wiring connections, and ensure that the buzz box is functioning. Ensure that the correct red and white wire pair to the leads of the buzzer are connected. Verify that RF is on (#6401). Ensure that the reader is in the correct interface mode for the test tag using Command #570.

## When testing the Encompass 4-S Reader, all the wires are connected correctly but the unit does not respond.

Check that the Encompass 4-S Reader communication cable is connected to the correct COM port.

## Unusual responses received from the Encompass 4-S Reader when testing with PC or laptop.

Verify the baud rate is correct on the PC or laptop terminal emulator.

**Nothing happens when the test tag is passed in front of the Encompass 4-S Reader.**

Ensure that the Encompass 4-S Reader is powered on and the reader is in the correct read mode (**#48N**). Verify that the reader is set to RF ON (**#6401**) or the red/green pair are shorted.

**The Encompass 4-S Reader came from another site and does not work the way the factory defaults indicate that it should.**

Different commands were likely used to support the other site. Restore the factory defaults by issuing command **#66F**. The factory defaults will be restored except for RF operating frequency, which will be retained.

# RF Interference or Poor Performance

Permanent structures and transient factors (such as large metal trucks) in the vicinity may affect RF signals. Metal objects, walls, wet pavement, and ice can reflect RF signals, degrading system performance (Figure 7).

Interference from RF and electrical sources can interfere with the optimal operation of the system.

Any RF interference at the site should be shielded, removed, or positioned farther from the Encompass 4-S Reader if possible.
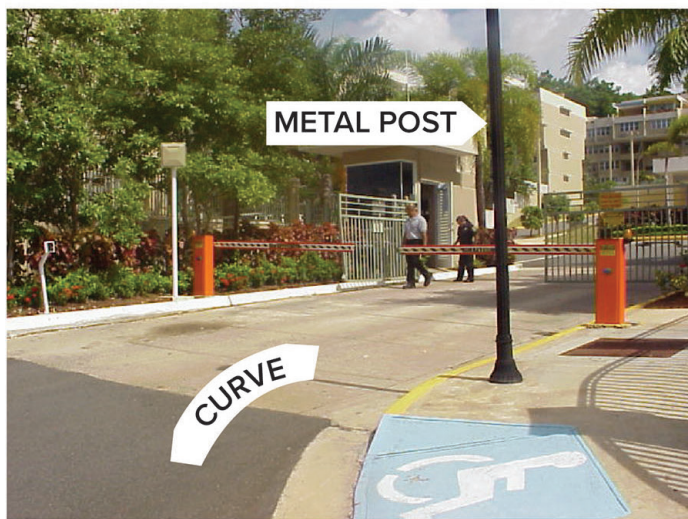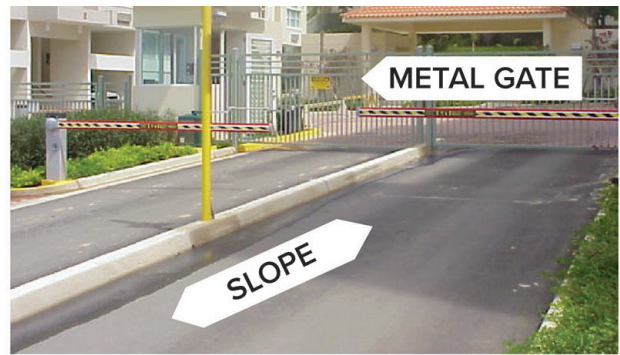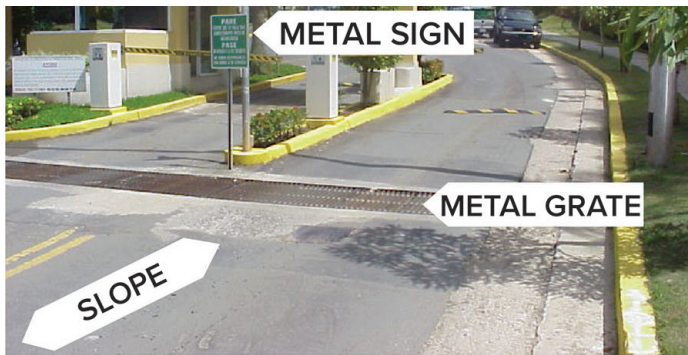


**Possible Sources of RF Interference or Poor Performance**

- ▶ Metal fences, gates, posts
- ▶ Wet or icy slopes
- ▶ Walls, buildings
- ▶ Curve at entrance
- ▶ Gate relays
- ▶ Incorrect location of reader

**Figure 7  Sources of RF Interference**

**For more information:**

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800.923.4824

**Technical Support**
505.856.8007

**transcore.com**

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