Encompass® 4 Flex

Quick Start Guide

16-0202-001 Rev A 6/25

TransCore's Encompass® 4 Flex Reader System is a multi-protocol reader that reads TransCore Super eGo® (SeGo), eGo, American Trucking Associations/International Organization for Standardization (ATA/ISO), or Inter-Agency Group (IAG) tag protocols, and ISO/IEC 18000-63 (6C).

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.

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

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FEDERAL COMMUNICATIONS COMMISSION (FCC)
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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 FIHE4FLEXV1. Access the FCC website at www.fcc.gov to obtain additional information concerning licensing requirements.

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 for communications lines 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 FIHE4FLEXV1. 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.

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-E4FRSS137V1 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-E4FRSS137V1. 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 FLEX 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 (the lowest frequency in the band of operation of this equipment) of 902 MHz and the internal antenna gain of this equipment, the minimum safe distance was calculated to be 5.5 in (14 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 (the lowest frequency in the band of operation of this equipment) of 902 MHz and the internal antenna gain of this equipment, the minimum safe distance was calculated. The MPE minimum distances are 9.8 in (25 cm) for the Occupational/ Controlled environment, and 21.7 in (55 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 915 MHz is 8.77 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/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 (the lowest frequency in band of operation of this equipment) of 902 MHz and the internal antenna gain that this equipment is certified for use in a final installation, the minimum safe distance was calculated. The MPE minimum distances are 12.2 in (31 cm) for the Controlled environment and 32.3 in (82 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/cm²)**	**MPE minimum distance**		**Time (min)**
		in	**cm**	
OSHA	10	5.5	14	6
FCC	3.05	9.8	25	6
IC	2.43	12.2	31	6

General Population/Public/Uncontrolled Environment				
Agency	**Power Density (mW/cm²)**	**MPE minimum distance**		**Time (min)**
		In	**cm**	
OSHA	10	5.5	14	6
FCC	0.61	21.7	55	30
IC	0.877	32.3	82	6

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

1. The antenna should be installed at least 32.3 in (82 cm) from the General Population/Public i.e. Uncontrolled Environment.
2. Maintenance personnel (i.e. Occupational/Controlled Environment) must remain at least 12.2 in (31 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 FLEX 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 (la fréquence la plus basse dans la bande de fonctionnement de cet équipement) de 902 MHz et le gain d'antenne interne de cet équipement, la distance minimale de sécurité a été calculée à 14 cm (5,5 po).

FCC (Federal Communication Commission)

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

Exposition professionnelle/contrôlée

Densité de puissance = fréquence (en MHz)/300 mW/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 (la fréquence la plus basse dans la bande de fonctionnement de cet équipement) de 902MHz et le gain d'antenne interne de cet équipement, la distance de sécurité minimale a été calculée. Les distances minimales de l'EMT sont de 25 cm (9,8 po) pour l'environnement professionnel ou contrôlé et de 55 cm (21,7 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° 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 8,77 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 (la fréquence la plus basse dans la bande de fonctionnement de cet équipement) de 902 MHz et le gain d'antenne interne que cet équipement est certifié pour une utilisation dans une installation finale, la distance de sécurité minimale a été calculée. Les distances minimales de l'EMT sont de 31 cm (12,2 po) pour l'environnement 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	5,3	13,5	6
FCC	3,05	9,6	24,4	6
IC	2,43	12,0	30,5	6

Population générale/environnement non contrôlé				
Organisme	**Densité de puissance (mW/ cm²)**	**Distance MPE minimale**		**Durée (en min.)**
		po	cm	
OSHA	10	5,3	13,5	6
FCC	0,61	21,5	54,5	30
IC	0,877	31,9	81,0	6

Avec l'equipment installé et fonctionnant à la puissance d'émission maximale de 2,0W (33 dBm), atténuation de transmission 0 dB, en utilisant l'antenne de gain interne de l'équipement, la recommandation pour chacun des environnements d'exploitation est la suivante: 1) L'antenne devrait être installée à au moins 81,0 cm (31,9 po).

1. L'antenne devrait être installée à au moins 81,0 cm (31,9 po) de la population générale/ du grand public, c'est-à-dire d'un environments non contrôlé.
2. Le personnel d'entretien (c'est-à-dire dans un environnement professionnel/contrôlé) doit rester à au moins 30,5 cm (12 po) de l'antenne et limiter son temps d'exposition à 6 minutes lorsque l'appareil est en fonctionnement.

Site Licensing

Encompass® 4 Flex 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 Flex 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 Flex 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 Flex 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 Flex 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 Flex 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
- ISO/IEC 18000-63 (6C)

Table 1 lists the Encompass 4 Flex Reader models and features.

Table 1 Encompass 4 Flex Reader Features

Reader Model*	Protocol(s)	Communications
10-4009-001	SeGo	RS-232, RS-422, Ethernet, BLE
10-4009-002	ATA/SeGo	
10-4009-003	eGo/SeGo	
10-4009-004	IAG/SeGo	
10-4009-005	SeGo/EPC	
10-4009-008	ATA	
10-4009-009	ATA/eGo	
10-4009-010	IAG/ATA	
10-4009-011	ATA/EPC	
10-4009-015	IAG/eGo	
10-4009-016	eGo/EPC	
10-4009-019	IAG	
10-4009-023	ATA/eGo/EPC	
10-4009-024	ATA/SeGo/EPC	
10-4009-025	IAG/SeGo/EPC	

Reader Placement

Encompass 4 Flex 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. If the read zone is much larger than 3 to 4 feet, a following car may be read (skip read), allowing a non-tagged vehicle to enter the facility.

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.

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 Microsoft HyperTerminal

Power and communications connections are made to terminal block through the access door as shown in *Figure 1*.

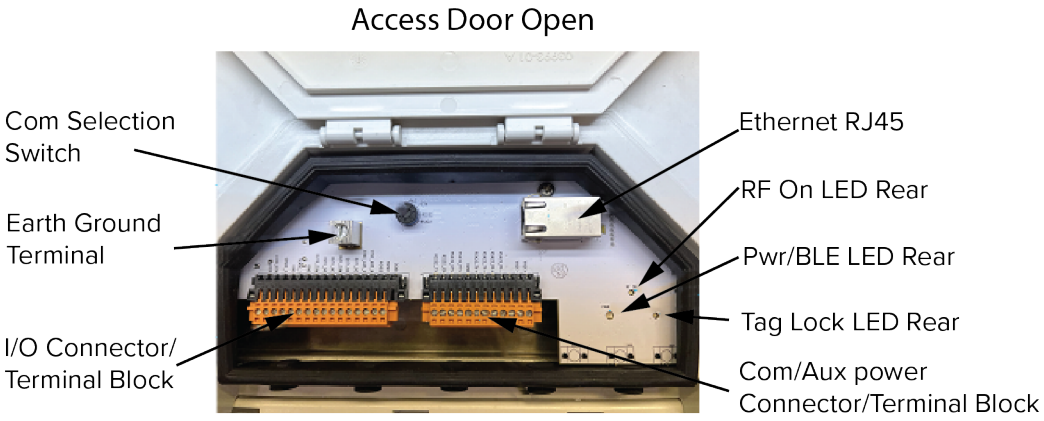

Figure 1 Detailed rear access view

Note: TransCore recommends using wire end ferrules to connect to the terminal block. Refer to Appendix A: Wire End Ferrules with Plastic Collars.

Ensure that the communication selection switch has been set to AUTO. For more information on the function of this switch, please refer to the E4 Flex User Guide.

Power and Communications Wiring

Cable length for power and communications depends on the physical characteristics of the Encompass 4 Flex Reader installation site.

Electrical Power

Power Over Ethernet (POE)

The Encompass 4 Flex Reader can be powered by two methods. The first is through the Ethernet data cable via Power Over Ethernet (POE). Refer to *Figure 2.* The Encompass 4 Flex has been designed to IEEE 802.3bt using a POE supply (i.e. POE capable switch or POE injector with at least a Type 3 Class 5 rating). With a POE supply the power current is kept separate from the data source. The supply power enters the Ethernet cable via the POE switch or injector and is delivered to the Encompass 4 Flex by the Ethernet port on the reader. A 4-pair Cat 5 or better cable with a length no longer than 328 feet (100 meters) needs to be used to power the reader.

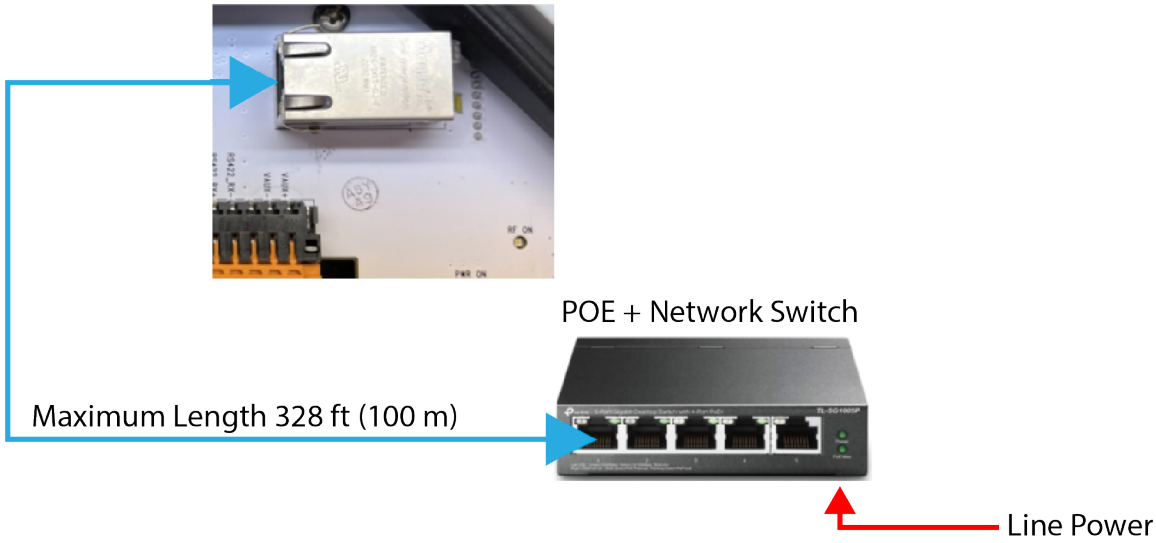

Figure 2 Power over Ethernet (POE)

Auxiliary Power

The secondary way the Encompass 4 Flex can be powered is through the auxiliary power input *(Figure 3*). Note that if the auxiliary power input is used the POE input is disabled. The auxiliary power must be 16-20V AC or 16-28V DC. A step-down transformer is available (North America only) to convert a 120V AC duplex wall outlet with ground to 18V AC, as is a step-up transformer to convert a low-voltage 12V AC outlet to 18V AC. Consult local and national electrical codes for installation and safety requirements.

Note: Encompass 4 Flex Readers installed outside North America require a locally supplied transformer. If 18V AC or 18V DC power is available, the transformer option is unnecessary.

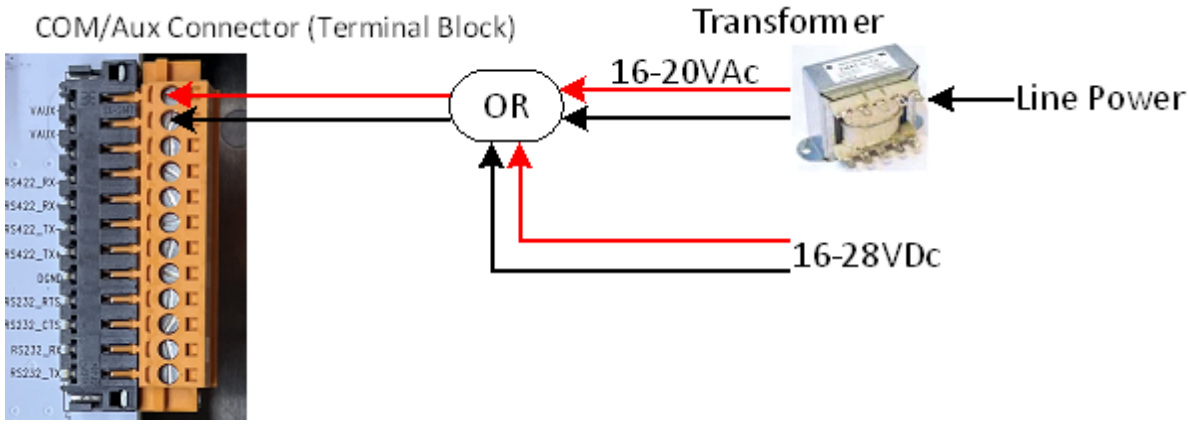

Figure 3 Auxiliary power

TransCore offers a Class C transformer accessory kit (part number 76-1620-005) for sites where 110V AC is available. It is the installer's responsibility to supply conversion equipment and wiring for other voltages.

Power and Communications Wiring

Cable length for power and communications depends on the physical characteristics of the Encompass 4 Flex Reader installation site.

Reader Cable Grounding

Ensure that the proper Earth Ground to the Earth Ground Terminal on the reader is connected (*Figure 4*).

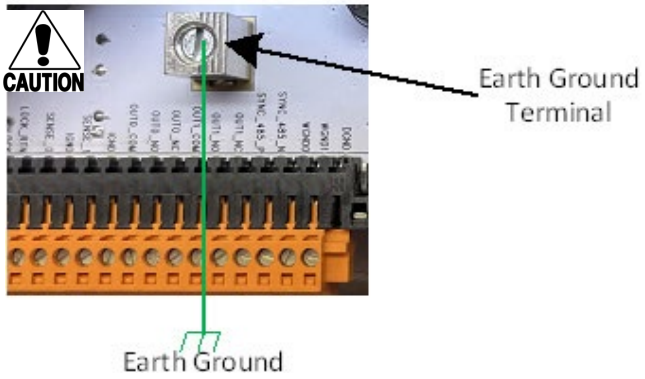

Figure 4 Earth grounding terminal on reader

Caution

Do not earth ground either side of the auxiliary input power.

Host Communications

The site design must include communications between the Encompass 4 Flex Reader and a host computer/system. The Encompass 4 Flex Reader can communicate with various standard interfaces (RS–

232, RS–422, Ethernet, and Wiegand). The host computer/systems must be able to accept one of the interfaces shown in *Table 2.*

Table 2 Communications interfaces and conductor requirements

Interface	Number of Conductors
RS–232 (with RTS & CTS)	3 (5)
RS–422	5
Ethernet	8
Wiegand	3

RS–232 Interface

At 9600 baud, the maximum cabling length between the host computer system and the E4 Flex is 50 feet. If the cabling length must be greater than 50 feet, avoid the RS–232 interface and use RS–422 or Ethernet instead.

*Note: When wiring the RS–232 interface, a low capacitance type cable should be used (such 2–32 as Belden 9832). TransCore recommends using one pair each for the Transmit, Receive, CTS, RTS, and ground signals (*Figure 5*), where one part of the pair is use for the signal and the other is reference to ground. The cable shield should be tied to a single-point earth ground on the computer/systems end of the cable.*

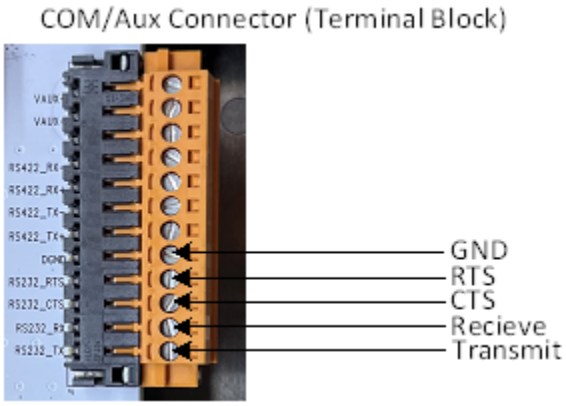

Figure 5 Com/Aux connector terminal block

RS–422 Interface

The standard RS–422 connection maximum distance depends on the baud rate, cable type, and the RS – 422 device at the other end. If the connection distance is more than 50 feet from the Encompass 4 Flex reader to the PC, TransCore recommends using RS–422 rather than RS–232.

Note: When wiring the RS–422 interface, a low capacitance type cable should be used (such as Belden 9832). The cable shield should be tied to a single-point earth ground on the computer/systems end of the cable (Figure 6).

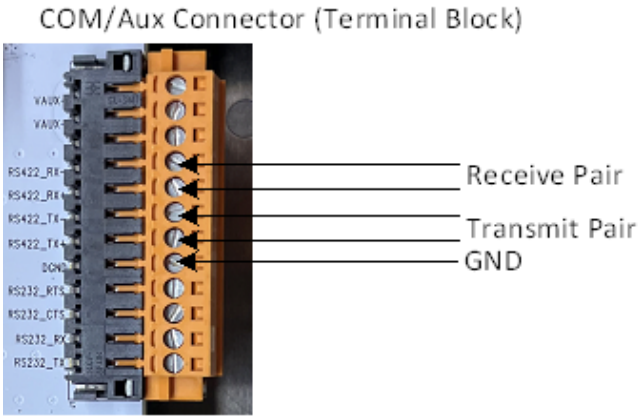

Figure 6 Wiring the RS-422 interface

Ethernet Interface

When using the Ethernet interface the host computer should be no more than 328 ft (100 meters) from the Encompass 4 Flex Reader - the cabling length must be no more than 100m.

Note: A 4-pair Cat 5 or better cable with a length no longer than 328 feet (100 meters) should be used to be used for communications and if needed to power the reader. The cable should be terminated with an RJ45 plug at the reader (Figure 7).

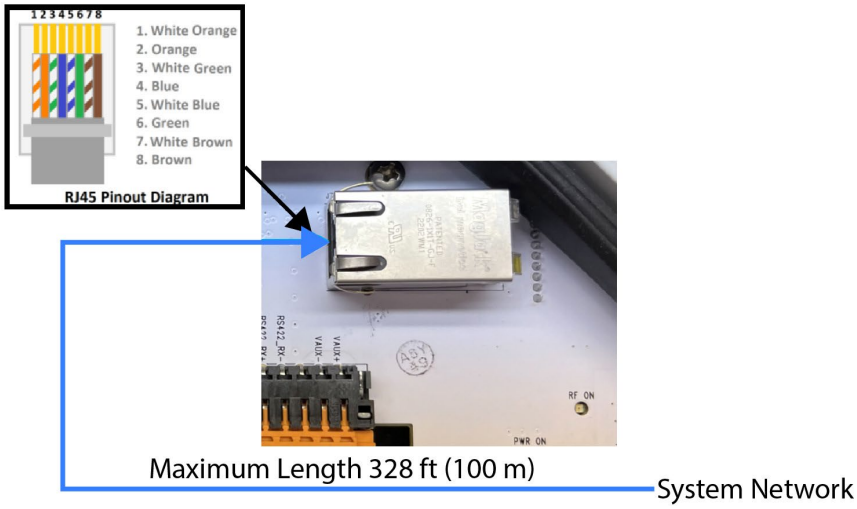

Figure 7 Ethernet interface

Using an Audible Circuit Tester (Buzzer)

An audible circuit tester is also called a buzzer or buzz box. These boxes are available at some electronic parts supply stores, or you can make a buzz box, as shown in *Figure 8*. The buzz box is powered by a 9V DC battery and is wired to the I/O Connector (Terminal Block).

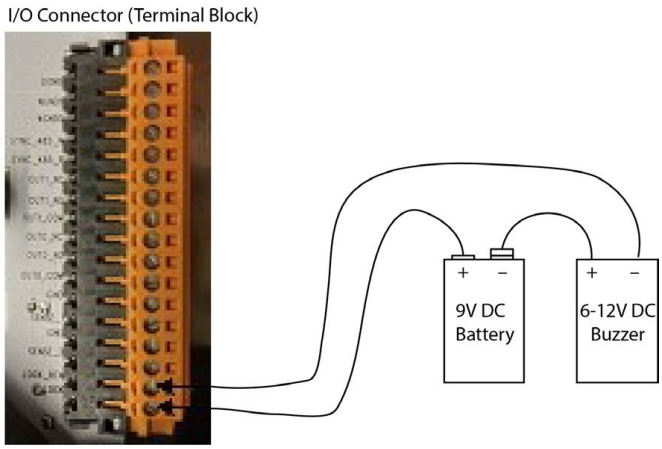

Figure 8 Wiring for audible circuit tester (buzzer)

Bench Testing the Encompass 4 Flex Reader

The Encompass 4 Flex Reader is set to read the tag protocol(s) programmed into the reader.

Power the Reader

1. Power the reader through the Aux or POE.
2. Once the reader is 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 Flex Reader unit being used.

Note: Test tags should match the protocol(s) selected for the reader. These tags can be ATA-protocol, ISO-compliant tags, or Inter-Agency Group tags affixed to a plastic or wooden yardstick, or eGo Plus Windshield Sticker Tags (WSTs) affixed to a piece of nonmetallic windshield-type glass 0.190 to 0.230-in (4.82 to 5.84-mm) in thickness. The eGo Plus sticker tags have a reduced read range when not attached to glass.

Test that the Encompass 4 Flex Reader has power and can read a tag presented in the read zone.

1. Confirm that the Encompass 4 Flex Reader is correctly connected to a suitable power supply.
2. Confirm that the Encompass 4 Flex Reader colored-wire pair cable communications are connected correctly.
3. There are two methods to get a buzzer for audio feedback.
   a. Set up the BLE application
   b. Connect the two leads from the audible circuit tester to the reader.

4. Start the terminal emulation application.
5. Set the properties in the terminal emulation application as follows:
    a. Bits per second: 9600 baud
    b. Data bits: 8
    c. Parity: none
    d. Stop bits: 1
    e. Flow control: none
6. Cycle the power on the Encompass 4 Flex Reader and ensure that the sign-on message displays.
7. Input the following commands in the order provided in *Table 3*. Commands include those to switch to command mode, set radio frequency (RF), turn on RF, and return the reader to data mode.

Table 3 Commands for bench testing

Entry	Reader Response	Notes
#01 <CR>	#Done <CR/LF>	Switches Encompass 4 Flex Reader to command mode
#647XXX <CR>	#Done <CR/LF>	Sets frequency
#6401 <CR>	#Done <CR/LF>	Turns on RF
#00 <CR>	#Done <CR/LF>	Returns Encompass 4 Flex Reader to data mode

8. Pass the correct test tag for the reader application in front of the Encompass 4 Flex Reader or antenna. The audible circuit tester should sound a tone when the tag is read. If no tone sounds, ensure that steps 1 through 5 were performed correctly and that a compatible tag is used. Repeat steps 6 and 7. If no tone sounds, contact TransCore Technical Support.
9. Disconnect the circuit tester from the Encompass 4 Flex Reader power/communications cable.
10. Disconnect the power and communications connections made for pre-installation testing.

Note: The audible circuit tester will be needed again to determine the read zone when installing the Encompass 4 Flex Reader at the site.

Frequency Plan

The Encompass 4 Flex 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.

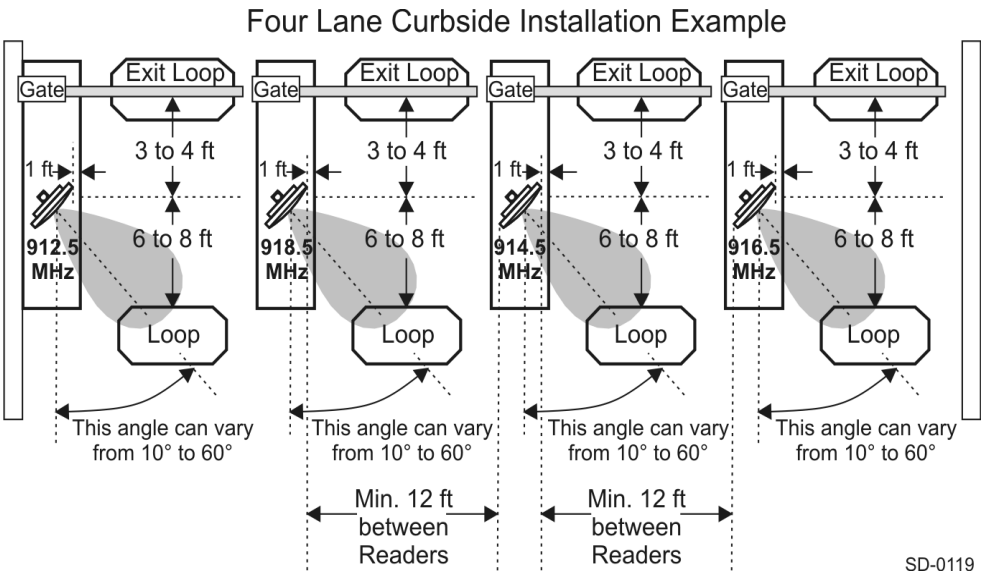

Figure 9 Frequency separation for four lanes

If readers are spread out within a facility (readers ½ mile or so apart) and loops are used, then frequencies may be reused. *Figure 9* shows frequency separation for 4 lanes.

Table 4 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 4 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

Table 5 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 5 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

Configure for Wiegand Operation

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

Table 6 Wiegand Testing Commands

Enter	Reader Response	What It Does
#01	#Done	Switches reader to command mode
#489	#Done	Sets operational mode to read ATA tags
#451	#Done	Switches reader to Wiegand mode
#6401	#Done	Turns RF ON
#00	#Done	Returns reader to data mode and saves settings to memory

Table 7 Wiegand interface

Colored Wire Pair	Use This Color	Connect to Data Wire of Wiegand Controller
Blue/Red	Blue	Data0
	Red	Data1
Yellow/Black	Black	Ground

Read Test Tags

1. 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.

2. 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

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 Flex 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 10*).

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).

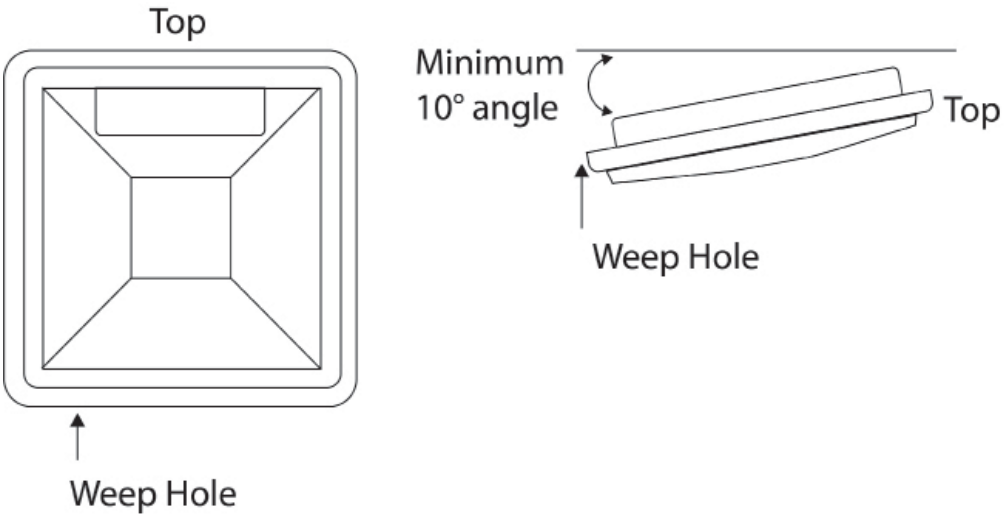

Figure 10 Correct Orientation of Reader

Overhead installations are typically used in parking garages and other areas where an overhead mounting surface already exists. These antennas 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:
For reliable reader operation, ensure that the reader is connected to Earth Ground. Connect the Ground terminal on the E4 Flex to Earth Ground. TransCore strongly recommends following the National Electric Code for lightning protection for the locale where the Encompass 4 Flex Reader is installed.

Connect All Wiring

Connecting the Encompass 4 Flex Reader

Encompass 4 Flex Reader communications and interface signals are supplied from the reader to the host system through connectors/terminal blocks. The connector/terminal blocks are accessed from the back of the reader. These sections contain instructions for connecting RS–232, RS–422, and Wiegand communications between the Encompass 4 Flex Reader and the PC. Each section contains wiring

instructions and pin assignments followed by step-by-step connection procedures. The Encompass 4 Flex Reader can remain powered up while connecting reader-to-host PC communications.

RS–232 Interface

RS–232 interface signals are supplied by three or five wires from the Encompass 4 Flex Reader communications cable (*Figure 11*).

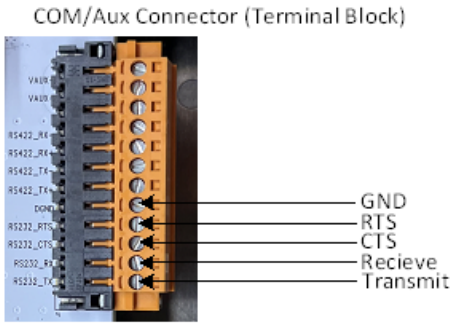

Figure 11 RS–232 Com/Aux connector

Note: When wiring the RS–232 interface, a low capacitance type cable should be used (such as Belden 9832). TransCore recommends using one pair each for the Transmit, Receive, CTS, RTS, and ground signals where one part of the pair is used for the signal and the other is reference to ground. The cable shield should be tied to a single-point earth ground on the computer/systems end of the cable.

RS–422 Interface

RS–422 interface signals are supplied by four wires (plus a ground for reference) from the reader (*Figure 12*). The PC/laptop must have an RS–422 interface or an RS–422 to RS–232 converter will be required.

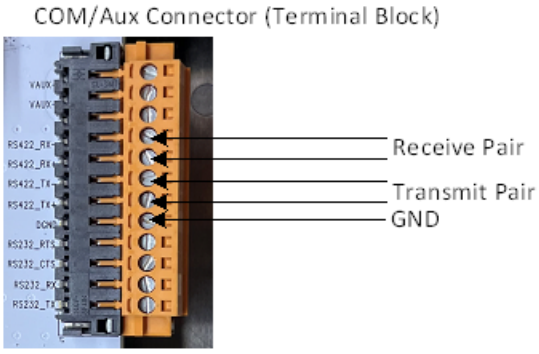

Figure 12 RS–422 interface

Note: When wiring the RS–422 interface, a low capacitance type cable should be used (such as Belden 9832). The cable shield should be tied to a single-point earth ground on the computer/systems end of the cable.

Wiegand Interface

Wiegand interface signals are supplied by three wires from the Encompass 4 Flex Reader I/O Connector (*Figure 13*). The Wiegand interface can only be used by the reader to output valid Wiegand tag reads. All reader commands and responses are issued through the serial interface.

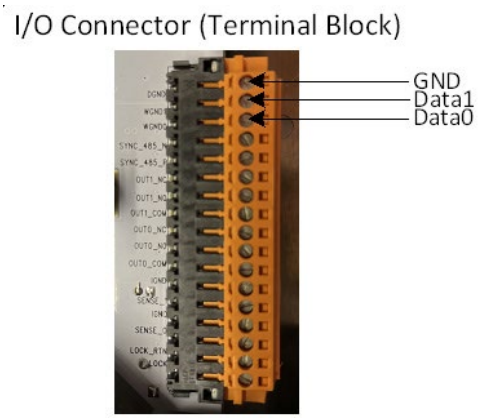

Figure 13 I/O Connector

Note: To get Wiegand data from the Encompass 4 Flex Reader it will need to be configured (i.e. enabled) by using one of the communication interfaces (RS–232, RS–422, Ethernet or BLE). Tags must also be properly programmed with Wiegand-formatted data when using the Wiegand mode of operation.

When connecting the Wiegand interface to the reader, Transcore recommends using a 3-pair cable such as Belden 82502. Use one of the twisted pairs for Data1 and the other for Data0, with one part of the pair for the signal (Data1/Data0) and the other for a ground. The cable shield should be tied to a single-point earth ground on the controller (i.e. system) side of the cable.

Connecting Sense Input and Sense Output Circuits

The Encompass 4 Flex Reader has two sense input circuits and three sense output circuits available. The sense input circuits can be used to notify the Encompass 4 Flex Reader of external events and are designed to be connected to a free-of-voltage dry contact. Sense output circuits are single-pole, double-throw relays that provide normally closed (NC) and normally open (NO) dry contacts. The relay contacts are rated at 42.2V AC peak (30 Vrms) or 60V DC at 1 A maximum. If controlling an external gate or device requiring high current, an isolation transformer is required.

Sense Input Circuits

The Encompass 4 Flex Reader supports two sense inputs (Sense_0 and Sense_1). To activate each line they should be referenced to the Sense Ground. Sense_0 is the presence detection device line and is used to control RF power. The Reader expects the Sense_0 circuit to close (i.e. reference to Sense Ground) when a vehicle is present. The minimum presence true period is fixed at 0 ms, which indicates that no delay occurs in closing the circuit when a vehicle is present.

Sense input 1 allows the reader to monitor the status of a peripheral device. The host computer can then check the status by polling the reader for status of the peripheral device (*Figure 14*).

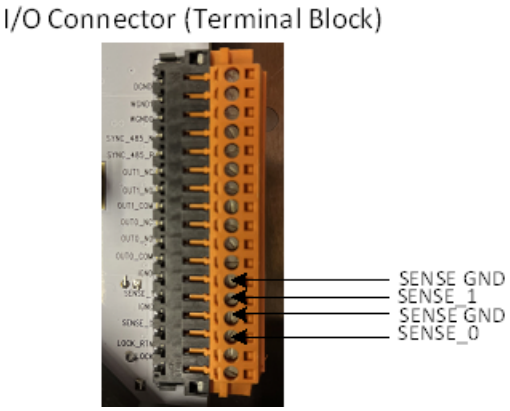

Figure 14 Sense input circuits

Sense Output Circuits

The Encompass 4 Flex Reader supports three sets of output signals. Two sets – OUT0 and OUT1 – provide NO or NC outputs. The third output is dedicated for testing and set up of the reader, LOCK which indicates a valid tag is in the read field. LOCK is a NO output only.

OUT0 and OUT1 are dry contacts that provide NO and NC outputs. The relay contacts are rated at 42.2V AC peak (30 Vrms) or 60V DC at 1 A maximum. If controlling an external gate or device requiring high current, a secondary isolation transformer is required.

In Wiegand mode operation, the sense outputs are not controlled by a predefined output mode.

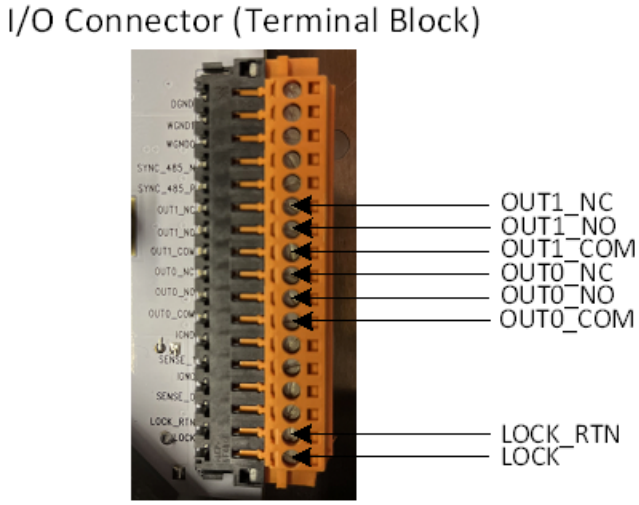

Figure 15 Sense output circuits

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.

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 9 provides the commands frequently used in testing, setting up, and tuning the Encompass 4 Flex Reader.

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

Table 9 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 NN = 01–FF Hex (01 Default) Refer to #533

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

#527	#RFST Cx Ox T1 Fxx Rxx Gxx Axx Ixx
	C0 = RF controlled by host, Refer to #6400, #6401
	C1 = RF-by-input control, Refer to #641 O0 = RF off, Refer to #6400
	O1 = RF on, Refer to #6401
	T1 = uniqueness timeout of 2 min, Refer to #441
	Fxx = RF output frequency 00 to 34, or 000 to 118 (Refer to #642NN, #647XXX
	Rxx = ATA RF output range, 00 to 1F (Default = 1F = max range), Refer to #643NN
	Gxx = eATA SeGo/eGo range control, 00 to 1F (Default =1F = max range) , Refer to #645NN
	Axx = RF power attenuation, 00 to 0A (Default = 00 = Max Power), Refer to #644NN
	Ixx (IAG Attenuation) = 00-0F (04 Default) 00=Max Power, Refer to #646NN
		Display RF status

#531	#WC x FFC y Val hhhh Where x = 0 through 5 to line up with #870 through #875 commands y = 0 Disabled fixed facility code y = 1 Enabled fixed facility code	Display Wiegand Translator conversion settings Refer to Commands #870-#879, #863.

	hhhh = Fixed Facility code value (Decimal)	
Enter	**Reader Response**	**What It Does**

#532	#TOF <0 to 1>, Refer to #450, #451
	0 = Wiegand disabled
	1 = Wiegand enabled
		Display Wiegand mode status

#533	#WTI <01 to FF> seconds (1-255) in hex, Refer to #46NN	Display Wiegand retransmit interval

#570	#ATA:_ eGo: _ SeGo: _ IAG:_ EPC:_ SORT: _TMM:_
	I = SeGo ID (64 bits)
	E = enabled
	F = full transaction D = disabled
	Refer to commands: #480 – #489, 838, and #839
		Display reader protocols

#63	#Model [model] Ver [version no.] SN [serial no.] Copyright [date] 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).
#643NN (00-1F)	#Done	Set operating range for ATA protocol (distance): (00 to 1F Hex) 1F = max range (Default)
#644NN (00 – 14) Hex	#Done	Set RF attenuation in 1.0 dB increments; 0 to 20 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) 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).
#66F	#Done	Load default operating parameters (does not affect RF operating frequency)
#863hhhh	#Done	Set facility code value (4 hex chars) (factory default = 0000)
Enter	**Reader Response**	**What It Does**
#870	#Done	Disable wiegand conversion (factory default)
#871	#Done	Enable 26 bit format
#872	#Done	Enable 32 bit LSU format
#873	#Done	Enable 34 bit Cardkey format
#874	#Done	Enable 35 bit HID format
#875	#Done	Enable 37 bit McGann format
#878	#Done	Disable fixed facility code (factory default)
#879	#Done	Enable fixed facility code

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

Long RF cable runs to antennas

For the external antenna-series Encompass 4 Flex Readers, long RF cable runs between the reader and the antenna may cause signal degradation or loss. This scenario may be site-specific, but TransCore recommends limiting antenna cable runs to less than 3dB of cable loss.

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 (Output has O1, not O0).

Improper grounding

E4 Flex Ground terminal 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 #531, #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.

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 Flex 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 Flex Reader, all the wires are connected correctly but the unit does not respond.
Check that the Encompass 4 Flex Reader communication cable is connected to the correct COM port. Unusual responses received from the Encompass 4 Flex 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 Flex Reader.
Ensure that the Encompass 4 Flex 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 Flex 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 16*).

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 Flex Reader if possible.

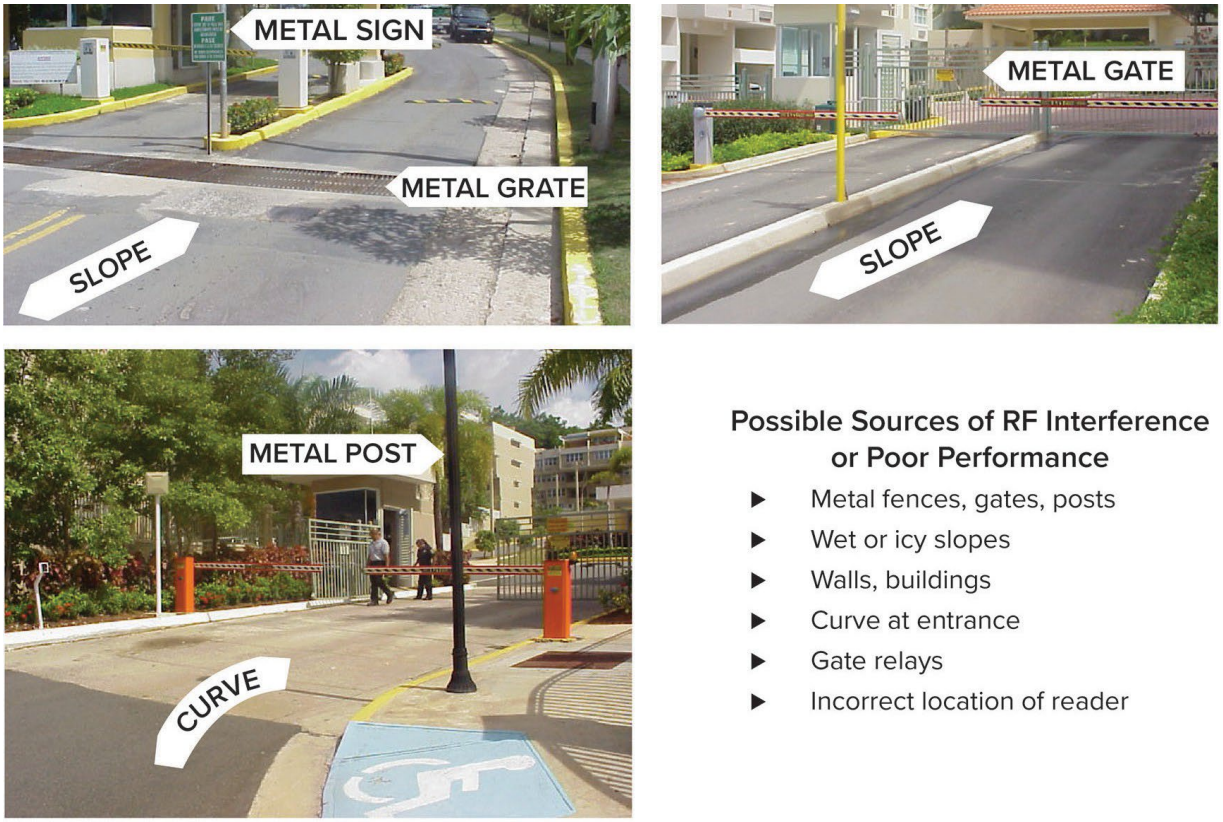

Figure 16 Sources of RF interference

Appendix A

Wire End Ferrules with Plastic Collars

This appendix describes the use of wire-end ferrules with plastic collars when connecting the E4 Flex to the user's end system. Wire end ferrules with plastic collars offer additional ease of insertion due to the conical shape that is integrated in the inner diameter of the collar. Using ferrules keeps the rough insulation edges of the conductor from getting caught when connecting at the clamping point of the connector. The ferrule plastic collar can be ordered in different colors to help distinguish between various circuit functions.

In order to create an optimal crimped connection, Standard DIN 46228 recommends using tools and ferrules from the same supplier. The examples shown in this appendix are from Weidmüller (*weidmuller.com*). Other manufacturers can be used if they meet the proper dimensions and electrical properties similar to the Weidmüller part numbers listed in *Table 10*.

Table 10 Recommended part numbers

Weidmüller P/N	Description
9025980000	Wire-end ferrule, Red, AWG 20-7
9025240000	Wire-end ferrule, Black, AWG 20-7
9002650000	Wire cutters
9005000000	Wire strippers
1444050000	Ferrule crimping tool

1. Trim the wire to the proper length with a clean, non-squeezed and burr-free cut, using a pair of Weidmüller P/N 9002650000 or equivalent wire cutters (*Figure 17*).

Figure 17 Trim wire to length

2. Cleanly and precisely remove the insulation to expose the proper amount of wire with a pair of wire strippers (Weidmüller P/N 9005000000 or equivalent) to ensure that the entire cross-section is being crimped in the tube of the ferrule. The wire conductor should not be fanned out (refer to DIN EN 60352). The strands should only be allowed to twist slightly, re-establishing the original condition. Refer to *Figure 18*.

Figure 18 Stripped wire with conductor exposed

3. Crimp the ferrule to the wire end and conductor with the proper crimping tool (Weidmüller P/N 1444050000 or equivalent). The conductor should be visible 1/16 of an inch out of the copper tube (*Figure 19*).

Figure 19 Conductor overhang

4. This will ensure that there will be enough conductor exposed during the crimping process for a proper crimping. When placing the ferrule into the crimper, the ferrule should be positioned as close as possible to the plastic collar (*Figure 20*).

Figure 20 Proper ferrule crimping position

5. It is essential to select a crimping tool with a suitable crimping shape for the connection point. The recommended tool is Weidmüller P/N 1444050000. This tool produces a shape that is compatible with the mating connector of the E4 Flex. If an equivalent crimping tool is going to be used, that tool should match the crimping shapes shown in *Figure 21*.

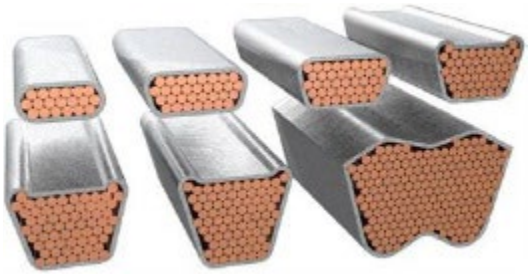

Figure 21 Crimping shape