

Hardware Interfaces

This appendix describes the physical interconnections within the Encompass[®] Reader.

Hardware Interfaces

This appendix describes the hardware interfaces in the Encompass Reader and to external components, such as antennas. [Figure B-1](#) shows the basic hardware interconnections for the Encompass Reader.

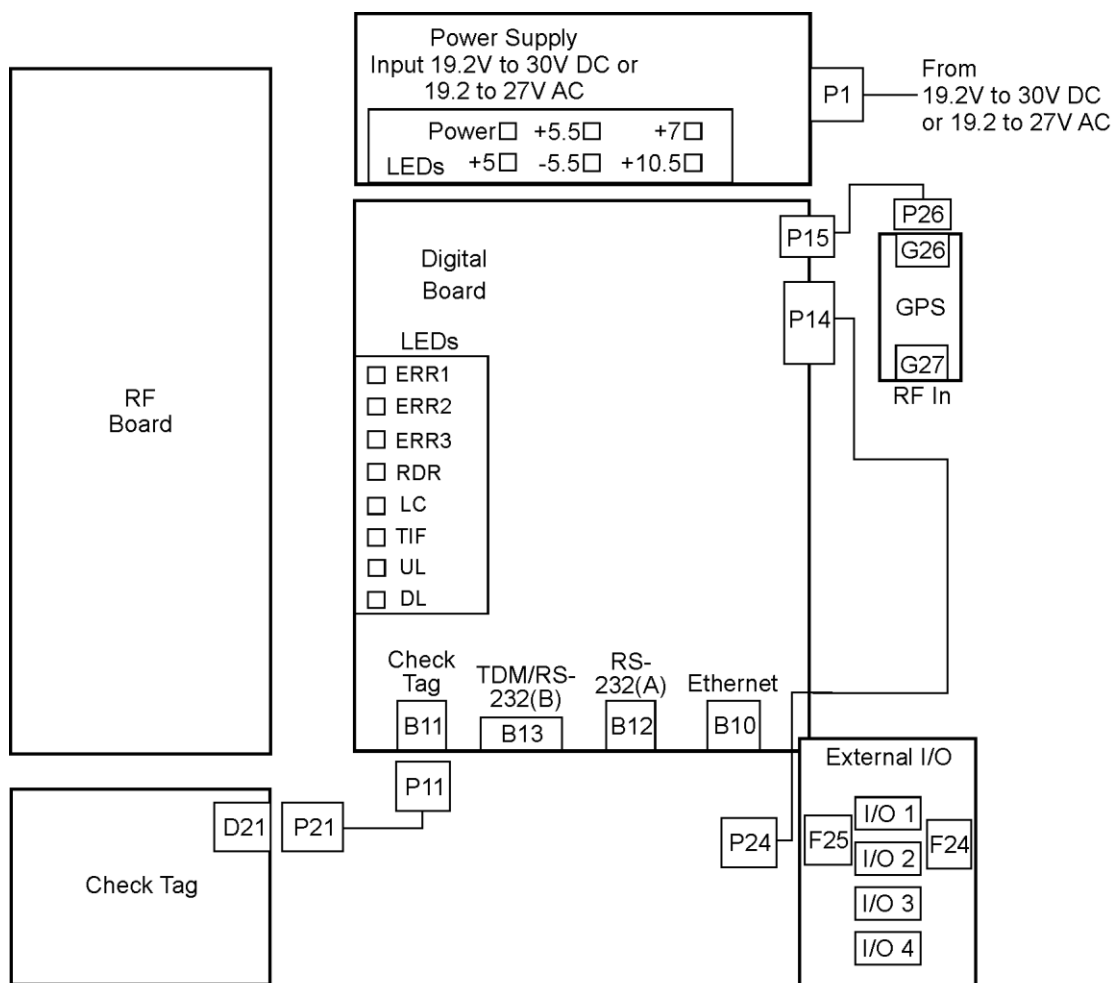


Figure B-1 Encompass Reader Hardware Interconnection Block Diagram

Communications

The Encompass Reader communicates with a host via an Ethernet or serial communication protocol.

UDP/IP Fast Ethernet Connection

The Encompass Reader communicates with a host via an Ethernet communications protocol. This connection requires an RJ-45 connector. If you connect the Encompass Reader directly to a host personal computer (PC) then you need a crossover cable. TransCore recommends that you use Belden 7929A Category 5e twisted-pair cable for Ethernet connections.

The Ethernet connector is an RJ-45 jack and uses a 100-base T interface. If the Encompass Reader is connected directly to the host system then a crossover cable is required. [Table B-1](#) lists the Ethernet connector pin assignments.

Table B-1 Ethernet Connector

Pin	Signal	Description	568A ^a	568B ^a
1	TX+	Output Differential Transmit Data (+)	White w/ green stripe	White w/ orange stripe
2	TX-	Output Differential Transmit Data (-)	Green w/ white stripe or solid green	Orange w/ white stripe or solid orange
3	RX+	Input Differential Receive Data (+)	White w/ orange stripe	White w/ green stripe
4	Not connected	N/A	Blue w/ white stripe or solid blue	Blue w/ white stripe or solid blue
5	Not connected	N/A	White w/ blue stripe	White w/ blue stripe
6	RX-	Input Differential Receive Data (-)	Orange w/ white stripe or solid orange	Green w/ white stripe or solid green
7	Not connected	N/A	White w/ brown stripe or solid brown	White w/ brown stripe
8	Not connected	N/A	Brown w/ white stripe or solid brown	Brown w/ white stripe or solid brown

a. 568A and 568B are Ethernet cable designations.

TDM/COM1 Port

This connector is an 8-pin block header receptacle (TransCore P/N 33357-01). The signal descriptions are listed in [Table B-2](#).

Table B-2 RS-232B/TDM Connector Parameters

Pin	Signal	Description	DB-9 Socket Connector
1	TXD	Transmit Data	2
2	RXD	Receive Data	3
3	DTR	Data Terminal Ready (not connected)	4
4	RTS	Request to Send	7
5	CTS	Clear to Send	8
6	GND	Ground	5
7	TDM+	TDM positive signal	-
8	TDM-	TDM negative signal	-

Diagnostic COM2 Port

This connector is a DB-9 subminiature plug. The diagnostic signal descriptions are listed in [Table B-3](#).

Table B-3 Diagnostic Communications Connector Parameters

Pin	Signal	Description
1	RSD	Received line signal detect (not connected)
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready (not connected)
5	GND	Ground
6	DSR	Data Set Ready (not connected)
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring indicator (not connected)

Hardware Diagnostic Port

This 40-pin connector is used for factory diagnostics checks. The signal parameters are listed in [Table B-4](#).

Table B-4 Encompass Reader Hardware Diagnostic Port Parameters

Pin	Signal	Source	Description
1	I	RF	I channel from RF receiver
2	Q	RF	Q channel from RF receiver
3	IQ Switch	RF	Active channel: high for I, low for Q
4	RANGE_ADJ_CNTL	RF	Range adjust control signal
5	+3.3V	Digital	+3.3V
6	Spare	RF	N/A
7	GND	-	Ground
8	Spare	RF	N/A
9	Spare	RF	N/A
10	IAG_New_Sig_Det	RF	IAG new signal detection line
11	IAG	RF	IAG channel from RF receiver
12	GND	-	Ground
13	Config Type 0	Digital	Configuration selection bit 1
14	Config Type 1	Digital	Configuration selection bit 2
15	Config Type 2	Digital	Configuration selection bit 3
16	Config Type 3	Digital	Configuration selection bit 4
17	Tag Type Ack	RF	Acknowledges the tag type inputs and indicates that the DL and DOM DACS are settled.
18	Ready to Tx	RF	Ready to transmit
19	Config Load	Digital	Signal to RF to load new configuration
20	MOD	Digital	RF modulation signal
21	RF ON/OFF	Digital	RF on-off control
22	UL/DL Cntrl	Digital	Controls whether active source is uplink or downlink
23	TDM	Digital	TDM synchronization pulse
24	GPS 1pps	Digital	1 pulse-per-second signal for frequency stabilization

Table B-4 Encompass Reader Hardware Diagnostic Port Parameters (continued)

25	Error (txcvr fault)	RF	RF error indicator active low
26	Power Supply Fault	Digital	Fault signal from the power supply board
27	GND	-	Ground
28	Tx Serial Comm	Digital	Transmit serial signal
29	Rx Serial Comm	RF	Receive serial signal
30	GoodTagRead	Digital	Active high pulse from FPGA1
31	CRC Failed	Digital	Active high pulse from FPGA1
32	ActivatePort	Digital	Enable the test port buffer when the connector plugged in
33	GND	-	Ground
34	SW1	Digital	GPIO from MPC852
35	SW2	Digital	GPIO from MPC852
36	SW3	Digital	GPIO from MPC852
37	SW4	Digital	GPIO from MPC852
38	DecoderOutput	Digital	Decoder bit stream from FPGA1
39	PLL Clock (decoder)	Digital	PLL clock from FPGA1
40	GND	Digital	Ground

Antenna Multiplexer/Check Tag Connector

The antenna multiplexer is used to power multiple antennas in multiple AVI lanes. This connector is a DB9 subminiature connector. The signal descriptions are listed in [Table B-5](#).

Table B-5 Antenna Multiplexer Connector Pin-outs

Pin	Signal	Description
1	Trinity_Control	Check tag control signal
2	Antenna Mux Control A	Control signal A for antenna multiplexer
3	CTMEM_WR_EN	Check tag control signal
4	IT2200 Control	Check tag control signal
5	GND	Ground
6	+5V PWR	+5V power
7	Antenna Mux Control B	Control signal B for antenna multiplexer

Table B-5 Antenna Multiplexer Connector Pin-outs

8	No signal	Not connected
9	RESET	Check tag reset

External Digital Input/Output Connector

This connector is used for the digital input/output assembly, which is used to interface the Encompass Reader with external inputs and outputs. Inputs can be devices such as light curtains or loops, and outputs can be devices such as gates or lights (connector is TransCore P/N 33357-01). The signal descriptions are listed in [Table B-6](#).

Table B-6 Digital I/O Connector Pin-outs

Pin	Signal	Description	I/O	Type	Level
1	5V PWR	5V power supply for I/O board	O	Supply	+5V DC $\pm 2\%$
2	GND	GND	I/O	Return	Ground
3	I/O Signal 1		I/O	CMOS	+5.0V
4	I/O Signal 2		I/O	CMOS	+5.0V
5	I/O Signal 3		I/O	CMOS	+5.0V
6	I/O Signal 4		I/O	CMOS	+5.0V
7	Tag in Field 1 ^a	Contact Closure 1 for Tag in Field Signal	I/O	Switch	+5.5V
8	Tag in Field 2 ^a	Contact Closure 2 for Tag in Field Signal	I/O	Switch	+5.5V

a. 125 mA maximum switch rating

C

System Technical Specifications

C

System Technical Specifications

This appendix provides reference specifications for the Encompass[®] Reader components.

Component Specifications

This appendix describes the engineering specifications for the reader components. This appendix does not include specifications for reader options, those are described in Appendix D, “Options.”

Encompass Reader

The reader environmental specifications are listed in [Table C-1](#).

Table C-1 Encompass Reader Environmental Specifications

Environment	Specification
Shock	10 G, sawtooth pulse @11ms duration
Vibration	5-20 Hz: 0.1 inch; peak to peak 20-200 Hz: 2 G peak Note No more than 2-dB tag-in-box sensitivity degradation under the vibration conditions on all 3 axis
Temperature range	Operational without a NEMA enclosure: -40C to +70C Operational mounted inside a NEMA 4X enclosure: -40C to +55C Storage temperature range: -40C to +85C
Humidity	0% to 95% noncondensing over all temperatures.

AA3152 Universal Toll Antenna

The AA3152 Universal Toll Antenna (UTA) specifications are as follows:

- Operates in the location and monitoring service band (902 to 928 MHz).
- Optimum radiation pattern — Virtually no side or back lobes help to confine

antenna coverage to a single lane.

- Weatherproof — Each antenna is housed in a radome made of materials with favorable electrical characteristics and resistance to ultraviolet radiation.
- Bandpass filtering helps to attenuate interference from other RF sources.

Environmental Specifications

The AA3152 UTA can withstand the environmental tolerances shown in [Table C-2](#).

Table C-2 Antenna Environmental Tolerances

Environment	Specification
Dust	NEMA pub 250-1991, Sec. 6.5, page 18
Rain	NEMA pub 250-1991, Sec. 6.4, page 17 and Sec. 6.7, page 19
Corrosion resistance	NEMA pub 250-1991, Sec. 6.9, page 20
Shock	5 G $\frac{1}{2}$ -sine pulse, 10 ms duration, 3 axes
Vibration	0.5 G _{rms} 10-500 Hz
Temperature range	-40°F to +167°F (-40°C to +75°C)
Humidity	100% condensing

D

Encompass Reader Options

Appendix D

Encompass Reader Options

This appendix will describe each of the options available with the Encompass[®] Reader.

Encompass Reader Options

This appendix describes the installation, operation, technical specifications, and preventive maintenance for the options available with the Encompass Reader. Not all of the options can be used on the same Encompass Reader due to conflicts between the connectors.

- “NEMA 4X Enclosure”
- “Check Tag Assembly and Antenna”
- “Antenna Multiplexer”
- “Digital Input/Output Assembly”
- “Global Positioning System Timing Option”

Figure D-1 shows the optional assemblies.

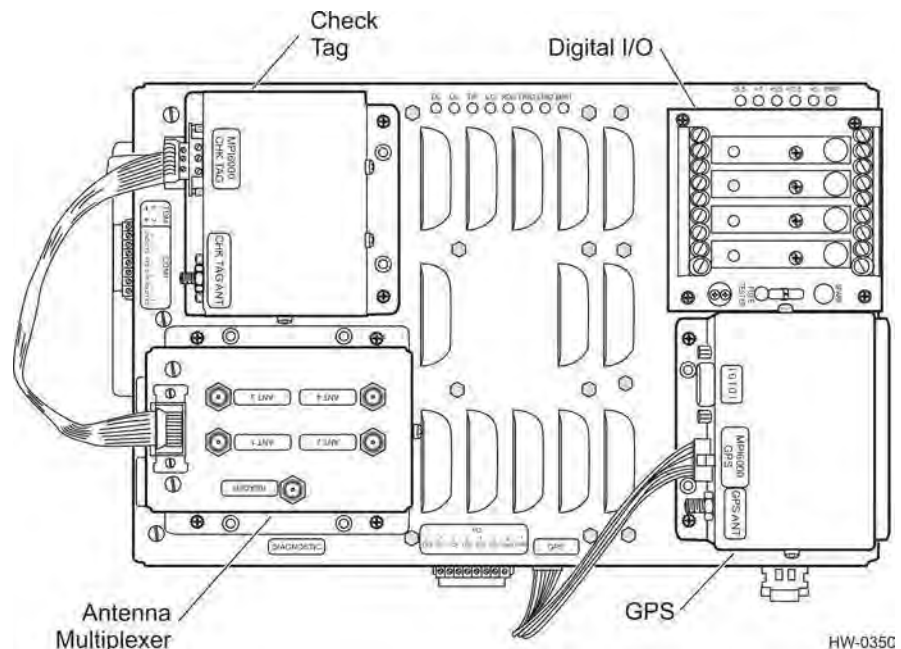


Figure D-1 Connector Locations for External Options

NEMA 4X Enclosure

The NEMA enclosure is a weatherproof fiberglass enclosure with easy, flip-open latches. For the Encompass Reader application, the NEMA enclosure comes mounted to a stainless steel backing plate. The entire assembly is then mounted to a pole or other structure using the mounting hardware provided with the NEMA kit.



Caution

TransCore recommends that you install the NEMA enclosure with the cable connectors at the bottom.

Required Equipment/Tools

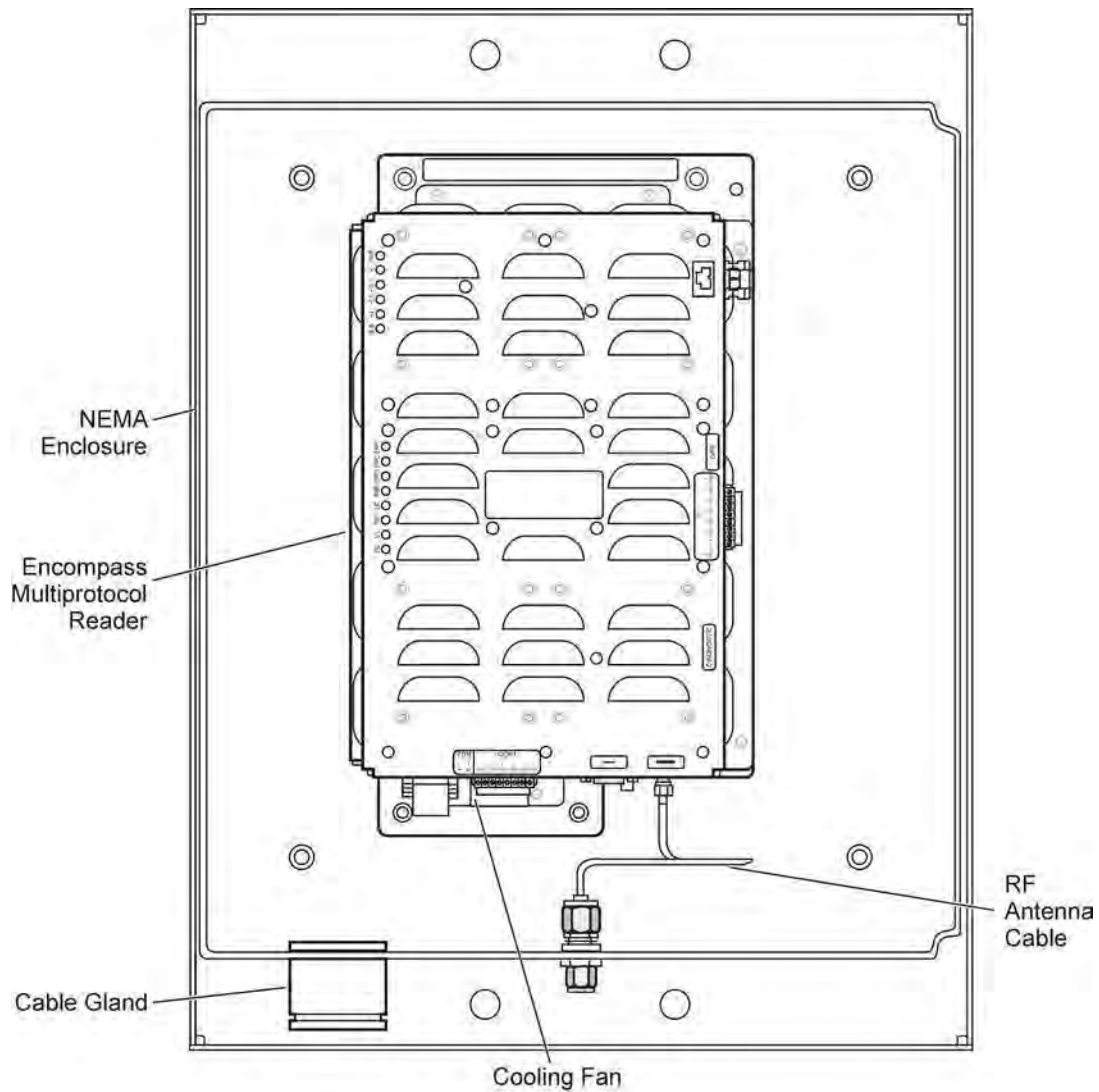
Before proceeding, make sure you have the following TransCore-supplied items:

- Cable entry system (TransCore P/N 71023-01)
- Tube of Dow Corning[®] 111 Valve Lubricant and Sealant

You need the following additional equipment and tools to install the NEMA enclosure:

- 5/16-inch torque wrench for SMA connector on RF antenna cable. The maximum torque specification for the SMA connector is 10 inch-pounds (in-lb). Do not exceed this specification.
- Two adjustable wrenches with 3-inch (7.6-cm) jaw capacity and/or two wrenches available from Roxtec (www.roxtec.com) to tighten gland assembly
- Standard set of tools (wrenches, screwdrivers, and pliers)

Figure D-2 shows the NEMA enclosure and backplate.



HW-0356

Figure D-2 Encompass Reader Mounted in NEMA Enclosure

NEMA Enclosure Connections

TransCore offers three NEMA enclosure options:

- NEMA enclosure that has a cable gland and one RF cable connector
- NEMA enclosure without the cable gland and one RF cable connector
- NEMA enclosure with the cable gland and two RF cable connectors

If your NEMA enclosure has the cable gland (TransCore P/N 71023-01), you need to install it. This connector routes the wires and cables from the Encompass Reader through the NEMA enclosure wall. You need to follow the installation instructions packed with the Roxtec cable gland kit.



Caution

TransCore recommends that you use the Dow Corning lubricant instead of the lubricant supplied with the Roxtec gland housing.

1. Pull all cables and wires through the gland and secure the gland in accordance with the packed instructions.
2. Check all wiring and cable connections before installing the NEMA enclosure.

If you chose the NEMA enclosure without the cable gland, you will need to install a different cable pass-through fitting into the NEMA enclosure.

Installation/Mounting

Connect the stainless steel backplate used to mount the NEMA enclosure to earth ground using a ground cable and stake. TransCore recommends that you follow the National Electric Code for lightning protection for the locale where you are installing the Encompass Reader. [Figure D-3](#) shows an example of a site installation using a

NEMA enclosure.

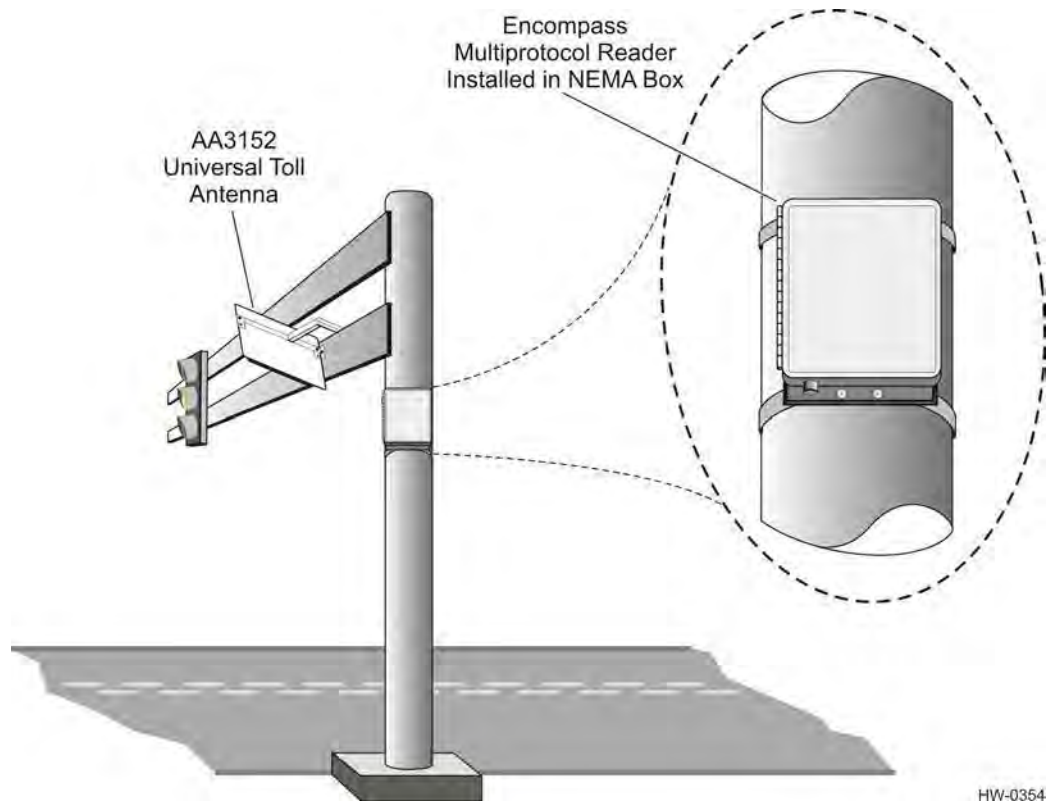


Figure D-3 Sample NEMA Enclosure Installation



Caution

To protect the Encompass Reader, TransCore also recommends that you attach the mounting plate to the ground cable. To ensure that the mounting structure and NEMA enclosure housing the Encompass Reader are sufficiently grounded, have a licensed electrician certify the grounding system.

If you install the backplate on a mounting pole or other assembly that is sufficiently grounded to earth, and all of the surfaces are good conductors, you may not need to use a grounding cable.

Tighten the mounting hardware to 50 ft/lb (68 N/m) to ensure that the box will sustain vibration requirements.

Troubleshooting the NEMA Enclosure Installation

These troubleshooting procedures need to be completed.

- Check power supply

- Check ground cable continuity

Testing

Once you have installed the Encompass Reader/NEMA enclosure, connect the Encompass Reader to the other system components and then configure and test the entire system. Follow the operating procedures listed in Chapter 3.

Preventive Maintenance

Perform visual inspection of NEMA enclosure. Open NEMA enclosure and check for moisture. Check bulkhead connections for leakage.

Technical Specifications

The backing plate dimensions are 22.20 x 16.75 x 1.50 in (56.4 x 42.5 x 3.81 cm). The NEMA enclosure dimensions are 18.6 x 18.0 x 10.6 in (47.2 x 45.7 x 26.9 cm).

Check Tag Assembly and Antenna

This section explains how to install and connect the check tag assembly and check tag antenna.

Installing the Check Tag Assembly

Before proceeding, make sure you have the following TransCore-supplied items:

- Check tag accessory kit (TransCore P/N 13-6000-001), which consists of the items listed in [Table D-1](#):

Table D-1 Check Tag Accessory Kit Contents

Quantity	Description
1	Check tag assembly
1	Check tag antenna assembly (see “Required Supplies for Assembling and Installing Check Tag Antenna” on page D-11)
1	DB9 ribbon cable assembly
4	#6-32 x 3/8 inch stand-off
4	#6-32 x 1/4 inch Phillips screw
2	3/4-inch round spacer
1	Coaxial in-line attenuator, 8-dB, 1 watt, SMA
1	RF cable assembly

Note: The 8-decibel inline attenuator supplied with the check tag assembly kit should be adequate for most applications; however, the attenuator value may need to be adjusted depending on a customer’s reader and system configuration.

Note: If you plan to use a check tag and antenna multiplexer on the same Encompass Reader, you must use a different data cable (TransCore P/N 08315-01) to connect the two optional assemblies to the Encompass Reader’s DB-9 port.

You need the following additional equipment and tools to install the check tag assembly.

- 50-ohm coaxial cable from check tag to check tag antenna (no more than 3 decibel (dB) loss in cable). Use same type of coaxial cable as used to connect RF antenna to Encompass Multiprotocol Reader.)
- N-type coaxial cable connectors
- Cable terminating/crimping tools

- Torque-limiting wrench (in-lb range)
- Standard set of tools (wrenches, screwdrivers, and pliers)

Mounting and Connecting the Check Tag Assembly

To mount and connect the check tag assembly

1. Check that you have all parts as listed on the check tag assembly accessory kit.
2. Insert and tighten the four mounting stand-offs.
3. Place the check tag assembly on top of the stand-offs and secure with Phillips screws.
4. Connect 8-dB inline attenuator to check tag assembly antenna port (Figure D-4) and tighten to 10 in-lb.
5. Connect check tag antenna cable fitting to other end of inline attenuator and tighten to 10 in-lb.
6. Connect the serial cable to the serial ports on the check tag assembly and Encompass Reader. Secure connections by tightening screws.

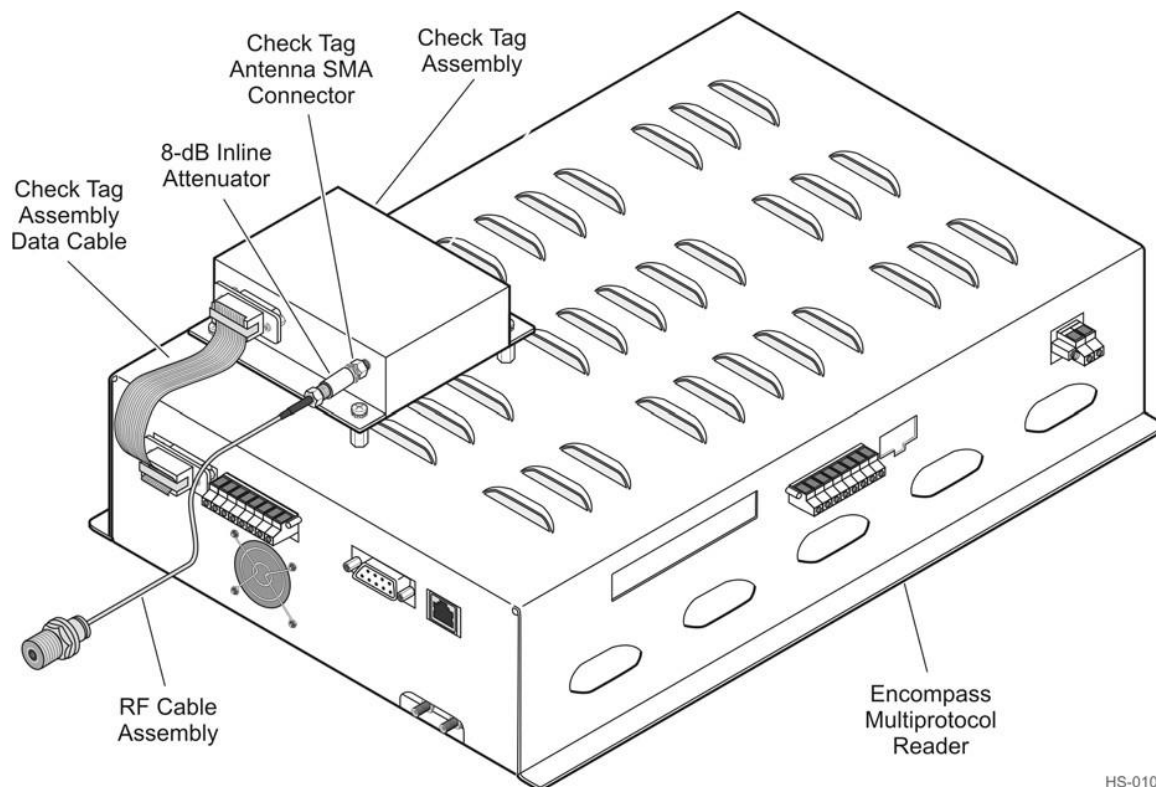


Figure D-4 Check Tag Assembly Mounted on Encompass Housing

Do not connect the check tag antenna cable to the check tag assembly until you have completed the antenna installation.

The check tag is mounted next to or directly on a Universal Toll Antenna (UTA).



Caution

When using a non-TransCore supplied enclosure, to prevent damage to the SMA connectors, TransCore strongly recommends that you provide a strain-relief bracket or other means of securing the antenna coaxial cable that terminates at the check tag assembly.

Assembling the Check Tag Antenna

Follow the instructions in this section to assemble and install the check tag antenna.

Required Supplies for Assembling and Installing Check Tag Antenna

- Check tag antenna kit (TransCore P/N 05429-01), which consists of the items listed in [Table D-2](#):

Table D-2 Check Tag Antenna Accessory Kit Contents

Quantity	Description
1	Check tag antenna mounting bracket
1	N-connector antenna mount
1	Antenna connector spacer
1	3/32" hex wrench
2	O-ring, .614", .754" OD
1	Antenna

- Standard set of tools
- Torque wrench with 0 to 100 ft-lb (0 to 136 N-m) range

Note: Check tag antenna has been factory-tuned to 912 MHz. This setting permits operation in the 902.25 to 921.5 MHz frequency range.

To assemble the check tag antenna and base

1. Insert whip antenna into collar ([Figure D-5](#)).



Caution

Ensure the whip antenna is fully seated in the collar.

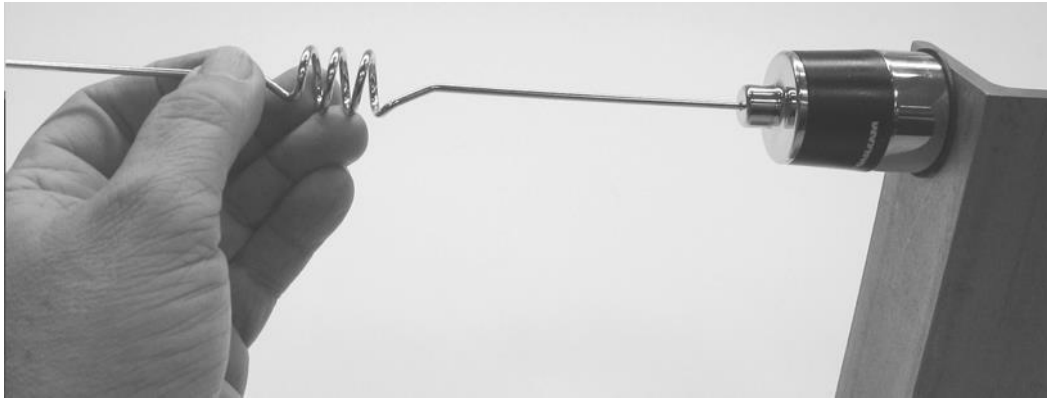


Figure D-5 Whip Antenna Inserted into Collar

2. Tighten the lower and upper hex screws (Figure D-6).



Figure D-6 Lower and Upper Hex Screws

The check tag antenna is now ready for installation with the UTA.

Installing the Check Tag Antenna with UTA

Figure D-7 shows where the check tag antenna is located in the reader system. The check tag antenna is installed on a mounting pipe next to the UTA and the check tag antenna extends in front of the UTA radome. For UTA installations that do not use a mounting pipe, the check tag antenna can be installed on the antenna radome.

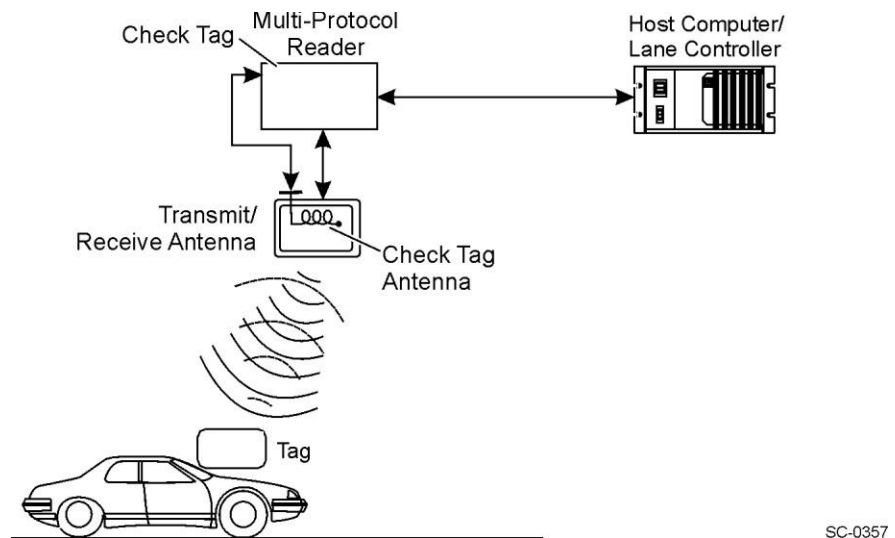
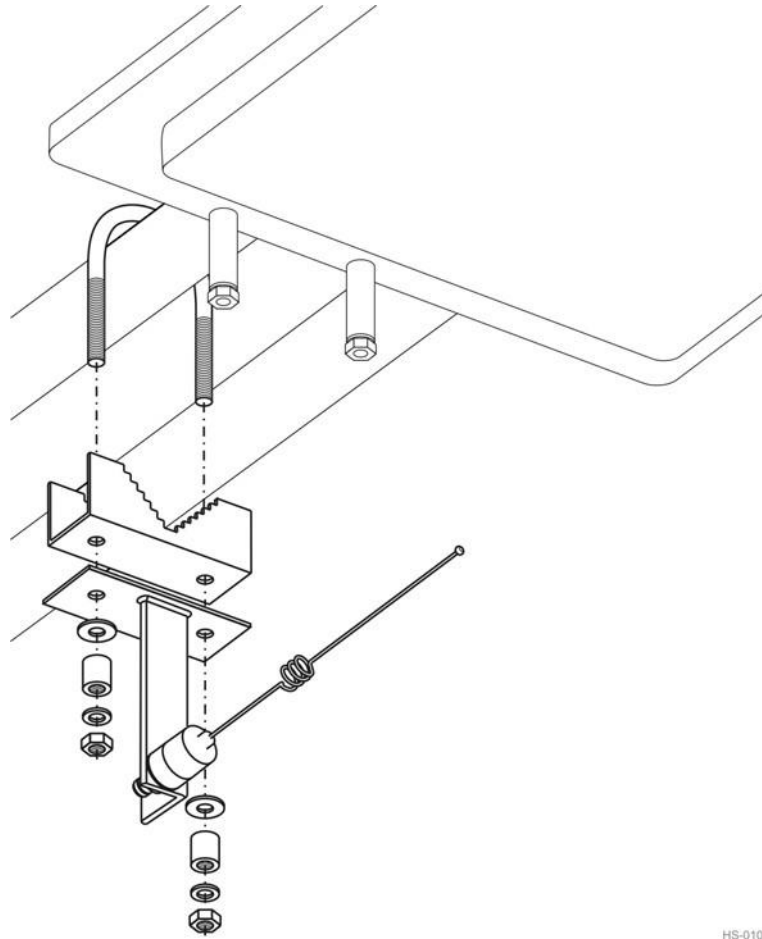


Figure D-7 Installation Location for Check Tag Antenna

To install the check tag antenna on the mounting pipe next to the UTA

1. Place the check tag antenna along the mounting pipe and insert a U-bolt around the pole and through the mounting bracket. Place a washer, spacer, lock washer and nut in that order over each side of the U-bolt. For a typical configuration, adjust the check tag antenna so that it is about 1 inch (2.5 cm) from and centered on the transmit antenna. It should extend across about 1/3 of the transmit antenna's width. The check tag antenna should be visible to the receive antenna.
2. Tighten the nuts with a torque wrench to 50 ft-lb (68 N-m).
3. Slide the shrink tubing over the check tag antenna cable, but do not heat it.
4. Leave the shrink tubing loose until you have finished tuning the lane.

Figure D-8 illustrates the correct way to mount a check tag antenna on the mounting pipe next to the UTA.



HS-0101

Figure D-8 Check Tag Antenna Installed on Mounting Pipe

To install the check tag antenna on the UTA radome

1. Place the check tag antenna on the UTA radome. On the end opposite the check tag antenna, place a 1-inch spacer, lock washer, and locking nut over each end of the U-bolt. At the end where you are mounting the check tag antenna, place a short spacer (9/16 inch) between the check tag antenna bracket and UTA radome. Place a lock washer and nut over each of the bolts.
2. Tighten the nuts with a torque wrench to 50 ft-lb (68 N-m).
3. Slide the shrink tubing over the check tag antenna cable and heat shrink it.

Figure D-9 shows the correct way to mount the check tag antenna on the UTA.

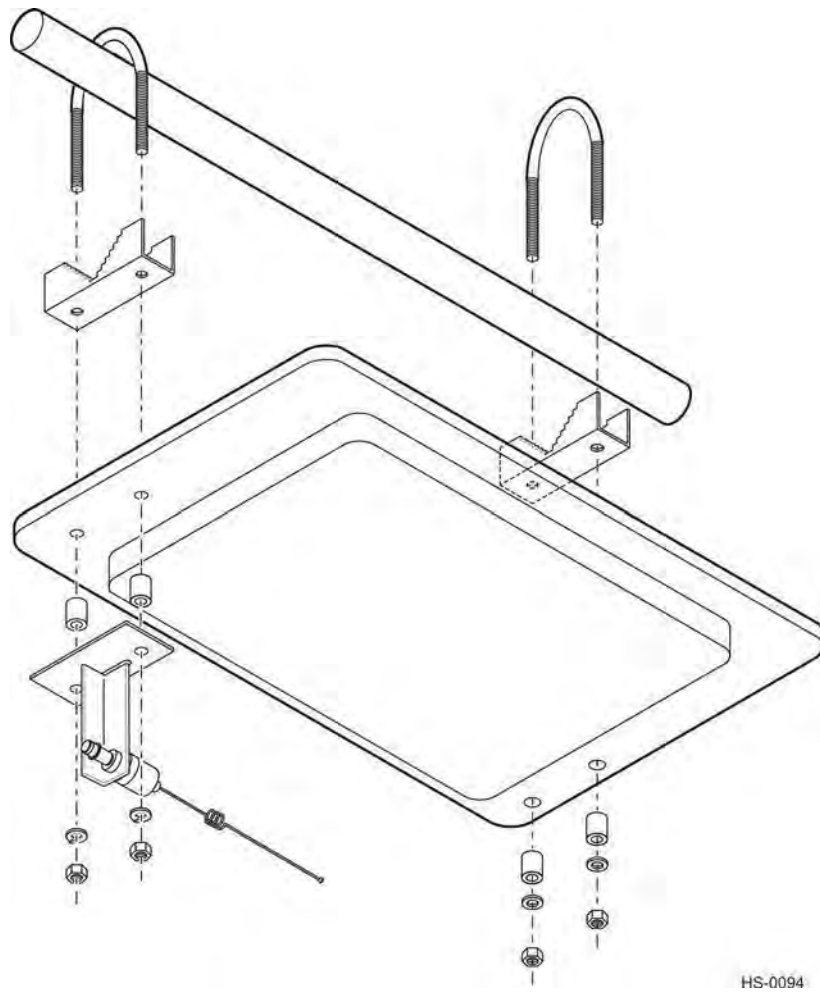


Figure D-9 Check Tag Antenna Installed on UTA Radome

Testing the Check Tag Using UDP Commands

Once you have installed the check tag assembly and antenna, test the check tag to see if it is working properly.

Before testing the check tag, remove all other tags in the field or run the test with no vehicles present.

To test the check tag using UDP commands

Set the check tag using the Run Check Tag command.

Run Check Tag

The check tag is designed to test the Encompass Reader system. The Run Check Tag command activates the check tag for a system test. The check tag is designed to oper-

ate without interfering with vehicle tag reads. The check tag function switches on for one synchronous pulse frame.

For optimum results, TransCore recommends that you operate the check tag when no vehicles are in the Encompass Reader system read zone. [Table D-3](#) lists the command data.

Table D-3 Run Check Tag Command (0025H)

Run Check Tag Command Data								Data Payload
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Run Check Tag Command (MSB)								00H
Run Check Tag Command (LSB)								25H
Protocol				Unused				X0H

Protocol — This field sets the check tag protocol.

Protocol	Definition
0	IT2200, Title 21 – manual
1	SeGo, eGo, ATA – manual
2	IT2200, Title 21 – periodic
3	SeGo – periodic
E	Enable all protocols – periodic
F	Enable all protocols – manual

Note: There is no specific response to the Run Check Tag command. Any response is reported as a tag read through the Mode Command Group responses. The reader responds with a command complete.

Testing the Check Tag Using AI1200-Emulation Commands

To test the check tag using AI1200-emulation commands

1. Enter the appropriate #813YX SET SYSTEM CHECK TAG PERIODIC TIME INTERVAL command for the tag mode using a host terminal.
2. Enter command #00 to place the reader in data mode. The reader sends a check tag response to the host terminal.

#813YX SET SYSTEM CHECK TAG PERIODIC TIME INTERVAL

This command sets the time interval for the periodic system check tag test and activates the check tag.

Format

#813YX

Parameters

Time interval Y = range 0–9 [30 seconds to 8 hours]

#813YX	Periodic Time Value
#8130X	30 seconds
#8131X	2 minutes
#8132X	4 minutes
#8133X	8 minutes
#8134X	15 minutes
#8135X	30 minutes
#8136X	1 hour
#8137X	2 hours
#8138X	4 hours
#8139X	8 hours

Tag Type X = range 0–3

where

0 = eGo, SeGo, or ATA – periodic

1 = Title 21 or IT2200 – periodic

2 = eGo, SeGo, or ATA – manual

3 = Title 21 or IT2200 – manual

E = enable all protocols – periodic

F = enable all protocols – manual

***Note:** Enable all runs the check tag on all of the protocols that have been enabled by the Set Protocols command (#4ANNNN).*

Pre-condition

Not applicable

Post-condition

This command takes effect immediately.

Default

F = enable all protocols

Response

#DONE Valid setting

#ERROR Invalid setting

Note: *You can choose only one value for X at a time.*

Troubleshooting

If the testing shows the check tag is not working, follow the steps in [Table D-4](#) and [Table D-5](#) to troubleshoot the check tag.

Table D-4 Failure During Check Tag Test

Indication	Action
No response to check tag read request	Repeat the check tag test described in the Testing section, being careful to verify that all test parameters are correctly set.
Slow or intermittent read count or incorrect check tag response	The check tag antenna may have failed. Verify that the check tag antenna is correctly positioned in relation to the UTA. See Figure D-8 or Figure D-9 for correct location of check tag antenna depending on the installation. Be sure that the check tag antenna coaxial cable is securely fastened to the check tag antenna port on the check tag assembly and that the data cable is securely fastened between the check tag assembly and the Encompass Reader. Repeat the check tag test described in the Testing section. If the problem persists, replace the check tag antenna.

Table D-5 Unacceptable RF Attenuation Statistics Using Check Tag

Indication	Action
Unacceptable RF attenuation statistics using check tag	Verify that the check tag antenna is correctly positioned in relation to the UTA. See Figure D-8 or Figure D-9 for correct location of check tag antenna depending on the installation. Be sure that the check tag antenna cable is securely fastened to the check tag antenna port on the check tag assembly and that the data cable is securely fastened between the check tag assembly and the Encompass 6. Repeat the Run Check Tag command described on page D-14. If the problem persists, replace the check tag antenna.

Preventive Maintenance

Visually inspect the check tag antenna and coaxial cable and replace or repair components as needed.

To perform a visual inspection

1. Inspect the check tag antenna for signs of damage or corrosion.
2. Check cables between the check tag assembly and Encompass Reader. Look for damaged or loose connections.

Check Tag Antenna Removal and Replacement Procedures

To remove the check tag antenna

1. Disconnect the check tag antenna cable.
2. Note the position of the check tag antenna with relation to the UTA. See [Figure D-8](#) or [Figure D-9](#) for correct check tag antenna mounting location.
3. Remove the nuts securing the antenna to the mounting bracket U-bolts or the UTA radome, then remove the check tag antenna. If you do not have a replacement check tag antenna available, be sure to fasten the UTA by replacing the mounting hardware.

To install the replacement check tag antenna

1. Follow the steps outlined previously for installing the check tag antenna.
2. Perform a check tag test.
3. When lane tuning is complete, use a heat gun to shrink the tubing covering the check tag antenna cable connection.

Technical Specifications

The specifications apply to the check tag assembly and check tag antenna.

Check Tag Assembly

[Table D-6](#) lists the check tag assembly specifications.

Table D-6 Check Tag Assembly Specifications

Parameter	Specification
Operating temperature Installed in NEMA enclosure Not installed in NEMA enclosure	-40°F to +131°F (-40°C to +55°C) -40°F to +158°F (-40°C to +70°C)
Storage temperature	-40°F to +185°F (-40°C to +85°C)
Humidity	0% to 95% noncondensing
Power supply	+5V DC $\pm$ 0.1V
Current	<20 mA
Vibration 5 to 20 Hz 20 to 200 Hz	0.1 inch, peak-to-peak displacement 2.0 G, peak acceleration
Vibration, random limits 10 to 500 Hz	2 g _{rms}
Shock	10 G, sawtooth, 11-ms duration

Table D-7 lists the frequency range for each tag protocol.

Table D-7 Check Tag Frequency Range

Protocol	FCC Frequency Range (MHz)	
	Downlink (modulated)	Uplink (continuous wave)
eGo	911.75 - 919.75	902.25 - 903.75 910.00 - 921.50
SeGo	911.75 - 919.75	
IT2200	912.75 - 918.75	
Title 21	912.75 - 918.75	

Check Tag Antenna

Table D-8 lists the check tag antenna specifications.

Table D-8 Check Tag Antenna Specifications

Parameter	Specification
Polarization	Linear with Universal Toll Antenna
Output VSWR	<1.5:1
Gain	3 dB

Antenna Multiplexer

The antenna multiplexer option provides a means for multiplying the coverage of a single Encompass Reader to four antennas covering four traffic lanes.

Required Components/Tools

Before installing the antenna multiplexer assembly, make sure you have the necessary components.

Antenna Multiplexer Accessory Kit (TransCore P/N 14-6000-001), which consists of the items listed in [Table D-9](#).

Table D-9 Antenna Multiplexer Accessory Kit Contents

Quantity	Description
1	Antenna multiplexer assembly
4	#6-32 x 3/8 inch stand-off
4	#6-32 x 1/4 inch Phillips screw
1	Reader-to-antenna multiplexer RF cable
1	DB9 ribbon cable assembly

Note: If you are installing an antenna multiplexer assembly and check tag assembly on the same Encompass Reader, you need to use a different DB9 data cable (TransCore P/N 08315-01) to connect the two assemblies.

You need the following additional equipment and tools to complete the installation, testing, and troubleshooting.

- 50-ohm coaxial cable from antenna multiplexer assembly cable port(s) to RF antenna(s) (no more than 2 decibel (dB) loss in cable). Use same type of coaxial cable as used to connect RF antenna to Encompass Multiprotocol Reader.)
- N-type plug connectors and SMA plug connectors
- 50-ohm, 2-watt receptacle SMA termination for unused antenna multiplexer output ports
- RF power meter and RF source capable of operating in the 915-MHz frequency range
- Cable terminating/crimping tools
- Torque-limiting wrench (in-lb range)

- Standard set of tools (wrenches, screwdrivers, and pliers)

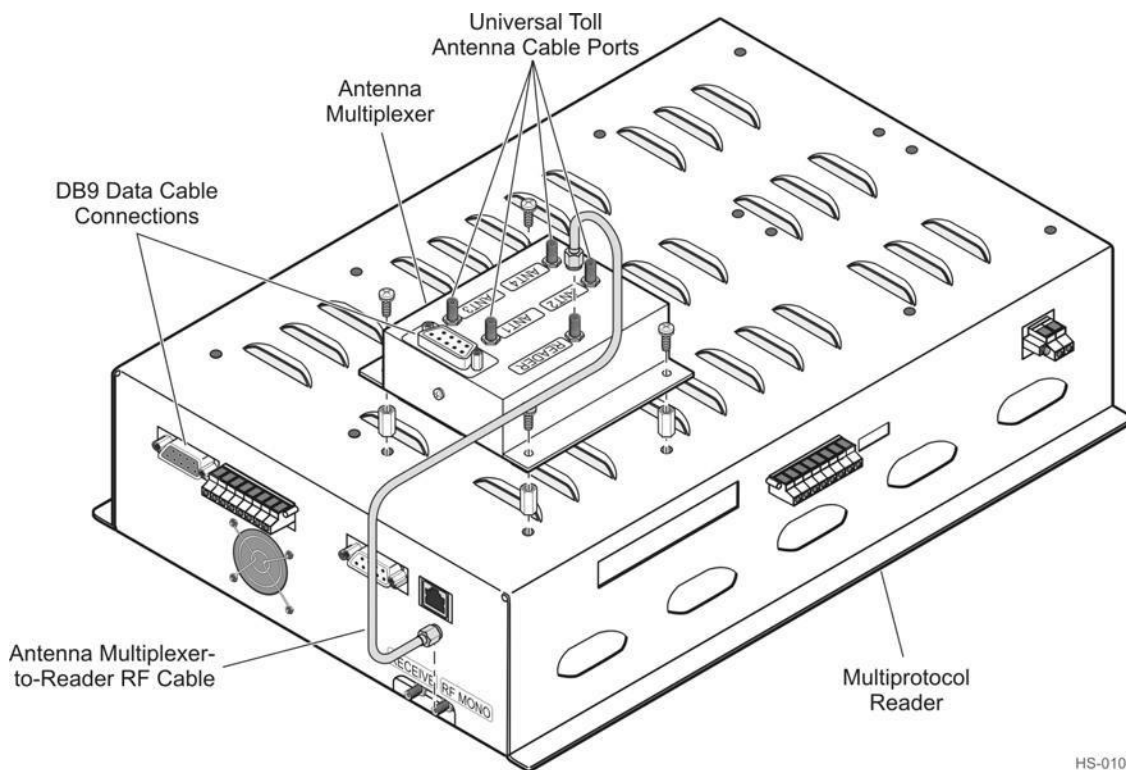
Installation/Mounting

Refer to [Figure D-10](#) for all procedure steps listed here.

To mount the antenna multiplexer assembly on the Encompass Reader

1. Screw the four standoffs into the mounting holes as shown in [Figure D-10](#).
2. Place the antenna multiplexer assembly on the standoffs and secure with the Phillips screws provided in the kit.
3. Connect and secure the DB9 data cable.
4. Connect the antenna multiplexer assembly (READER port) to the Encompass reader (RF MONO port) with the RF cable and tighten both SMA connectors to 10 in-lb.
5. Connect all antenna coaxial cables to multiplexer ports ANT0, ANT1, ANT2, ANT3, if used, and tighten all SMA connectors to 10 in-lb.

Note: You must terminate all unused antenna multiplexer output ports using a 50-ohm, two-watt SMA termination.



HS-0104

Figure D-10 Antenna Multiplexer Assembly Location



Caution

When using a non-TransCore supplied enclosure, to prevent damage to the SMA connectors, TransCore strongly recommends that you provide a strain-relief bracket

or other means of securing the antenna coaxial cables that terminate at the antenna multiplexer assembly.

Figure D-11 shows the locations of the reader and the four antenna connections.

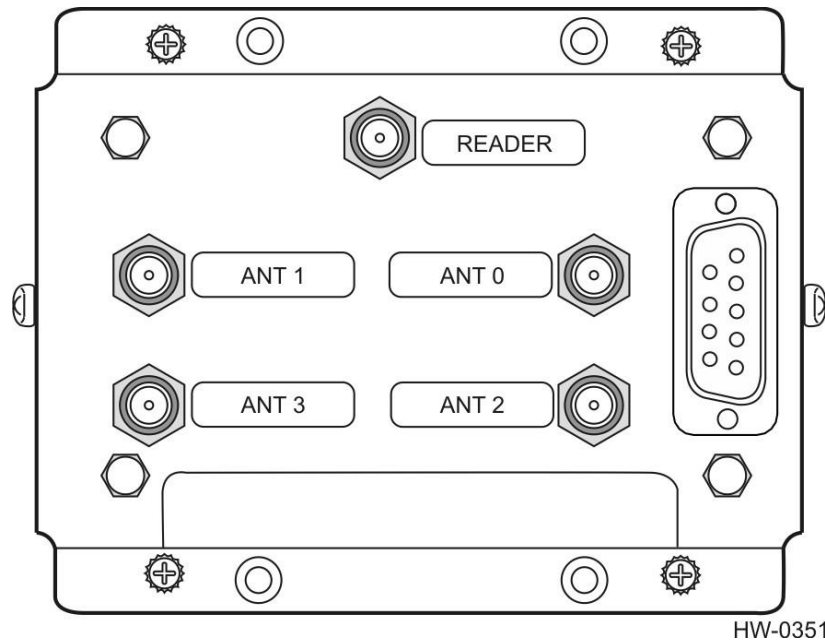


Figure D-11 Antenna Multiplexer Connector Locations

With the Encompass Reader RF output connected to the antenna multiplexer input (READER), the multiplexer output can be directed via a host computer by sending the appropriate UDP or AI1200-emulation commands.

Testing the Antenna Multiplexer Components Using UDP Commands

To test the antenna multiplexer using UDP commands, place a tag under antenna 0 and send the following commands:

- Set/Get Digital I/O RF Multiplexing Mode (0008H/0009H)
- Set/Get Manual Antenna Channel Control

Testing the Antenna Multiplexer Components Using AI1200-Emulation Commands

To test the antenna multiplexer using AI1200-emulation commands, place a tag under antenna 0 and send a #6401 command. You should receive a tag read response. Continue the test for the other three antennas 1, 2, and 3 by sending commands #6402, #6403, and #6404. For each succeeding test, place the test tag under the corresponding antenna. You should get the results listed in [Table D-10](#).

Table D-10 Antenna Multiplexer Results Using AI1200-emulation Commands

Test	Tag Read			
	Antenna 0	Antenna 1	Antenna 2	Antenna 3
#6401	Y	N	N	N
#6402	N	Y	N	N
#6403	N	N	Y	N
#6404	N	N	N	Y

Refer to #642N commands when using the automatic multiplexing operation. Be sure to send a #6405 command to restore automatic multiplexing operation after sending #640N manual multiplexing commands. Command #311 Append Auxiliary Information appends the antenna number to the tag response.

Troubleshooting the Installation

If the testing shows the antenna multiplexer is not working, perform these troubleshooting steps.

1. Ensure that the cables are not crossed and are routed to the correct antennas.
2. Verify that the connectors at the antenna multiplexer, Encompass Reader, and at the UTAs are connected.
3. Verify that the data cable between the Encompass Reader and the antenna multiplexer is connected.
4. Test the line loss for each RF cable between the antenna multiplexer and the UTAs.
5. Connect the RF power meter to the RF source without the cable in-line and measure the power.
6. Connect the RF power meter to the RF source with the cable in-line and measure the power.

Line loss is the difference between the two measurements. Line losses greater than 2 dB indicate potential problems for SeGo and eGo protocol installations. Large line losses indicate potential cable problems. Inspect the suspect cable for faulty terminations or connectors. Replace and/or repair as needed.

If Steps 1 to 6 do not remedy the problem, contact TransCore Systems Engineering for further assistance.

Preventive Maintenance

Visually inspect the antenna multiplexer assembly and coaxial cables and replace or repair components as needed.

To perform a visual inspection

1. Inspect the UTAs for signs of damage or corrosion.
2. Check RF and data cables between the antenna multiplexer, Encompass Reader, and UTAs. Look for damaged or loose connections. Repair and/or replace cables as needed.

Technical Specifications

Table D-11 lists the antenna multiplexer specifications.

Table D-11 Antenna Multiplexer Specifications

Parameter	Specification
Operating temperature	-40°F to 158°F (-40°C to +70°C), when Encompass Reader is not installed in NEMA enclosure. -40°F to 131°F (-40°C to +55°C), when Encompass Reader is installed in NEMA enclosure.
Storage temperature	-40°F to 185°F (-40°C to +85°C)
Vibration 5-20 Hz (sinusoidal) 20-200 Hz (sinusoidal) 10-500 Hz (random)	0.1 inch, peak-to-peak displacement 2.0 G, peak acceleration 2 gRMS
Shock	10 G sawtooth pulse at 11-ms duration
Humidity	0% to 95%, non-condensing

Table D-12 lists the RF control port cable pin-outs.

Table D-12 Antenna Multiplexer RF Control Port Pin-outs

Pin	Description	Function	Limits
1	Not connected	N/A	N/A
2	MUX_SEL_A	Switch logic input	0-5V, 2 mA maximum
3	Not connected	N/A	N/A
4	Not connected	N/A	N/A
5	GND	Ground	N/A

Table D-12 Antenna Multiplexer RF Control Port Pin-outs (continued)

Pin	Description	Function	Limits
6	+5V input	DC bias	5V $\pm$ 5%, 5 mA maximum
7	MUX_SEL_B	Switch logic input	0-5V, 2 mA maximum
8	Not connected	N/A	N/A
9	Not connected	N/A	N/A

Digital Input/Output Assembly

The digital input/output (I/O) assembly is used to interface the Encompass Reader with external inputs and outputs. Inputs can be devices such as light curtains or loops, and outputs can be devices such as gates or lights.

The digital I/O circuit board can accommodate up to four OPTO 22 G4-model input or output modules and screw terminal connectors for connecting the Encompass reader to external interfaces.

Presence detectors (loop detectors, wheel detectors, infrared/laser lights) can be installed through the input sense circuits to turn on the Encompass reader when an object is detected approaching the reading range.

Output functions such as traffic lights, cameras, signs and gates may be controlled through the reader's status output circuits.

The output modules are controlled by 5V signals from the Encompass reader. The output modules support voltages up to 100V DC or 130V AC on their output pins. The input module outputs a 5V signal to the Encompass reader. The input modules recommended by TransCore use from 2.5V to 28V DC.

The OPTO 22 input/output modules are not supplied with the digital I/O assembly. Go to www.opto22.com for a listing of input and output modules.



Caution

*The Encompass Reader digital I/O port is not surge protected, therefore TransCore **strongly recommends** that only OPTO 22 modules be used to configure any external I/O device that will be controlled through the digital I/O port. **DO NOT** connect any external device directly to the digital I/O port.*

Damage to the Encompass Reader caused by power surges or spikes linked to incorrect use of the digital I/O port will void the reader warranty.

Required Components/Tools

Before installing the digital I/O assembly and modules, make sure you have the necessary components.

- Digital I/O Kit (TransCore P/N 77-6000-001). Here is a parts list for the kit:

Quantity	Description
----------	-------------

1	Mounting rack for OPTO modules
4	#6-32 x 1/4 inch Phillips screw

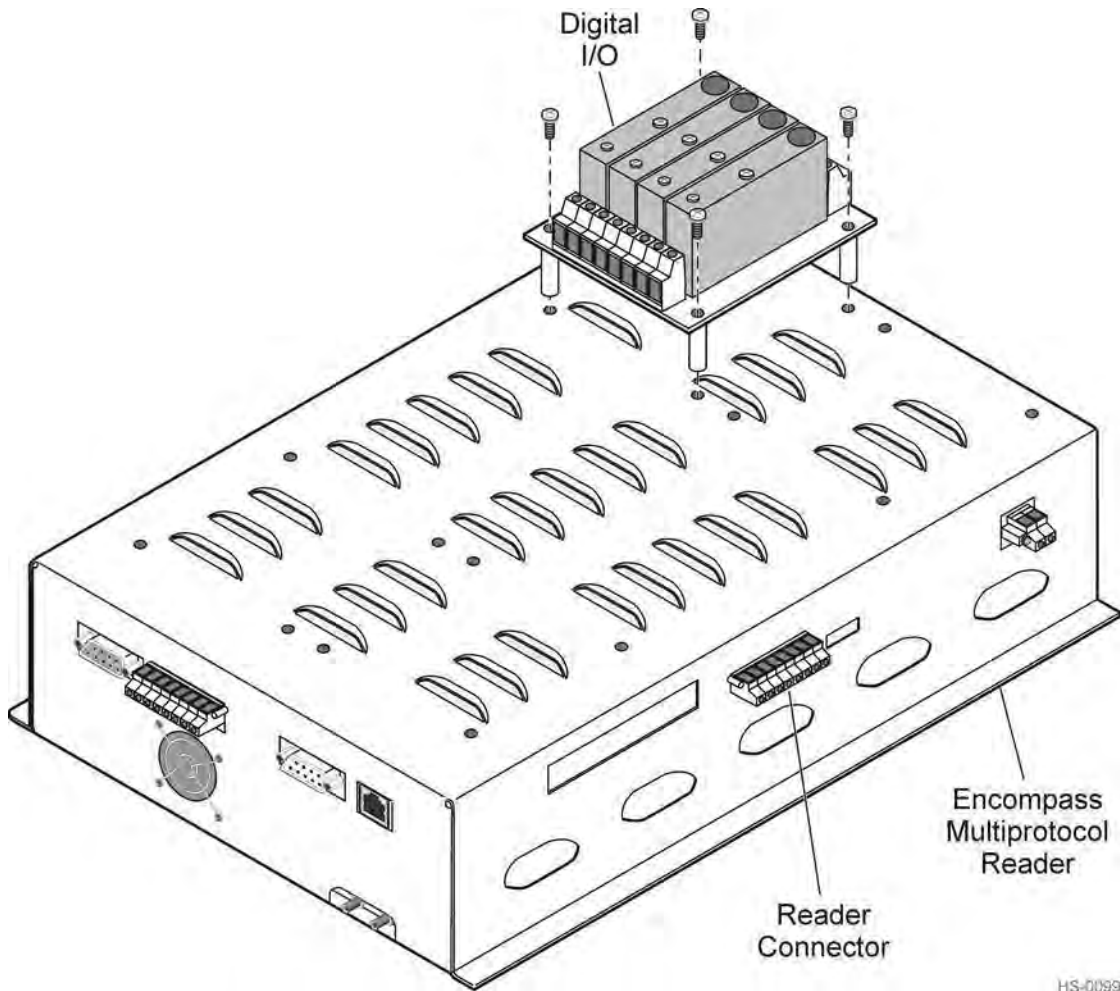
- Phillips head screwdriver for installing the I/O assembly and modules to the Encompass reader.

- Assortment of 14-22 AWG wires to connect modules to mounting rack.

Installation/Mounting

To mount the digital I/O assembly on the Encompass reader

1. Place the assembly on the housing as shown in [Figure D-12](#).



HS-0099

Figure D-12 Location of Digital I/O Assembly on Encompass Reader

2. Insert and tighten the four Phillips head mounting screws.
3. Insert I/O module(s) into assembly and tighten mounting screw at top of module.
4. Connect wires to plug (TransCore P/N 33357-01). TransCore recommends you use 14-22 AWG wire to connect modules to the mounting rack.
5. Connect mounting rack wires to Encompass reader plug as shown in [Figure D-13](#).

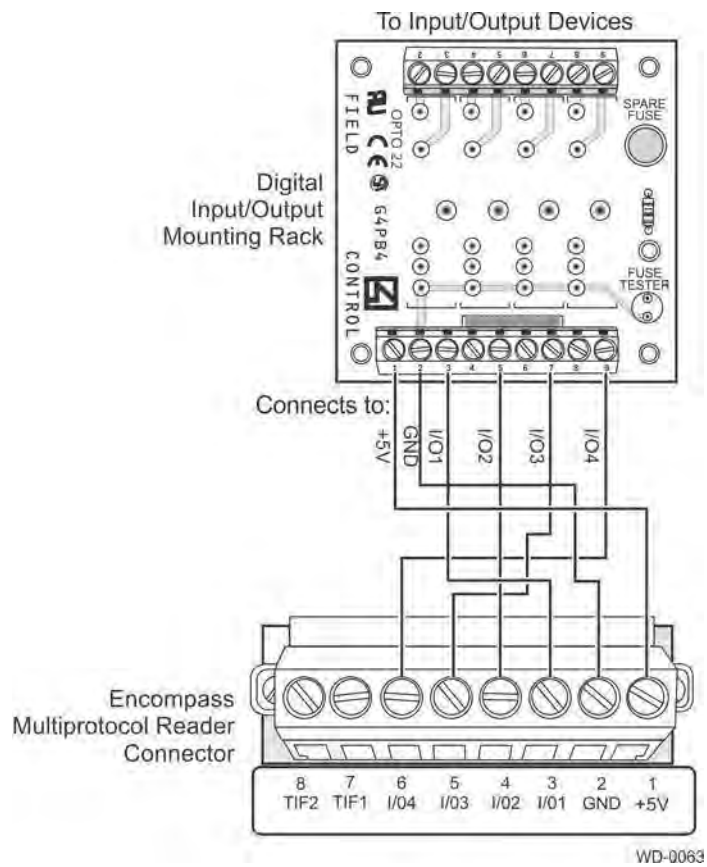


Figure D-13 Digital I/O Mounting Rack-to-Encompass Reader Connector Wiring Diagram

Figure D-14 shows sample wiring schematic for digital I/O Input 1.

Table D-13 Digital I/O Command Group Commands (continued)

Digital I/O Configuration Command	Command Code
Set Digital I/O RF Multiplexing Mode	0008H
Get Digital I/O RF Multiplexing Mode	0009H
Set Digital I/O Output Pulse Duration	000AH
Get Digital I/O Output Pulse Duration	000BH
Set Digital I/O Minimum Presence True Period	000CH
Get Digital I/O Minimum Presence True Period	000DH
Set Digital I/O Sensor Input Inversion	000EH
Get Digital I/O Sensor Input Inversion	000FH
Set Digital I/O Port Configuration	0010H
Get Digital I/O Port Configuration	0011H
Set Digital I/O Sensor Input Report	0012H
Get Digital I/O Sensor Input Report	0013H
Set Digital I/O Presence RF Control Algorithm	0014H
Get Digital I/O Presence RF Control Algorithm	0015H
Set Digital I/O Presence RF Control Time-Out Period	0016H
Get Digital I/O Presence RF Control Time-Out Period	0017H
Get Digital I/O Port Status	0018H
Set Digital I/O Mode	0019H
Get Digital I/O Mode	001AH
Set External Interrupt Control	056DH
Get External Interrupt Control	06ADH

Testing the Digital I/O Components Using AI1200-Emulation Commands

To test the digital I/O components using AI1200-emulation commands, send the appropriate I/O commands (e.g., #620N and #62N) to the external devices and verify the device response.

Troubleshooting

To troubleshoot the digital I/O assembly

1. Plug the spare fuse into the fuse tester. If the LED lights, the assembly has power. If the LED fails to light, replace the fuse and/or assembly.
2. Configure reader port direction (Set Digital I/O Port Configuration (0010H) for UDP and SET OPTO PORT(S) DIRECTION (#697N) for AI1200-emulation to required site application (i.e., number of inputs, number of outputs).
3. Toggle input lines by activating devices and ensure the devices assert correct signal and that the corresponding I/O module LED lights.
4. If performing steps 1 to 3 does not remedy the problem, contact TransCore Systems Engineering for further assistance.

Preventive Maintenance

Ensure that the I/O modules and wire connections are tight, and that the connection to the Encompass reader is secure.

Technical Specifications

Table D-14 lists the digital I/O assembly specifications.

Table D-14 Technical Specifications

Parameter	Specification
Nominal Input Voltage	5V DC $\pm$ 0.1V DC
Dimensions	3.25 x 3.25 x 1.5 in. (8.26 x 8.26 x 3.8 cm) assembly only 3.25 x 3.25 x 2.25 in. (8.26 x 8.26 x 5.7 cm) assembly and modules
Weight	2.7 oz (76.5 g) assembly only 6.4 oz (181.4 g) assembly and modules
Operating temperature Installed in NEMA enclosure Not installed in NEMA enclosure	-40°F to +131°F (-40°C to +55°C) -40°F to +158°F (-40°C to +70°C)
Storage temperature range	-40°F to +185°F (-40°C to +85°C)

Table D-14 Technical Specifications (continued)

Relative humidity	5% to 95% non-condensing
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Guidelines for Ordering the I/O Modules

The digital I/O assembly can accommodate up to four OPTO 22 G4-model input or output modules for connecting the Encompass reader to external interfaces. TransCore recommends that the I/O modules have the following specifications:

Input Module — input voltage from Encompass reader: 2.5V to 28V DC; output voltage to Encompass reader: 5V DC logic

Output Module — input voltage from Encompass reader: 5V DC logic; output voltages of up to 100V DC or 130V AC on their output pins.

[Table D-15](#) lists the acceptable OPTO 22 input modules and [Table D-16](#) lists the acceptable OPTO 22 output modules to be used with the Encompass reader.

Table D-15 Acceptable Input Modules

OPTO 22 MODULE P/N	INPUT VOLTAGE	OUTPUT VOLTAGE
G4IAC5	90V-140V AC or DC	4.5V-6V DC
G4IAC5L	90V-140V AC or DC	4.5V-6V DC
G4IAC5MA	90V-140V AC or DC	4.5V-6V DC
G4IDC5	10V-32V DC or 12V-32V AC	4.5V-6V DC
G4IDC5B	4V-16V DC or AC	4.5V-6V DC
G4IDC5D	2.5V-28V DC	4.5V- 6V DC
G4IDC5K	2.5V-16V DC	4.5V-6V DC
G4IDC5MA	10V-32V DC or 12V-32V AC	4.5V-6V DC
G4IDC5-SW	Dry contact	4.5V-6V DC
G4IDC5-SWNC	Dry contact	4.5V-6V DC

Table D-16 Acceptable Output Modules

OPTO 22 MODULE P/N	INPUT VOLTAGE	OUTPUT VOLTAGE
G4OAC5	4V-8V DC	12-140V AC
G4OAC5FM	4V-8V DC	12-140V AC
G4OAC5MA	4V-8V DC	12-140V AC

Table D-16 Acceptable Output Modules (continued)

G4ODC5	4V-8V DC	5V-60V DC
G4ODC5FM	4V-8V DC	5V-60V DC
G4ODC5MA	4V-8V DC	5V-60V DC
G4ODC5R	4.8V-6V DC	100V DC or 130V AC
G4ODC5RFM	4.8V-6V DC	100V DC or 130V AC
G4ODC5R5	4.8V-6V DC	100V DC or 130V AC
G4ODC5R5FM	4.8V-6V DC	100V DC or 130V AC

You can configure the I/O assembly with any combination of the four modules; for instance, four inputs, four outputs, three inputs and one output, three outputs and one input, and so on.

Global Positioning System Timing Option

The Global Positioning System (GPS) timing option available on Encompass 6 and Encompass 5 Multiprotocol Readers permits a GPS-equipped multiprotocol reader in one plaza to be synchronized with another GPS-equipped multiprotocol reader in another location without being physically connected by a time-division multiplexing (TDM) data cable. This configuration is highly useful when physical barriers or boundaries prevent a TDM data cable between plazas to be used. The GPS option also can be used to synchronize any number of GPS-equipped multiprotocol readers when no physical barrier is present.

The GPS timing assembly, which uses the globally available NAVSTAR GPS satellite navigation and timing service, can provide a precise 1 pulse per second (PPS) timing signal to the Encompass Reader. The GPS timing assembly mounts to the top of the Encompass Reader (Figure D-15).

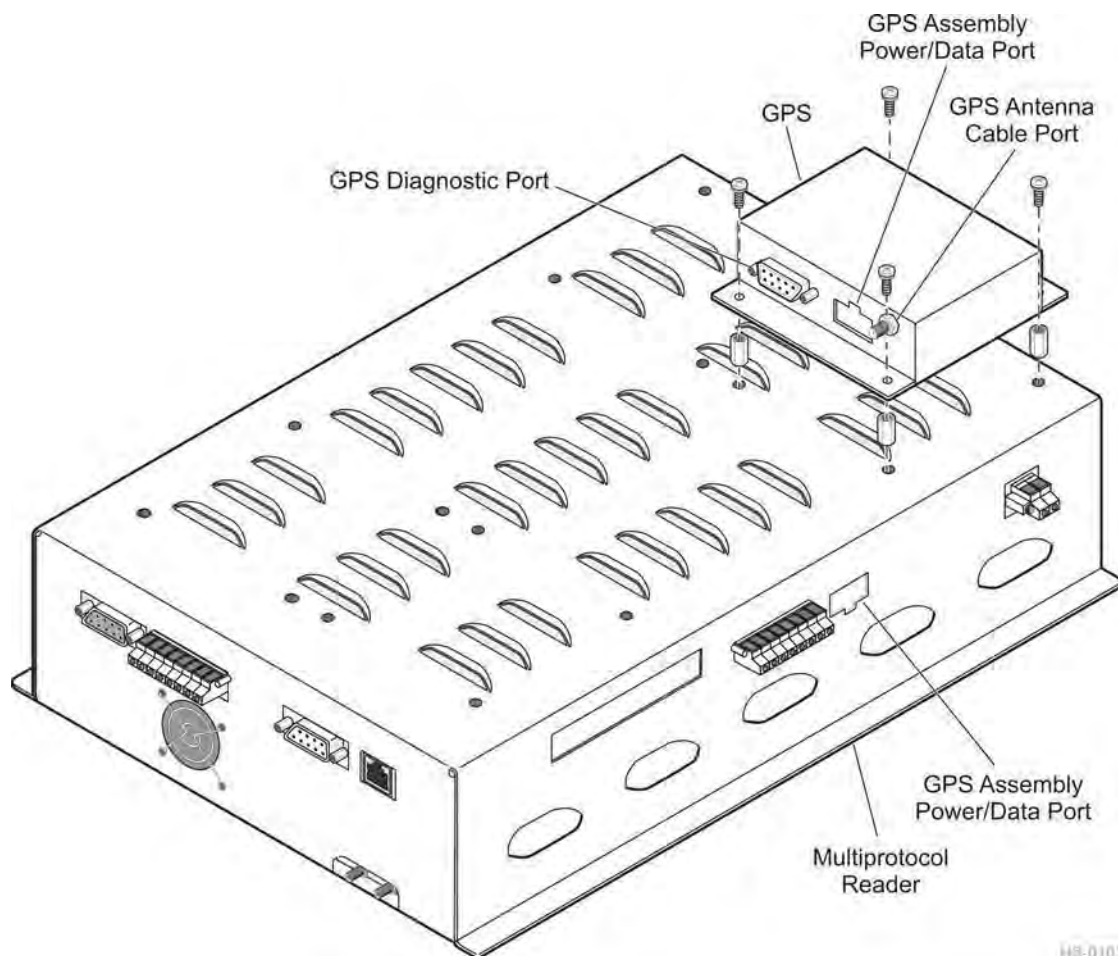
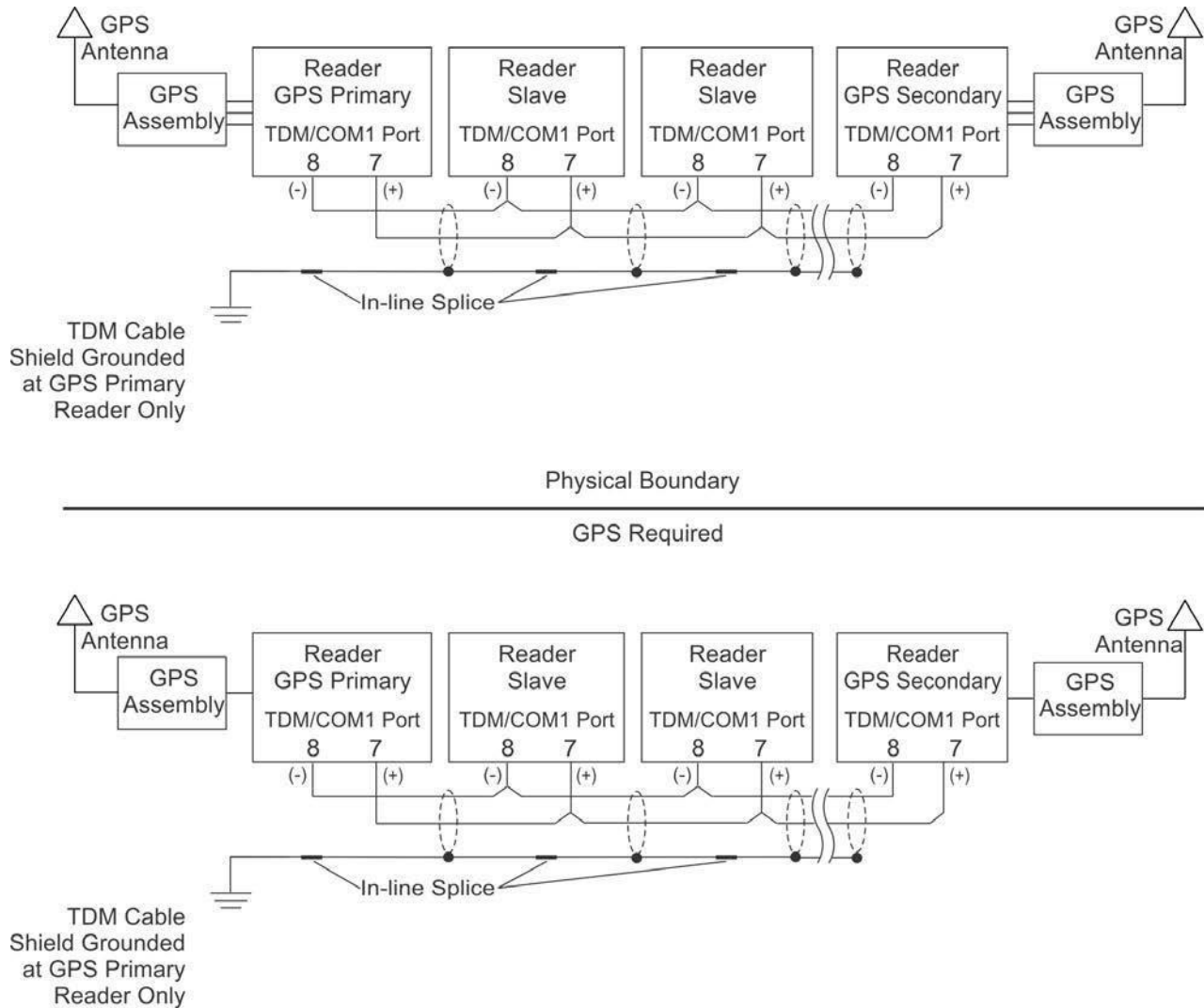


Figure D-15 GPS Assembly Mounted to Encompass Reader

This GPS timing option permits a GPS-equipped Encompass Reader in one plaza to

be synchronized with another GPS-equipped Encompass Reader in another plaza without being physically connected by a TDM data cable (Figure D-16). This configuration is useful when physical barriers or long distances prevent a TDM data cable between plazas to be used.



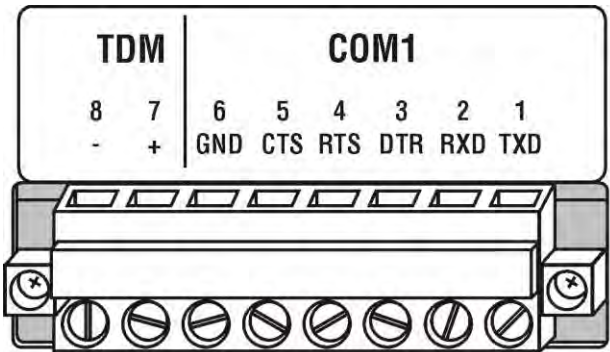
WD-0085

Figure D-16 TDM Configuration Using GPS Timing Option

TransCore recommends Belden 89182 (150 Ω impedance), which is a single twisted-pair shielded cable rated for outdoor use, or 8132 (120 Ω impedance), which is a double twisted-pair shielded cable that must be installed in conduit. The Belden 8132 cable has an extra pair that is not used. Using these low-loss, low-capacitance twisted-pair cable, a distance of 1000 feet (305 m) has been obtained. This maximum distance may be slightly longer or shorter depending on the cable type used.

TransCore recommends using the cable shielding and grounding scheme shown in [Figure D-16](#) to reduce the risk of electromagnetic interference disrupting or damaging the TDM circuitry in the Encompass reader.

Additional slave Encompass Readers are connected to the primary Encompass Reader through pins 7 and 8 of the TDM/COM1 port ([Figure D-17](#)), which is located just above the fan. Refer to [Figure D-15](#) for the connector location.

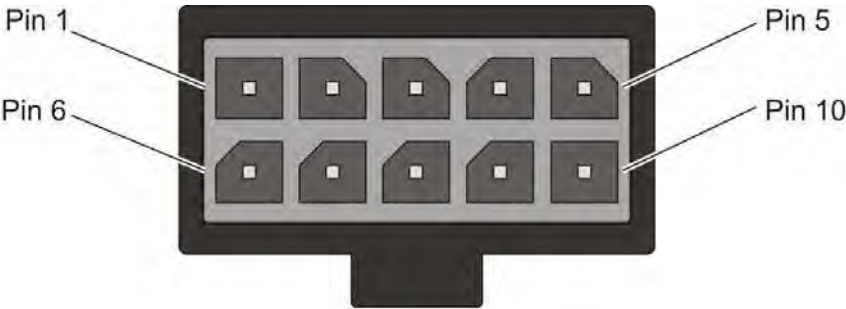


HW-0345

Figure D-17 GPS Timing Module Port

GPS Power and Data Connector

[Figure D-18](#) shows the power and data connector and [Table D-17](#) lists the connector pin assignments and descriptions.



HW-035E

Figure D-18 GPS Assembly Power/Data Connector

Table D-17 GPS Assembly Connector Pin Assignments and Signal Descriptions

Pin	Signal	Description
1	TXD1	Transmit data (3V logic)
2	RXD1	Receive commands (3V logic)

Table D-17 GPS Assembly Connector Pin Assignments and Signal Descriptions

3	Not connected	N/A
4	1 PPS	1 pulse-per-second output
5	Ground	Signal and power common
6	Not connected	N/A
7	Not connected	N/A
8	Not connected	N/A
9	GPS receiver and antenna power	+5V
10	Not connected	N/A

The GPS antenna mounts outside the plaza structure (Figure D-19). The antenna connects to the GPS assembly with a coaxial cable.

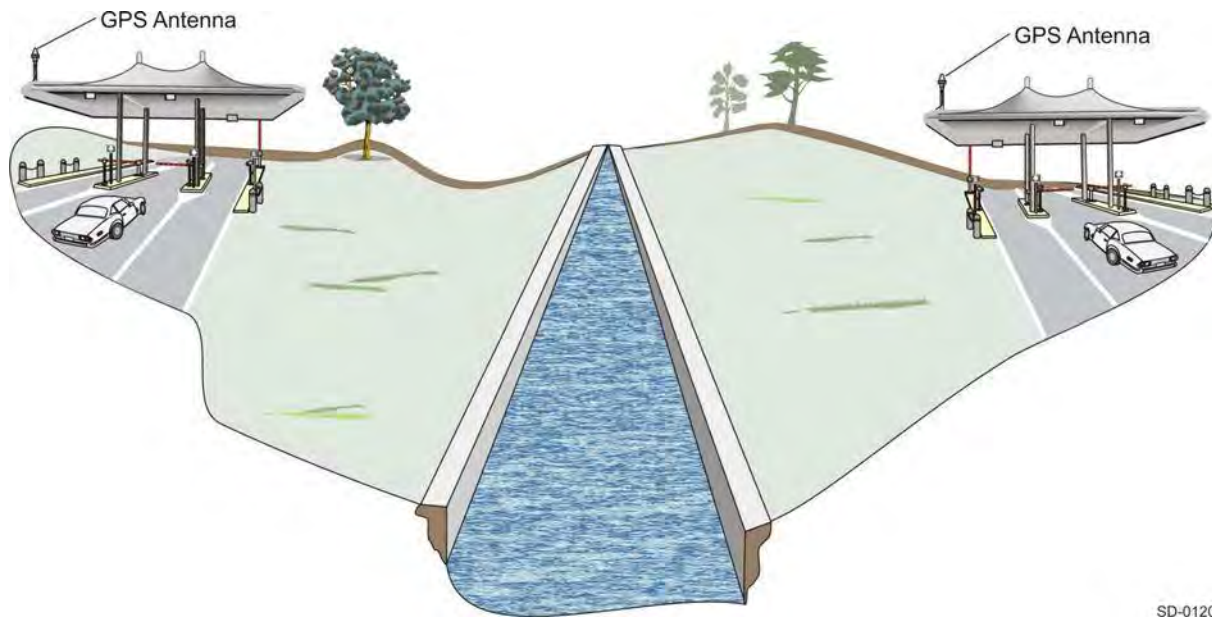


Figure D-19 Example of GPS Used to Connect Separate Parking Sites

Before Installing the GPS Antenna

Before installing the GPS for the toll plaza, you need to ensure that the antenna will be visible to GPS satellites. You should choose an antenna location that has clear, 360-degree visibility to the sky.

Once you are sure that the antenna reception will be unobstructed, you can begin installing the antenna. Make sure you have the following TransCore-supplied items:

GPS kit (TransCore P/N 23-5000-001 or 23-6000-001) consists of the items listed in [Table D-18](#):

Table D-18 Global Positioning System Accessory Kit Contents

Quantity	Description
1	Global positioning system assembly
1	Active GPS antenna
1	GPS power/data cable
4	#6-32 x 3/8 inch stand-off
4	#6-32 x 1/4 inch Phillips screw

Required Components/Tools

Once you are sure that the antenna reception will be unobstructed, you can begin installing the antenna. Make sure you have the following TransCore-supplied items:

- GPS timing accessory kit (GPS assembly, power/data cable, antenna, and mounting hardware, TransCore P/N 19100-00)

You need the following additional equipment and tools to complete the installation:

- Coaxial cable connectors (Type-N plug connector for GPS antenna and 50-ohm SMA plug connector for GPS assembly)
- Fifty-ohm antenna coaxial cable with attenuation loss of less than 12 dB @1.575 GHz.

***Note:** Maximum cable length is determined by cable attenuation loss. Installer should calculate the cable loss for the specific cable being used.*

- Pole/pipe mounting hardware (e.g., anchor bolts)
- Length of 1 1/4-inch (3.175 cm) Schedule 40 pipe (stainless steel, aluminum, or galvanized steel) to be used for antenna pole
- Cable terminating/crimping tools
- Torque-limiting wrench (in-lb range)
- Standard set of tools (screwdrivers, pliers, wrenches) for fastening the GPS assembly to the multiprotocol reader.
- Special tools for installing the GPS antenna at site, for example, impact hammer for drilling into concrete, if needed.

You can order additional GPS antennas (P/N 20015-01) from TransCore.

GPS Timing Assembly Mounting

1. Screw the four standoffs into the mounting holes of the multiprotocol reader as shown in [Figure D-15](#).
2. Place the GPS assembly on the standoffs and secure with the Phillips screws provided in the kit.



Caution

Tighten the standoffs and mounting screws until snug. Do not overtighten.

3. Connect the GPS assembly to the reader with the power/data cable provided in the GPS assembly kit.

GPS Antenna Mounting

***Note:** The GPS antenna installation must comply with applicable structural and building codes for the locale where it is being installed.*

1. Select a location for the GPS antenna that provides maximum visibility to the sky.
2. Secure the antenna pole mounting hardware to the site structure.
3. Connect the antenna pole to the mounting hardware.
4. Insert the RF coaxial cable up through the inside of the mounting pipe and connect the cable to the antenna using a Type-N plug connector.

Refer to [Figure D-20](#) when assembling the antenna components.

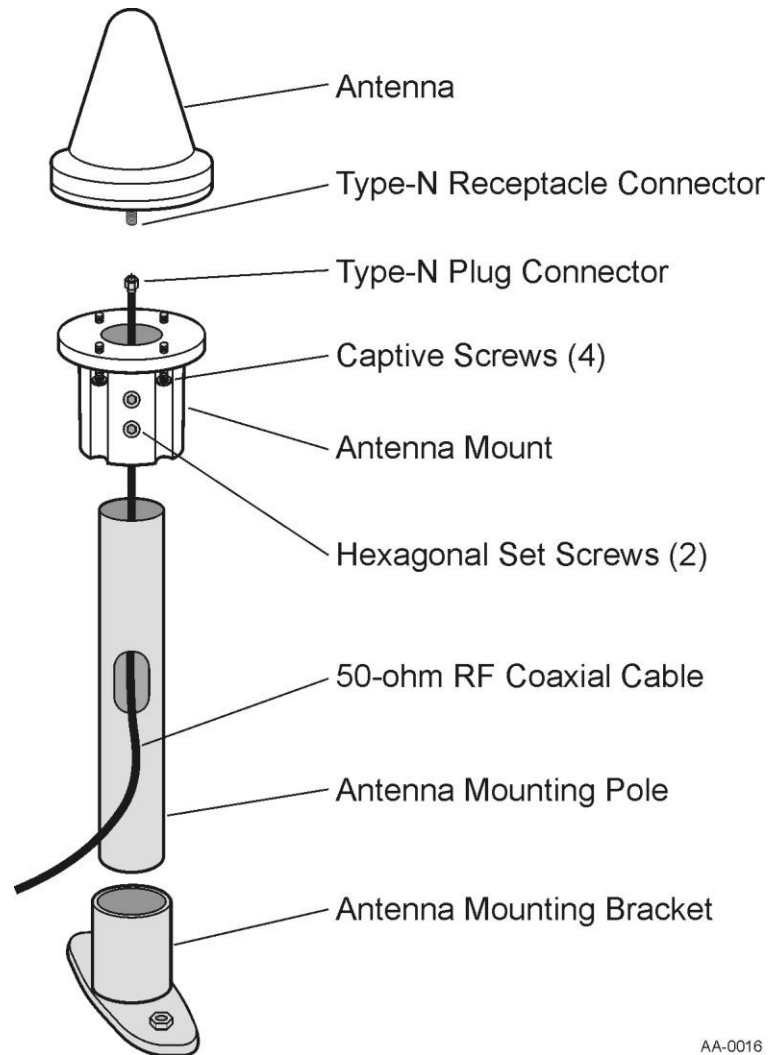
You also can cut a 1-inch (2.54-cm) wide by 2-inch (5.1-cm) long slot in the side of the mounting pipe ([Figure D-20](#)). TransCore recommends this procedure for installing the RF coaxial cable when it cannot be pulled through the bottom of the pipe.

5. Pull the cable up through the pipe bottom or slot and terminate it at the antenna port.

***Note:** If you choose to use a different mounting pole material than the 1-¼ inch (3.175 cm) Schedule 40 pipe, the pole material should have a nominal outside diameter of 1.66 inches (4.2 cm). Proper material selection for the field installation is left to the system installers.*

6. Slip the antenna mount over the coaxial cable.
7. Screw the Type-N plug connector onto the type-N antenna receptacle connector and tighten until snug.
8. Connect the mount to the antenna by tightening the four captive screws until snug.
9. Push the antenna-mount assembly onto the antenna pipe or pole and tighten the hex-head set screws on the antenna mount.

10. Connect the antenna to the multiprotocol reader at the GPS antenna cable port (Figure D-15). Tighten this SMA connector to 10 in-lb.



AA-0016

Figure D-20 GPS Antenna Assembly



Caution

To prevent damage to the SMA connector, TransCore strongly recommends that you provide a strain-relief bracket or other means of securing the GPS antenna coaxial cable that terminates at the GPS timing assembly.

Note: *The antenna mount must be grounded in accordance with National Electrical Code regulations for the locale where the Encompass reader/GPS antenna system is being installed.*

Testing the GPS Timing System

The following sections list basic command information for testing using a UDP or AI1200-emulation command.

***Note:** As the GPS system activates, the TDM error LED lights on the Encompass reader. This error indication usually clears in about 1 minute, but it can take as long as 15 minutes.*

Using the UDP Command Set

Configure and test the GPS timing option using the UDP command set by sending the appropriate UDP command ([“Set Master/Slave Mode” on page 6-115](#)).

Using the AI1200-Emulation Command Set

Configure the GPS timing option using the AI1200-emulation command set by sending the [“#984NYY SET TDM AS MASTER OR SLAVE” on page 7-138](#) to enable the GPS primary function.

Configuring the Reader/Slave Count

This section explains how to configure the reader/slave hierarchy (GPS primary/GPS secondary or master/slave) using the GPS UDP or AI1200-emulation command.

Choose one field only, for example, GPS primary, GPS secondary, master, or slave.

GPS Primary — This field specifies whether the reader is to be configured as the GPS primary.

GPS Primary	Definition
0	Not GPS Primary
1	GPS Primary

***Note:** For AI1200-emulation command set use #9843YY.*

GPS Secondary — This field specifies whether the reader is to be configured as the GPS secondary.

GPS Secondary	Definition
0	Not GPS Secondary
1	GPS Secondary

***Note:** For AI1200-emulation command set use #9842YY.*

Master — This field specifies whether the reader is to be configured as the master.

Master	Definition
0	Not Master
1	Master

Note: For A11200-emulation command set use #9841YY.

Slave — This field specifies whether the reader is to be configured as the slave.

Slave	Definition
0	Not Slave
1	Slave

Note: For A11200-emulation command set use #9840YY.

For this example, the sum of the delay and duration period is 19.9 milliseconds, which is less than the synchronization rate of 20 milliseconds. If the sum of the delay and duration periods equals the synchronization rate, unexpected results can occur.

Slave Select Count — This field specifies the order that a slave or GPS primary or secondary reader issues a synchronization pulse whenever a given reader within a synchronization group fails to recognize the signal from the preassigned master or whenever a GPS receiver fails to issue a 1-pps signal, respectively. The maximum slave count = 26.

Scenario 1 — One master, n slaves. The master has no slave behavior, therefore it is assigned a slave select count of 0. Each slave is assigned an increasingly greater number from 1 to n. When the master fails, slave 1 becomes the master, and so on.

Scenario 2 — GPS primary, GPS secondary, N slave readers. When in fault mode (1-pps signal missing), a GPS primary is slave to a GPS secondary and all other slaves and is assigned the last slave select count, n. A GPS secondary takes over when a GPS primary is in fault mode, therefore it is assigned a slave select count of 1. All slaves are assigned increasingly greater numbers from 2 to n+1.

Scenario 3 — One GPS primary and n slaves. This scenario forces the GPS primary to have no slave behavior by specifying a slave select count of 0. Each slave is an increasingly higher number from 1 to n. When the master fails, slave 1 becomes the master. If slave 1 should fail, slave 2 takes over, and so on ([Table D-19](#)).

Table D-19 Reader Slave Count Configuration Table

Scenario 1 — One Master, n Slaves						
Reader Mode	Master	Slave	Slave	Slave	Slave	Slave
Slave Select Count	0	1	2	...	n-1	n
Scenario 2 — GPS Primary, GPS Secondary, n Slaves						
Reader Mode	GPS Secondary	Slave	Slave	Slave	Slave	GPS Primary
Slave Select Count	1	2	3	...	n+1	n+2
Scenario 3 — One GPS Primary, n Slaves						
Reader Mode	GPS Primary	Slave	Slave	Slave	Slave	Slave
Slave Select Count	0	1	2	...	n-1	n
n = Total number of slave readers						

Environmental

Temperature Range for GPS Assembly

The GPS assembly can operate within the following operating and storage temperature conditions ([Table D-20](#)).

Table D-20 Operating/Storage Temperature Limits and Conditions

Specification	Limits/Conditions
Operating temperature Installed in NEMA enclosure	-40°F to +131°F (-40°C to +55°C)
Not installed in NEMA enclosure	-40°F to +158°F (-40°C to +70°C)
Storage temperature range	-40°F to +185°F (-40°C to +85°C)

Humidity

The Encompass Reader GPS assembly is rated to operate within humidity levels of 0% to 95%, non-condensing.

GPS Antenna

Table D-21 lists the GPS antenna specifications.

Table D-21 GPS Antenna Specifications

Parameter	Specification
Operating temperature	-40°F to +185°F (-40°C to +85°C)
Operating frequency	1527.42 ±1.023 MHz, typical
Power supply	5V DC
Current	27 mA maximum
Polarization	RT hand circular
Output VSWR	2.5 maximum
Gain	30 dB minimum

GPS Assembly Connector

GPS Diagnostic Port

The GPS diagnostic port is used for factory diagnostics only.

GPS Antenna Cable

The antenna connects to the GPS assembly via an RF coaxial cable that is supplied by the Encompass Reader user. The GPS antenna cable connects the receiver to the assembly's end panel and is externally available.

For applications requiring lightning protection on the GPS assembly/antenna system, the lightning arrestor must be able to pass DC voltage or current on the center conductor of the coaxial cable. The GPS assembly transmits a DC bias voltage and current through the center conductor from the antenna to power the low-noise amplifier, which is integrated into the active GPS antenna. Using a DC-block lightning protection system will not work. TransCore recommends you use a gas-discharge-type system designed for an active GPS antenna.

Regulatory Requirements

Emissions

The GPS assembly complies with the requirements of FCC Part 90, FCC Part 15, and industry Canada RSS-137 (where applicable).

Safety

The GPS assembly is UL60950 approved.

Electrical Protection

ESD

With the GPS assembly installed and operated as part of a complete Encompass chassis assembly, the assembly complies with the requirements of the International Electrotechnical Commission/Comite, Europe, en de Normalisation (IEC/EN) 61000-4-2, Class 4 standard ([Table D-22](#)).

Table D-22 ESD Limits and Conditions

Discharge Voltage	16.0 kV
Polarity	Positive
Number of Repetitions	2 pulses
ESD System	NSG438 system, which complies with a 150-picofarad/330-ohm discharge network of the IEC/EN 61000-4-2 standard
Test conditions	All ESD tests are performed at +77°F (+25°C)

Antenna Drive and Protection Circuitry

The receiver uses an antenna sense circuit that detects under-current (open), over-current (shorted or exceeding maximum), or valid antenna connection. The receiver supplies up to 80 milliamps (mA) of current via the antenna power supply circuit.

If the antenna draws 15 mA or more, a status bit in the antenna status information is set, giving a good indication that an antenna is attached.

If the antenna draws less than 15 mA, an alarm bit is set indicating an under-current condition in the antenna status information.

If more than 80 mA is drawn through the antenna port, then the over-current detection circuitry will reduce the antenna feed current to approximately 45 mA until the fault is cleared.

Detection of an under-current situation will not prevent the receiver from operating. The receiver will continue to operate normally, but will issue an error flag indicating a possible antenna problem.

Antenna Drive Current Limits

Undercurrent detect @+77°F (25°C)

Good Indication: greater than 15 mA

Undercurrent Indication: less than 15 mA

Over-current Detect @+77°F (25°C): 80 mA maximum for normal operation

Troubleshooting the GPS System

Note: See “Communicating Via Diagnostic Port (COM2)” on page 10-4 to learn how to access system diagnostics fault messages.

When the GPS receiver initializes, it performs a self-test, which includes a check of the GPS antenna status. If a fault condition exists, the message displays GPS Self Test Fault = 1, which means that an error condition exists with either the GPS receiver or coaxial antenna cable. You can display the fault status by entering a ShowSysStatus-Bits command from a PC.

If a fault condition exists, first check the GPS coaxial cable and connections. After checking the cable, if the fault condition remains, switch the cable with another, good, cable. If the fault condition continues, return the GPS assembly to TransCore.

If the GPS self-test reveals no faults, the status bit displays GPS Self Test Fault = 0. No further action is required.

E

Command-Based Pre- and Post-Conditions

Command-Based Pre- and Post-Conditions

This appendix lists pre- and post-conditions for both user datagram protocol (UDP) and AI1200-emulation configuration commands. In these tables, Stop Mode Required indicates that the reader first must be set to Stop Mode (Mode 0) as a pre-condition to entering the specified command. The post-conditions, Immediate or Reset Required, indicate that the command either takes effect immediately or that the reader must be reset after the command has been entered. This is a subset of the complete list of commands and lists only those commands that are needed to configure an Encompass multiprotocol reader.

UDP Command Pre- and Post-Conditions

Table E-1 lists the UDP command pre- and post-conditions.

Table E-1 Pre- and Post-Conditions for UDP Commands

UDP Command Group	Command #	Command	Stop Mode Required/ Immediate/Reset Required
0x0200 - Diagnostics	0x0005	Clear Error Logs	Immediate
0x0400 - Mode	0x0001	Set Mode	Immediate if 1) UDP host startup selected and mode and has not been set previously; 2) Stop Mode is requested; or 3) Mode has been set previously, Stop Mode is current mode, and requested mode is same as previous operational mode. Reset Required if 1) UDP non-volatile memory startup selected and requested mode is not Stop Mode; or 2) requested mode is different from previous operational mode.

Table E-1 Pre- and Post-Conditions for UDP Commands (continued)

UDP Command Group	Command #	Command	Stop Mode Required/ Immediate/Reset Required
0x0400 - Mode	0x0003	Set Protocol	Reset Required
0x0400 - Mode	0x0043	Set Tag Command Data	Immediate if 1) Protocol is ATA or ATA 1/2-frame 2) Protocol is IT2200 and request is host driven; or 3) Protocol is CVISN. Stop Mode Required if 1) Protocol is IT2200 and request is not host driven. Reset Required if 1) Protocol is SeGo or eGo and Command Action is 0.
0x0400 - Mode	0x0066	Set Seen Count	Immediate
0x1000 - Tag	0x0002	Set Append Data	Immediate
0x1000 - Tag	0x0025	Run Check Tag	Immediate
0x1000 - Tag	0x002A	Set Manual Antenna Channel Control	Immediate
0x1000 - Tag	0x0030	Set IAG Slot	Reset Required
0x1000 - Tag	0x0040	Set Secondary Tag Sequence	Reset Required
0x1000 - Tag	0x0045	Set Master/Slave Mode	Immediate
0x2000 - RF	0x51	Set Attenuation	Immediate
0x2000 - RF	0x53	Set Data Detect	Immediate
0x2000 - RF	0x55	Set Line Loss	Immediate
0x2000 - RF	0x57	Set Uplink Source Control	Immediate
0x2000 - RF	0x60	Set Frequency in MHz	Stop Mode Required
0x4000 - Digital I/O	0x0000	Set Sensor Status Change Report	Immediate

Table E-1 Pre- and Post-Conditions for UDP Commands (continued)

UDP Command Group	Command #	Command	Stop Mode Required/ Immediate/Reset Required
0x4000 - Digital I/O	0x0002	Set Output Host Control	Immediate if output host control is enabled (i.e., both predefined output control and output by channel are disabled) Reset Required if output host control is disabled (i.e., either predefined output control or output by channel is disabled)
0x4000 - Digital I/O	0x0004	Set Output Tag Read Control	Reset Required
0x4000 - Digital I/O	0x0006	Set RF Control	Reset Required
0x4000 - Digital I/O	0x0008	Set RF Multiplexing Mode	Reset Required
0x4000 - Digital I/O	0x000A	Set Output Pulse Duration	Stop Mode Required
0x4000 - Digital I/O	0x000C	Set Minimum Presence True Period	Stop Mode Required
0x4000 - Digital I/O	0x000E	Set Sensor Input Inversion	Stop Mode Required
0x4000 - Digital I/O	0x0010	Set Port Configuration	Reset Required
0x4000 - Digital I/O	0x0012	Set Sensor Input Report	Immediate
0x4000 - Digital I/O	0x0014	Set Presence RF Control Algorithm	Stop Mode Required
0x4000 - Digital I/O	0x0016	Set Presence RF Control Time-out Period	Stop Mode Required
0x4000 - Digital I/O	0x056D	Set External Interrupt Control	Reset Required (may only be set if UDP Host Startup is configured, and must be set prior to setting mode. Reset is required to change parameters.)
0x8000 - System	0x0003	Set Time and Date	Immediate
0x8000 - System	0x0009	Delete All Buffered Tag Transactions	Immediate
0x8000 - System	0x0011	Set UDP/IP Core Lane Controller Parameters	Reset Required
0x8000 - System	0x0013	Set UDP/IP Core IP Address	Immediate

Table E-1 Pre- and Post-Conditions for UDP Commands (continued)

UDP Command Group	Command #	Command	Stop Mode Required/ Immediate/Reset Required
0x8000 - System	0x0016	Set Buffered Tag Transaction Mode	Immediate
0x8000 - System	0x0018	Set Data Acknowledge Time-out Period	Immediate
0x8000 - System	0x001A	Set Switch Buffered Tag Transaction Mode Enable	Immediate
0x8000 - System	0x001F	Get System Serial Number	Immediate

AI1200-Emulation Command Pre- and Post-Conditions

Table E-2 lists the AI1200-emulation command pre- and post-conditions.

Table E-2 Pre- and Post-Conditions for AI1200-emulation Commands

AI1200-emulation Command #	Command	Stop Mode Required/ Immediate/Reset Required
#00	Switch to Data Mode	Immediate
#01	Switch to Command Mode	Immediate
#100N	Set Baud Rate	Reset Required
#101N	Set COM1 Port Stop Bits	Reset Required
#102N	Set COM1 Port Parity	Reset Required
#103N	Set End of Line Delay	Reset Required
#20	Set Time	Immediate
#21	Set Date	Immediate
#30N	Append Time and Date Selection	Immediate
#31N	Append Auxiliary Information Selection	Immediate
#40	Transmit All ID Codes	Immediate

Table E-2 Pre- and Post-Conditions for AI1200-emulation Commands (continued)

AI1200-emulation Command #	Command	Stop Mode Required/ Immediate/Reset Required
#410N	Select Unique ID Code Criteria	Immediate
#420N	Select Valid ID Code Criteria	Immediate
#440	Reset Uniqueness on All Channels	Immediate
#440N	Reset Uniqueness Per Channel	Immediate
#44N	Set Variable Time-out	Immediate
#47NN	Select Tag Type Mode	Immediate if 1) Stop Mode is requested; or 2) Mode has been set previously, Stop Mode is current mode, and requested mode is same as previous operational mode. Reset Required if 1) Mode has not been set previously; or 2) Requested mode is different from previous operational mode, and is not Stop Mode.
#487N	Set IAG Slot Number	Immediate
#493	Set Tag Command Parameters	Immediate if protocol is IT2200. Reset Required if protocol is SeGo or eGo.
#4ANNNN	Set Protocols — Universal Tag Mode	Reset Required
#4B[APN]	Set Secondary Tag Sequences	Reset Required
#60NN	Set Reader ID Number	Immediate
#61N	Select Communication Protocol	Immediate
#612NN	Set Error Correcting Protocol Time-out	Immediate
#614N	Flow Control Settings	Reset Required
#616N	Buffer Control Mode Settings	Immediate
#617N	Echo Settings	Immediate

Table E-2 Pre- and Post-Conditions for AI1200-emulation Commands (continued)

AI1200-emulation Command #	Command	Stop Mode Required/ Immediate/Reset Required
#620N	Set Output Control	Immediate
#62N	Set Predefined Output Control	Reset Required
#640N	RF Control	Immediate
#641N	RF Mode Control	Reset Required
#642N	RF Antenna Multiplexer Mode	Immediate
#65	Reset Power Outage Bit	Immediate
#66F	Load Default Operating Parameters	Reset Required
#67NP	Set Output Pulse Duration	Immediate
#690N	Sensor Input Reports	Immediate
#691N	Set Minimum Presence True Period	Immediate
#692N	Select Presence RF Control Algorithm	Immediate
#693N	Select Presence RF Control Time-out Period	Immediate
#694N	Select Sense Input Inversion	Immediate
#696S...S	Store Hardware Configuration	Immediate
#697N	Set Opto Port(s) Direction	Reset Required
#810	Disable System Check Tag Periodic Mode	Immediate
#813YX	Set System Check Tag Periodic Time Interval	Immediate
#82N	Set Sensor Status Change Mode	Immediate
#920NDU	Set RF Attenuation	Immediate
#921NRR	Set Range Adjust	Immediate
#9CNNNNN	Set Uplink Frequency in MHz	Stop Mode Required
#94PS	Set Uplink Source Control	Immediate
#9FNNNNN	Set Downlink Frequency in MHz	Stop Mode Required
#960N	Set Line Loss	Immediate
#980	Turn TDM Off	Immediate

Table E-2 Pre- and Post-Conditions for AI1200-emulation Commands (continued)

AI1200- emulation Command #	Command	Stop Mode Required/ Immediate/Reset Required
#984NNYY	Set TDM As Master or Slave	Immediate

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