

# Multiprotocol Rail Reader System Guide

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**This version of the MPRR guide is preliminary information, which was provided to Rogers Lab to satisfy FCC licensing submittal requirements.**

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**TRANSCORE®**

TransCore  
8600 Jefferson Street NE  
Albuquerque, New Mexico 87113

October 2010

P/N 412123

## ***Multiprotocol Rail Reader System Guide***

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For further information, contact:

TransCore  
3410 Midcourt Road, Suite 102  
Carrollton, Texas 75006 USA

Phone: (214) 461-4031  
Fax: (214) 461-6478

Technical Support

Web: [transcore.com/rfidsupport](http://transcore.com/rfidsupport)

For comments or questions about this document, e-mail [tech.pubs@transcore.com](mailto:tech.pubs@transcore.com).

**WARNING TO USERS IN THE UNITED STATES**

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

**NOTE:** The user is required to obtain a Part 90 site license from the FCC to operate this radio frequency identification (RFID) device in the United States. See product label for FCC ID number. Access the FCC Web site at [www.fcc.gov/Forms/Form601/601.html](http://www.fcc.gov/Forms/Form601/601.html) or at [wireless.fcc.gov/index.htm?job=online\\_filing](http://wireless.fcc.gov/index.htm?job=online_filing) to obtain additional information concerning licensing requirements.

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

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

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate RF energy and may cause harmful interference to radio communications if not installed and used in accordance with the instruction manual. Operating this equipment in a residential area is likely to cause harmful interference, in which case, depending on the laws in effect, the user may be required to correct the interference at their own expense.

**NO UNAUTHORIZED MODIFICATIONS  
47 CFR §15.21**

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

**USE OF SHIELDED CABLES IS REQUIRED  
47 CFR §15.27(a)**

**NOTE:** Shielded cables must be used with this equipment to comply with FCC regulations.

**TransCore, LP  
USA**

## Health Limits for Multiprotocol Rail Reader Using External Antenna (902 to 928 MHz)

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Within the United States, environmental guidelines regulating safe exposure levels are issued by the Occupational Safety and Health Administration (OSHA).

Section 1910.97 of OSHA Safety and Health Standards 2206 legislates a maximum safe exposure limit of 10 milliwatts per square centimeter ( $\text{mW}/\text{cm}^2$ ) averaged over 6 minutes at 902 MHz.

Although not binding, other organizations such as the American National Standards Institute (ANSI) have issued similar guidelines that are more restrictive than the OSHA limits (ANSI C95.1). ANSI guidelines recommend a maximum safe power density in  $\text{mW}/\text{cm}^2$  of:

**Frequency (in MHz)**  
**1500**

Thus, the maximum permissible exposure for general population/uncontrolled exposure at 902 MHz is  $0.60 \text{ mW}/\text{cm}^2$ . The power limit is a six-minute average.

The RF power density generated by the Multiprotocol Rail Reader (MPRR) was calculated using a maximum antenna gain of 9.5 dBd, equivalent to the antenna gain of the external antenna.



### **Warning**

*At 2 W conducted into the antenna and a distance of 30 inches (77 cm) from the antenna, the maximum power density calculated was less than  $0.60 \text{ mW}/\text{cm}^2$ . Install the antenna at least 30 inches (77 cm) from the general public. Maintenance personnel must remain at least 14 inches (35 cm) from antenna when system is operating.*

The data confirms that the TransCore MPRR effectively meets OSHA requirements and thus does not represent an operating hazard to either the general public or maintenance personnel.

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PRELIMINARY

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Introduction

PRELIMINARY



# Chapter 1

---

## Introduction

***This chapter is the introduction to this manual and provides information pertaining to the audience, organization, document conventions, system description, and license information for the Multiprotocol Rail Reader System.***

### ***Purpose***

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This guide provides site planning and testing, installing, and operating instructions for TransCore's Multiprotocol Rail Reader (MPRR) System, which reads TransCore Super eGo<sup>®</sup> (SeGo) and American Trucking Associations (ATA)/International Organization for Standardization (ISO) protocols. Before you begin installing the MPRR, TransCore recommends that you read this entire manual.

### ***Audience***

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This document is intended to be used by authorized TransCore MPRR dealers, installers, and service personnel. Because the MPRR has no operator- or end-user serviceable components or features, no end-user manual or operator guide exists. Once the system is set up and tested by the *authorized* installer, MPRR operation requires no end-user intervention.

### ***System Guide Organization***

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The chapters of this guide and a description of the contents are listed below.

- Chapter 1, "[Introduction](#)," explains the purpose and describes the audience for the guide, outlines the manual's organization, provides a brief description of the MPRR, and discusses Federal Communications Commission (FCC) licensing requirements.
- Chapter 2, "[Developing the Site Plan](#)," discusses factors to be considered when developing the site plan and before ordering equipment and installing the MPRR. These considerations include antenna and tag alignment, site layout and traffic flow, and electrical and communications requirements.
- Chapter 3, "[Choosing, Installing, and Removing Tags](#)," contains information on compatible tag models and provides procedures for installing tags onto, and removing tags from, railcars where the MPRR is installed.
- Chapter 4, "[Installing the MPRR](#)," lists the materials needed and provides procedures to install the MPRR. Steps include:



- Pre-testing
- Installing the MPRR in a raiiside hut or NEMA enclosure (TBD)
- Connecting power and communications
- Connecting to TransCore's Train Recording Unit (TRU)
- Marking the read zone
- Chapter 5, "General Software Information," and Chapter 6, "Communications Protocols," provide reference information on various software-related topics and communications protocols.
- Chapter 7, "Commands," discusses the host-transmitted commands that are used to control MPRR configuration and operation.
- Chapter 8, "Configuring the MPRR," provides procedures for configuring and fine-tuning the MPRR after installing it at the site.
- Chapter 9, "Troubleshooting and Maintenance," answers the most commonly asked questions about installing and maintaining the MPRR.
- Chapter 10, "Interfacing with Train Recording Unit," describes the interoperability between the MPRR and TRU.
- Chapter 11, "Assembling and Connecting AT5720 Check Tags to the MPRR," explains how to connect one or two check tags to the MPRR.
- Appendix A, "Glossary," contains frequently used terms.
- Appendix B, "Technical Specifications," provides the MPRR specifications.
- Appendix C, "Wiring Tables," shows the wiring connections for the communications interfaces, electrical cable connections, and the external interface signal wiring.
- Appendix D, "Command Quick Reference," lists the MPRR factory default configuration settings and provides host software commands in numerical and alphabetical order.
- Appendix E, "Compatible Tag Information," provides helpful information about tags that are compatible with the MPRR.
- **Index** provides an alphabetical listing of guide topics. *(To be provided in the final version of the guide)*

## Typographical Conventions

---

The conventions listed in [Table 1-1](#) are used in this manual:

**Table 1-1** *Typographical Conventions*

Convention	Indication
	Concerns about a procedure.
Code	Code, including keywords and variables within text and as separate paragraphs, and user-defined program elements within text appear in courier typeface.
<b>Dialog Box Title</b>	Title of a dialog box as it appears on screen.
<b>Menu Item</b>	Appears on a menu. Capitalization follows the interface.
<i>Note</i>	Auxiliary information that further clarifies the current discussion. These important points require the user's attention. The paragraph is in italics and the word Note is bold.
NUL	Zero-value ASCII character or a zero-value byte.
NULL	Zero-value pointers. Null-terminated string refers to strings of printable ASCII characters with a zero-value byte placed in memory directly after the last printable character of the string.
	This procedure might cause harm to the equipment and/or the user.

## Licensing Requirements

---

An FCC license provides the user with the legal authorization to operate the MPRR on the licensed frequencies at the site specified in the license. Only an authorized installer or service technician can set the RF frequency of the MPRR to the frequency specified in the FCC site license. No end-user-operated controls exist on the MPRR.

The FCC license may provide the user with protection and authorization to maintain the system should any other RFID product be used in the licensed area after the MPRR equipment is installed.

Users of the MPRR in the United States must obtain a license from the FCC. In the United States, the authorized *modulated* frequency band for this product is 911.75 to

919.75 MHz and the authorized *continuous wave* frequency band is 902.25 to 903.75 MHz and 910.00 to 921.50 MHz.

The user is responsible for filing the FCC license according to FCC regulations, but the TransCore dealer will provide assistance and support as necessary to complete these forms. Forms are available online at the FCC internet site <http://wireless.fcc.gov/uls>. For further information on obtaining the license contact TransCore.

## **Technical Support**

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Authorized dealers and distributors are responsible for the direct support of all customers. Authorized dealers and distributors needing technical support can contact:

Technical Support  
Web: [transcore.com/rfidsupport](http://transcore.com/rfidsupport)

or

TransCore  
3410 Midcourt Road, Suite 102  
Carrollton, Texas 75006 USA

Phone: (214) 461-4031  
Fax: (214) 461-6478

Please be prepared to answer a series of questions that are designed to direct you to the best support resource available.



---

Developing the Site Plan

PRELIMINARY



# Developing the Site Plan

*This chapter provides a brief description of the Multiprotocol Rail Reader (MPRR) and discusses site plan development for installing the MPRR System.*

## System Description

The MPRR is a reader that supports the low-cost, high-performance SeGo radio frequency identification (RFID) technology. The MPRR also supports TransCore ATA/ISO tag types.

The MPRR is a high-power unit that can read both half- and full-frame tags. The reader output power can be adjusted using reader commands.

### Reader

The MPRR consists of an input/output (I/O) module, a power supply, a reader logic board (also called a tag decoder), and a radio frequency (RF) transmitter/receiver (called the RF module) in a compact enclosure. These MPRR components are contained in a highly reliable, compact, and easy-to-install package. Figure 2-1 shows the end views of an MPRR.



**Figure 2-1 MPRR End Views**

### Tags

The MPRR has the capability to read TransCore SeGo protocol tags and TransCore ATA/AAR protocol read-only full- and half-frame tags.

### How It Works

The MPRR directs the RF module to generate an RF signal, which is broadcast through the external antenna mounted railside. Entering the MPRR's reading range, a TransCore RFID tag installed on a railcar or other asset to be tracked adds its pro-

grammed identification information to the signal and reflects the signal back to the MPRR. The MPRR receives this modified, or modulated signal, and decodes the tag data carried by the reflected signal and transmits this data to a local host computer for processing.

## ***Overview of Site Planning***

---

Developing a site plan provides the foundation for the site's system design and establishes the following system configuration parameters:

- Number and general location of primary components
- Number of different radio frequencies required

Gathering relevant site information is crucial before applying for Federal Communications Commission (FCC) approval and ordering and installing MPRR(s) and tags.

Also, consider the following factors when developing a site plan:

- Type of tags used
- Antenna and tag alignment
- Site layout and rail traffic flow
- MPRR and/or antenna mounting requirements
- MPRR electrical requirements
- MPRR communications requirements

These factors provide relevant information regarding each site's physical and electromagnetic environment and the conditions under which the system must perform.

## ***Reading of Mixed Population Tags***

---

The MPRR reads TransCore's Super eGo® (SeGo) protocol tags and the American Trucking Association (ATA) and International Organization for Standardization (ISO) read-only tags, whether powered by battery or beam, application-specific integrated circuit (ASIC)-based tags with Intellitag technology.

The factors that influence the readability include, but are not limited to physical orientation and configuration, type of read-only tag, ratio of backscatter cross-section of the tags, and whether the tag is battery- or beam-powered.

## ***Antenna and Tag Alignment***

---

The position of the antenna and placement of the tag on the vehicle must be compatible.

Two primary criteria must be satisfied to achieve the highest read reliability:

- Polarization of the tag and the antenna must be aligned in the same direction — both horizontal.
- The installed tag must be in a direct, unobstructed line of sight to the antenna.



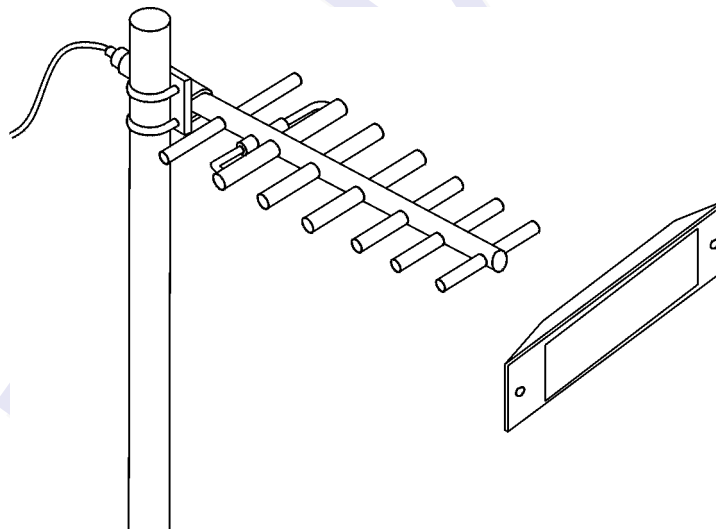
**Caution**

*A tag may not be reliably read unless the preceding criteria are met.*

**Polarization**

The polarization of the tag must be aligned in the same direction as the antenna, as shown in [Figure 2-1](#).

*Note: Matching the tag and antenna polarization is critical to obtain optimal system performance.*



TA-0016

**Figure 2-1 Tag and Antenna Orientation**

**Unobstructed Line of Sight**

For optimum readability, install the MPRR and antenna(s) and the railcar's tag so that when the railcar approaches the antenna(s), the tag is directly facing the antenna and the line of sight is clear between the antenna and the tag. If there is a physical obstruction between the tag and the antenna(s), the MPRR cannot reliably read the tags. [Figure 2-2](#) illustrates possible installation locations of an antenna in relation to a tag's mounting location on a railcar. If the tags are not in the recommended location, reliable optimum operation requires lower train speeds.



Figure 2-2 Antenna Location Relative to Tag Position

## Antenna Selection

---

This section contains guidelines that assist in antenna selection for an MPRR installation that uses an external antenna. The following antennas are compatible with the MPRR installation.

---

### **AA3100 Yagi (without radome)**

Appropriate for installations with the following requirements and conditions:

- 902 to 928 MHz operation
- Non-icing environments
- Relatively symmetrical reading range
- Antenna profile not a major consideration

---

### **AA3101 Yagi (with radome)**

Appropriate for installations with the following requirements and conditions:

- 902 to 928 MHz operation
- Exposure to harsh environments
- Relatively symmetrical reading range
- Antenna profile not a major consideration

---

### **AA3110 Parapanel**

Appropriate for installations with the following requirements and conditions:

- 902 to 928 MHz operation
- Exposure to harsh environments
- Broad radiation pattern in one dimension, narrow in the other
- Low antenna profile
- Horizontal polarization

---

### **AA3140 PCB Log Periodic**

Appropriate for installations with the following requirements and conditions:

- 845 to 950 MHz operation
- Exposure to harsh environments
- Maximum coverage at close range (<20 ft [6.1 m])
- Vertical or horizontal polarization

---

## **Site Layout and Traffic Flow**

The following site layout and traffic flow considerations are critical when determining MPRR installation locations:

- The MPRR read zone
- Other MPRR units and antennas in the area
- Reflection, refraction, and diffraction of RF signals
- Existing signal interference at the site

---

### **The MPRR Read Zone**

The MPRR must be able to read the tag data properly within a specified area, called the read zone, without reading other nearby tags or interfering with other MPRRs at the site. The following are some of the factors that affect the size and shape of the read zone:

- Mounting method used for the antenna
- Mounting location of the antenna
- Height from the ground and mounting angle of the antenna

- RF output attenuation
- Range discrimination setting
- Other sources of interference and reflection

The railside antenna must be positioned so that the RF signal travels to and return from the tags within the designated range and must be placed in an area where it is not likely to be bumped out of alignment. If the antenna becomes misaligned or some nearby structure is added or removed, system operation can be seriously affected.

For instructions on setting the read zone, see [“Fine-Tuning and Verifying the Read Zone” on page 8-18.](#)

---

### ***Other MPRRs in the Area***

Sites with more than one MPRR in proximity should have them configured with a frequency separation of at least 2 MHz from adjacent readers. If more than one MPRR is in a side-by-side or multiple track application, the frequencies should be staggered. MPRR antennas can face each other across a rail track as long as they are multiplexed and controlled by the same MPRR. [Table 2-2](#) shows examples of staggered reader frequencies in a site with up to 5 readers.

**Table 2-1 Examples of Staggered Reader Frequencies**

<b>Rail Number</b>	<b>Reader Frequency</b>	<b>Rail Number</b>	<b>Reader Frequency</b>
1	911.75	2	913.75
3	915.75	4	917.75
5	919.75		

---

### ***Reflection, Refraction, and Diffraction of RF Signals***

RF signals can be reflected, refracted, or diffracted by metal objects, walls, and even wet pavement or ice. Any of these factors can alter or degrade system performance. When designing your site plan, you must consider permanent structures and transient factors in the vicinity that may affect RF signals being generated by the MPRR. Permanent structures include buildings, chain link fences, guard shacks, and gates. Transient factors include passing traffic and local weather conditions, such as rain or snow. Symptoms of reflection, refraction, and diffraction include reading tags that are out of the desired read zone or tags being read from another track.

The most common RF reflectors are metallic surfaces. RF signals may also be partially reflected by nonconducting materials such as dirt, wood, ice, asphalt, and concrete. When nonconducting materials in the system environment become wet, they increase reflection of RF signals.



The antenna mounting location, aiming, and range control adjustment, and use of presence detectors can reduce interference from RF reflections. When these actions cannot adequately control reflections, other techniques such as shielding, absorbing, range sensitivity adjustment, or barriers can also be used. See Chapter 9, “[Troubleshooting and Maintenance](#)” for more information.

---

### **Existing Interference**

Interference from RF and electrical sources can degrade system performance and must also be considered in the site design. Fluorescent lights, neon signs, nearby radio stations, or power lines can interfere with the optimal operation of the system. The magnetic impulse noise from relays that control gate opening and closing can also disrupt the RF signal.

Interference may degrade both reader and tag performance. Existing interference at the site may be shielded, removed, or positioned further from the antenna. In some cases, changing the operating frequency of the MPRR may provide a simple solution. Readers in proximity should have at least a 2 MHz frequency separation. See “[Other MPRRs in the Area](#)” on page 2-8. Strong RF sources of any frequency, in proximity to the tag, can preclude the tag receiving the reader interrogation. See Chapter 9, “[Troubleshooting and Maintenance](#).”

---

## **Electrical and Communications Requirements**

All construction work at the site must be completed before installing the MPRR. Electrical and communications cables should be installed according to all applicable local and federal building code requirements. Specific instructions for positioning and installing the MPRR are discussed in Chapter 4, “[Installing the MPRR](#).”

---

### **Junction Box**

Use a watertight junction box that meets applicable local and national building codes for connecting power and communications wiring. The junction box houses the terminal strip for power and communications connections. TransCore recommends a NEMA Type-4 junction box with a back mounting panel.

---

### **Power and Communications Cables**

Cable length for power and communications depends on the physical characteristics of the MPRR installation site. [Table 2-2](#) lists accessory kits available for cabling options based on your site’s requirements.

**Table 2-2 Connector Cabling Accessory Kits**

Part Number	Description
58-7001-001	MPRR-to-TRU six-foot cable assembly
58-7001-002	MPRR-to-TRU 20-foot cable assembly
58-7001-003	MPRR cable assembly, no TRU

### **Electrical Power**

A dedicated electrical power supply must be present at the site and available to the MPRR at all times. The 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 your local and national electrical codes for installation and safety requirements.

*Note: MPRRs installed outside North America require a locally supplied transformer.*

If 18V AC or 18V DC power is available, the transformer option is unnecessary.

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. [Table 2-3](#) contains power supply current requirements.

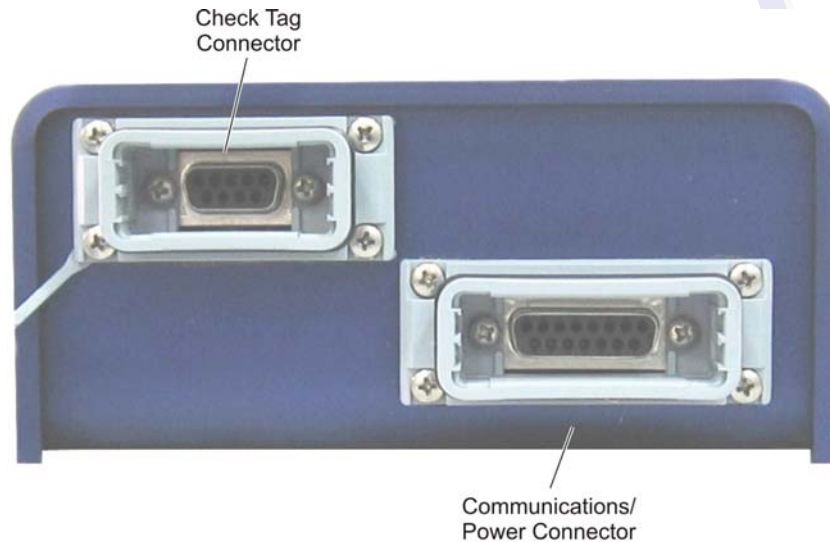
**Table 2-3 Power Supply Current Requirements**

Supply	(RF On) Worst Case Maximum Current at 68°F (20°C)	(RF Off) Standby Operating Current at 68°F (20°C)
16 to 20V AC	1.7 A at 18V AC	1 A at 18V AC
16 to 28V DC	1.7 A at 18V DC	1 A at 18V DC

Power circuits are protected internally against power surges.

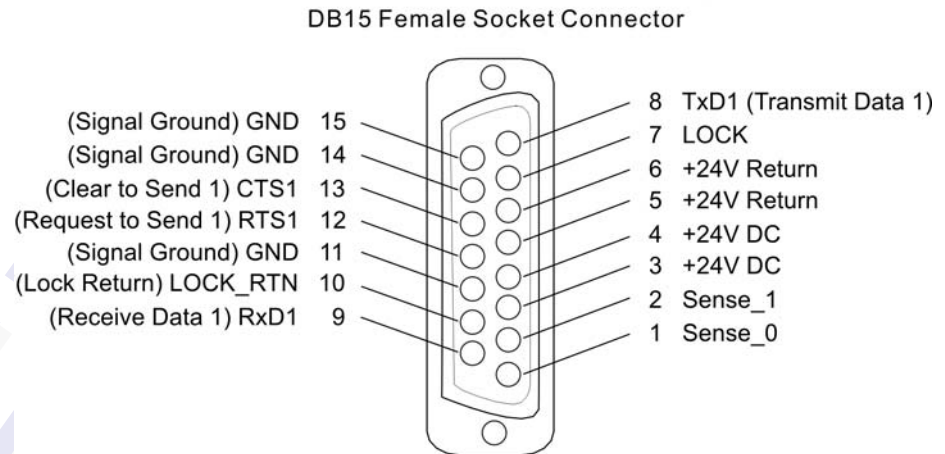
### **Host Communications**

Your site design must include communications between the MPRR and a host device. The MPRR communicates with the host device through an asynchronous serial line. This serial line is an RS–232 interface. [Figure 2-3](#) shows the MPRR communications port and [Figure 2-4](#) shows the connector pin designations.



HW-0416

**Figure 2-3 Location of Communications/Power Port on MPRR**



HW-0415

**Figure 2-4 Pin Assignments for Communications Connectors**

The standard RS–232 connection maximum distance depends on the baud rate, cable type, and the RS–232 device at the other end.

## Input/Output Circuits

The MPRR’s two RF sense input circuits are designed to connect to dry contact closures. The MPRR’s tag lock output circuit is a single-pole, double-throw relay providing a dry contact closure. These contacts are rated at 42.2V AC peak (30V<sub>rms</sub>) or 60V DC, at 1 A maximum with noninductive load.

Output circuit is not intended for the direct control of electromechanical devices such as motorized barrier arms. For such applications, the MPRR output circuit should be used to drive a secondary, appropriately rated high-power relay.

---

## **Antenna Interface**

The site design must include interface cable(s) between the MPRR and the compatible antenna(s) chosen for the site. The antenna interface is RF coaxial cable with male Type N sockets on each end.

Table 2-4 is a summary of coaxial cable performance. Figures indicate maximum lengths of cable in feet.

**Table 2-4 Reader to Antenna Cable Performance**

Cable Type <sup>a</sup>	Overall Diameter (in.)	915MHz	
		Low Loss <sup>b</sup>	Medium Loss <sup>c</sup>
RG-223	0.216	6	18
RG-214	0.425	12	37
FHJ1-50	0.250	16	48
FSJ1-50	0.250	15	45
LDF2-50	0.375	28	85
FSJ4-50B	0.500	27	83
LDF4-50A	0.500	42	128
LDF5-50A	0.875	76	229
LDF6-50	1.125	103	310
LDF7-50A	1.625	122	366

a. Suffixes 50, 50A, and 50B indicate 50-ohm cables available from the Andrew Corporation.

b. These cable lengths ensure optimal system performance (1 dB loss).

c. These cable lengths ensure adequate, but not optimal, system performance (3 dB loss).

---

Choosing, Installing, and Removing  
Tags

PRELIMINARY



# Choosing, Installing, and Removing Tags

*This chapter describes the various tag types compatible with the Multiprotocol Rail Reader (MPRR) and the procedures for installing and removing compatible internal and external tags.*

## Compatible Tag Types

The MPRR provides the capability to read the various TransCore tags employing Super eGo (SeGo) protocol. Depending on options ordered, the MPRR can read SeGo protocol, ATA-protocol, and ISO-compliant tags.

See [Appendix E](#) for information about the numerous tag models.

### Reader and Tag Model Interoperability

Table 3-1 lists the tags that are read by the MPRR. See [www.transcore.com/pdf/Tag-Reader-Matrix.pdf](http://www.transcore.com/pdf/Tag-Reader-Matrix.pdf) for most current information concerning readers and supported tag protocols.

**Table 3-1 Tags Read by the MPRR**

Reader	Beam Tags	Battery Tags
MPRR	AT5110; AT5112; AT5113; AT5118; AT5125; AT5133;	AT5114; AT5510; AT5541; AT5549

## Recommended Mounting Locations

Each piece of rail equipment has a specific area or *window* for optimum tag placement. Tag positioning in the tag placement window is based on the center of the tag in reference to window physical specifications.

### Required Materials

- Torque wrench (in/lb. range)
- Bolts and nuts (#10-24 NC threaded studs and nuts)
- Aluminum pop rivets
- Pop rivet gun

---

## **Mounting Surface**

The mounting surface must be metal, vertical, and smooth within the area of the tag. If the mounting area does not meet this requirement, you must use a metal mounting bracket.

If the mounting surface is irregular or non-metal (e.g., fiberglass), the tag must be attached to a metal bracket to provide an electrical reflector for the tag. Use a 1/8-inch (0.32-cm) or thicker smooth metal bracket whose dimensions are at least equal to those of the tag. Mounting brackets are preferred for application of the tag such that the tag and the bracket are in intimate contact to avoid interference with transmission of radio waves.

---

## **Tag Positioning**

Each piece of equipment has a specific area or *tag placement window* for optimum tag placement. Tag positioning in the tag placement window is based on the center of the tag in reference to window physical parameters.

The tag placement window is on opposite ends and opposite sides of the equipment. The front and rear ends of the equipment are referred to as the “A” end and “B” end. The “B” end represents the hand brake end and the “A” end represents the opposite end looking forward. To determine left and right sides, stand at the “B” end and look toward the front end of the equipment.

Refer to the appropriate section for tag placement window location rail cars and locomotive devices. Where possible, tags should be mounted in locations to minimize the likelihood of damage from equipment such as forklifts, cranes, and other hazards.

Mount the tag on a plane perpendicular to the rail (back of the tag against the equipment) with the long edge of the tag horizontal to the rail.

There is a clear zone surrounding the tag and toward the wayside that allows for unobstructed transmission of data. This zone must not be obstructed by any metallic objects or protrusions.



As Figure 3-1 illustrates, there should be no obstructions in the area extending 45° from the center line of the tag to one inch outside either narrow side of the tag. The side view depicts the tag as viewed from the top of the equipment.

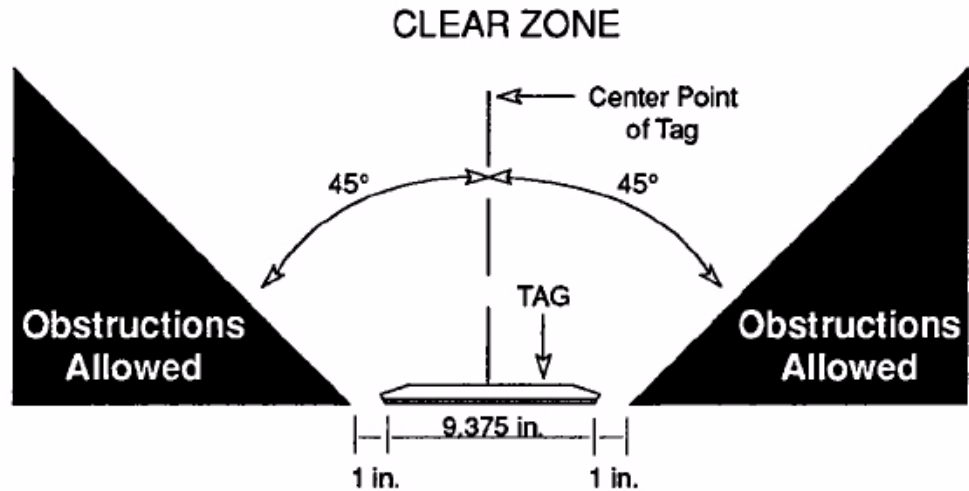


Figure 3-1 . Clear Zone - Side View

Figure 3-2 illustrates that there should be no obstructions in the area extending 60° from the center line of the tag to 1 inch outside either long side of the tag. The end view depicts the tag as viewed from the end of the equipment.

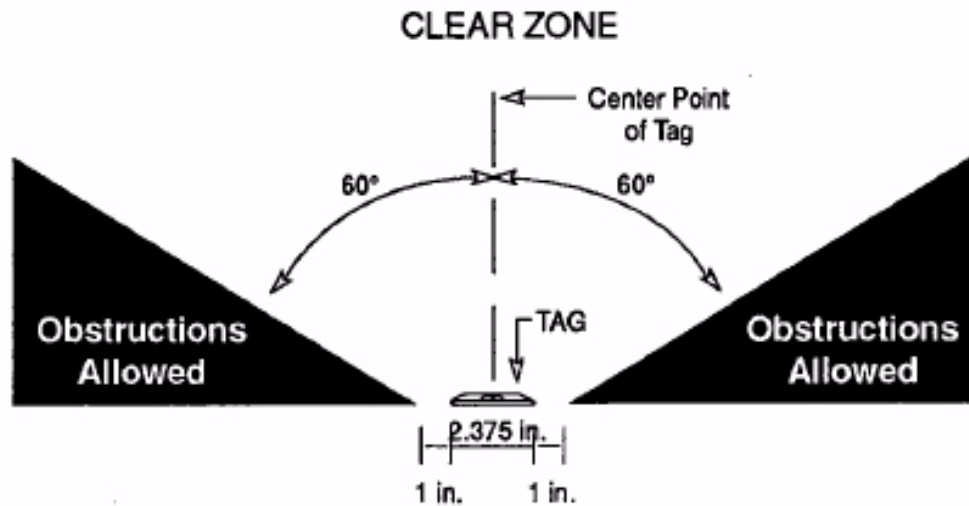
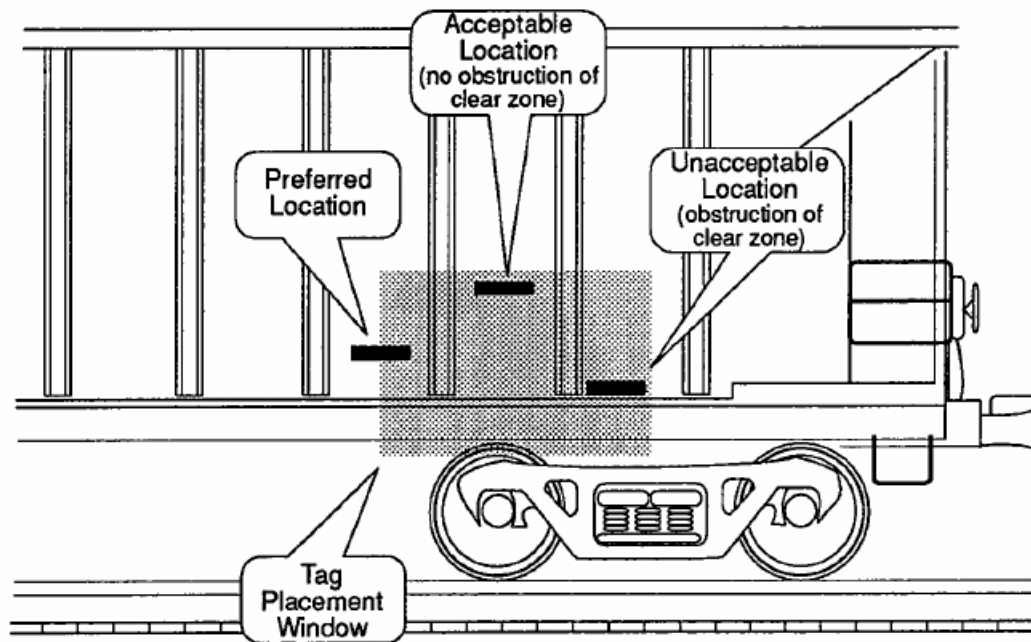


Figure 3-2 . Clear Zone - End View

Figure 3-3 shows examples of acceptable and unacceptable mounting locations based on the clear zone. Any obstructions in the clear zone may introduce reading problems

with the tag. Refer to the mounting specifications chapters for each type of equipment for tag placement window locations.



**Figure 3-3 . Mounting Location Examples**

## **Surface Installation Techniques**

Backing plates are preferred for attaching tags to equipment, but tags may be mounted directly to the car at the owner's discretion. Aluminum material is permitted as a substitute for the mounting plate material specified, when required for compatibility with the car surface.

When painting the backing plates, protect the studs from paint.

Two approved methods for mounting tags and backing plates on locomotives and railcars are rivet and bolt mounting.

*Note: Weld the backing plate to the freight car side sheet, but be certain the backing plate is kept flat. If the car side sheet is deformed, spacing of welds may vary to accommodate waviness of the freight car side.*

*Note: Allow the backing plate to cool after welding before applying the tag.*

### **Rivet/Bolt Mounting Guidelines**

Select a means for mounting the tag that secures the tag but does not compromise the tag case.

Aluminum pop rivets are permissible, but TransCore advises against using high-pressure rivets for mounting the tag.

If using bolts and nuts to mount the tag, avoid using excessive torque, which may crack or break the tag case. Tighten the nut until snug, then tighten an additional 1/2 turn only.

## Locomotive Mounting Guidelines

Install two tags on each locomotive on opposite ends and opposite sides of the equipment. Install one on the right front (engineer's side) and another on the left rear (fireman's side).

### Tag Placement Window Location

Horizontally, the tag placement window extends from the center line of the truck to 2to feet from the center line of the inside axle (measure toward the center of the vehicle). Vertically, the tag placement window begins two feet above the top of the rail and extends to a maximum of five feet above the top of the rail.

Figure 3-4 illustrates the tag placement window on the right front portion (engineer's side) of the locomotive.

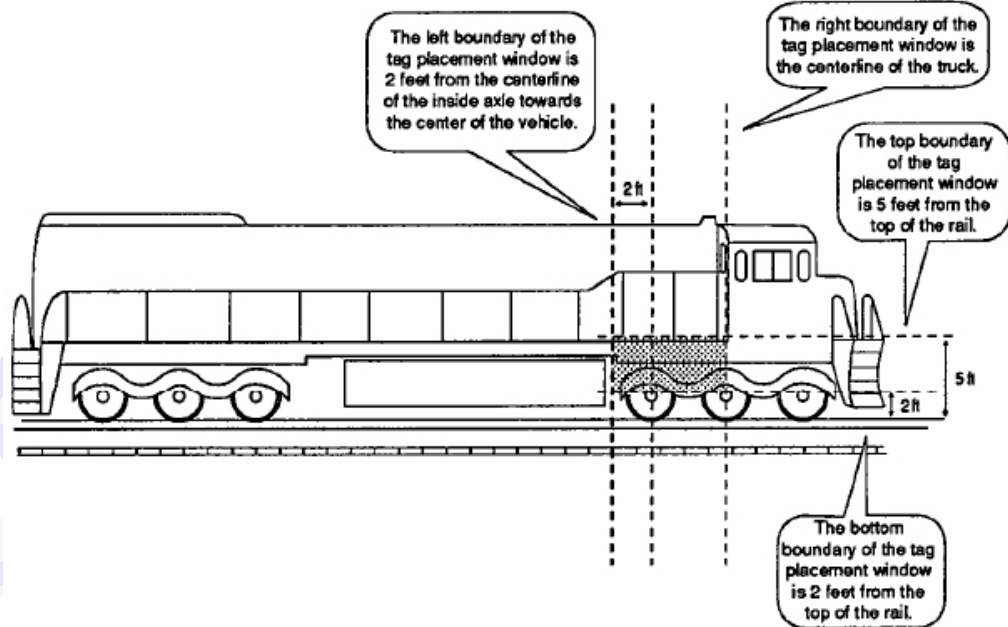


Figure 3-4 . Tag Placement Window for Locomotives -- Right Front

Figure 3-5 illustrates the tag placement window on the left rear portion (brakeman's side) of the locomotive.

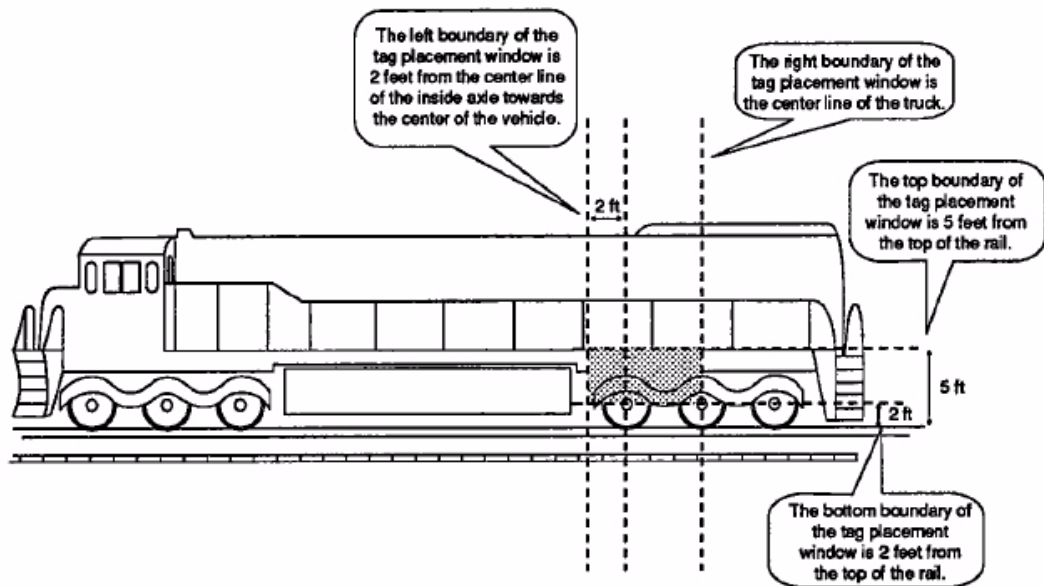


Figure 3-5 . Tag Placement Window Location for Locomotives -- Left Rear

### Tag Placement

Optimal tag placement centers the tag on the left boundary line of the tag placement window (Figure 3-6). Alternately, the center of the tag may be mounted anywhere within the tag placement window, provided there are no obstructions to the tag's clear zone.

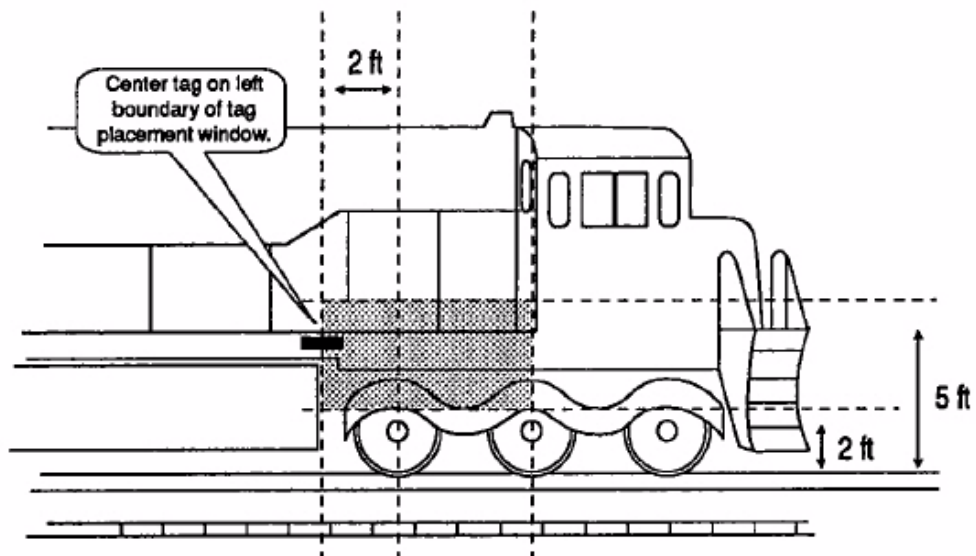


Figure 3-6 . Optimal Tag Placement for Locomotives

## Rail Car Mounting Guidelines

Install two tags on each rail car on opposite ends and opposite sides of the equipment. Install one on the right front (“A” end) and another on the left rear (“B” end).

### Tag Placement Window Location

Horizontally, the tag placement window extends from the center line of the truck to two feet from the center line of the inside axle (measure toward the center of the vehicle). Vertically, the tag placement window begins at two feet above the top of the rail end and extends to a maximum of five feet above the top of the rail. The tag should not cover car stenciling.

Figure 3-7 illustrates the tag placement window on the right front portion (“A” end) of the rail car.

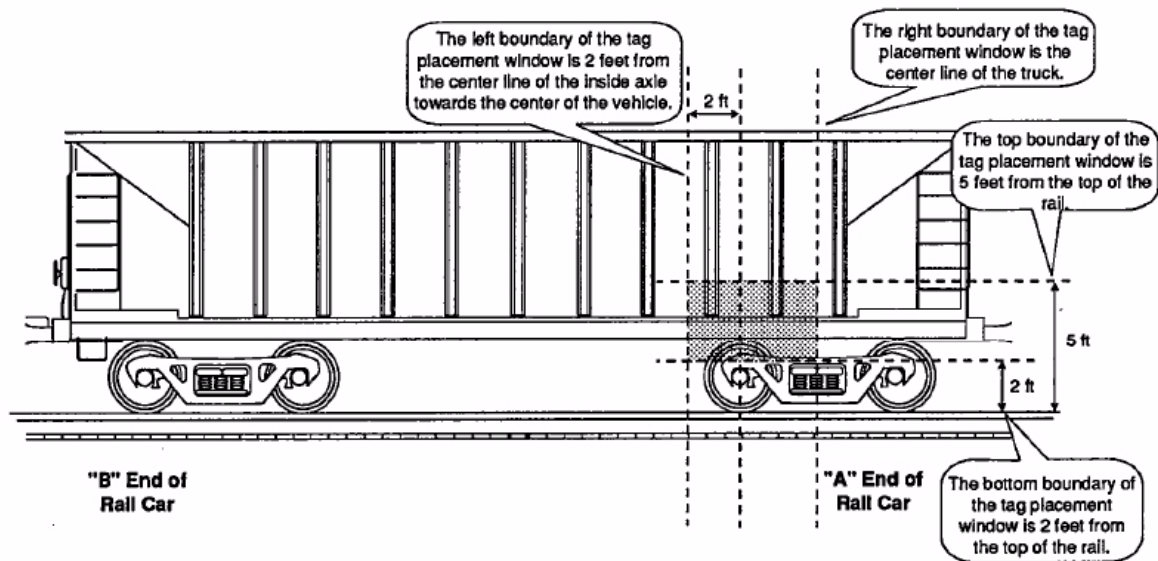


Figure 3-7 . Tag Placement Window Location for Rail Cars -- "A" Right Side

Figure 3-8 illustrates the tag placement window on the left rear portion (“B” end) of the rail car.

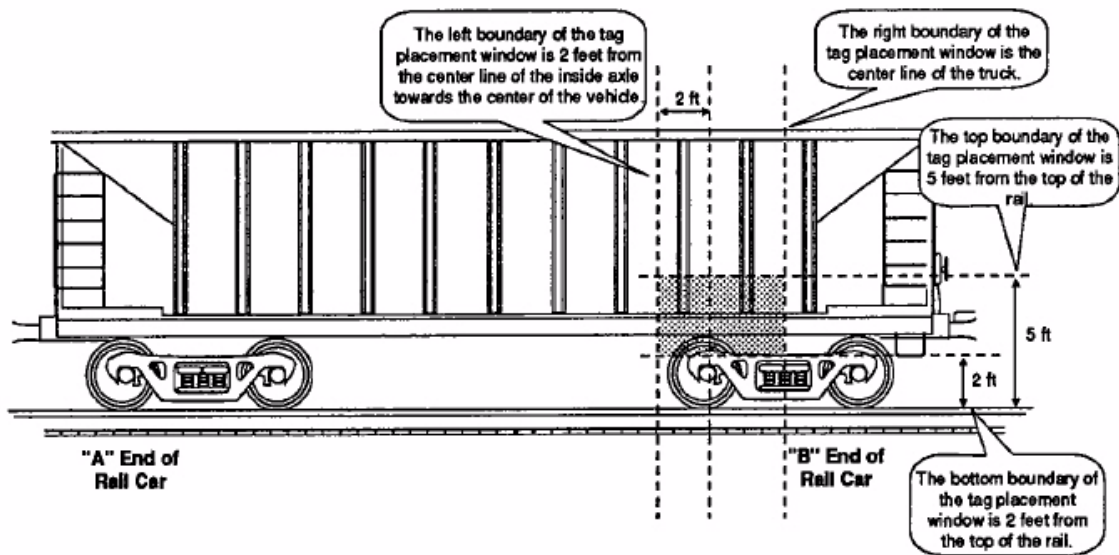


Figure 3-8 . Tag Placement Window Location for Rail Cars -- “B” Left Side

### Tag Placement

Optimal tag placement centers the tag on the left boundary line of the tag placement window (Figure 3-9). Alternately, the tag may be mounted so that the center of the tag falls anywhere within the tag placement window, provided there are no obstructions of the tag’s clear zone.

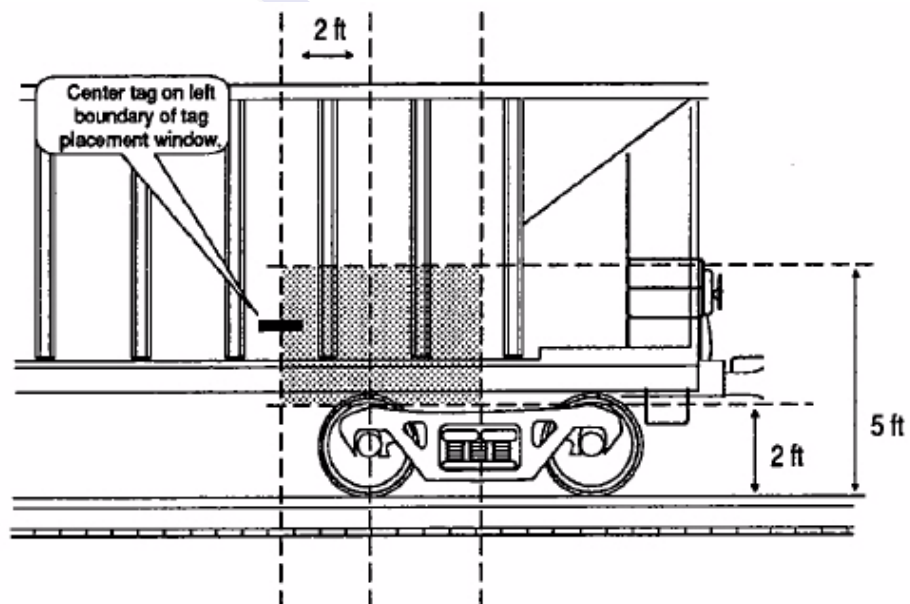


Figure 3-9 . Optimal Tag Placement for Rail Cars

## Tank Car Mounting Guidelines

Tank car mounting is essentially the same as that for rail cars, except that the tag placement window area has been expanded 18 inches to the right of the center of the truck.

### Tag Placement Window Location

Horizontally, the tag placement window extends from 18 inches to the right of the center line of the truck to two feet from the center line of the inside axle (measured toward the center of the vehicle). Vertically, the tag placement window begins at two feet above the top of the rail and extends to a maximum of five feet above the top of the rail. The tag should not cover car stenciling.

Figure 3-10 illustrates the tag placement window on the left rear portion (“B” end) of the tank car.

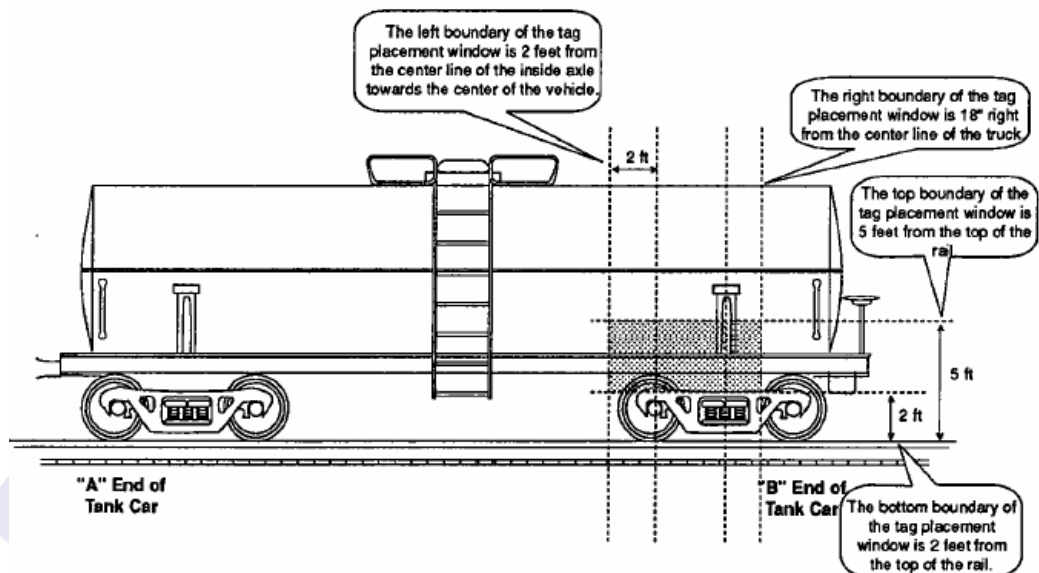
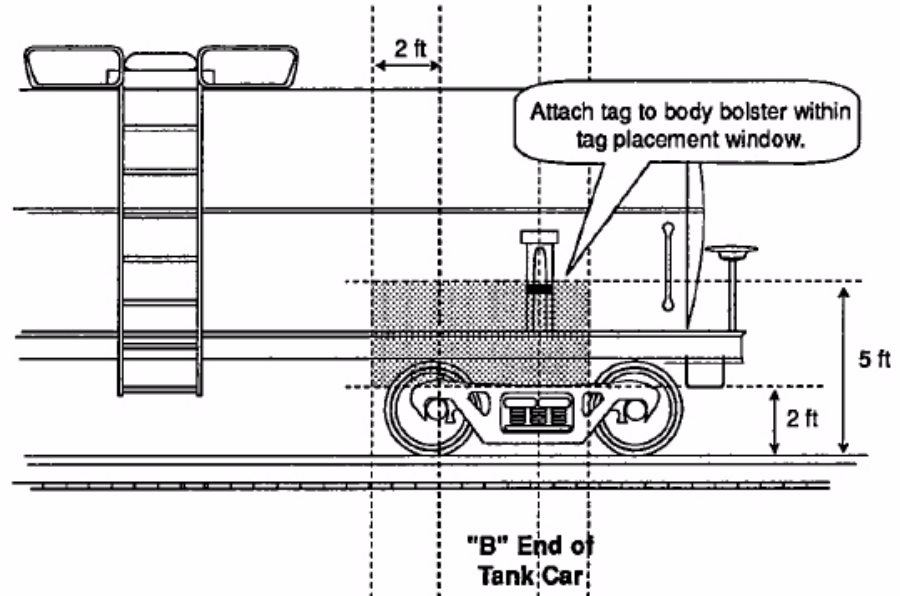


Figure 3-10 . Tag Placement Window Location for Tank Cars -- "B" Left Side

### Tag Placement

Optimal tag placement positions the tag on the center line of the truck on the body bolster (Figure 3-11). Alternately, the tag may be mounted so that the center of the tag

falls anywhere within the tag placement window, provided there are no obstructions of the tag's clear zone.



*Figure 3-11 . Optimal Tag Placement for Tank Cars*



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## Installing the Multiprotocol Rail Reader

PRELIMINARY



# Installing the Multiprotocol Rail Reader

*This chapter lists the materials needed and presents the procedures to pre-test and install the Multiprotocol Rail Reader (MPRR).*

## **Installation Process**

---

After you have developed the site plan and identified the location to install the MPRR and antennas<sup>1</sup>, if required, you are ready to install the equipment. Installation involves the following tasks:

- Pre-installation testing of MPRR power and tag read capability
- Mounting the MPRR in a railside shack
- Mounting the railside antenna(s)
- Connecting the antenna(s)
- Connecting the MPRR power
- Marking the read zone
- Connecting the MPRR host and sense input/sense output and communications

---

## **Materials Supplied by TransCore**

You need the following materials to pre-test and install the MPRR. TransCore supplies some of the materials; other materials must be obtained from other sources.

### **Contents of Shipping Carton**

Ensure that you have received all parts before beginning your pre-installation MPRR tests. Your MPRR is packaged with the following materials:

- One MPRR
- One *MPRR Quick Start Guide*
- Any accessories ordered as options as shown in [Table 4-1](#)

Required accessories are a power/communications cable harness and a 110V AC-to-18V AC wall transformer, a 12 to 18V AC step-up transformer, or a 16 to 28V DC power source. You also require at least one MPRR-compatible antenna and an antenna RF cable. These may be ordered as accessories from TransCore or obtained from other sources.

---

1. The MPRR is designed with RF cable connectors for use with N-type RF cables.

## Installation Accessory Options

Table 4-1 lists optional TransCore MPRR installation accessory items.

Table 4-1 Installation Accessories

Part No.	Description
58-7001-001	MPRR-to-Train Recording Unit (TRU) six-foot cable assembly
58-7001-002	MPRR-to-TRU 20-foot cable assembly
58-7001-003	MPRR cable assembly, no TRU
20-7001-001	MPRR check tag accessory kit

## Additional Materials Needed for Testing

You need these additional materials to perform the pre-tests on the MPRR:

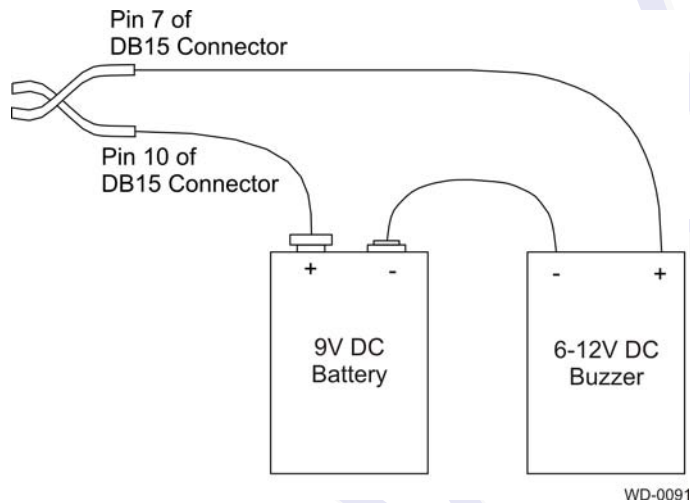
- Test tags, supplied by the TransCore dealer or distributor
- Suitable 16 to 20V AC or 16 to 28V DC power wiring for the MPRR
- Audible circuit tester and 9V DC battery for circuit tester power
- Wire stripper
- At least one MPRR-compatible antenna
- Suitable RF interface coaxial cable

## Pre-installation Testing of the MPRR

Before installing the MPRR permanently at the site, you should use an audible circuit tester to confirm that the MPRR has power and can read a tag presented in the tag read zone.

### Testing the MPRR Using an Audible Circuit Tester

An audible circuit tester is also called a buzz box. These boxes are available at some electronic parts supply stores, or you can make a buzz box, as shown in Figure 4-1. The buzz box is powered by a 9V DC battery and is equipped with two alligator-clip leads. When you touch the leads together, the box makes an audible sound.



**Figure 4-1 Wiring for Audible Circuit Tester**

To test the MPRR, connect the antenna and power supply as described in the appropriate section below.

---

## Connecting the Antenna

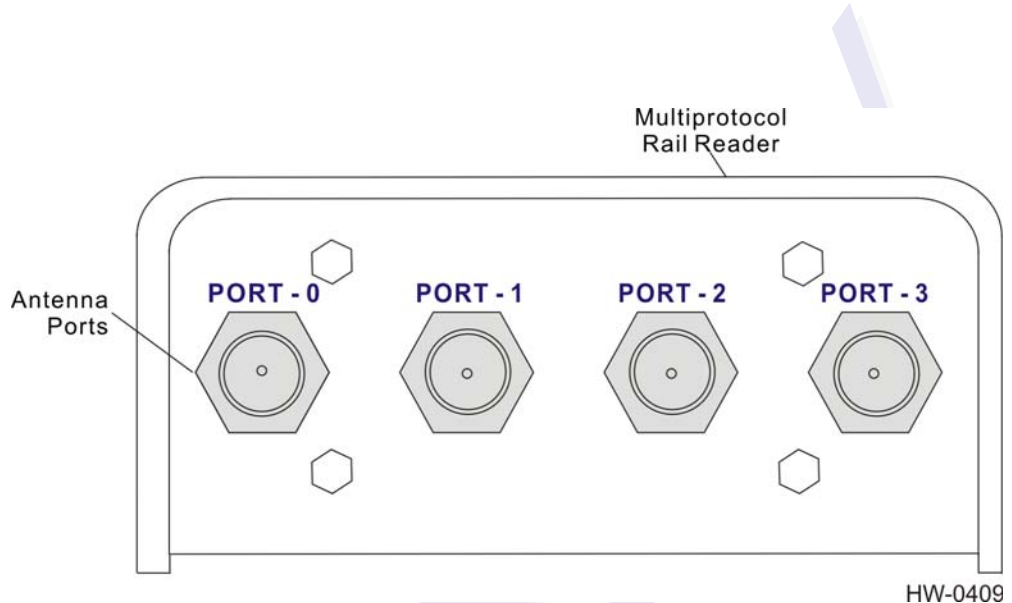
This section explains the connection between the MPRR and antenna(s).



### Caution

*To avoid damage to the MPRR*

- *During shipping and installation, an external antenna can build up a very high voltage charge. The voltage needs to be discharged before connecting the antenna to the reader.*
- *Connect the MPRR to ground before powering up the reader or connecting the antennas.*
- *Connect the antenna(s) before applying power to the reader.*



**Figure 4-2 MPRR Showing Antenna Ports**

**To connect the reader and antenna**

1. Ensure the reader is turned off and unplugged.
2. Connect one end of the RF interface cable to the antenna.
3. Connect the other end of the RF interface cable to the appropriate antenna port on the side of the MPRR. See [Figure 4-2](#).
4. For consistent performance, terminate unused antenna ports using a 50-Ohm, N-type terminator.

---

## **Connecting the MPRR to a Power Supply**



**Caution**

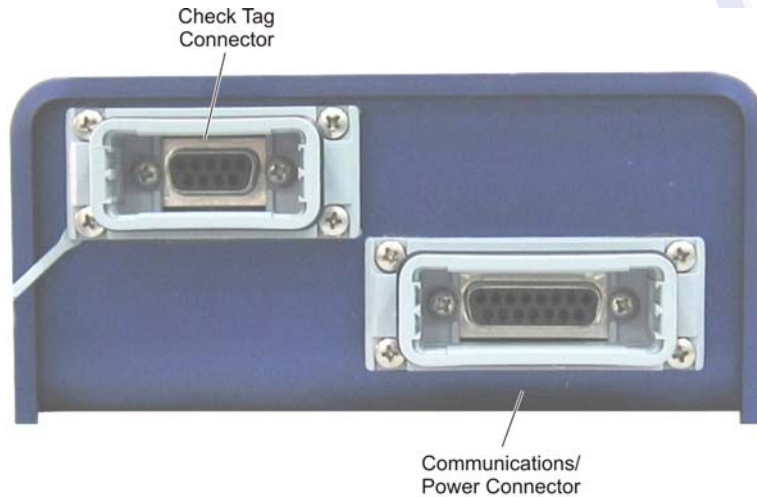
*To avoid damage to the MPRR*

- *Connect the MPRR to ground before powering up the reader or connecting the antennas.*
- *Connect the antenna before applying power to the reader.*

**To connect the MPRR to a power supply**

1. Connect the MPRR to a power supply using the interface cable (P/N TBD).

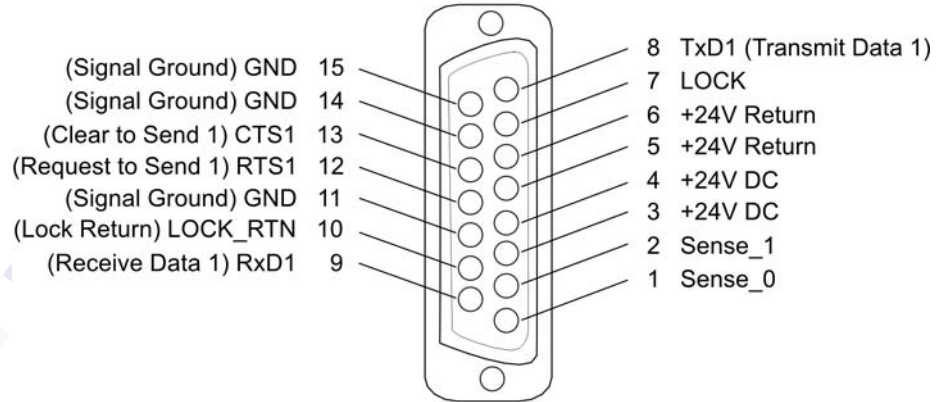
The pin assignments for the signals on the reader DB15 connector ([Figure 4-3](#)) is shown in [Figure 4-4](#). If the MPRR is connected directly to a TransCore Train Recording Unit (TRU), all power supply connections are made through the MPRR-to-TRU cable assembly.



HW-0416

**Figure 4-3 Location of Communications/Power Port on MPRR**

DB15 Female Socket Connector



HW-0415

**Figure 4-4 Pin Assignments for Signal to Host Connectors**

## Mounting the MPRR

This section lists procedures and materials required for mounting the MPRR on a wall or other flat surface based on the site's requirements.

In permanent installations the MPRR should be positioned as close as possible to the antenna. Long cable runs increase system sensitivity to noise. See [Table 2-4 on page 2-12](#) for maximum RF cable lengths.

---

## Mounting to an Enclosure Wall or Flat Surface

### Required Materials

You need the following materials to install the MPRR on an enclosure wall or flat surface. Ensure the use of high-quality, corrosion-resistant anchor hardware.

- Anchor hardware suitable for the surface on which you mount the MPRR  
The MPRR weighs 5.1 lbs (2.31 kg) so choose mounting hardware that is adequate to secure the unit to a wall.



### Caution

*Connect the reader bracket to earth ground using a ground cable and stake. TransCore recommends that you follow the National Electric Code or equivalent code for lightning protection for the locale where you are installing the MPRR.*

After mounting the MPRR, you must connect it to a dedicated 16 to 20V AC or 16 to 28V DC power supply.



### Caution

*To avoid damage to the MPRR*

- *Connect the MPRR to ground before powering up the reader or connecting the antenna(s).*
- *Connect the antenna(s) before applying power to the reader.*

---

## Mounting the Antenna Rail-Side

The antenna should be positioned as close as possible to the MPRR. Long cable runs increase system sensitivity to noise. See [Table 2-4 on page 2-12](#) for maximum RF cable lengths (TBD). This section provides guidelines for mounting antennas.

After mounting the antenna, you must connect it to the MPRR. Follow the procedures described previously in the section [“Connecting the Antenna” on page 4-5](#).

*Note: Adjust the antenna(s) to provide the most direct line of sight to the tags.*

---

## Connecting the Power Supply

After mounting the MPRR and antenna, connect the reader to a dedicated 16 to 20V AC or 16 to 28V DC power supply. If the MPRR is connected directly to a TRU, all power supply connections are made through the MPRR-to-TRU cable assembly.



### Caution

*To avoid damage to the MPRR*

- *During shipping and installation, an external antenna can build up a very high voltage charge. The voltage needs to be discharged before connecting the antenna to the reader.*



- *Connect the MPRR to ground before powering up the reader or connecting the antenna(s).*
- *Connect the antenna(s) before applying power to the reader.*

## **Connecting Communications**

---

The MPRR communicates through RS–232 protocol.

### **Required Materials**

You need the following materials to connect the communications cable to the host device:

- Host device
- Any terminal emulation program such as Procomm Plus™ or Hyper Terminal™ running on a PC
- If the MPRR is connected directly to a TRU, all communications connections are made through the MPRR-to-TRU cable assembly.

### **Connecting the MPRR to the Host**

MPRR communications and customer interface signals are supplied from the MPRR to the host through a multiwire cable. The connector for this cable is located on the end of the MPRR.

Plug one end of the MPRR communications/power interface connector into the DB15 connector at the MPRR and the other end, using the customer-supplied wiring, into the host device.

## **Connecting Sense Input and Sense Output Circuits**

---

The MPRR has two sense input circuits and a tag lock output circuit available. Sense0 is used to enable RF on antenna ports 0 and 1 if enabled, and Sense1 is used to enable RF on antenna ports 2 and 3. The sense input circuits can be used to notify the MPRR of train presence and are designed to be connected to a free-of-voltage dry contact. The tag lock output circuit is a single-pole, double-throw relay that provides a normally closed and normally open dry contact. The relay contact is 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 MPRR supports two sense inputs – sense input0 and sense input1 – which require two sense input lines (SENSE<sub>x</sub> and GND) for each loop sense or a total of four sense input connections. Sense input0 is the presence detection and is used to control RF

power. As shown in [Figure 4-4](#), the sense inputs are wired through the reader DB15 connector. The MPRR expects the sense input0 circuit to close when a railcar is present (on the track with antennas connected to ports 0 and 1). Sense1 must be closed when a railcar is present on the track connected to antenna ports 2 and 3. The minimum presence true period is fixed at 0 ms, which indicates that no delay occurs in closing the circuit when a railcar is present.

---

## Sense Output Circuit

The sense output is dedicated for testing and set up of the reader. It is defined as the TAG\_LOCK signal, which indicates a valid tag is in the read field.

This sense output is a dry contact that provides a normally open and normally closed sense output. The relay contacts are rated at 42.2V AC peak (30 V<sub>rms</sub>) or 60V DC at 1 A maximum. If controlling an external gate or device requiring high current, an isolation transformer is required.

---

## Marking the Read Zone



### Caution

*Be sure to follow all applicable rail safety regulations when marking the read zone.*

The area where the MPRR reads tags at the current RF range is called the read zone. The antenna pattern, or read zone, of the MPRR would look roughly like a pear-shaped balloon if you were able to see it. When installing the MPRR, you should first mark the unit's read zone using the RF range set at the factory-default maximum. You can later adjust the read zone using the techniques discussed in [“Fine-Tuning and Verifying the Read Zone”](#) on page 8-18.

If two MPRRs are installed near each other, TransCore recommends that you fine-tune each reader for the ideal read zone before connecting it permanently to sense input/sense output and communications cables. A minimum of 2 MHz frequency separation and 40 feet (12.2 m) of antenna separation between the two adjacent readers is required for correct operation.

---

## Required Materials

You need the following materials to mark the read zone:

- Test tags, supplied by the TransCore dealer or distributor

### To mark the read zone

1. Confirm that you have correctly connected the power supply/communications cable as described in this chapter.
2. Start the terminal emulation application Microsoft HyperTerminal by selecting **Programs>Accessories>Communications>HyperTerminal** and press **ENTER**.

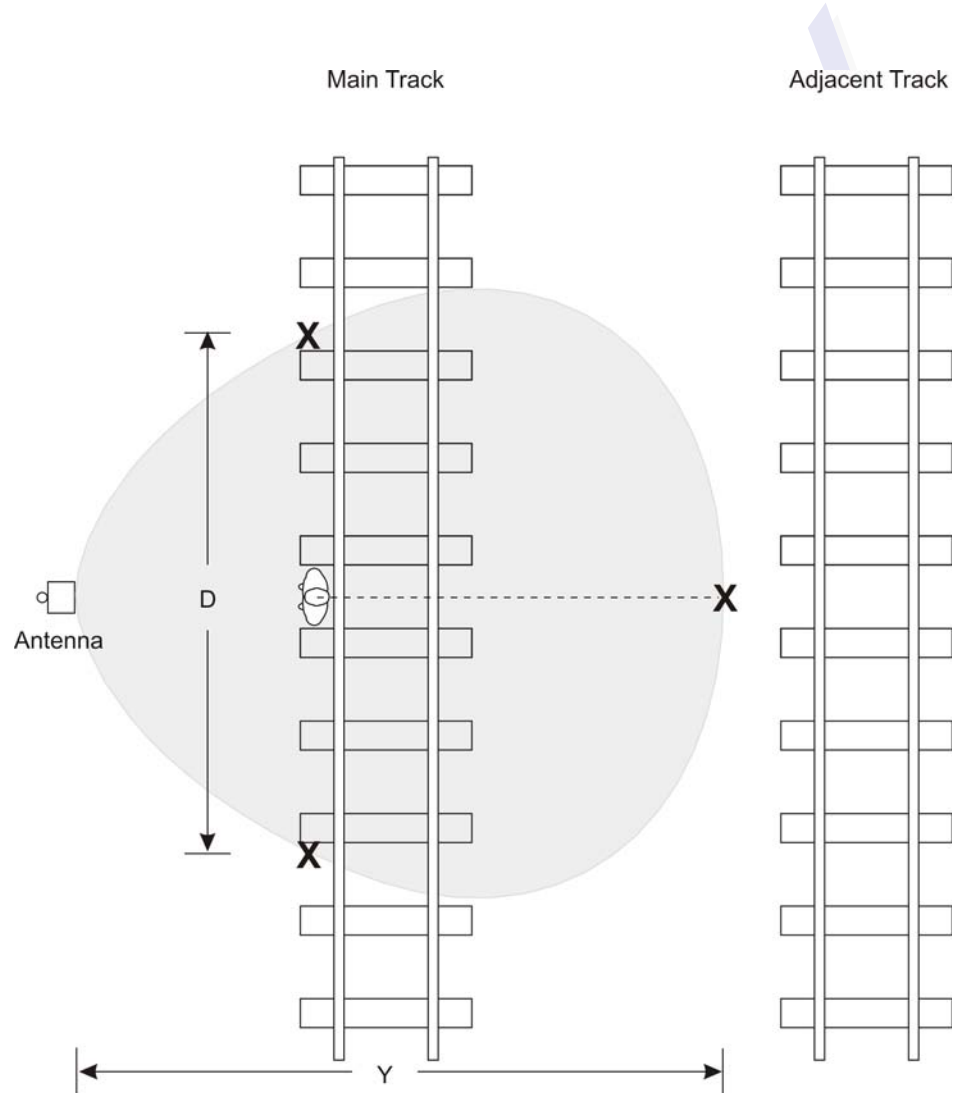
3. In the HyperTerminal dialog boxes choose the com port to which the communications interface is attached and set the properties as:
  - Bits per second: 9600 baud
  - Data bits: 8
  - Parity: none
  - Stop bits: 1
  - Flow control: none
4. Cycle the power on the MPRR and ensure that the sign-on message displays.
5. Input the commands listed in [Table 4-2](#).

**Table 4-2 Commands for Testing**

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

You can now connect the outer marks to draw the outer boundary of the read zone.

[Figure 4-5](#) is a view of a sample read zone. The outer X marks show the outside edges of the read zone.



SD-0158

**Figure 4-5 Sample Read Zone Marking Pattern**

6. Place the MPRR in single-antenna operation using the antenna of interest. Standing at the edge of the rail sleepers closest to the antenna walk the test tag along the track to determine the farthest read point in both directions (see D in [Figure 4-5](#)). Record the distance.
7. In a multiple track installation, walk the tag toward the adjacent track in a line with the antenna (see [Figure 4-5](#)) to determine whether the MPRR reads tags from the adjacent track. Record that distance (Y). If the MPRR reads tags on the adjacent track, reduce the range control value, or increase RF attenuation until the MPRR cannot read tags on the adjacent track.

---

General Software Information

PRELIMINARY



## General Software Information

***This chapter provides software-related information for the Multiprotocol Rail Reader (MPRR) System.***

This chapter presents various software-related topics arranged in alphabetical order by subject. In addition to this chapter, see Chapter 6, “[Communications Protocols](#),” and Chapter 7, “[Commands](#),” for more information.

### Command Entry Conventions

All MPRR commands are preceded by the start-of-message character (#). The end-of-message sequence expected from the host is a carriage return (CR). The MPRR terminates messages with a return and a line-feed (CR/LF). For example, the command #01 Switch To Command Mode is typed as follows:

```
#01<ENTER>
```

where <ENTER> is the Enter or Return key.

Some command characters may be represented by the letter N. This letter indicates you are to supply a value. Maximum valid entries are the numbers 0 through 9 and the uppercase letters A through F. These letters allow for as many as 16 available user responses and are based on the hexadecimal numbering system.

Commands have at least two characters following the # character. [Table 5-1](#) shows the basic structure of a four-character command.

**Table 5-1 Four-Character Command Structure**

#1005 Set Baud Rate To 9600 Baud	
#	All commands are preceded by the # character.
1	Indicates the command group. This command is in Group 1-Communications Port Control.
0	Indicates the command subgroup. In this example, all commands with a second digit of 0 apply to the main port.
0	The command digit. In this example, the 0 indicates that this command affects the baud rate.
5	Indicates the setting. Normally this is a variable and is usually a hexadecimal value from 0 through F. In this example, 5 sets the baud rate to 9600, the factory setting. In some commands, this digit may be a four-place hexadecimal string or a character string.

## Command Response Conventions

---

Like the MPRR commands, responses are preceded by the # character. Many MPRR commands respond with #Done or #Error indicating the command was or was not recognized and completed. Other commands respond with a four-character identifier followed by one or more values.

Table 5-2 shows an example of a command/reply sequence. This example assumes that an MPRR with serial number SN97001P running version X.XX software is connected to a PC running a terminal emulation software package such as Windows Hyper Terminal or Procomm Plus. The command sequence verifies that communications are working correctly.

**Table 5-2 Sample Command Sequence**

Entry	MPRR Response	Notes
#01 <CR>	#Done <CR/LF>	Switches MPRR to command mode.
#505 <CR>	#Model E4 Series Ver X.XX SN08001P <CR/LF>	Reports the software version and serial number.
#00 <CR>	#Done <CR/LF>	Returns MPRR to data mode.

In command discussions, MPRR response characters may be shown in brackets <>. The use of brackets indicates that the response is a value in the range of characters. The brackets are not part of the response. For example, the response to command #520 Display Power Fail Bit is either a 0 or a 1. In the command discussion, the response is shown as:

#PWRB <0-1>

with actual MPRR response being one of the following:

#PWRB 0

#PWRB 1

In this example, PWRB is the four-character identifier for *power fail bit*, and the 0 or 1 is the value. All spaces shown in the response are actual spaces sent from the MPRR. In this example, one space is between the letter B and the number.

## Operating Parameters

---

The MPRRs maintain their operating parameters in non-volatile memory (NVRAM) so that the parameters are preserved after a power-down sequence.



## Power Fail

---

The system maintains a power fail flag. The host transmits command #520 Display Power Fail Bit to determine if a power down has occurred. This flag is cleared by both command #63 Reset Reader and command #65 Reset Power Fail Bit.

## Program Download

---

Program download stores the MPRR applications software into the reader's flash memory. Program download is used to install program upgrades, add features, and to recover from corrupted program data.

*Note: Program download is a hosted process. Exercise caution so that you don't inadvertently enter download mode.*

---

### Download Considerations

You should consider the following factors when performing program download:

- The MPRR does not process tags while in download mode.
- The MPRR does not accept any program data unless a successful erase of flash memory has been performed before transmitting the data. Erasing the flash memory typically takes two seconds.
- Exiting from download mode re-executes startup. If the new software has been loaded without errors, the MPRR comes up in data mode. If a flash checksum error is detected, the MPRR reenters download mode and transmits a sign-on message with a boot version of 0.00x and without a serial number.

*Note: The MPRR uses default communications parameters when operating in download mode – 38400 baud, 8 data bits, 1 stop bit, no parity, basic protocol – and does not echo commands.*

---

### Download Procedures

If TransCore releases a new version of the MPRR software or if the MPRR seems not to be working properly, you may need to download the software to the MPRR. Contact technical support or your TransCore MPRR sales representative.

## Startup

---

Upon startup, MPRR transmits a sign-on message or a boot ROM failure message.

---

## Sign-On Message

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 assigned to the MPRR unit being used.

Serial number 000000 is the default setting and is not a valid number. If this number appears in the sign-on message, the serial number has never been stored into reader memory. The serial number must be assigned by factory-authorized personnel using command #695S...S Set Serial Number. Because only six digits are allowed in the software, when setting the serial number skip the fourth (middle) digit of the seven-digit number shown on the reader label.

If the flash memory checksum does not indicate verification, the sign-on message appears as follows:

```
Model [E4] Ver 0.00x  
[Copyright notice]
```

---

## Boot Failure Message

The software performs a checksum function on itself. The function returns a specific value for the particular version of software. If the value returned is not correct, the boot ROM checksum assumes that locations have been corrupted and a failure condition exists. If the boot ROM checksum is not correct, a boot failure message is transmitted. If the failure message does not transmit, a communications error has occurred or the boot failed to the extent that it cannot transmit the failure message.

If the failure message version number equals 0.00 and no serial number exists, the flash memory checksum has failed, and the MPRR is operating out of boot ROM. In this case, the MPRR automatically enters download mode and waits for a new program to be loaded into the flash memory. Follow the instructions in [“Program Download” on page 5-5](#) to download a new program.

---

## Tag/Message Buffer

In basic communication protocol, the MPRR does not provide tag memory storage beyond the quantity required for uniqueness checking. This feature allows adequate buffering of tag data under normal operating conditions. The MPRR cannot operate as a stand-alone component. When the buffer fills, subsequent tag IDs will be lost.

In error correcting protocol (ECP), a buffer of up to three additional tag reads will be held in case a host system is unable to acknowledge tag reads in real time.

---

Communications Protocols

PRELIMINARY



---

# Communications Protocols

*This chapter describes the communications protocols for the Multiprotocol Rail Reader (MPRR).*

## **Introduction**

---

The MPRR supports the following communications protocols:

- Basic
- Error correcting protocol (ECP)

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

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

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

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

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

Software (XON/XOFF) flow control is optionally supported. Be careful in the use of XON/XOFF since noise-induced characters may be interpreted by the MPRR as the XOFF character, which would suspend reader output without information reaching the host computer. For more information see [“Software Flow Control” on page 8-18](#).

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

## Basic Protocol

---

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

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

The host must be ready to receive reader-transmitted messages because in basic protocol the MPRR does not wait for the host to acknowledge a message before transmitting the next message. If necessary, the host may halt reader transmissions by using software or hardware flow control. Refer to Chapter 8 for flow control information.

## Error Correcting Protocol

---

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

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

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

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

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

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

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

## Basic Protocol and ECP Format

---

*Note: In the following text, the symbols < and > are used to represent required variable message data, and the symbols [and] are used to represent optional data. These symbols are not part of the message syntax.*

---

### Reader Transmissions

The basic protocol format and the data inquiry protocol format are as follows:

<som><data><eom>

The ECP format is as follows:

<som><seq><data><crc><eom>

where

<som>	Start-of-message (ASCII # character)
<seq>	Sequence number (ASCII hex) that represents an even number in the range 0–9, A–F (0, 2, 4, 6, 8, A, C, E). The MPRR maintains the number. The host must acknowledge reader transmissions by sending an ACK message with the same sequence number received from the MPRR. The MPRR updates its sequence number upon receipt of a valid host ACK. If an ACK is not received, the MPRR retransmits the message. A reader transmission sequence is not considered complete until the MPRR receives an ACK and updates its sequence number.
<data>	An ASCII string up to 72 characters long. This string may contain tag data, a presence without tag report; an input status change report; an Error06, Error07, Error08, or Error11 message; or a sign-on message. Auxiliary data may also be included.
<crc>	Field containing four ASCII digits that represent the 16-bit CRC value calculated on the message. The CRC value is calculated on bytes between the som character and the first <crc> byte.

When the host receives a properly framed message, it can calculate a 16-bit CRC value. The calculation is applied to the character string that immediately follows the <som> and that ends with the character immediately preceding the first <crc> character.

The transmitted CRC value can then be compared with the binary equivalent of the received <crc> characters. If the transmitted and received CRC values do not match, the recipient assumes the

message was received in error, and transmits a NAK message response.

<eom> End-of-message characters (ASCII CR and LF). The system includes both a carriage return (CR) and line feed (LF) to facilitate the use of terminals and printers.

If the host receives a <som> character in the middle of a data message, the message in progress is aborted. The assumption is that an <eom> was lost and the MPRR is in the process of retransmitting the previous message.

---

### **ECP Host ACK/NAK Response**

With ECP, the host computer responds to all data message transmissions from the MPRR using the following acknowledgment or negative acknowledgment response format.

<som><seq><ack/nak><crc><eom>

where

<som> Start-of-message (ASCII # character)

<seq> An echo of the sequence number received from the MPRR. The sequence number should correspond to the data message that is being positively or negatively acknowledged by the host. If the MPRR receives an ACK message with the incorrect sequence number, the data message is retransmitted.

The host computer resets the anticipated data message sequence number to that of the MPRR before communications can resume without error.

<ack/nak> ASCII @ character for ACK response; ASCII ? character for NAK response

<crc> CRC value for the message

<eom> End-of-message character (ASCII CR)

The MPRR sets a user-programmable timeout delay at the time each message is transmitted based on command #612NN Set Error Correcting Protocol Timeout, where NN = timeout delay. To disable the timeout delay for diagnostic purposes, issue the command #612FF Disable Error Correcting Protocol Timeout.

If the timeout delay expires before the MPRR receives an ACK or NAK message from the host, a logical NAK condition will be declared. If the MPRR receives a NAK or timeout, the reader retransmits the data message.

When the MPRR receives an ACK message, the system software treats the message as having been properly received by the host. The software increments the sequence



number, and advances pointers to the next message in the MPRR's message queue to prepare for sending the next message.

---

## Switch to Command Mode Request

The host computer may issue command #01 Switch to Command Mode while in data mode.

The basic protocol format is as follows:

```
<som><cmd><eom>
```

The ECP format is as follows:

```
<som><seq><cmd><crc><eom>
```

where

<som>	Start-of-message (ASCII # character)
<seq>	Sequence number generated by the host computer separately from that appearing in data messages transmitted by the MPRR
<cmd>	Switch to command mode (ASCII characters 01)
<crc>	CRC value for the message
<eom>	End-of-message character (ASCII CR)

---

## Host Transmission

The host computer initiates synchronous communications between the MPRR and the host. The host begins a sequence by issuing a command; the MPRR responds accordingly.

The basic protocol format is as follows:

```
<som><cmd> [ <data> ] <eom>
```

The ECP format is as follows:

```
<som><seq><cmd> [ <data> ] <crc><eom>
```

where

<som>	Start-of-message (ASCII # character)
<seq>	Sequence number (ASCII hex digit) that represents an odd number in the range 0–9, A–F (1, 3, 5, 7, 9, B, D, F). The host should use odd sequence numbers in its command since the MPRR uses even sequence numbers in its transmissions. This method eliminates the possibility of a synchronous host command and an asynchronous reader transmission having the same sequence number.

Upon receiving a host command, the MPRR echoes the command's sequence number in its response. Therefore, the host computer updates its sequence number upon receipt of a valid reader message. If the sequence number is not updated before transmission of the next command, the MPRR will not service the new command; it will retransmit its previous message. A command/message sequence is not complete until the host updates its sequence number.

<cmd>	Command code, a string that contains from two to four ASCII hex characters
[ <data> ]	Optional data field, an ASCII string of as many as 20 characters in length. For example, the store hardware configuration string command is #696S...S or command #696 Store Hardware Configuration String followed by the data string S...S.
<crc>	CRC value for the message
<eom>	End-of-message character (ASCII CR)

---

## **Reader Command Response**

The basic protocol format is

<som><resp><eom>

The ECP format is

<som><seq><resp><crc><eom>

where

<som>	Start-of-message (ASCII # character)
<seq>	Echo of sequence number received in host command message
<resp>	Response string. The MPRR returns Done, Error, or another ASCII string depending on the host transmission. This string can be up to 72 characters long.
<crc>	CRC value for the message
<eom>	End-of-message character (ASCII CR and LF)

---

## **Sample Messages**

This section contains examples of typical messages transmitted between the MPRR and the host computer.

### **Reader Transmissions**

Basic protocol reader transmission

#KING 1302<eom>

Host response

No host response for non-ECP

ECP reader transmission

#4KING 1302 <crc><eom>

where

#	Start-of-message character
4	Message sequence number
KING 1302	Message data: Tag ID is shown. Other sample message data could be as follows: IOST C0 O2 IO D24 (display I/O status) Error06 (frequency not set)
<crc>	CRC value for the message
<eom>	End-of-message character

Host response

#4@<crc><eom>

where

#	Start-of-message character
4	Message sequence number
@	ACK (acknowledgment character) (? returned for a negative acknowledgment)
<crc>	CRC value for the message
<eom>	End-of-message character

### **Host Command Transmissions**

Basic protocol host transmission

#647XXX<eom>

Reader response

#Done<eom> or #Error<eom>

#Error<eom> is returned if the host transmission is not a legal command with legal data.

ECP host transmission

#7647XXX<crc><eom>

where

#	Start-of-message character
7	Message sequence number
647XXX	Select RF Operating Frequency command where 647XXX is the command and XXX is a hexadecimal value from 000 to 118. In this example, XXX sets the RF frequency to 903 MHz.
<crc>	CRC value for the message
<eom>	End-of-message character
Done	Command has been invoked by the MPRR

Reader response

#7Done<crc><eom> or #7Error<eom>

For some commands, the MPRR responds with data that relates to the command, such as TOF 0, to indicate (TBD) mode enabled for a #XXX Display (TBD) Mode Status command.

#7Error<eom> will be returned if host transmission is not a legal command with legal data.

---

## **Timing and Synchronization**

The ECP is largely independent of baud rate. The timeout delays previously described are a function of baud rate.

The MPRR supports an ECP timeout, which applies equally to both transmit and receive.

The receiver's minimum timeout delay equals the time to transmit/receive the longest anticipated message at the current baud rate setting. Additional margin should be included for idle periods between characters; for example, processing overhead, if any. The timeout delay period can be expressed as follows:

$$T_{rec} \text{ (ms)} = L \times [T_{char} + T_{idle}]$$

where

$$T_{char} \text{ (ms)} = 1000 \times [B_c / R_b]$$

$B_c$  Bits per character, typically 10

Rb	Baud rate, 1200–38.4 K
L	Length of message in characters
Tidle	Maximum idle period between characters (ms)

**Note:** The MPRR supports baud rates between 1200 and 38.4 K.

Likewise, the sender must set a timeout delay equal to the delay of nine characters at the current baud rate setting. For example, the time required to shift out the <eom> character plus the time to shift in the ACK or NAK message to be received plus a processing allowance for the receiver to process the message and check for error conditions.

Thus, the sending timeout delay can be expressed as follows:

$$T_{\text{send}} (\text{ms}) = 9 * T_{\text{char}} + T_{\text{errchk}}$$

where

$T_{\text{errchk}} (\text{ms})$  Processing period to perform error checking by receiver

The host computer can remotely set the MPRR's communications parameters while in the command mode, but TransCore does not recommend this action if communications conditions are marginal.

After the MPRR receives new communications parameters, the MPRR issues the Done message and switches to the new configuration immediately. The host computer switches its communications parameters immediately after the transaction is complete.

As noted, the message initiator, such as the MPRR in data mode and the host computer in command mode, starts a timeout counter at the time a message is transmitted. If the timeout expires before receiving an acknowledgement message, a logical NAK condition is declared, and the initiator assumes the message was received in error. In this instance, the message is retransmitted until an acknowledgement message is received.

The message recipient, such as the host computer in data mode and the MPRR in command mode, starts a timeout counter when a <som> character is received. If the timeout expires without the receipt of an <eom>, the message acquisition is aborted (reset), and the receiver waits for the next <som> character.

If the message recipient receives a second <som> character before an <eom> character, the message acquisition is aborted (reset), and retransmission of the previous message is assumed to be underway.

These strategies allow for recovery during periods when communications are marginal or completely lost.

**Note:** It is important that the host computer limit the period during which the MPRR remains in command mode to avoid losing tag IDs. RF is off in command mode and no tags can be read.

---

## **Reader-Addressed Failure Conditions**

The MPRR addresses the following failure conditions.

### ***Illegal Sequence Number (not in the range 0–9, A–F)***

If the MPRR detects an illegal sequence number in a host command message, it discards the received message and sends no response. If it receives an illegal sequence number in an ACK message, it responds as if a NAK had been received and retransmits the data.

### ***Wrong Sequence Number***

If the MPRR receives the wrong sequence number in an ACK message, it responds as if a NAK had been received, and it retransmits the data.

### ***Incorrect CRC***

If the MPRR detects an incorrect CRC value in a host command message, it discards the received message. No response is sent. If it receives an incorrect CRC value in an ACK message, it responds as if a NAK had been received, and it retransmits the data.

### ***Illegal Command***

If the MPRR receives an illegal command, it returns its standard Error message.

### ***Transmission Timeout***

If the MPRR transmits an asynchronous message and the host does not send an ACK before the ECP timeout occurs, the MPRR retransmits the message.

### ***Receive Timeout***

If the MPRR receives a <som> but does not receive a matching <eom> before the ECP timeout occurs, it discards the incomplete message and resets its receiver.

### ***Asynchronous Message/Command Message Collision***

If the MPRR transmits asynchronous data at the same time that the host sends a command, the MPRR gives priority to receiving the command. It processes the command and sends a message before it retransmits the asynchronous data.

---

## **Host-Addressed Failure Conditions**

The host computer addresses the following failure conditions.

### ***Illegal or Wrong Sequence Number***

If the host detects an illegal or wrong sequence number in a reader response, it retransmits the command with the same sequence number. If the host detects an illegal sequence number in an asynchronous reader transmission, it sends a NAK message.

**Incorrect CRC**

If the host detects an incorrect CRC value in a reader message, it retransmits the command with the same sequence number. If the host detects an incorrect CRC value in an asynchronous reader transmission, it transmits a NAK message.

**Transmission Timeout**

If the MPRR does not respond to a host command within a specified interval, the host software retransmits the command with the same sequence number.

**Receive Timeout**

If the host receives a `<som>` but does not receive a matching `<eom>` within a specified timeout interval, it discards the incomplete message and resets its receiver.

**Asynchronous Message/Command Message Collision**

If the host receives an asynchronous reader transmission at the same time it transmits a command, it ignores the asynchronous message and waits for the MPRR's response. The MPRR retransmits asynchronous data after it transmits the command message.

**ECP Reliability**

---

An undetected error is defined as a message having incorrect data or status but no parity or CRC errors. An error transaction is defined as a message having either a parity or CRC error. Laboratory testing indicates an undetected error rate of less than one undetected error per 1,000,000 error transactions with parity enabled.

To ensure this error rate is not exceeded, the host must enable parity and adhere closely to the timing specifications discussed previously in this chapter in the "Timing and Synchronization" section.

**CRC Calculation**

---

The CRC used by the ECP is based on a 16-bit algorithm. The algorithm, as implemented, operates on eight-bit characters, for example, seven-bit ASCII character plus one optional parity bit. The 16-bit result is converted to four ASCII hex characters and is appended to messages transmitted by the MPRR.

The MPRR accepts four ASCII `< ` >` characters (60 hex) as a wild card CRC value in lieu of a valid four-character CRC value to facilitate testing and diagnostic checkout.

The MPRR implements the algorithm with a 512-byte lookup table to reduce the processing overhead requirements.

To simplify the implementation of the CRC algorithm by host software developers, several examples of the calculation are provided in C source code on the following pages. The calculation may be performed with or without a lookup table, depending on the trade-off between code memory and processing overhead.

Example 1 presents an example of a function (CALCCRC) that calculates the CRC value through a call to a separate function (UPDCRC).

```
unsigned short calccrc(char *message)
{
    unsigned short crc = 0;
    for ( ; *message != (char)0; message++)
        crc = updcrc(*message & 0xff, crc);
    return (crc)
}
```

Example 2 shows an example of UPDCRC that does not require a lookup table.

```
#define BITS_PER_CHAR 8
unsigned short updcrc (unsigned short ch, unsigned short
crc)
{
    register short counter = BITS_PER_CHAR;
    register short temp = crc;
    while (--counter >= 0)
        if (temp & 0x8000) {
            temp <<= 1;
            temp += (((ch <<= 1) & 0x0100) != 0);
            temp ^= 0x1021;
        }
        else {
            temp <<= 1;
            temp += (((ch <<= 1) & 0x0100) != 0);
        }
    return(temp);
}
```

Example 3 contains an example of UPDCRC that does require a lookup table.

```
#define updcrc(cp, crc)( crctab[((crc >> 8) & 255)]^ (crc << 8) ^ cp
static unsigned short crctab [256] = {
0x0000, 0x1021, 0x2042, 0x3063, 0x4048, 0x50a5, 0x60c6, 0x70e7,
0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
```



```

0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
0xedaе, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0,
};

```

Example 4 shows an example of a function that creates the lookup table.

```

#include <stdio.h>

#define MAX_CHAR      256
#define BITS_CHAR     8
#define SIGN_BIT      0x8000
#define POLY          0x1021
unsigned short crctab [MAX_CHAR];
main ()
{
    unsigned short ch;
    unsigned short workval;
    unsigned short bit;

```

```
unsigned short carry;
for (ch = 0; ch != MAX_CHAR; ch++) {
    workval = ch << BITS_CHAR;
    for (bit = BITS_CHAR; bit != 0; bit--) {
        carry = (workval & SIGN_BIT);
        workval <<= 1;
        if (carry)
            workval ^= POLY;
    }
    crctab[ch] = workval;
}
for (ch = 0; ch != MAX_CHAR; ch++)
    printf("0x%04x\n", crctab[ch]);
}
```

## Manually Disabling ECP for Maintenance

---

Under certain conditions, communications between the host and MPRR may be lost temporarily and maintenance may be required. The reader or host is sending out a message and waiting for an acknowledgment. When the acknowledgment is not received, the message is sent again. Additional messages are also buffered. Often the first indication that the MPRR software is in an ECP “loop” is when the user/technician sees a recurring display of the same message repeated over and over again on the monitor. The procedure described in the following paragraphs enables the maintenance technician to change configuration or test tag reading manually.

Assuming that the ECP timeout is at the factory default of 12.7 seconds (or other value that allows enough time for the commands to be manually entered) the following command sequence may be used to break out of an ECP loop. This command sequence uses four ASCII <`> characters (60 hex) as wild card CRC values.

*Note:* The ASCII <`> character (60 hex) is commonly located on the ~ key.

You must acknowledge existing messages by issuing commands with the generic format:

**#x@` `` ` <eom>**

where

#	Start-of-message character
x	Message sequence number. This must be the same as the sequence number of the message being acknowledged
@	ACK (acknowledgment character)
<` `` ` >	Wild card CRC value for the message
<eom>	End-of-message character

The following is a typical sequence after power-on limiting buffered messages.

*Note:* Ensure that no tags are in the field when you are performing this troubleshooting procedure.



**Caution**

*To avoid damage to the MPRR, ensure that you have connected the antenna or a dummy load to the reader before applying power to the reader.*

Reader transmission on power-up:

#0 Model ... SN <crc><eom>

Manually enter: #0@` `` ` <eom>

Reader transmission #2 Copyright 2008 TransCore <crc><eom>

Manually enter: #2@` `` ` <eom>

Manually enter: #101` `` ` <eom> this puts reader into command mode

Reader response: #1Done<crc><eom>

Manually enter: #3610` `` ` <eom> this puts reader into basic protocol, disabling ECP

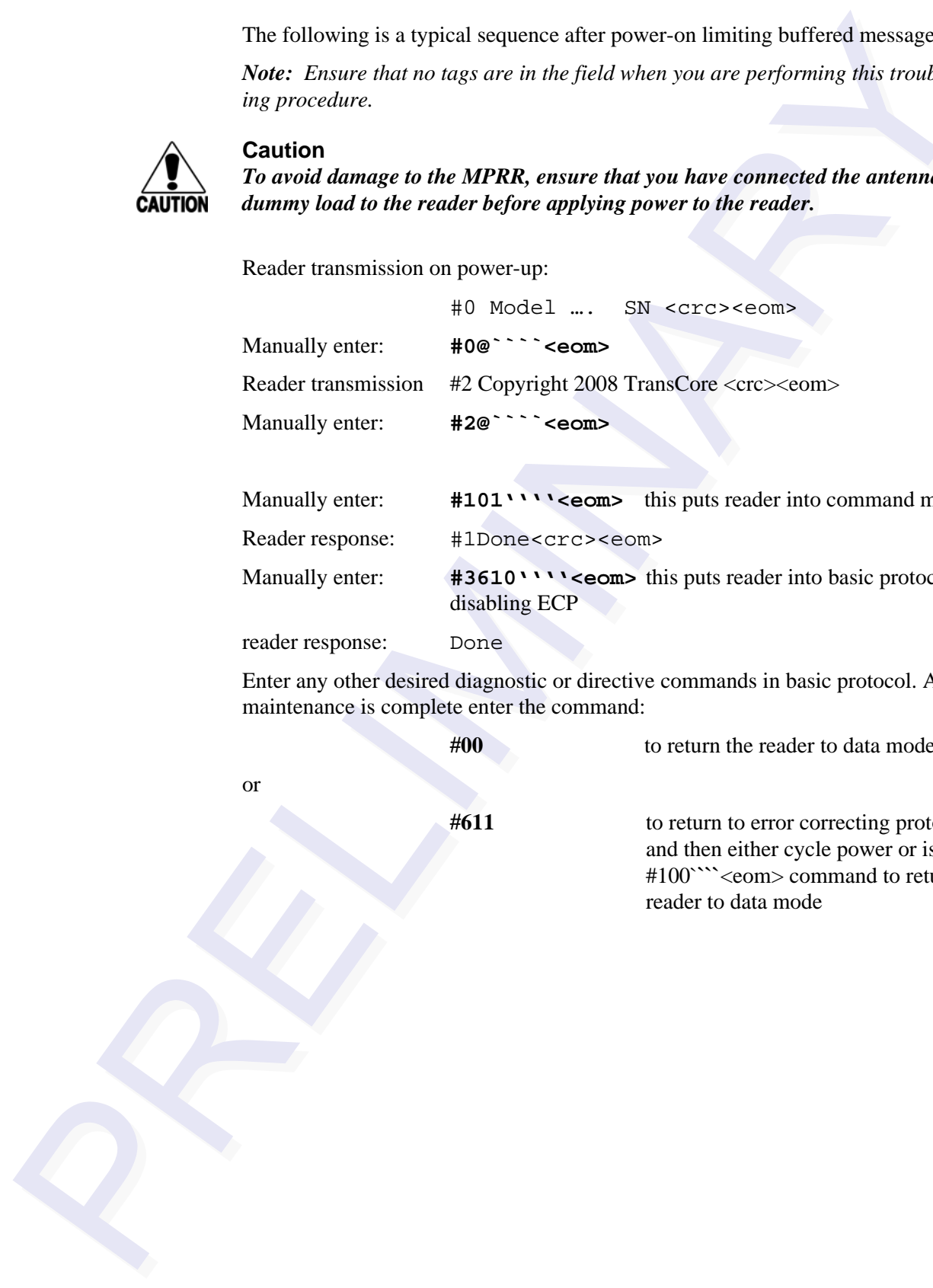
reader response: Done

Enter any other desired diagnostic or directive commands in basic protocol. After maintenance is complete enter the command:

#00 to return the reader to data mode

or

#611 to return to error correcting protocol, and then either cycle power or issue #100` `` ` <eom> command to return reader to data mode



PRELIMINARY

---

Commands

PRELIMINARY



# Chapter 7

---

## Commands

***This chapter discusses the host-transmitted commands that are used to control the Multiprotocol Rail Reader (MPRR) configuration and operation.***

### ***Introduction***

---

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

### ***Operating Modes***

---

The MPRR has three modes of operation: data mode, command mode, and download mode. The software for the MPRR contains two separate programs — boot and application. The boot program has control of the MPRR on startup and when operating in download mode. The application program has control of the MPRR during data mode and command mode operation and holds the application code. Together, they control the MPRR in the three modes of operation.

---

#### ***Data Mode***

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

- Command #01 Switch To Command Mode changes the MPRR from the data mode to the command mode. See [“01 Switch to Command Mode” on page 7-5](#).

***Note:*** The MPRR transmits ID codes to the host computer when the MPRR is in data mode. If the MPRR remains in the command mode with tags passing through the read zone, all tag IDs are not reported.

---

#### ***Command Mode***

While the MPRR is in the command mode, the host computer sends commands to the MPRR that can be used to control the operation and configuration of the reader. After the MPRR receives a command, it transmits a command response message. Typically,

the command message contains Error, Done, or data relating specifically to the command request. These messages may be of variable length since some commands require information as part of the message; for example, Display ATA Mode Status.

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

- If the host computer receives the Done message, then both the host and the MPRR switch to the new baud rate, and communications are maintained.

*Note:* In many applications, the host must be set to the new baud rate as it will not change automatically.

*Note:* The MPRR changes the baud rate immediately after issuing the Done message.

- However, if the host does not receive the Done message transmitted by the MPRR, the host assumes that the command was not properly sent and does not switch to the new baud rate, causing a loss of communications.



#### **Caution**

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

---

## **Download Mode**

In download mode, the MPRR allows the host to download new software.

While in download mode, the reader communications port parameters are fixed at the following factory-default settings: 38400 baud, 8 data bits, 1 stop bit, no parity, software flow control (XON/XOFF), basic protocol.

While in download mode, the MPRR turns RF off, does not process tags, and does not echo host commands.

---

## **Command List**

Reader commands are divided into groups based on primary function. The following sections provide information about each command in command number order. Refer to Appendix D for listings of commands in numerical and alphabetical order.

In the following text, the symbols < and > represent variable message data. These symbols are not part of the message syntax.

Hex digits (0–9, A–F) in either uppercase or lowercase characters may be used in data strings and for hex digits A–F.



## Reader Mode Control — Command Group 0

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

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

Command #00 switches the reader to data mode, which allows the reader to transmit tag data (ID codes) to the host. The reader enters data mode on power up.

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

- Command #01 Switch to Command Mode

Reader response:

Done

### 01 Switch to Command Mode

Command #01 switches the reader to command mode, which allows the reader to accept commands from a host or terminal. While in command mode, the reader turns RF off and does not acquire tags.

Reader response:

Done

## Communications Port Control — Command Group 1

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

### 100N Select Baud Rate

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

**Table 7-1 Select Baud Rate Commands**

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



**Caution**

*If ECP is enabled, ensure that the ECP timeout is sufficient for the new baud rate.*

Reader response:

Done

**101N Select Stop Bits**

Command #101N selects the number of stop bits for reader character transmission. The factory default setting is 1 stop bit. The N variable specifies the number of stop bits as indicated in [Table 7-2](#).

**Table 7-2 Select Stop Bits Commands**

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

Reader response:

Done

**102N Select Parity**

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

**Table 7-3 Select Parity Commands**

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

Reader response:

Done

**Command Group 2**

Group 2 commands control the real-time clock which maintains the MPRR internal time and date. This time and date can be appended to IDs, error messages, and sensor input reports. An internal battery supports the clock, so time and date are preserved if main power is lost.

**20 Set Time**

Command #20 sets the time. Enter the time in the proper format: two-digit decimal entries with no spaces between characters and using colons as delimiters.

The entry format is as follows:

*20HH:MM:SS or 20HH:MM:SS:hh*

where

*HH* represents hours (00 to 23).

*MM* represents minutes (00 to 59).

*SS* represents seconds (00 to 59).

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

*:* is the time delimiter.

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

Reader response:

Done

### **21 Set Date**

Command #21 sets the date. Enter the date in the proper format: two-digit decimal entries with no spaces between characters and using forward slashes “/” as delimiters.

The entry format is as follows:

*21MM/DD/YY*

where

*MM* represents the month (01 to 12).

*DD* represents the day (01 to 31).

*YY* represents the last two digits of the year (00 to 99).

*/* is the date delimiter.

Reader response:

Done

### **22 Display Time and Date**

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

Reader response:

*HH:MM:SS.hh MM/DD/YY*

where

*HH* represents hours.

*MM* represents minutes.

*SS* represents seconds.

*hh* represents hundredths of seconds.

: is the time delimiter.  
 MM represents the month.  
 DD represents the day.  
 YY represents the last two digits of the year.  
 / is the date delimiter.

### Append Information — Command Group 3

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

#### 30N Append Time and Date Selection

Command #30N selects the option of appending the time and date to transmitted IDs, error messages, presence without tag reports, and input status change reports. The factory default setting is time and date appended (command #302).

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

**Table 7-4 Append Time and Date Commands**

Command	Append Option
300	No time and date appended
<b>302</b>	Time and date appended (factory default)

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

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

where

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

& separates <string> from the time and date.

HH:MM:SS is the time delimiter.

MM/DD/YY is the date delimiter.

Reader response:

Done

### 31N Append Auxiliary Information Selection

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

**Table 7-5 Append Auxiliary Information Commands**

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

The reader transmits messages with auxiliary information appended as:

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

where

- % separates the auxiliary information and signals the host computer that auxiliary information is appended.
- xx reader ID. Value can be set with command #60NN.
- auxiliary information delimiter
- y antenna number. Value fixed at 0.
- zz number of reads (00 to FF hexadecimal) of the previous tag
- q current status of input0 and input1 (0 to 3). Not applicable to the MPRR.

Reader response:

Done

## ID Filtering — Command Group 4

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

### 40 Transmit All ID Codes

Command #40 instructs the reader to transmit all IDs without regard for uniqueness. This command can be useful when tuning the read zone and mapping the footprint or performing diagnostics.

After diagnostics are complete, you may want to reinstate the uniqueness check using command #410N Select Unique ID Code Criteria.

Reader response:

Done

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

Command #410N instructs the reader to buffer and transmit ID codes according to the following test: an ID is read if previously decoded IDs have changed value at least N+1 times since the new ID was last received. IDs that do not pass the test are not read. The factory-default setting is command #4100, which selects a separation of one ID. Variable N specifies ID separation as shown in [Table 7-6](#).

**Table 7-6 Unique ID Code Criteria**

Command	Uniqueness Criteria
4100	Separation of 1 ID (factory default)
4101	Separation of 2 IDs
4102	Separation of 3 IDs
4103	Separation of 4 IDs

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

- Item 1            Most recently acquired ID (different from Item 2)
- Item 2            Second-most recently acquired ID (different from Item 3)
- Item 3            Third-most recently acquired ID (different from Item 4)
- Item 4            Fourth-most recently acquired ID

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

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

The uniqueness test has a two-minute time limit. If an ID is buffered, it will not be accepted again unless it arrives at the reader more than two minutes from the previous arrival or until the receipt of one or more other IDs reset the uniqueness.

Reader response:

Done

**420N Select Valid ID Code Criteria**

Command #420N directs the reader to validate an ID received only after it has been

obtained a specified number of times in sequence. Values for N are 0 through 3 (Table 7-7). The factory setting is one acquisition (N = 0).

**Table 7-7 Select Valid Code Commands and Frames**

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

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

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

### **43 Buffer All ID Codes**

Command #43 buffers all acquired ID codes. It effectively cancels any uniqueness criteria previously set by select unique ID code criteria command 410N.

*Note: Command #43 is for diagnostic purposes only.*

After diagnostics are complete, reset the select unique ID code criteria using command 410N.

Reader response:

Done

### **440 Reset Uniqueness**

Command 440 causes the ID filtering process set by Select Unique ID Code Criteria (#410N) to restart. It is used in conjunction with the Variable Timeout #44N) commands. This command provides a one-time reset at which point the previously set time-out interval resumes. This command can be sent in data or command mode.

### **44N Set Uniqueness Timeout**

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

#### **Command Time-Out Clock**

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

#442 15 seconds

#443 30 seconds

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

The time-out clock is continually reset (does not expire) as long as the reader receives the same tag ID. For example, assume that the time-out clock is set for 2 minutes and there is a railcar parked on a siding in front of the reader. Without this reset feature, the railcar's ID would be reported every 2 minutes (each time the time-out clock expired).

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

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

Reader response:

*Done*

### **453 Enable Tag Translation Mode**

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

Reader response:

*Done*

### **454 Disable Multi-tag Sort (Factory Default)**

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

Reader response:

*Done*

### **455 Enable Multi-tag Sort**

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

Reader response:

*Done*

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



### **456 Enable SeGo Protocol Tag Initialization During Multi-tag Sort (Factory Default)**

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

Reader response:

Done

### **457 Disable SeGo Protocol Tag Initialization During Multi-tag Sort**

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

Reader response:

Done

### **480 Disable ATA**

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

### **481 Enable ATA**

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

### **484 Disable SeGo**

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

### **485 Enable SeGo**

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

### **488 Disable eATA**

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

### **489 Enable eATA**

Command #489 enables the reader to read factory-programmed eATA data from SeGo protocol tags.

### **496 Disable Alternate Group Select (Factory Default)**

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

Reader response:

Done

### **497 Enable Alternate Group Select**

Command #497 enables the alternate group select function that allows the reader to distinguish tags meeting specific criteria pre-programmed into the tags.

Reader response:

Done

---

## **Reader Status — Command Group 5**

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

### **505 Display Software Version**

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

Reader response:

Model E4 Series Ver X.XX SNYYYYYY

where

X.XX                      Version number

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

### **506 Display Hardware Configuration Information**

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

Reader response:

*An ASCII string from 1 to 20 characters in length*

### **510 Display RF Transceiver FPGA Version**

Command #510 displays RF FPGA VER = XX.XX

### **511 Display RF Transceiver I Filter Chip Version**

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

### **512 Display RF Transceiver Q Filter Chip Version**

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

### **513 Display DSP Board Actel Version**

Command #513 displays DSP FPGA VER = XX.XX

### 520 Display Power Fail Bit

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

Reader response:

PWRB P<0 to 1>R0

where

P0	No power failure detected
P1	Power failure detected
R0	Not applicable to the MPRR

### 521 Display Reader ID Number

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

Reader response:

RDID xx

where xx = 01 to FF (hexadecimal)

### 522 Display Communications Port Parameters

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

Reader response:

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

where

B2	1200 baud
B3	2400 baud
B4	4800 baud
B5	9600 baud (factory default)
B6	19.2 kbps
B7	38.4 kbps
S0	one stop bit (factory default)
S1	two stop bits

P0	no parity (factory default)
P1	even parity
P2	odd parity
D0	00 ms end-of-line delay (fixed)

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

```
MAIN B5 S0 P0 D0
```

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

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

### **524 Display Appended Information Status**

Command #524 displays the information being appended to the reader transmissions. Command #31N appends information.

Reader response:

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

where

T0	Time not appended
T1	Time appended
D0	Date not appended
D1	Date appended
X0	Auxiliary information not appended (factory default)
X1	Auxiliary information appended

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

```
IDAP T1 D1 X0
```

indicating time and date appended, and auxiliary information not appended.

*Note: Time and date may be appended to ID codes, error messages, presence without tag reports, and input status change reports. Auxiliary information may only be appended to ID codes, presence without tag reports, and input change reports.*

### 525 Display Communications Protocol Status

Command #525 displays the status of command #61N Selected Communications Protocol, command #614N Selected Mode of Flow Control, and command #612NN ECP Timeout.

Reader response:

```
ECPS P<0 to 1> T<01 to FF> X<0 to 2> S0
```

where

P0	Basic protocol enabled (factory default)
P1	ECP enabled
Txx	ECP timeout where xx = 01 to FE (hexadecimal) Timeout (ms) = 50 * xx If xx = FF timeout disabled
X0	Flow control disabled
X1	Software flow control enabled (factory default)
X2	Hardware flow control enabled
S0	start of message character is #

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

```
ECPS P0 TFE X1 S0
```

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

### 527 Display RF Status

Command #527 displays the current status of the RF module. The reader response indicates whether RF is controlled externally by the host, set by command #640N RF Control, or internally by input set by command #641 (not applicable to the MPRR). RF always controlled by Sense0 and Sense1 when reader is in MPRR mode. See [“MUX Operational Modes” on page 7-35](#). Command #527 also displays the current RF status and the uniqueness timeout.

*Note: If you enter RF settings using command #642NN, the display command for RF output frequency, F is “Fxx” and indicates use of the backward-compatible frequency entry method.*

Reader response:

```
RFST C<0 to 1> O<0 to 1> T<1 to 3> Fxxx Rxx Gxx Axx Ixx
```

where

C0	RF controlled by host
C1	RF controlled by presence sensor on input0, the red/green pair (factory default)
O0	RF off

O1	RF on
T1	Uniqueness timeout of two minutes
T2	Uniqueness timeout of 15 seconds
T3	Uniqueness timeout of 30 seconds
Fxxx	RF output frequency, xxx = 000 to 118 hexadecimal offset in 250 kHz from 860 MHz. If an invalid frequency value is stored (corrupted NVRAM), then xxx = "XXX" to indicate an error in the frequency setting.
Rxx	Tag decoder range (distance) for ATA tags, xx = 00 to 1F hexadecimal range value
Gxx	Tag decoder range (distance) for SeGo protocol tags, xx = 00 to 1F hexadecimal range value
Axx	RF power attenuation, where 00 is maximum output power and 0A is minimum output power (10dB less than maximum power).
Ixx	IAG RF power attenuation, where 00 is maximum output power and 0F is minimum output power (15 dB less than maximum power)

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

```
RFST C1 00 T1 Fxx R1F G1F A00 I04
```

which means that RF is enabled by presence sensor on input0, RF signal off, uniqueness timeout of two minutes, RF output frequency has not been set, maximum RF output range for ATA tags, maximum RF output range for eGo and eGo Plus tags, full RF power, and IAG power set at 4 dB attenuation.

### **529 Display Presence Input Status**

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

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

Reader response:

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

where

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

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

PRST P0 D0 A2 TF I0

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

### 530 Display RF0 Filter Status

Command #530 displays the parameter set for the RF input, including the selected unique ID code criteria (#410N Select Unique ID Code Criteria) and the valid ID code criteria, which are fixed at one acquisition.

Reader response:

RF0S U<0 to 2> V0

where

U0	One ID separation (factory default)
U1	Two ID separations
U2	Transmit all IDs
V0	Valid ID code criteria of one acquisition (fixed)

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

RF0S U0 V0

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

### 534 Display Tag Translation Mode Status

Command #534 displays tag translation mode status, enabled or disabled. If tag translation mode is enabled, incoming full-frame tags in AAR or ATA format are translated according to ISO standards. Refer to [“452 Disable Tag Translation Mode \(Factory Default\)” on page 7-12](#) and [“453 Enable Tag Translation Mode” on page 7-12](#) for more information.

Reader response:

TT <0 to 1>

where

0	tag translation mode disabled
1	tag translation mode enabled

### 537 Display Echo Status

Command #537 displays echo mode status. In basic protocol (#610 Select Basic Protocol), the reader may be configured to enable (#6171 Enable Echo Mode) or disable (#6170 Disable Echo Mode) the echo of received commands. Refer to sections [6170 Disable Echo Mode](#) and [“6171 Enable Echo Mode \(Factory Default\)” on page 7-25](#) for more information.



Reader response:

ECHO <0 to 1>

where

0 Echo status disabled (factory default)

1 Echo status enabled

### **540 Display Flash Checksum**

Command #540 displays the flash memory checksum.

Reader response:

PCKS I0000 Exxxx

where

0000 Not applicable to the MPRR

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

### **543 Display Boot Checksum**

Command #543 displays the boot ROM checksum.

Reader response:

BCKS xxxx

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

### **552 Display Antenna Multiplexing Mode**

Command #552 displays the antenna multiplexing mode. When the MPRR mode is enabled, the response is

Reader response:

MUX <x>

where

x = 0 antenna multiplexing disabled, RF on port 0 only

x = 1 antenna multiplexing between RF ports 0 and 1 when sense0 active

x = 2 antenna multiplexing between RF ports 0 and 1 when sense0 active and RF port 2 when sense1 active

x = 3 antenna multiplexing between RF ports 0 and 1 when sense0 active and RF ports 2 and 3 when sense1 active

### 560 Request Sensor Status Change

Command #560 displays the sensor status change reporting. Not applicable to the MPRR

Reader response:

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

where

E0	Input status change reports disabled (factory default)
E1	Input status change reports enabled
M0	Reporting disabled (factory default)
M1	Changes on input0 reported
M2	Changes on input1 reported
M3	Changes on either input reported

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

```
SSTC E0 M0
```

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

### 570 Display Operating Mode Status

Command #570 displays the currently selected tag read mode.

Reader response:

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

where

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

### 577 Report Buffered Handshakes

Command #577 reports the buffered handshakes. When in MPRR mode and/or if antenna multiplexing is enabled, the response is

Reader response:

```
HDSH C0 <ww> C1 <xx> C2 <yy> C3 <zz>
```

where

ww is count from part 0, xx is count from part 1, yy is count from part 2, and zz is count from part 3.

---

## Reader Control Functions — Command Group 6

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

### 60NN Set Reader ID Number

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

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

Reader response:

Done

### 610 Select Basic Communication Protocol (Factory Default)

Command #610 enables the basic communications protocol.

Reader response:

Done

### 611 Select Error Correcting Protocol

Command #611 enables the error correcting protocol.

Reader response:

Done



#### Caution

*Do not switch to ECP (command #611 Select Error Correcting Protocol) unless the host is prepared to acknowledge each reader transmission.*

### 612NN Select Error Correcting Protocol Timeout

Command #612NN selects the timeout interval for ECP. This timeout applies to the transmission of tag, report, and error messages and to the receipt of host commands. The transmit timeout is initiated immediately after the end-of-message sequence CR/LF is transmitted. If the host does not acknowledge the message within the specified interval, the reader times out and retransmits the message.

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

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

The value for NN specifies the timeout interval as follows:

ms	50 * NN for NN = 01 to FE (1–254)
FE	Factory default (12,700 ms, 12.7 seconds)

FF Disables the ECP timeout

Reader response:

Done



**Caution**

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

**613 Enable Data Inquiry Protocol**

Command #613 enable the data inquiry protocol.

Reader response:

Done

**614N Select Flow Control Option**

Command #614N selects the flow control option for reader-to-host communications. The factory default setting is software flow control (XON/XOFF) enabled. In download mode, flow control is not host-selectable; it is fixed at the default setting. However, during data mode and command mode operation, the following flow control options are available. The N variable specifies flow control as shown in [Table 7-8](#).

**Table 7-8 Flow Control Commands**

Command	Flow Control Option
6140	Disable flow control
<b>6141</b>	Enable software flow control (factory default)
6142	Enable hardware flow control

Reader response:

Done

If the reader is configured for software flow control (XON/XOFF), it stops transmitting if it receives an XOFF character (host software command 13H). It does not resume transmitting until it receives an XON character (host software command 11H). If the reader is configured for hardware flow control (RTS/CTS, request to send/clear to send), it stops transmission if it detects that the CTS line is no longer asserted. It resumes transmission when this line is asserted again.

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

**6170 Disable Echo Mode**

Command #6170 disables the reader’s echo of received host commands. If operating in basic protocol or data inquiry protocol, the reader echoes by default. As the reader receives a host command, it echoes each character of the command. Once the entire command has been received and processed, the reader transmits its response. If echo-

ing is disabled with command #6170, the reader does not echo the command, but only transmits its response. The reader never echoes while in ECP or download mode operation.

Reader response:

Done

### 6171 Enable Echo Mode (Factory Default)

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

Reader response:

Done

### 63 Reset Reader

Command #63 resets the power fail bit, clears all buffers, resets tag uniqueness, turns off both output lines, transmits the sign-on message, and returns to the data mode.

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

Reader response:

Model E4 Series Ver X.XX SNYYYYYY  
Copyright 2008 TransCore

where

X.XXD                      Version number

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

### 640N RF Control

Command #640N directly controls the RF module. The N value controls the RF power as shown in [Table 7-9](#).

*Note: These commands only have an effect when the reader is not in MPRR mode. See commands #836 and #837.*

**Table 7-9 RF Control Commands**

Command	RF Power
6400	Turns off RF
6401	Turns on RF
6402	Turns on continuous wave (CW) RF until command 6400 or 641 is received by the reader.

Command #6400 disables RF-by-input control command #641 Select RF-by-Input Control.

Reader response:

Done

### **641 Select RF-by-Input Control (Factory Default)**

Command #641 configures the reader for RF-by-input control. The reader automatically turns on RF when it detects a presence through sense0. The reader turns off RF according to the selected RF control algorithm (#692N Select RF Control Algorithm).

*Note: This command only has an effect when the reader is not in MPRR mode.*

Reader response:

Done

### **643NN Select ATA Operating Range (Distance)**

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

Reader response:

Done

### **644NN Set RF Attenuation**

Command #644NN sets the attenuation control for the output RF power where NN is a hexadecimal value from 00 to 0A. Settings for attenuation are 1.0 dB increments over a range of 10 dB of attenuation from the maximum power setting of 2 watts at 0-dB attenuation to a minimum power level of 200 milliwatts at 10-dB attenuation.

The Set RF Attenuation command NN variables and corresponding attenuation settings are shown in [Table 7-10](#).

**Table 7-10 RF Attenuation Command Variables**

Variable (NN)	Attenuation Setting (dB)
00	0 (factory default)
01	1
02	2
03	3
04	4
05	5
06	6
07	7

**Table 7-10 RF Attenuation Command Variables (continued)**

Variable (NN)	Attenuation Setting (dB)
08	8
09	9
0A	10

Reader response:

Done

**645NN Set SeGo Protocol Operating Range (Distance)**

Command #645NN sets the read range for SeGo protocol tags where NN is a hexadecimal value from 00 to 1F; the range increases with increasing NN value. The range can be adjusted for 32 discrete values where 00 is the shortest range and 1F is the longest range. The default range value is 1F.

Reader response:

Done

**647XXX Select RF Operating Frequency**

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

If the NVRAM becomes corrupted, the correct operating frequency cannot be guaranteed. In this circumstance, the RF section shuts down and the reader sends an `ERROR06` message to the host. Until the frequency is reset using command #647XXX, the unit displays the same error message every time it is powered up or if an attempt is made to enable the RF by host or by external sensor.

The commands to set the RF frequency are presented in [Table 7-11](#).

**Table 7-11 Select RF Frequency Commands**

Command	RF Frequency (MHz)
647000	860.00
.	.
.	.
.	.
6470CF	911.75
6470D0	912.00

**Table 7-11 Select RF Frequency Commands (continued)**

Command	RF Frequency (MHz)
6470D1	912.25
6470D2	912.50
6470D3	912.75
6470D4	913.00
.	.
.	.
.	.
6470EA	918.50
6470EB	918.75
6470EC	919.00
6470ED	919.25
6470EE	919.50
6470EF	919.75
.	.
.	.
.	.
657113	928.75
647114	929.00
647115	929.25
647116	929.50
647117	929.75
647118	930.00

Reader response:

Done

**65 Reset Power Fail Bit**

Command #65 resets the power fail bit to 0. The bit changes from 0 to 1 when power is restored to the reader. Upon reader power-up, the host transmits either command #65 or #63 Reset Reader to properly initialize this bit. The current state of the power fail bit may be displayed. Refer to [“520 Display Power Fail Bit” on page 7-15](#) for more information.



Reader response:

Done

### 66F Load Default Operating Parameters

Command #66F loads all the factory default operating parameters except RF operating frequency. Refer to [Table 8-2, MPRR Default Configuration Settings](#) for a listing of the defaults.

Reader response:

Done All parameters loaded OK

Error A parameter load failed

### 690N Select Presence Without Tag Report Option

Command #690N enables or disables the presence without tag report option. If the presence without tag reporting option is enabled using command #6901, input reports are transmitted when a tag presence is detected without the subsequent acquisition of a valid tag. The value for N specifies the reports as shown in [Table 7-12](#).

*Note: These commands only have an effect when the reader is not in MPRR mode.*

**Table 7-12 Presence Without Tag Report Commands**

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

Reader response:

Done

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

### 692N Select RF Control Algorithm

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

The values for N specify the RF control algorithms as shown in [Table 7-13](#).

*Note: These commands only have an effect when the reader is not in MPRR mode.*

**Table 7-13 RF Control Algorithm Commands**

Command	RF Power Off
6920	On timeout only
6921	Timeout or tag ID acquired

**Table 7-13 RF Control Algorithm Commands**

Command	RF Power Off
<b>6922</b>	Timeout or presence false (factory default)

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

Command #6921 allows RF power to be turned off either after the timeout period or upon acquisition of a valid tag ID, whichever occurs first.

Command #6922 turns off RF power either after the timeout period or upon the presence false condition, whichever occurs first.

Reader response:

Done

### **693N Select RF Timeout Period**

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

Command #693F disables the RF timeout. The reader turns off the RF immediately following the acquisition of a valid tag, whether or not it is unique.

Uppercase or lowercase characters are allowed for N; for example, hex digits A through F or a through f. The commands and corresponding timeouts are shown in [Table 7-14](#).

*Note: These commands only have an effect when the reader is not in MPRR mode.*

**Table 7-14 Timeout Period Values**

Command	Timeout (ms)
6930	0 (always expired)
6931	4
6932	8
6933	12
6934	20
6935	24
6936	32
6937	48
6938	60
6939	92
693A	152

**Table 7-14 Timeout Period Values (continued)**

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

Reader response:

Done or Error.

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

**694N Select Input Inversion Option**

Command #694N enables or disables input inversion. When inversion is enabled, an open circuit input is interpreted as a closed circuit, and a closed circuit input is interpreted as an open circuit. This feature allows greater flexibility in the attachment of external equipment to the reader inputs. For example, some proximity sensors indicate presence with an open circuit. In this instance, command #6941 can enable input inversion so that an open circuit input indicates a presence. The values for N represent the two inversion options as shown in [Table 7-15](#).

**Table 7-15 Input Inversion Options**

Command	Option
<b>6940</b>	Disable input inversion (factory default)
6941	Enable input inversion

Reader response:

Done

**695S...S Set Serial Number**

Command #695 assigns the reader serial number according to the format:

695SSSSSS

where SSSSSS is the serial number.

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

*Note:* The factory-assigned serial number of the reader contains seven characters. However, to maintain backward compatibility, the reader software allows only six

characters to be entered. When setting the serial number, skip the fourth (middle) character of the seven-character number shown on the reader product label.

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

Reader response:

Done

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

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

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

696S . . . S

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

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

Reader response:

Done

---

## **Auxiliary Reader Control — Command Group 8**

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

### **8110**

Command #8110 turns on RF port0, sends the command on Ctag pin 0 to fire off Ctag address 0.

### **8111**

Command #8111 turns on RF port1 and sends the command on Ctag pin 0 to fire off Ctag address 1.

### **8112**

Command #8112 turns on RF port2 and sends the command on Ctag pin 1 to fire off Ctag address 0.

### **8113**

Command #8113 turns RF port3 and sends the command on Ctag pin 1 to fire off Ctag address 1.

### **8142X**

Command #8142X sends the command on Ctag pin 0 to set the Ctag character.

**8143X**

Command #8143X sends the command on Ctag pin 1 to set the Ctag character.

**8150**

Command #8150 sets the check tag address to 0 on check tag pin 0.

**8151**

Command #8151 sets the check tag address to 1 on check tag pin 0.

**8152**

Command #8152 send the command on Ctag pin 1 to set the Ctag address to 0.

**8153**

Command #8153 send the command on Ctag pin 1 to set the Ctag address to 1.

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

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

Reader response:

Done

**831 Enable Automatic Periodic RF Status Report**

Command #831 enables the automatic periodic RF status report. This function sends out a periodic RF status report if no other message (a tag read) is sent from the reader for a period of time. This message is the same message that would be sent in response to the #527 Display RF Status command. Enabling this function is helpful in some sites where there may not be much tag activity, and the user wants an automatic way to ensure the communication channel with the reader is still intact. With this function enabled, the host system will get a message from the reader at least every three minutes.

Reader response:

Done

**836 Disable MPRR Mode**

Command #836 disables the MPRR mode.

Reader response:

Done

**837 Enable MPRR Mode**

Command #837 enables the MPRR mode.

Reader response:

Done

**850 MUX RF Port 0 (Factory Default)**

Command #850 enables RF port 0.

Reader response:

Done

**851 MUX Between RF Port 0**

Command #851 multiplexes between RF port 0.

Reader response:

Done

**852 MUX Between RF Ports 0 and 1**

Command #852 multiplexes between RF ports 0 and 1.

Reader response:

Done

**853 MUX Between RF Ports 0, 1, and 2**

Command #853 multiplexes between RF ports 0, 1, and 2.

Reader response:

Done

**891 MUX RF Port 1 Only**

Command #891 multiplexes RF port 1 only.

Reader response:

Done

**892 MUX RF Port 2 Only**

Command #892 multiplexes RF port 2 only.

Reader response:

Done

**893 MUX RF Port 3 Only**

Command #893 multiplexes RF port 3 only.

Reader response:

Done

---

## ***Check Tag Operation***

### **To enable check tag 0, issue the following commands**

#8110 – turn on RF port0, send the command on Ctag pin 0, to fire off Ctag address 0.

#8111 – turn on RF port1, send the command on Ctag pin 0, to fire off Ctag address 1.

#8142X – send the command on Ctag pin 0 to set the Ctag character.

#8150 – send the command on Ctag pin 0 to set the Ctag address to 0.

#8151 – send the command on Ctag pin 0 to set the Ctag address to 1.

### **To enable check tag 1, issue the following commands**

#8112 – turn on RF port2, send the command on Ctag pin 1, to fire off Ctag address 0.

#8113 – turn on RF port3, send the command on Ctag pin 1, to fire off Ctag address 1.

#8143X – send the command on Ctag pin 1 to set the Ctag character.

#8152 – send the command on Ctag pin 1 to set the Ctag address to 0.

#8153 – send the command on Ctag pin 1 to set the Ctag address to 1.

---

## ***MUX Operational Modes***

### **To enable antenna multiplexing (muxing) operational modes, issue the following commands**

#836/#837 – Disable/enable MPRR mode

#850 – RF port 0 only (factory default)

#851 – mux between RF port 0

#852 – mux between RF port 0, 1

#853 – mux between RF port 0, 1, 2

#552 – Display mux setting. This display message will include “MPRR” if MPRR mode is enabled (#837).

When MPRR mode is disabled, the reader will continuously step through each port that has been enabled with #85X, running through whichever tag protocols are enabled on each port, in order. The reader turning RF on will be qualified “RF on by sense” setting. Command #6401 is used to turn RF on continuously and bypass the RF on by sense. Sense0 is used for all antennas that are enabled, if RF is turned on by sense, #641.

When MPRR mode is enabled, you must use Sense0 and Sense1 to turn on RF and read tags. Sense0, when shorted to reader signal ground, will enable tag reads on RF ports 0 and 1 (if enabled with #851) and Sense1 will enable tag reads on Ports 2 and 3 (if enabled with #853). For example, if commands #837 and #853 have been entered, Sense0 is open, Sense1 shorted, and the reader is in data mode, the reader will attempt tag reads toggling between RF ports 2 and 3 only. Smart muxing, ATA tag data sniff-

ing and ATA dwell of two handshakes per antenna is automatic in MPRR mode.

---

## ***MUX Test Modes***

**To enable antenna muxing test modes, issue the following commands**

#891 – RF port 1 only

#892 – RF port 2 only

#893 – RF port 3 only

To use these test modes, MPRR mode must be disabled (#836) and muxing must be disabled (#850). These command modes are not saved to non volatile memory, and will be cleared by a power cycle of the reader, or by enabling either MPRR mode or muxing. When these modes are enabled, the reader will continually run through whichever tag protocols have been enabled, but only on the selected RF port. These test mode commands are qualified by the RF on by sense settings. Use #6401 to disable RF on by sense, if desired.



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# Configuring the Multiprotocol Rail Reader

PRELIMINARY



---

# Configuring the Multiprotocol Rail Reader

*This chapter provides instructions for configuring the Multiprotocol Rail Reader (MPRR), including factory configuration parameter defaults and instructions for using terminal emulation software to check and change the MPRR factory configuration defaults.*

---

## Configuring the Reader

---

After installing the MPRR, you need to configure its operating parameters. Terminal settings should be initially set at 9600 baud, 8 data bits, no parity, 1 stop bit, and no flow control.

---

### General Configuration Labeling

Each MPRR and its shipping carton are labeled to indicate the unit's general configuration. [Table 8-1](#) contains explanations of the MPRR label fields.

**Table 8-1 MPRR Configuration Label Fields**

Field	Description
1st	TransCore reader designator (10-)
2nd	<b>Model number</b> To be provided in the final version of the guide (7032-)
3rd	<b>Interface</b> To be provided in the final version of the guide (TBD-)
4th	To be provided in the final version of the guide (TBD-)

## Default Operating Parameter Settings

Table 8-2 contains the factory default configuration settings for the MPRR operating parameters. The default configuration settings may not be the correct operating configuration settings for a specific site. Changes to the configuration settings may have to be made, depending on the site plan, as described in Chapter 2 “Developing the Site Plan.”

Review the default configurations shown in Table 8-2 to determine which parameters, in addition to operating frequency and operating range, need to be adjusted. Refer to Chapter 7, “Commands,” for a complete list of parameters and the corresponding commands.

*Note: The dual-protocol MPRR internal timing varies depending on the operative tag read mode and the type of tag in the read field.*

**Table 8-2 MPRR Default Configuration Settings**

Parameter	Setting	Command
Operating mode	Data	00
Baud rate	9600	1005
Stop bits	1	1010
Parity	None	1020
Time and data appended	Enabled	302
Auxiliary information appended	Disabled	310
Unique ID code criteria	Separation of 1 ID	4100
Tag translation mode	Disabled	452
Multi-tag sort	Disabled	454
SeGo protocol tag initialization during multi-tag sort	Enabled	456
Alternate group select	Disabled	496
Reader ID number	00	6000
Communications protocol	Basic	610
Error correcting protocol (ECP) timeout	12.7 sec	612FE
Flow control	Software (XON/XOFF)	6141
Echo mode	Enabled	6171
ATA operating range	Maximum	6431F

**Table 8-2 MPRR Default Configuration Settings (continued)**

Parameter	Setting	Command
RF attenuation	Full power	64400
SeGo protocol tag operating range	Maximum	6451F
Sense output pulse duration	228 ms	67C
Presence without tag reports	Disabled	6900
RF-off control	Timeout or no presence	6922
RF timeout	Never true	693F
Input inversion	Disabled	6940
Serial number	NNNNNN	695
Store hardware configuration	Hardware configuration not known	696
Input status change reports	Disabled	820
Automatic periodic RF status report	Disabled	830

a. Local laws apply. The authorized frequency band for the TransCore MPRR in the United States is 911.75 MHz to 919.75 MHz. Contact TransCore if your application requires a frequency outside of this range.

## **Configuring Parameters with Terminal Emulation Software**

To configure the MPRR using a PC and terminal emulation software to manually enter MPRR host commands, follow the instructions in the section [“Connecting the MPRR to the Host” on page 4-9](#). Then, enter the appropriate configuration commands through the terminal emulation software on the host.

See [Chapter 7, “Commands,”](#) for a detailed description of all available configuration commands.

### **Starting the Terminal Emulation Software**

You can use a PC and any terminal emulation software to enter the host commands to download flash software, configure reader operating parameters, perform diagnostics, and retrieve tag data. The following procedures show examples using Hyper Terminal™, an application included with Microsoft Windows. Most terminal emulation applications have a similar sequence for launching.

#### **To start the terminal emulation software**

1. At the command prompt, type your terminal emulation start command; or if using Windows Hyper Terminal, select:

Programs>Accessories>Hyperterm  
and press **ENTER**.

The application displays the Connection Description dialog box as shown in Figure 8-1.



Figure 8-1 Connection Description Dialog Box

2. Enter a name for the session and click **OK**.

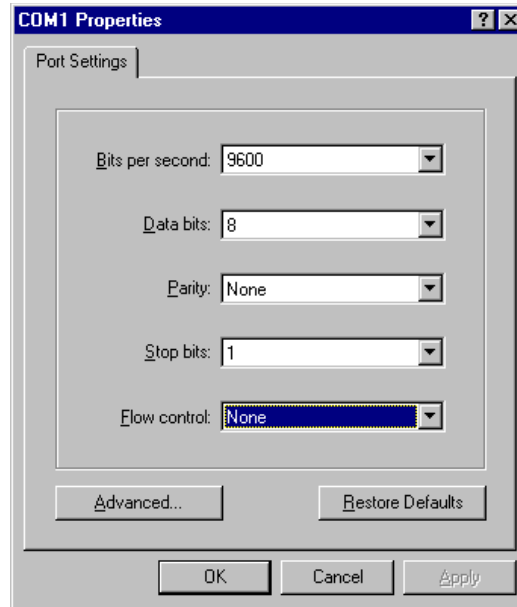
The application displays the **Phone Number** dialog box as shown in Figure 8-2.



Figure 8-2 Phone Number Dialog Box

3. From the **Connect using** pull-down list, choose the **Com 1** option (or whichever com port on the PC to which the RS-232 cable is attached) and click **OK**.

The application displays the **COM1 Properties** dialog box as shown in [Figure 8-3](#).



**Figure 8-3 COM 1 Properties Dialog Box**

4. In the pull-down lists on the **COM1 Properties** dialog box, choose the following values:
  - Bits per second: 9600 baud
  - Data bits: 8
  - Parity: None
  - Stop bits: 1
  - Flow control: None

Click **OK**.

The application displays the **configparms - Hyper Terminal** main screen as shown in [Figure 8-4](#).

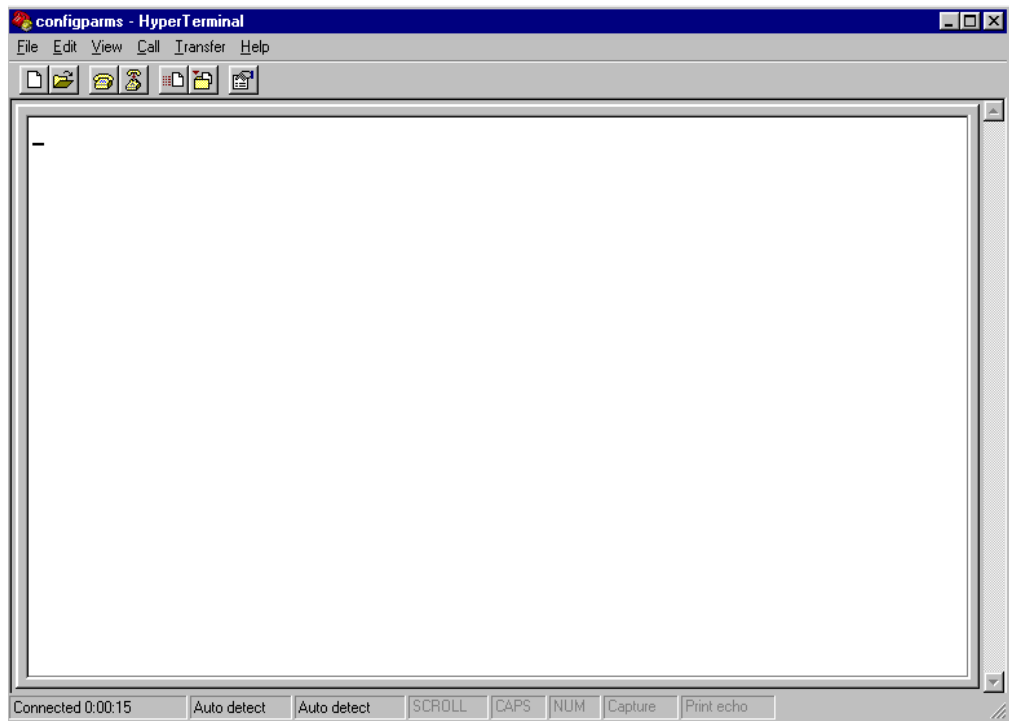


Figure 8-4 Hyper Terminal Main Screen

---

## Verifying Communications

You must verify that the MPRR and the PC or laptop are communicating.

### To verify communications

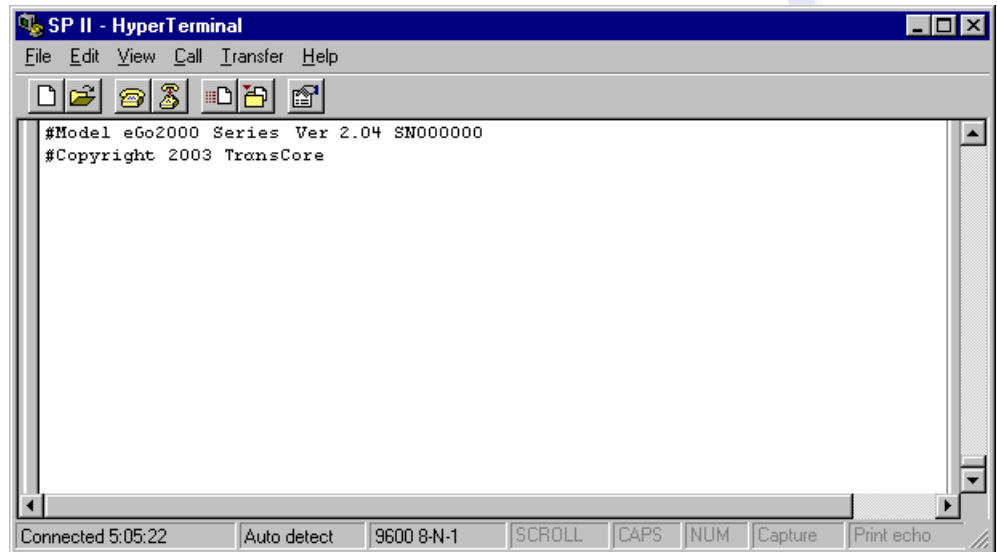
1. Start the terminal emulation application as described previously in [“Starting the Terminal Emulation Software”](#) on page 8-5.

*Note:* When testing the MPRR using a laptop, TransCore recommends that you configure laptop communication parameters to match those of the host computer to which the MPRR will be connected after testing and configuration are completed.

2. Cycle the power on the MPRR.

Upon startup, the MPRR transmits a sign-on message, displayed on the terminal emulation screen as shown in [Figure 8-5](#), or a boot ROM failure message.





**Figure 8-5 Sign-on Message**

The sign-on message appears as follows:

```
Model [software version] SNYYYYYY
[Copyright notice]
```

where YYYYYY is the serial number assigned to the MPRR skipping the fourth character printed on the reader product label.

Serial number 000000 is the default setting and is not a valid number. If this number appears in the sign-on message, the serial number has never been stored into reader memory. Contact TransCore Technical Support.

If the flash memory checksum is not verifiable, the sign-on message appears as follows:

```
Model [E4 BOOT] Ver 0.00 A
[Copyright notice]
```

If the failure message version number equals 0.00 E and no serial number exists, the flash memory checksum has failed, and the MPRR is operating out of boot ROM. In this case, the MPRR automatically enters download mode and waits for a new program to be loaded into the flash memory. Follow the instructions in [“Program Download” on page 5-5](#).

Communications can also be verified by using the command sequence in [Table 8-3](#).

**Table 8-3 Command Sequence to Verify Communications**

Entry	MPRR Response	Notes
#01 <CR>	#Done <CR/LF>	Switches the MPRR to command mode.
#505 <CR>	#Model E4 Series Ver X.XX SN97001P <CR/LF>	Reports the software version and serial number.
#00 <CR>	#Done <CR/LF>	Returns the MPRR to data mode.

3. If a successful sign-on message is not returned, check connections and communications factors and correct any errors.

**To check connections and communications factors**

1. Confirm that the MPRR has power.
2. Verify the connections between the PC and the MPRR.
3. Verify the receive (Rx) and transmit (Tx) connections.
4. If using handshaking, verify the RTS and CTS connections.
5. Verify the COM port settings for the MPRR using the instructions in [“Serial Port Communications” on page 8-16](#).

Repeat the procedures in [“Verifying Communications” on page 8-8](#).

If you still cannot verify the MPRR and PC communications, use the information in [“Technical Support” on page 9-6](#) to contact TransCore.

## Verifying Tag Read Capability

After verifying communications between the MPRR and the PC, verify the capability to read tags.

*Note:* The default tag read mode of the reader is the protocol(s) programmed into the reader. [Table 8-1](#) shows how to determine which tag protocol(s) your MPRR supports. Use only those test tags programmed with the correct protocol(s) for the reader.



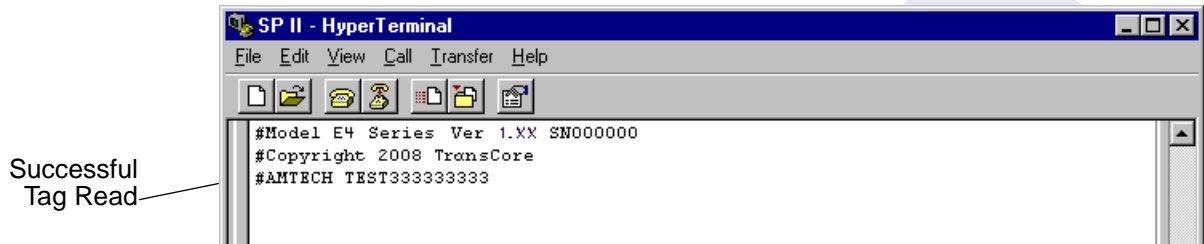
**Caution**

*To avoid damage to the MPRR using an external antenna, you must connect the antenna before applying power to the reader.*

**To verify tag read capability**

1. Once communications are verified as described in [“Verifying Communications” on page 8-8](#), enter the following sequence of commands to turn on continuous RF:
  - #01
  - #6401
  - #40
  - #00

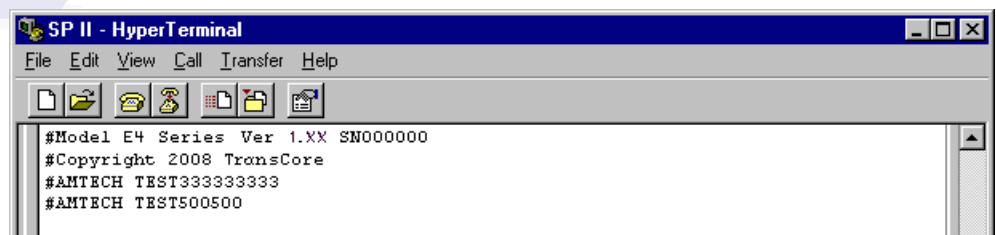
2. Pass one test tag in front of the unit. If the MPRR reads the tag, the terminal emulation application displays the tag information on the screen as shown in [Figure 8-6](#).



**Figure 8-6 Successful Tag Read**

If the tag ID is not displayed, perform the following actions:

- Verify that the MPRR is in data mode (command #00 Switch to Data Mode).
  - Ensure that the tag you are using is compatible with the MPRR. The MPRR can read tag types that are compatible with the reader model.
  - An MPRR displays the tag read for any tag that is compatible with the reader programming. [Table 8-1](#) shows how to determine which tag protocol(s) your MPRR supports.
  - Using the audible circuit tester as described in “[Testing the MPRR Using an Audible Circuit Tester](#)” on [page 4-4](#), verify that the reader is capable of reading the tag in the read zone. If it is, the problem is probably in the communications between the MPRR and the host.
3. Pass a different reader-compatible test tag in front of your MPRR.
  4. When the MPRR reads the second tag successfully, the terminal emulation application displays that tag’s information in the main screen below the information for the first tag, as shown in [Figure 8-7](#).



**Figure 8-7 Second Successful Tag Read**

If the read is unsuccessful, perform the following actions:

- Ensure the tag you are using is compatible with the MPRR.
- Using the audible circuit tester as described in [“Testing the MPRR Using an Audible Circuit Tester” on page 4-4](#), verify that the reader is capable of reading the tag in the read zone. If it is, the problem is probably in the communications between the MPRR and the host computer.

## **Configuring MPRR Parameters**

---

Follow the procedures in this section to configure MPRR parameters using a PC, laptop, or terminal emulator. The PC or laptop must be connected to and communicating with the MPRR, and the terminal emulation application must be configured correctly, as described in the section [“Verifying Communications” on page 8-8](#).

### **To configure parameters**

1. Switch to command mode by typing **#01** at the prompt on the terminal emulation screen, and pressing **ENTER**.

*Note:* All MPRR commands are preceded by the start-of-message character (#).

2. To meet requirements of your site, make changes to default operating parameters as described in the following sections.

The following sections contain procedures to set some of the parameters that are commonly changed to meet the requirements of a specific site. Procedures are listed in alphabetical order by parameter.

---

## **Appended Tag Data**

Use this procedure to set appended tag data parameters using the terminal emulation application. See [“31N Append Auxiliary Information Selection” on page 7-9](#) for more information.

### **To set appended tag data parameters**

1. Ensure that the host computer is in command mode.
2. Enter command **#311** to append auxiliary information or command **#310** to have no auxiliary information appended (factory default). Press **ENTER**.

---

## **ID Separation**

The host can select a unique ID separation of one ID or two IDs. The reader default operation is for a unique ID separation of one ID and a uniqueness timeout of two minutes. You can disable the uniqueness check using command **#40** Transmit All ID Codes. In this case, every tag ID received is transmitted without regard to uniqueness. You can reinstate uniqueness checking with commands **#4100** or **#4101** Select ID Separation.

*Note:* The MPRR internal timing varies depending on the operative tag read mode and the type of tag in the read field.

See section “40 Transmit All ID Codes” on page 7-9 and section “410N Select Unique ID Code Criteria (Anti-passback Feature)” on page 7-10.

### To set ID separation parameters

1. Ensure that the host computer is in command mode.
2. Enter command **#4100** to select a separation of one ID; enter command **#4101** to select a separation of two IDs. Press **ENTER**.

---

## Reports

The MPRR can be configured to transmit presence without tag reports and input status change reports. A presence without tag report is transmitted in data mode only, *and only if the system has a presence detector*. This report is sent if a presence is detected without the detection of a valid tag ID. See sections “529 Display Presence Input Status” on page 7-18 and “690N Select Presence Without Tag Report Option” on page 7-29.

If configured with command **#82N** Select Input Status Change Report Option to transmit input status change reports, the reader will transmit a message to the host computer any time the inputs change state. Input status change reports are transmitted in data mode only. Input status change reporting is disabled by default. See “560 Request Sensor Status Change” on page 7-22. Also refer to Chapter 6, “Communications Protocols” for information on message formats.

### To set presence reporting

1. Ensure that the host computer is in command mode.
2. Enter command **#529** to display presence input status and press **ENTER**. P0 indicates presence without tag reports disabled (factory default), and P1 indicates presence without tag reports enabled.
3. Enter command **#6901** to enable presence without tag reports, or enter command **#6900** to disable presence without tag reports (factory default). Press **ENTER**.

### To set input status change reporting

1. Ensure that the host computer is in command mode.
2. Enter command **#560** to display input status change report options and press **ENTER**.
  - EO = input status change reports disabled (factory default)
  - E1 = input status change reports enabled
  - M0 = reporting disabled (factory default)
  - M1 = changes on input0 reported
  - M2 = changes on input1 reported
  - M3 = changes on either input reported

3. Enter command **#821** to report any change on input0, command **#822** to report any change on input 1, command **#823** to report changes on input0 and input1, or command **#820** to disable status change reports (factory default). Press **ENTER**.

---

## Reset Reader

Command #63 Reset Reader resets uniqueness, clears the power fail bit, and transmits the sign-on message. The reader returns to data mode following the completion of this command.

*Note:* This command does **not** reset any of the configuration parameters.

See “63 Reset Reader” on page 7-25.

### To reset the reader

1. Ensure that the host computer is in command mode.
2. Enter command **#63**. Press **ENTER**.

The terminal emulation screen displays the sign-on message as shown in [Figure 8-5 on page 8-9](#).

---

## Radio Frequency



### Caution

*The authorized continuous wave (CW) frequency band for the MPRR in the U.S. is 902.25 to 903.75 MHz and 910.00 to 921.50 MHz. The authorized modulated frequency band for the MPRR in the U.S. is 911.75 to 919.75 MHz. The RF for each MPRR at the site must be set according to the frequency specified in the FCC site license. Only trained, authorized installation and maintenance personnel are permitted by FCC to set the RF.*

By using the MPRR an authorized person can set the frequency within the range from 902 to 928 MHz in 0.25 MHz steps. You can set the frequency by using a terminal emulation program and issuing the frequency command, as discussed in section “647XXX Select RF Operating Frequency” on page 7-27.

*Note:* For backward compatibility to existing controllers, you can set the RF operating frequency in 500-kHz steps using command #642NN.

### To set the frequency range

1. Ensure that the host computer is in command mode.
2. Enter command **#647XXX** – where XXX is a hexadecimal value from 000 to 118 – and press **ENTER**. See command “647XXX Select RF Operating Frequency” on page 7-27 for a complete listing of the hexadecimal values and the corresponding frequencies.
3. To verify that the RF has been changed to the proper setting, type in command **#527** to see the current frequency setting.



**Caution**

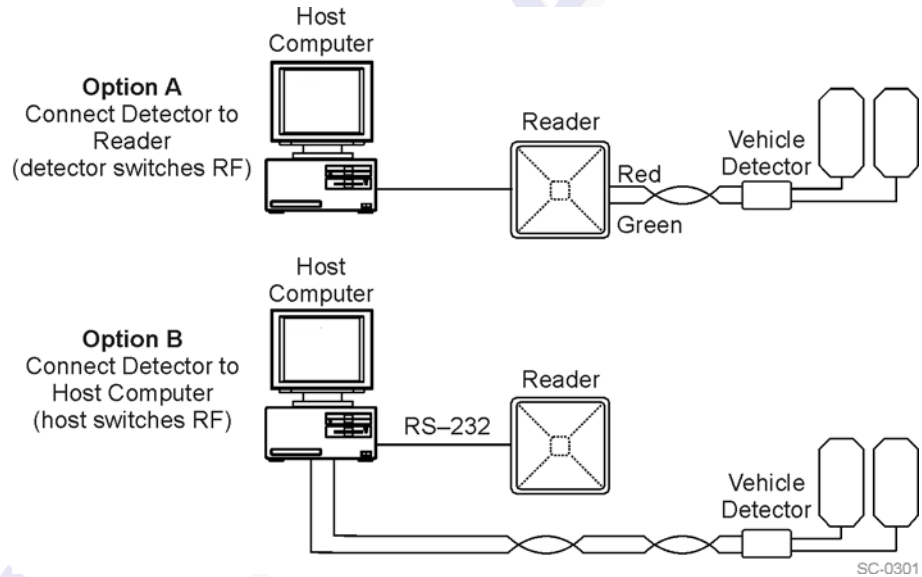
Contact TransCore if your application requires a frequency outside of the authorized frequency range.

**RF Transmission**

The RF transmission can be controlled by one of the following methods:

- Connecting a vehicle detector to the sense input0 circuit
- The host device sending software commands to the MPRR

As a factory default, the MPRR is configured to control the RF power with a vehicle detector. Figure 8-8 illustrates the methods of controlling RF sense output.



**Figure 8-8 MPRR RF Control Options**

**Vehicle Detector Controlling RF Transmission**

The vehicle detector can be a loop detector, an infrared sensor, or an ultrasonic detector that is connected to sense input0 to turn on the MPRR RF transmitter. In [Figure 8-8](#), Option A shows a vehicle detector controlling the RF transmitter. This operation is preferred because the RF transmits only when a vehicle is in the MPRR read zone. Command #641 Select RF-by-Input Control (factory default) must be enabled.

To set the option of the vehicle detector controlling the MPRR

Ensure that the host computer is in command mode.

Enter command **#641**. Press **ENTER**.

Leave the setting on RF-by-input control for normal operation.

## Host Controlling RF Transmission

In Figure 8-8, Option B shows the host controlling the RF transmitter.

If the vehicle detector is connected to the host computer, as shown in Option B, commands #6400 RF Off and #6401 RF On sent from the host computer turn on and off the MPRR RF transmitter.

---

## Sense Inputs

The RS-232 configuration used by the MPRR has two sense inputs — sense input0 and sense input1. Sense0 is used to enable RF on antenna ports 0 and 1 if enabled, and Sense1 is used to enable RF on antenna ports 2 and 3. The sense input circuits can be used to notify the MPRR of train presence and are designed to be connected to a free-of-voltage dry contact. The MPRR sense inputs are designed to connect to a dry contact closure.

You can configure the MPRR to generate input status change reports, which are transmitted like tag IDs. The host can then respond based on the true/false (closed/open) status of the sense inputs. See the section “Reports” on page 8-13.

The following procedures describe how to set sense inputs using the terminal emulation software. See command “694N Select Input Inversion Option” on page 7-31 for more information.

### To set sense inputs

1. Ensure that the host computer is in command mode.
2. Enter command **#6940** to disable input inversion (factory default) or command **#6941** to enable input inversion, and press **ENTER**.

---

## Sense Output Device

The sense output is dedicated for testing and set up of the reader. It is defined as the TAG\_LOCK signal, which indicates a valid tag is in the read field.

This sense output is a dry contact that provides a normally open and normally closed sense output. The relay contacts are rated at 42.2V AC peak (30 V<sub>rms</sub>) or 60V DC at 1 A maximum. If controlling an external gate or device requiring high current, an isolation transformer is required.

---

## Serial Port Communications

The MPRR supports one RS-232 communications port. For the RS-232 communications specification, the MPRR maintains the following three sets of parameters that affect serial port communications:

- Port configuration parameters (baud rate, data bits, stop bits, parity)
- Communications protocols (basic, error correcting)



- Flow control scheme (none, software, hardware)

The default serial port configuration for each of these three parameters is as follows:

- 9600 baud, 8 data bits, 1 stop bit, no parity
- Basic communications protocol
- Software flow control (XON/XOFF)

You can change these parameters in data mode and command mode operation by issuing commands with the host device. Use the following procedures to set serial port communications parameters using the terminal emulation program.

---

## Port Configuration Parameters

Use this procedure to set port configuration parameters using the terminal emulation program. Consult sections [“100N Select Baud Rate”](#) through [“102N Select Parity”](#) on [page 7-6](#).

### To set baud rate

1. Ensure that the host computer is in command mode.
2. Enter command **#100N** and press **ENTER**.

### To set stop bits

1. Ensure that the host computer is in command mode.
2. Enter command **#101N** and press **ENTER**.

### To set parity

1. Ensure that the host computer is in command mode.
2. Enter command **#102N** and press **ENTER**.

---

## Communications Protocol

Use the following procedures to set communications protocol. Consult sections [“610 Select Basic Communication Protocol \(Factory Default\)”](#) through [“612NN Select Error Correcting Protocol Timeout”](#) on [page 7-23](#) for more information.

### Caution

*Do not switch to ECP (command #611) unless the host is prepared to acknowledge each reader transmission.*



### To select a communications protocol

1. Ensure that the host computer is in command mode.
2. Enter command **#610** to select basic protocol (factory default) or command **#611** to select ECP and press **ENTER**.

---

## Software Flow Control

Two modes of flow control are supported — software (XON/XOFF) and hardware (CTS - clear to send). The host can enable or disable flow control with command #614N Select Flow Control Option.

The host can use software control characters (XON/XOFF) or the hardware CTS handshake line to interrupt reader transmissions. When the reader is configured for software flow control, it stops transmitting if it receives the XOFF character from the host (host software command 13H). It resumes transmitting only when it receives the XON character (host software command 11H) from the host. Likewise, when the reader is configured for hardware flow control, it stops transmitting if it detects that the CTS line is no longer asserted. It resumes transmitting when this line is asserted. If flow control is not needed, the reader should be configured for no flow control (#6140 Disable Flow Control).

*Note: TransCore recommends that XON/XOFF flow control be disabled while using the error correcting protocol.*

Use the following procedure to set flow control parameters using the terminal emulation program. See section [“614N Select Flow Control Option” on page 7-24](#).

### To select flow control

1. Ensure that the host computer is in command mode.
2. Enter command **#6140** to disable flow control, command **#6141** to enable software flow control (factory default), or command **#6142** to enable hardware flow control and press **ENTER**.

---

## Fine-Tuning and Verifying the Read Zone

If the read zone is too wide or too deep for your application, it can be fine-tuned by physically adjusting the MPRR or external antenna mounting orientation, reprogramming the actual RF power output (#644NN Set RF Attenuation), and/or reprogramming the RF sensitivity range (#643NN Set ATA Operating Range and #645NN Set SeGo Protocol Tag Operating Range). The combination of these adjustments allows you to confine the read zone to the area where tagged vehicles pass.

See sections [“643NN Select ATA Operating Range \(Distance\)” on page 7-26](#), [“645NN Set SeGo Protocol Operating Range \(Distance\)” on page 7-27](#), and [“644NN Set RF Attenuation” on page 7-26](#) for more information.

*Note: As described in “Marking the Read Zone” on page 4-10, marking the read pattern using test tags that are not mounted to vehicles give a general idea of the read pattern but the pattern will vary somewhat when actual vehicles with tags are tested. Final adjustments must be made with tags properly mounted on a variety of vehicles.*

### Physically Orienting the MPRR Antenna(s)

You can manually adjust the location of the read zone by loosening the antenna(s) mounting hardware and pointing the antenna in the desired direction. The unit should be aligned to point directly at the tag as it enters the desired read zone.

### Fine-Tuning the Read Zone by Lowering Output Power

You can make the read zone smaller by adjusting the MPRR RF power output from a maximum of 2 watts to a minimum of 200 milliwatts using command #644NN Set RF Attenuation.

#### To adjust the read zone by lowering output power

1. Ensure that your PC is communicating with the MPRR using a terminal emulation program as described in section “Verifying Communications” on page 8-8.
2. Mark the current read zone as described in section “Marking the Read Zone” on page 4-10.



#### Caution

*Test tags should be compatible with your MPRR. Test tags can be ATA-protocol, ISO-compliant, or SeGo-protocol tags.*

3. Enter command #01 to switch to command mode. You are prompted with #DONE from the reader and can now enter reader commands.
4. Enter in command #64401 to lower the RF power by 1 dB below 2 watts (default). Press **ENTER**.

*Note: In the command #644NN, NN can be any hexadecimal value from 00 to 0A. Settings for attenuation are 1.0 dB increments over a range of 10 dB of attenuation from the maximum power setting of 2 watts at 0 dB attenuation to a minimum power level of 200 milliwatts at 10 dB attenuation. Increasing the attenuation lowers the output RF power.*

5. Switch to data mode by entering command #00 and pressing **ENTER**.
6. Verify that the read zone has decreased by moving the tag through the desired read area. If the read zone is still too large, switch to command mode and enter the command #64402 to lower the output RF power another 1 dB. Continue increasing the NN value until the read zone matches the desired read zone.

When the desired read zone is established, test the read zone with simulated and real traffic by performing the following procedures:

#### To test the read zone

1. Ensure that the MPRR is in data mode.
2. With the MPRR running, place one tag behind your back while you hold another tag in the new read zone. If a valid read, the data from the tag held in the read zone displays on the PC screen.
3. Switch tags, placing the other tag behind your back and holding the first tag in the read zone. If a valid read, the data from this tag held in the read zone displays

on the PC screen. If both tags are read, you have successfully adjusted the read range.

4. If one or both tags did not read, follow the suggestions in [“Verifying Tag Read Capability” on page 8-10](#).
5. As a last test, attach test tags to vehicles and simulate traffic going through the read zone to verify that the system performs accurately in a live environment.

### ***Fine-tuning the Read Zone by Adjusting Sensitivity Range***

The MPRR read zone can be fine-tuned by using command #643NN for ATA tag read mode or #645NN for SeGo protocol tag read mode to reprogram the RF sensitivity range. Sensitivity range adjustments have less impact on the read pattern than RF power adjustment, thus RF power adjustment should be used as the main read pattern adjustment tool. Sensitivity range control may be helpful in stopping some tag reads on the very edges of the read pattern. To produce a noticeable change in the read pattern, you must decrease the range sensitivity by more than one increment.

#### **To adjust the read zone by adjusting sensitivity range**

1. Ensure that your PC is communicating with the MPRR using a terminal emulation program as described in [“Verifying Communications” on page 8-8](#).
2. Mark the current read zone as described in [“Marking the Read Zone” on page 4-10](#).
3. Enter command #01 to switch to command mode. You are prompted with #DONE from the reader and can now enter reader commands.
4. Enter command #64318 or #64518 to decrease the range sensitivity seven increments below the maximum (default). Press **ENTER**.

*Note: In the command #643NN or #645NN, NN can be any hexadecimal value from 00 to 1F. The reader’s receiver becomes less sensitive to tag signals as the value of NN is lowered from the maximum sensitivity of 1F to the minimum sensitivity of 00.*

5. Verify that the read zone has decreased by moving the tag through the desired read area. If the read zone is still too large, switch to command mode and enter the command #64317 or #64517 to decrease the range another increment. Continue increasing the NN value until the read zone matches the desired read zone.

When the desired read zone is established, test the read zone with simulated and real traffic by performing the following procedures.

#### **To test the read zone**

1. Ensure that the MPRR is in data mode.
2. With the MPRR running, place one tag behind your back while you hold another tag in the new read zone. If a valid read, the data from the tag held in the read zone displays on the host device screen.
3. Switch tags, placing the other tag behind your back and holding the first tag in the read zone. If a valid read, the data from this tag held in the read zone displays on the host device screen.

4. If both tags are read, you have successfully adjusted the read range. If one or both tags did not read, follow the suggestions in [“Verifying Tag Read Capability”](#) on [page 8-10](#).
5. As a last test, attach test tags to vehicles and simulate traffic going through the read zone to verify that the system performs accurately in a live environment.

PRELIMINARY

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Troubleshooting and Maintenance

PRELIMINARY





## Troubleshooting and Maintenance

*This chapter contains information for troubleshooting a Multiprotocol Rail Reader (MPRR) and performing minimal maintenance checks. It also includes information for returning products for repair, obtaining support, and contact information for providing feedback and suggestions to TransCore.*

### Error Messages

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

Table 9-1 contains a list of error messages.

**Table 9-1 Error Messages**

Error Message	Description	Corrective Action
Error06	NVRAM parameters have been lost. The MPRR will not function properly because the RF section is shut off until the frequency is reset.	Reset the frequency using command #647XXX.
Error07	The RF phase locked loop (PLL) has lost lock and is unable to operate at its intended frequency. RF output is disabled while the MPRR attempts to reset the PLL.	Reset the RF frequency. Refer to “Radio Frequency” on page 8-14 for instructions.
Error08	The RF PLL has successfully regained lock and has been reset to its proper operating frequency. The RF section is returned to its state prior to losing lock (enabled/disabled). <i>Error08</i> will only be issued after <i>Error07</i> has been issued.	No action necessary; the previous error has been corrected.
ErrorRF1	Warning message that the RF board did not return an update acknowledge signal	If the reader indicates a single ErrorRF1 event and recovers from the error, no corrective action is required. You may want to track this error message if it should occur again. If the reader indicates repeated ErrorRF1 warning messages then return the reader to the factory.

Table 9-1 Error Messages (continued)

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

## Troubleshooting

You can use the following table for troubleshooting. Should problems continue, contact TransCore for return and replacement procedures. If you contact Technical Support, use the symptom number in [Table 9-2](#) to reference the problem that you are having with the MPRR.

Table 9-2 Symptoms and Remedies

Symptom Number <sup>a</sup>	Symptom	Remedy
1	When performing a quick test of the MPRR, the buzz box does not buzz.	<p>Check all your wiring connections and antenna connections (if using external antenna), and ensure that your buzz box is functioning.</p> <p>The wires from the MPRR are grouped in pairs. You could find more than one red wire, more than one black wire, and so on. You must connect the correct red and white wire pair to the leads from the battery.</p> <p>Verify that RF is on. Using a terminal emulation program, you may switch to command mode and issue command #527 to determine RF status. See page 7-17 for more information.</p>
2	The baud rate is selected correctly but nothing happens.	The MPRR is not communicating with your PC. Check the power supply to your PC, and check the connections between the PC and the MPRR. Try reversing the receive and transmit connections.

Table 9-2 Symptoms and Remedies (continued)

Symptom Number <sup>a</sup>	Symptom	Remedy
3	When testing the MPRR, all the wires are connected correctly but the unit does not respond.	<p>The MPRR may not have the software loaded inside the unit. Contact Technical Support as described on page 9-6.</p> <p>If you are using a terminal emulation program, check that the terminal emulation setting on the MPRR is VT100.</p> <p>Check that the MPRR communication cable is connected to the correct COM port.</p> <p>Verify that the external antenna is connected correctly.</p>
4	Strange signal responses come from the MPRR when tested with the PC.	<p>Ensure that the reader is in the correct interface mode for the test tag, i.e., ATA mode for an ATA tag.</p> <p>Check the system defaults using a terminal emulation program. Both PC and reader should be set to 9600 baud, 8 bits, 1 stop bit, and no parity.</p>
5	When a tag is moved in front of the antenna, a clicking sound comes from the MPRR.	<p>The MPRR works. The sound is the relay inside the MPRR that is controlled by a lock signal. The relay is actuated when a tag is in the read zone. (TBD)</p>
6	Nothing happens when the test tag is passed in front of the MPRR or external antenna.	<p>Ensure that the MPRR is powered on and is in predefined output mode. (#621)</p> <p>Verify that the reader is set to RF ON (#6401).</p> <p>Verify that the external antenna is connected correctly.</p>
7	The MPRR came from another site and does not work the way the factory defaults indicate that it should.	<p>Different commands were probably used to support the other site's specific configuration. You can restore the factory defaults by using a terminal emulation program to switch to command mode and issuing command #66F Load Default Operating Parameters. All factory defaults except RF frequency will be restored.</p>
8	When connected to a PC that is running terminal communications software, a just-powered up MPRR displays one of the following messages: #Model E4 Series X.XX SNYYYYYY #[Copyright notice]	<p>The MPRR works. The software is now loaded. YYYYYY is the TransCore-assigned serial number for this MPRR. However, if YYYYYY = 000000, a serial number has never been assigned. If a serial number has not been assigned to your MPRR, contact TransCore Technical Support.</p>

Table 9-2 Symptoms and Remedies (continued)

Symptom Number <sup>a</sup>	Symptom	Remedy
9	The read zone is too small, even before the RF power and range control have been adjusted.	<p>If another MPRR is in the same area, ensure that it is operating on another frequency that is at least 2 MHz different.</p> <p>Check for possible interference from another nearby RF source: fluorescent lights, neon signs, high voltage power lines, nearby cellular telephone, or radio stations. Lights will need to be removed or shielded. Point the MPRR or external antenna in a different direction to see if interference comes from only one direction. You may require a different MPRR that uses another frequency. (TBD)</p> <p>Verify that the RF power is set to an appropriate value.</p> <p>Verify that the range adjustment is set to the maximum.</p> <p>Verify that the reader is getting at least 16V.</p>
10	The perimeter of the read zone has been defined, but there is a “hollow” spot in the center of the zone that does not read tags.	<p>The angle of the MPRR or external antenna may need adjustment. Slightly tilt the MPRR or external antenna to a different angle to change either the length or width of the read zone.</p> <p>Check the range control adjustment. See <a href="#">“Radio Frequency” on page 8-14.</a></p>
11	The MPRR is reading tags out of the desired read zone.	<p>Some interference from other RF or electrical sources may be occurring. See <a href="#">“Reflection, Refraction, and Diffraction of RF Signals” on page 2-8.</a></p> <p>Verify that the read zone has been properly set up. See <a href="#">“Fine-Tuning and Verifying the Read Zone” on page 8-18.</a></p>

<sup>a</sup>Use this number to reference the problem you are having with the MPRR if you contact Transcore for Technical Support.

## MPRR Repair

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

## Technical Support

Authorized dealers and distributors are responsible for the direct support of all customers. Authorized dealers and distributors needing support can locate the appropriate contact phone number at [www.transcore.com/rfidsupport](http://www.transcore.com/rfidsupport). Send faxes to (214) 461-6478 ATTN: Technical Support. Please be prepared to answer a series of questions that are designed to direct you to the best TransCore support resource available. These questions will relate to symptoms, configuration, model, and tags used.

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

## **Marketing Support**

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Dealers requiring marketing support may call TransCore Marketing at (214) 461-4031, 9:00 a.m. to 5:00 p.m. Central Standard Time, Monday through Friday. Send faxes to (214) 461-6478 ATTN: TransCore Marketing.

## **Find a Problem with the MPRR or Have Suggestions?**

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Send faxes to (214) 461-6478 ATTN: MPRR product manager.

PRELIMINARY

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## Interface to Train Recording Unit

PRELIMINARY





## Interface to Train Recording Unit

*This chapter will describe the interface between the Multiprotocol Rail Reader (MPRR) and the Train Recording Unit (TRU).*

**TBD**

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TBD

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AT5720 Check Tag-to-MPRR Assembly

PRELIMINARY



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# AT5270 Check Tag-to-MPRR Assembly

*This document describes the procedures to assemble and connect a check tag assembly to a Multiprotocol Rail Reader.*

## Required Supplies

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Before assembling the check tag antenna kit, make sure you have the necessary supplies and tools. Check Tag Kit (TransCore P/N 20-7001-001). [Table 11-1](#) lists the kit parts.

**Table 11-1 Check Tag Kit Parts List**

Quantity	Description
1	Terminal connector strip (9 position)
2	Self-tapping screw
1	Plastic connector housing sleeve
2	Plastic nut cap with rubber insert
1	Nylon closing cap
1	Check Tag Assembly Instructions

You need the following additional materials and/or tools to complete the installation.

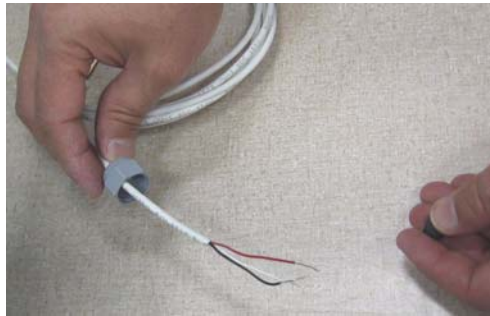
- AT5270 Check Tag(s)
- Jeweler flat-blade screwdriver
- Standard tools (Phillips screwdriver, wire stripper, crescent wrench)
- Multiprotocol Rail Reader

## Procedures

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### To assemble the kit for two check tags

1. Strip the cable insulation to expose the three check tag wires. Strip wire insulation approximately 1/4 inch to expose bare wire. Slide the plastic nut and rubber grommet over the wires ([Figure 11-1](#)).



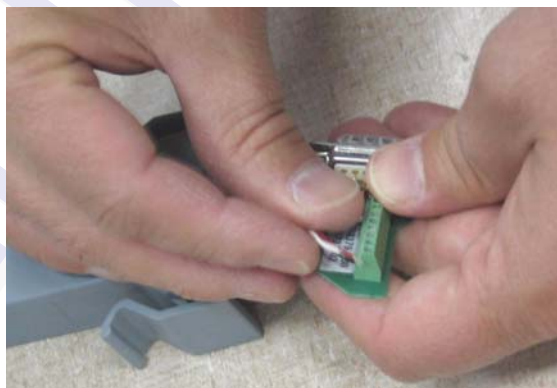
**Figure 11-1 Place Nut and Grommet Over Exposed Check Tag Wires**

2. Pull the check tag wires through the connector housing (Figure 11-2).



**Figure 11-2 Feed Check Tag Wires through Plastic Housing Connector**

3. For Check Tag 0, insert and tighten the check tag wires to the terminal strip as shown in Figure 11-3 and Table 11-2.



**Figure 11-3 Connect Check Tag Wires**

**Table 11-2 Check Tag 0 Wire Assignments**

Wire	Color	Pin No.
Ground	Black	3
Power	Red	4
Data	White	5

4. If connecting two check tags, repeat steps 1 through 3. Connect Check Tag 1 to the terminal strip as listed in [Table 11-3](#).

**Table 11-3 Check Tag 1 Wire Assignments**

Wire	Color	Pin No.
Ground	Black	7
Power	Red	8
Data	White	9

[Figure 11-4](#) shows both check tags connected to terminal strip.



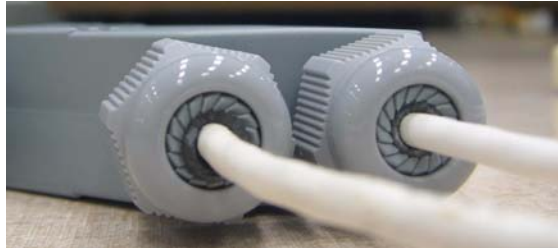
**Figure 11-4 Two Check Tag Assemblies Connected to Terminal Strip**

5. Insert and tighten the two self-tapping screws to secure the terminal strip ([Figure 11-5](#)).



**Figure 11-5 Securing Terminal Strip into Connector Housing**

6. To complete the connector assembly, tighten the nuts on the cable end snugly (Figure 11-6).



**Figure 11-6 Plastic Nuts with Grommets**

As the nut is tightened, the connector compresses the grommet around the check tag cable.

**To assemble the kit for one check tag**

1. Follow the procedure steps described above in steps 1 through 6, but connect only one check tag cable.



**Caution**

*If connecting only one check tag, you must insert and secure the nylon closing cap into the unused terminal connector to protect the terminal strip from possible contamination.*

2. To cover the unused terminal connector, insert the nylon closing cap into the plastic cap with rubber grommet and tighten snugly (Figure 11-7).



**Figure 11-7 Nylon Cap Securely Fastened in Unused Port**

**To connect the check tag assembly to the Multiprotocol Reader**

Remove the dust cover from the Check Tag port of the MPRR and plug in the check tag cable assembly (Figure 11-8). Be sure that the two handles snap into place on the MPRR. This ensures a solid connection.





**Figure 11-8 Check Tag Assembly Secured to MPRR Port (single check tag assembly shown)**

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A

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Glossary

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# Appendix A

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## Glossary

### A

<b>AAR</b>	Association of American Railroads
<b>AC</b>	alternating current
<b>ACK</b>	acknowledge (data valid)
<b>ANSI</b>	American National Standards Institute
<b>antenna</b>	passive device that converts RF energy into magnetic energy (RF signal)
<b>ASCII</b>	American Standard Code for Information Interchange
<b>ASIC</b>	application-specific integrated circuit
<b>ATA</b>	American Trucking Association
<b>aux</b>	auxiliary
<b>AWG</b>	AWG (American Wire Gauge) is a U.S. standard set of non-ferrous wire conductor sizes

### B

<b>backscatter</b>	portion of an RF signal that is modulated by a tag and radiated back to the reader
<b>baud</b>	measure of number of bits per second of a digital signal; for example, 9600 baud = 9600 bits per second
<b>BCKS</b>	boot checksum
<b>BCM</b>	buffer control mode
<b>bps</b>	bits per second
<b>byte</b>	a binary character; for example, one 8-bit ASCII character

### C

<b>check tag</b>	tag mounted inside a reader assembly, inside or in close proximity to an external antenna that is used to check operation of the reader
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## ***Multiprotocol Rail Reader System Guide***

<b>cmd</b>	command
<b>comm</b>	communications
<b>command</b>	data set that is recognized by the receiving device as intending to elicit a specific response
<b>conduit</b>	flexible steel pipe use for electrical wiring
<b>cps</b>	characters per second
<b>CR</b>	carriage return
<b>CRC</b>	cyclic redundancy check
<b>CTRL</b>	control
<b>CTS</b>	clear to send
<b>D</b>	
<b>data</b>	information that is processed by a computing device
<b>DC</b>	direct current
<b>DIAG</b>	diagnostic
<b>E</b>	
<b>ECP</b>	error correcting protocol
<b>ECPS</b>	error correcting protocol status
<b>eol</b>	end of line
<b>eom</b>	end of message
<b>EPROM</b>	erasable programmable read-only memory
<b>F</b>	
<b>field</b>	physical area/space in which a tag can be read by the reader; also, an element of a data record/frame. For example, division within a tag's data frame.
<b>frames</b>	consecutive bits of data in memory that are read and written as a group
<b>frequency bands</b>	a range of RF frequencies assigned for transmission by an RF device

**H**

<b>hex</b>	hexadecimal
<b>hexadecimal</b>	base 16 numbering system that uses the characters 0 through 9 and A through F to represent the digits 0 through 16
<b>host</b>	device, generally a computer, that is connected to the Multiprotocol Rail Reader through the communications port

**I**

<b>I/O or IO circuits</b>	input/output circuits
<b>IAG</b>	E-ZPass <sup>®</sup> Interagency Group, North American RFID tag protocol
<b>ID</b>	identification; encoded information unique to a particular tag
<b>INCITS</b>	American National Standards Institute International Committee for Information Technology standards
<b>interface</b>	connection point for communication with another device
<b>IOST</b>	I/O status
<b>ISO</b>	International Standardization Organization

**L**

<b>LF</b>	line feed
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**M**

<b>m</b>	meter
<b>MHz</b>	megahertz
<b>mode</b>	method of operation
<b>MPRR</b>	Multiprotocol Rail Reader
<b>ms</b>	milliseconds

**N**

**NAK** negative acknowledgment (data not valid)

**P**

**passback** used to refer to a tag ID that is not passed on to the tag buffer

**PC** personal computer

**PCKS** EPROM flash checksum

**protocol** specified convention for the format of data messages communicated between devices

**PRST** presence status

**PWRB** power fail bit

**R**

**RAM** random access memory

**RDID** reader ID

**read** process of acquiring data from a device; for example, from a tag or from computer memory

**reader** controlled interrogating device capable of acquiring data from a device; for example, acquiring and interrupting data from a tag

**read zone** the physical area in which a tag can be read by the reader

**RF** radio frequency

**RFID** radio frequency identification

**RFST** RF status

**ROM** read-only memory

**RTC** real-time clock

**RTS** request-to-send

**S**

**SCTS** status of check tag status

**SeGo** Super eGo (SeGo) is a superset of the eGo protocol



<b>SN</b>	serial number
<b>som</b>	start of message
<b>SSTC</b>	input status change reporting options
<b>T</b>	
<b>tag</b>	small self-contained device acting as an identifying transponder
<b>Tau</b>	timeout delay
<b>TRU</b>	Train Recording Unit
<b>TT</b>	tag translation
<b>V</b>	
<b>v</b>	volts
<b>Ver</b>	version (software)
<b>W</b>	
<b>write</b>	process of recording data; for example, writing to computer memory or to a tag's memory. Writing writes over (erases) previous data stored at the specified memory locations.
<b>X</b>	
<b>XON/XOFF</b>	protocol for controlling the flow of data between computers and other devices on an asynchronous serial connection. X/ON and X/OFF are signals to turn a transmitter on or off. The actual signal for X/ON is the same bit configuration as the ASCII Ctrl-Q keyboard combination (11 hexadecimal). The X/OFF signal is the Ctrl-S character (13 hexadecimal).

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# B

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## Technical Specifications

PRELIMINARY



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# Technical Specifications

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## **Reader Specifications**

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### **Communications**

Frequency Selection	860 to 930 MHz capable
Reading Range	Read performance varies depending on tag, reader, and external antenna (if required) configuration and environment.  Typical read range should be 12 to 17 ft (3.7 to 5.2 m). <sup>a</sup>
	a. Reading range depends on reader or external antenna configuration, tag type, tag read mode, and operating environment.

### **Hardware Features**

Integrated system with connector for external antenna	RF module, tag decoder, power supply, I/O ports, and serial communications interface all housed in a single package.
Case	(TBD)

### **Power Requirements**

Input Voltage	16 to 20V AC, 47 to 63 Hz  or  16 to 28V DC
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### **Physical Attributes**

Size	13 x 5 x 2.49 inches (33 x 7.62 x 6.32 cm)
Weight	5.1 pounds (2.31 kg)

### **Environmental Parameters**

Operating Temperature	-40°F to +158°F (-40°C to +70°C)
Humidity	95% noncondensing
Vibration Tolerance	0.5 G <sub>rms</sub> , 10 to 500 Hz TBD

### **Options**

Communications Interface	RS-232 or RS-422
Cable Accessory Kits	58-7001-001: MPRR-to-TRU cable assembly, 6 ft (1.8 m) 58-7001-002: MPRR-to-TRU cable assembly, 20 ft (6.1 m) 58-7001-003: MPRR cable assembly, no TRU
Transformer	A Class C transformer is available to allow 110V AC to 18V AC conversion. Include the part number 76-1620-005 when ordering. A Class C transformer (part number 76-1620-008) to allow 220V AC to 18V AC conversion is available by special request.

C

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Wiring Information

PRELIMINARY





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# Wiring Information

*This appendix will contain a graphical representation that shows the wiring connections as well as any wiring signal tables that may be needed used to test and install the Multiprotocol Rail Reader (MPRR).*

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## Communications Interfaces

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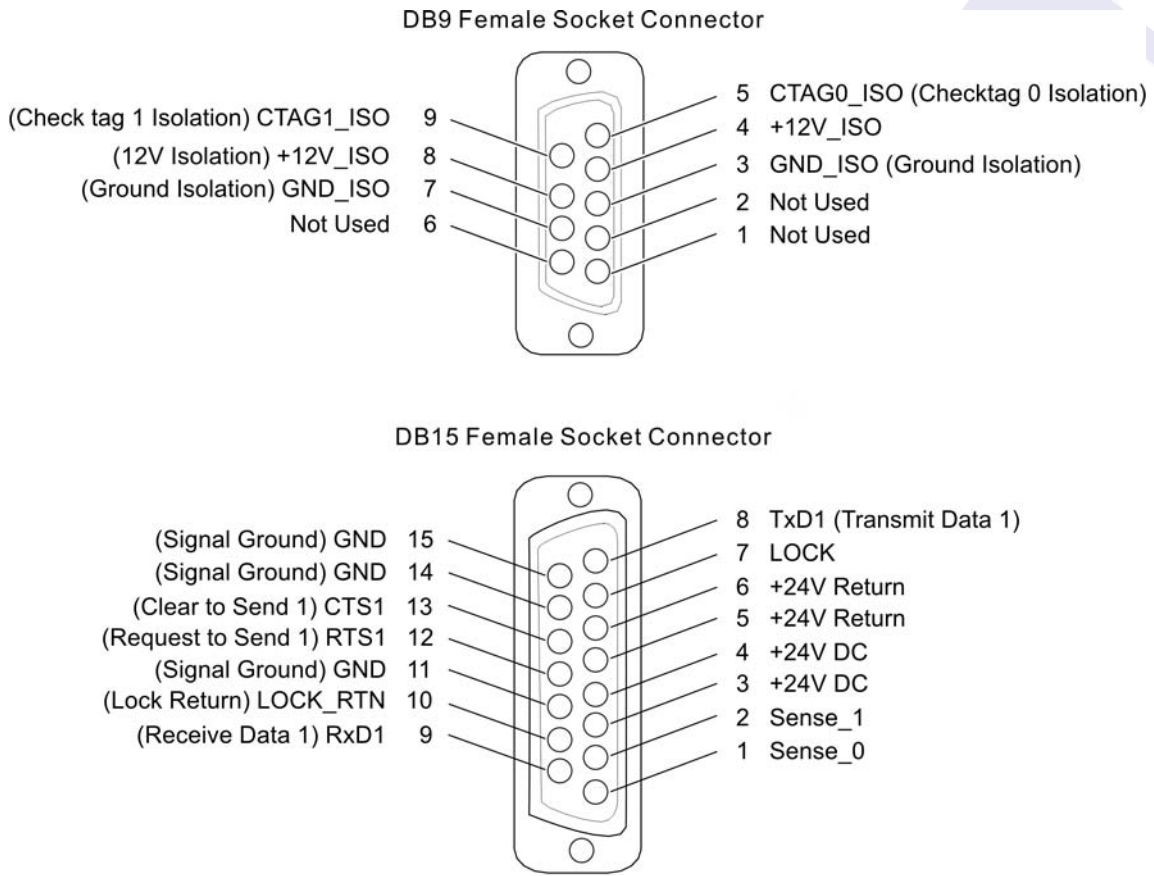
Table C-1 lists the interfaces available with the MPRR.

**Table C-1 Communications Interfaces and Conductor Requirements**

Interface	Number of Conductors
RS-232	3
RS-232 with RTS and CTS hardware handshake signals	5

PRELIMINARY

Figure C-1 shows the pin assignments for the RS-232 interface signal to the host male DB9 and DB15 connectors.



HW-0410

**Figure C-1 DB9 and DB25 Connector Pin Assignments for Signal to Host**

# D

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## Command Quick Reference

PRELIMINARY



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## Command Quick Reference

*This appendix lists the default configuration settings for the Multiprotocol Rail Reader (MPRR) and its commands. Commands are listed both numerically and alphabetically.*

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### Command Syntax

The command numbers consist of from 2 to 4 hex digits. The letters N or S may follow a command number. The letter N indicates that part of the command number is variable. The letter S indicates the requirement for an alphanumeric data string that is to be included immediately following the command number. Hex digits (0–9, A–F) in either uppercase or lowercase characters may be used in data strings and for hex digits A–F. For more information see Chapter 5, “General Software Information”.

Table D-1 lists factory default settings. Table D-2 on page D-5 lists, in numerical order, all of the commands available to users. Table D-3 on page D-16 lists the same commands by command name.

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### Factory Default Settings

**Note:** Table D-1 lists the factory default settings for the MPRR.

**Table D-1 MPRR Default Configuration Settings**

Parameter	Setting	Command
Operating mode	Data	00
Baud rate	9600	1005
Stop bits	1	1010
Parity	None	1020
Time and data appended	Enabled	302
Auxiliary information appended	Disabled	310
Unique ID code criteria	Separation of 1 ID	4100
Valid ID code criteria	Acquisition of 1 ID	4200
Uniqueness time-out	2 minutes	441
Tag translation mode	Disabled	452

**Table D-1 MPRR Default Configuration Settings (continued)**

<b>Parameter</b>	<b>Setting</b>	<b>Command</b>
Multi-tag sort	Disabled	454
SeGo protocol tag initialization during multi-tag sort	Enabled	456
Second alternate group select	Disabled	458
Third alternate group select	Disabled	490
Fourth alternate group select	Disabled	492
Fifth alternate group select	Disabled	494
Alternate group select	Disabled	496
Reader ID number	00	6000
Communications protocol	Basic	610
Error correcting protocol (ECP) timeout	12.7 sec	612FE
Flow control	Software (XON/XOFF)	6141
Buffer control mode	Disabled	6160
Echo mode	Enabled	6171
Set output control	Turn on both outputs	6203
Sense output control	Predefined	621
RF-by-input control	Enabled	641
ATA operating range	Maximum	6431F
RF attenuation	Full power	64400
SeGo protocol operating range	Maximum	6451F
Sense output pulse duration	228 ms	67C
Presence without tag reports	Disabled	6900
RF-off control	Timeout or no presence	6922
RF timeout	Never true	693F
Input inversion	Disabled	6940
Serial number	NNNNNN	695
Store hardware configuration	Hardware configuration not known	696
Input status change reports	Disabled	820

**Table D-1 MPRR Default Configuration Settings (continued)**

Parameter	Setting	Command
Automatic periodic RF status report	Disabled	830

## Numerical Command List

The following conventions are used in [Table D-2](#):

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

Refer to [Chapter 6, “Communication Protocols,”](#) for the complete syntax of commands and messages.

**Table D-2 MPRR Commands Listed Numerically**

Number	Command Name	Reader Message
<b>00</b>	<b><i>Switch to data mode</i></b>	<b><i>Done</i></b>
01	Switch to command mode	Done
06	Transmit buffer entry	Done, error, or tag data Done = buffer empty Error = not in buffer control mode Tag data = highest priority tag ID
1002	Set baud rate = 1200 baud	Done
1003	Set baud rate = 2400 baud	Done
1004	Set baud rate = 4800 baud	Done
<b>1005</b>	<b><i>Set baud rate = 9600 baud</i></b>	<b><i>Done</i></b>
1006	Set baud rate = 19.2 K baud	Done
1007	Set baud rate = 38.4 K baud	Done
<b>1010</b>	<b><i>Use one stop bit</i></b>	<b><i>Done</i></b>
1011	Use two stop bits	Done
<b>1020</b>	<b><i>Disable parity</i></b>	<b><i>Done</i></b>
1021	Select even parity	Done
1022	Select odd parity	Done
20	Set time	Done

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
21	Set date	Done
22	Display time and date	Time and date
300	No time and date appended	Done
<b>302</b>	<b><i>Time and date appended</i></b>	<b><i>Done</i></b>
<b>310</b>	<b><i>Disable aux info append</i></b>	<b><i>Done</i></b>
311	Enable aux info append	Done
40	Transmit all IDs	Done
<b>4100</b>	<b><i>Select one ID separation</i></b>	<b><i>Done</i></b>
4101	Select two ID separation	Done
4102	Select three ID separation	Done
4103	Select four ID separation	Done
<b>4200</b>	<b><i>Select 1 valid ID code</i></b>	<b><i>Done</i></b>
4201	Select 2 valid ID codes	Done
4202	Select 3 valid ID codes	Done
4203	Select 4 valid ID codes	Done
43	Buffer all ID codes	Done
440	Reset uniqueness	Done
<b>441</b>	<b><i>Set uniqueness time-out to 2 minutes</i></b>	<b><i>Done</i></b>
442	Set uniqueness time-out to 15 seconds	Done
443	Set uniqueness time-out to 30 seconds	Done
<b>454</b>	<b><i>Disable multi-tag sort</i></b>	<b><i>Done</i></b>
455	Enable multi-tag sort	Done
<b>456</b>	<b><i>Enable SeGo protocol tag initialization during multi-tag sort</i></b>	<b><i>Done</i></b>
457	Disable SeGo protocol tag initialization during multi-tag sort	Done



Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
<b>458</b>	<b><i>Disable second alternate group select</i></b>	<b><i>Done</i></b>
459	Enable second alternate group select	Done
480	Disable ATA	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
481	Enable ATA	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
484	Disable SeGo	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
485	Enable SeGo	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
488	Disable eATA	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
489	Enable eATA	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
<b>490</b>	<b><i>Disable third alternate group select</i></b>	<b><i>Done</i></b>
491	Enable third alternate group select	Done
<b>492</b>	<b><i>Disable fourth alternate group select</i></b>	<b><i>Done</i></b>
493	Enable fourth alternate group select	Done
<b>494</b>	<b><i>Disable fifth alternate group select</i></b>	<b><i>Done</i></b>
495	Enable fifth alternate group select	Done
<b>496</b>	<b><i>Disable alternate group select</i></b>	<b><i>Done</i></b>
497	Enable alternate group select	Done
505	Display version	Model [model] Ver [version no.] SN [serial no.]

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
506	Display hardware configuration information	S...S S...S = ASCII string (maximum length of 20 characters)
510	Display RF transceiver FPGA version	RF FPGA VER = XX.XX
511	Display RF transceiver I filter chip version	FIL IC I VER = XX.XX
512	Display RF transceiver Q filter chip version	FIL IC Q VER = XX.XX
513	Display DSP board Actel version	DSP FPGA VER = XX.XX
520	Display power fail bit	PWRB Px R0 P0 = no power fail has occurred P1 = power fail has occurred R0 = not applicable
521	Display reader ID number	RDID xx xx = 00–FF
522	Display comm port parameters	MAIN Bx Sx Px D0 B2 = 1200 B3 = 2400 B4 = 4800 B5 = 9600 B6 = 19.2 B7 = 38.4 S0 = one stop bit S1 = two stop bits P0 = no parity P1 = even P2 = odd D0 = EOL delay of 0 ms
524	Display appended info status	IDAP T0 D0 Xx T0 = time not appended T1 = time appended D0 = date not appended D1 = date appended X0 = aux info not appended X1 = aux info appended

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
525	Display comm protocol	ECPS Px Txx Xx S0 P0 = basic P1 = ECP P2 = echo Inquiry Txx = ECP timeout ms = 50 * xx FF = disabled ECP timeout X0 = no flow control X1 = software flow control X2 = hardware flow control S0 = som character is #
526	Display I/O status	IOST Cx Ox lx Dx C0 = host controls outputs C1 = predefined output mode O0 = both outputs off O1 = output0 on O2 = output1 on O3 = both outputs on I0 = both inputs false I1 = input0 true I2 = input1 true I3 = both inputs true D0 - DF = output pulse duration where D0 = 4 ms D1 = 8 ms D2 = 12 ms D3 = 16 ms D4 = 20 ms D5 = 24 ms D6 = 32 ms D7 = 40 ms D8 = 48 ms D9 = 60 ms DA = 76 ms DB = 152 ms DC = 228 ms DD = 300 ms DE = 376 ms DF = 752 ms

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
527	Display RF status	<p>RFST Cx Ox Tx Fxxx Rxx Gxx                      Axx lxx                      C0 = RF controlled by host                      C1 = RF-by-presence sensor                      O0 = RF off                      O1 = RF on                      T1 = uniqueness timeout of 2 min                      T2 = uniqueness timeout of 15 sec                      T3 = uniqueness timeout of 30 sec                      Fxxx = RF output frequency, xxx = 000 to 118                      Rxx = Tag decoder range (distance) for ATA tags, 00 to 1F hexadecimal range value                      Gxx = Tag decoder range (distance) for eGo Plus Tags, 00 to 1F hexadecimal range value                      Axx = RF power attenuation, 00 max to 0A min (10 dB less than max)                      lxx = IAG RF power attenuation, 00 max to 0F min (15 dB less than max)</p> <p><b>Note</b> If you enter RF settings using command #642NN, the display command for RF output frequency, F is "Fxx" and indicates use of the backward-compatible frequency entry method.</p>

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
529	Display presence input status	PRST Px D0 Ax Tx Ix P0 = disable presence w/o tag reports P1 = enable presence w/o tag reports D0 = min presence true period of 0 ms A0 = RF off on timeout A1 = RF off on timeout or tag A2 = RF off on timeout or no presence T0: RF timeout of 0 ms (always expired)  T1: RF timeout of 4 ms T2: RF timeout of 8 ms T3: RF timeout of 12 ms T4: RF timeout of 20 ms T5: RF timeout of 24 ms T6: RF timeout of 32 ms T7: RF timeout of 48 ms T8: RF timeout of 60 ms T9: RF timeout of 92 ms TA: RF timeout of 152 ms TB: RF timeout of 300 ms TC: RF timeout of 452 ms TD: RF timeout of 600 ms TE: RF timeout of 752 ms TF: RF timeout infinite, never expires (factory default) I0 = Input inversion disabled (factory default) I1 = Input inversion enabled
530	Display RF0 filter status	RF0S Ux V0 U0 = one ID separation U1 = two ID separation U2 = transmit all IDs U3 = buffer all IDs V0 = valid ID code criteria of one acquisition (fixed)
534	Display tag translation mode status	TT <0 to 1> 0 = tag translation mode disabled 1 = tag translation mode enabled
535	Display buffer control status	BCM <0 to 1> 0 = buffer control mode disabled 1 = buffer control mode enabled

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
536	Display dual-frame processing mode	<i>DUAL</i> <0 to 3> 0 = reset uniqueness on A, transmit A 1 = reset uniqueness on B, transmit B 2 = reset uniqueness on A, transmit both A and B 3 = reset uniqueness on B, transmit both A and B
537	Display echo status	ECHO x 0 = disabled 1 = enabled
540	Display flash checksum	PCKS I0000 Exxxx xxxx = 4-byte ASCII checksum
543	Display boot checksum	BCKS xxxx xxxx = 4-byte ASCII checksum
550	Display periodic check tag status	<i>SCTS M0 (fixed)</i>
551	Display selected check tag option	<i>CTAG 0 (fixed)</i>
560	Display input status change	SSTC Ex Mx E0 = status change reports disabled E1 = status change reports enabled M0 = no reporting M1 = report change on input0 M2 = report change on input1 M3 = report change on either input
570	Display operating mode status	ATA:<E, D> eGo:<I, F, D> SeGo:<I, F, D> IAG:<E, D> Sort:<E, D> I = ID (64 bits) E = Enabled F = Full transaction (eATA) D = Disabled
577	Report buffered handshakes	XX = number of handshakes
60NN	Set reader ID number NN = 00–FF (00 = factory default)	Done
<b>610</b>	<b>Select basic protocol</b>	<b>Done</b>
611	Select ECP protocol	Done

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
612NN	Set ECP timeout NN = 01–FE (1–255) timeout = 50 ms * NN (if NN = FF, timeout is disabled)	Done
<b>612FE</b>	<b>Set ECP timeout = 12.7 sec</b>	<b>Done</b>
613	Enable data inquiry protocol	Done
6140	Disable flow control	Done
<b>6141</b>	<b>Enable software flow control</b>	<b>Done</b>
6142	Enable hardware flow control	Done
<b>6160</b>	<b>Disable buffer control mode</b>	<b>Done</b>
6161	Enable buffer control mode	Done
6170	Disable echo	Done
<b>6171</b>	<b>Enable echo</b>	<b>Done</b>
6200	Turn both outputs off	Done
6201	Turn output0 on	Done
6202	Turn output1 on	Done
<b>6203</b>	<b>Turn both outputs on</b>	<b>Done</b>
<b>621</b>	<b>Select predefined output mode</b>	<b>Done</b>
63	Reset reader	Model [model] Ver [version no.] SN [serial no.] Copyright [date] TransCore
6400	Turn off RF	Done
6401	Turn on RF	Done
6402	Turns on continuous wave RF until commands 6400 or 641 are received by the reader	Done
<b>641</b>	<b>Select RF-by-input control</b>	<b>Done</b>
642NN	Select RF operating frequency	Done
643NN	Set ATA operating range NN = 00 (shortest) to 1F (longest) <b>1F = default</b>	Done

Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
644NN	Set RF attenuation NN = 00 to 0A	Done
645NN	Set SeGo protocol operating range NN = 00 (shortest) to 1F (longest)	Done
647XXX	Select RF operating frequency from 860 to 930 in 250 kHz steps XXX = 000 - 118 (hexadecimal)	Done
65	Reset power fail bit	Done
66F	Load default operating parameters (except RF operating frequency)	Done
<b>67C</b>	<b>Output pulse duration = 228 ms set</b>	<b>Done</b>
67N	Set output pulse duration N = 0–F (4,8,12,16,20,24,32,40,48,60,76,152, 228,300,376,752 ms)	Done
<b>6900</b>	<b>Disable presence without tag reports</b>	<b>Done</b>
6901	Enable presence without tag reports	Done
6920	Turn RF off on timeout	Done
6921	Turn RF off on timeout/tag	Done
<b>6922</b>	<b>Turn RF off on timeout/no presence</b>	<b>Done</b>
693N	Set RF timeout N = 0–F (always expired, 4,8,12,20,24,32,48,60,92,152, 300,452,600,752, infinite)	Done
<b>693F</b>	<b>Set RF timeout = infinite</b>	<b>Done</b>
<b>6940</b>	<b>Disable input inversion</b>	<b>Done</b>
6941	Enable input inversion	Done
<b>695S...S</b>	<b>Set serial number S...S = ASCII string (maximum length of 6 characters)</b>	<b>Done</b>



Table D-2 MPRR Commands Listed Numerically (continued)

Number	Command Name	Reader Message
<b>696S...S</b>	<b>Store hardware configuration string</b> <b>S...S = ASCII string</b> <b>(maximum length of 20 characters)</b>	<b>Done</b>
<b>820</b>	<b>Disable status change reports</b>	<b>Done</b>
821	Report change on input0	Done
822	Report change on input1	Done
823	Report changes on both	Done
<b>830</b>	<b>Disable automatic periodic RF status report</b>	<b>Done</b>
831	Enable automatic periodic RF status report	Done

PRELIMINARY

## Alphabetical Command List

The following conventions are used in [Table D-3](#):

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

Refer to [Chapter 7](#) for the complete syntax of commands and messages.

**Table D-3 MPRR Commands Listed Alphabetically**

Command Name	Code	Reader Message
All IDs buffer	43	Done
All IDs transmit	40	Done
<b><i>Alternate fifth group select disable</i></b>	<b>494</b>	<b>Done</b>
Alternate fifth group select enable	495	Done
<b><i>Alternate fourth group select disable</i></b>	<b>492</b>	<b>Done</b>
Alternate fourth group select enable	493	Done
<b><i>Alternate group select disable</i></b>	<b>496</b>	<b>Done</b>
Alternate group select enable	497	Done
<b><i>Alternate second group select disable</i></b>	<b>458</b>	<b>Done</b>
Alternate second group select enable	459	Done
<b><i>Alternate third group select disable</i></b>	<b>490</b>	<b>Done</b>
Alternate third group select enable	491	Done
Appended info status display	524	IDAP T0 D0 Xx T0 = time not appended T1 = time appended D0 = date not appended D1 = date appended X0 = aux info not appended X1 = aux info appended
ATA disable	480	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
ATA enable	481	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
ATA operating range set NN = 00 (shortest) to 1F (longest) <b>1F = default</b>	643NN	Done
<b>Automatic periodic RF status report disable</b>	<b>830</b>	<b>Done</b>
Automatic periodic RF status report enable	831	Done
<b>Aux info append disable</b>	<b>310</b>	<b>Done</b>
Aux info append enable	311	Done
<b>Basic protocol select</b>	<b>610</b>	<b>Done</b>
Baud rate = 1200 baud set	1002	Done
Baud rate = 19.2 K baud set	1006	Done
Baud rate = 2400 baud set	1003	Done
Baud rate = 38.4 K baud set	1007	Done
Baud rate = 4800 baud set	1004	Done
<b>Baud rate = 9600 baud set</b>	<b>1005</b>	<b>Done</b>
Boot checksum display	543	BCKS xxxx xxxx = 4-byte ASCII checksum
<b>Buffer control mode disable</b>	<b>6160</b>	<b>Done</b>
Buffer control mode enable	6161	Done
Buffer control status display	535	BCM <0 to 1> 0 = buffer control mode disabled 1 = buffer control mode enabled
Buffer entry transmit	06	Done, error, or tag data Done = buffer empty Error = not in buffer control mode Tag data = highest priority tag ID
Buffered handshake report	577	XX = number of handshakes

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
Comm port parameters display	522	MAIN Bx Sx Px D0 B0 = 110 B1 = 300 B2 = 1200 B3 = 2400 B4 = 4800 B5 = 9600 B6 = 19.2 B7 = 38.4 S0 = one stop bit S1 = two stop bits P0 = no parity P1 = even P2 = odd D0 = EOL delay of 0 ms
Comm protocol display	525	ECPS Px Txx Xx S0 P0 = basic P1 = ECP P2 = data inquiry Txx = ECP timeout ms = 50 * xx TFF = disabled ECP timeout X0 = no flow control X1 = software flow control X2 = hardware flow control S0 = SOM character is #
Command mode switch	01	Done
Data inquiry protocol enable	613	Done
<b>Data mode switch</b>	<b>00</b>	<b>Done</b>
Date set	21	Done
Default operating parameters load (except RF operating frequency)	66F	Done
DSP board Actel version display	513	DSP FPGA VER = XX.XX
Dual-frame processing mode display	536	DUAL <0 to 3> 0 = reset uniqueness on A, transmit A 1 = reset uniqueness on B, transmit B 2 = reset uniqueness on A, transmit both A and B 3 = reset uniqueness on B, transmit both A and B
eATA disable	488	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
eATA enable	489	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
Echo disable	6170	Done
<b>Echo enable</b>	<b>6171</b>	<b>Done</b>
Echo status display	537	ECHO x 0 = disabled 1 = enabled
ECP protocol select	611	Done
<b>ECP timeout set = 12.7 sec</b>	<b>612FE</b>	<b>Done</b>
ECP timeout set NN = 01–FE (1–255) timeout = 50 ms * NN (if NN = FF, timeout is disabled)	612NN	Done
SeGo protocol operating range set NN = 00 (shortest) to 1F (longest)	645NN	Done
<b>SeGo protocol tag initialization during multi-tag sort</b>	<b>456</b>	<b>Done</b>
SeGo protocol tag initialization during multi-tag sort disable	457	Done
Even parity select	1021	Done
Flash checksum display	540	PCKS I0000 Exxxx xxxx = 4-byte ASCII checksum
Flow control disable	6140	Done
Hardware configuration information display	506	S...S S...S = ASCII string (maximum length of 20 characters)
<b>Hardware configuration string store</b> <b>S...S = ASCII string (maximum length of 20 characters)</b>	<b>696S...S</b>	<b>Done</b>
Hardware flow control enable	6142	Done

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
I/O status display	526	IOST Cx Ox lx Dx C0 = host controls outputs C1 = predefined output mode O0 = both outputs off O1 = output0 on O2 = output1 on O3 = both outputs on I0 = both inputs false I1 = input0 true I2 = input1 true I3 = both inputs true D0 - DF = output pulse duration where D0 = 4 ms D1 = 8 ms D2 = 12 ms D3 = 16 ms D4 = 20 ms D5 = 24 ms D6 = 32 ms D7 = 40 ms D8 = 48 ms D9 = 60 ms DA = 76 ms DB = 152 ms DC = 228 ms DD = 300 ms DE = 376 ms DF = 752 ms
<b>Input inversion disable</b>	<b>6940</b>	<b>Done</b>
Input inversion enable	6941	Done
Input status change display	560	SSTC Ex Mx E0 = status change reports disabled E1 = status change reports enabled M0 = no reporting M1 = report change on input0 M2 = report change on input1 M3 = report change on either input
Input0 change report	821	Done
Input1 change report	822	Done
<b>Multi-tag sort disable</b>	<b>454</b>	<b>Done</b>
Multi-tag sort enable	455	Done
Odd parity select	1022	Done

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
Operating mode status display	570	ATA:<E, D> eGo:<I, F, D> SeGo:<I, F, D> IAG:<E, D> Sort:<E, D> I = ID (64 bits) E = Enabled F = Full transaction (eATA) D = Disabled
<b>Output pulse duration = 228 ms set</b>	<b>67C</b>	<b>Done</b>
Output pulse duration set N = 0–F (4,8,12,16,20,24,32,40,48,60,76, 152, 228,300,376,752 ms)	67N	Done
Output0 turn on	6201	Done
Output1 turn on	6202	Done
Outputs turn off both	6200	Done
<b>Outputs turn on both</b>	<b>6203</b>	<b>Done</b>
<b>Parity disable</b>	<b>1020</b>	<b>Done</b>
Periodic check tag status display	550	SCTS M0 (fixed)
Power fail bit display	520	PWRB Px R0 P0 = no power fail has occurred P1 = power fail has occurred R0 = not applicable
Power fail bit reset	65	Done
<b>Predefined output mode select</b>	<b>621</b>	<b>Done</b>

Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
Presence input status display	529	PRST Px D0 Ax Tx lx P0 = disable presence w/o tag reports P1 = enable presence w/o tag reports D0 = min presence true period of 0 ms A0 = RF off on timeout A1 = RF off on timeout or tag A2 = RF off on timeout or no presence T0: RF timeout of 0 ms (always expired) T1: RF timeout of 4 ms T2: RF timeout of 8 ms T3: RF timeout of 12 ms T4: RF timeout of 20 ms T5: RF timeout of 24 ms T6: RF timeout of 32 ms T7: RF timeout of 48 ms T8: RF timeout of 60 ms T9: RF timeout of 92 ms TA: RF timeout of 152 ms TB: RF timeout of 300 ms TC: RF timeout of 452 ms TD: RF timeout of 600 ms TE: RF timeout of 752 ms TF: RF timeout infinite, never expires (factory default) I0 = Input inversion disabled (factory default) I1 = Input inversion enabled
<b>Presence without tag reports disable</b>	<b>6900</b>	<b>Done</b>
Presence without tag reports enable	6901	Done
Reader ID number display	521	RDID xx xx = 00–FF
Reader ID number set NN = 00-FF (00 = factory default)	60NN	Done
Reader reset	63	Model [model] Ver [version no.] SN [serial no.] Copyright [date] TransCore
Report changes both	823	Done
RF attenuation set NN = 00 to 0A	644NN	Done



Table D-3 MPRR Commands Listed Alphabetically (continued)

Command Name	Code	Reader Message
RF CW turns on until commands 6400, 6401, or 641 are received by reader	6402	Done
RF off on timeout	6920	Done
<b>RF off on timeout/no presence</b>	<b>6922</b>	<b>Done</b>
RF off on timeout/tag	6921	Done
RF turn off	6400	Done
RF turn on	6401	Done
<b>RF on by input control</b>	<b>641</b>	<b>Done</b>
RF operating frequency from 860 to 930 in 250 kHz steps select XXX = 000 - 118 (hexadecimal)	647XXX	Done
RF operating frequency select	642NN	Done
RF status display	527	<p>RFST Cx Ox Tx Fxxx Rxx Gxx                      Axx lxx                      C0 = RF controlled by host                      C1 = RF-by-presence sensor                      O0 = RF off                      O1 = RF on                      T1 = uniqueness timeout of 2 min                      T2 = uniqueness timeout of 15 sec                      T3 = uniqueness timeout of 30 sec                      Fxxx = RF output frequency, xxx = 000 to 118                      Rxx = Tag decoder range (distance) for ATA tags, 00 to 1F hexadecimal range value                      Gxx = Tag decoder range (distance) for eGo Plus Tags, 00 to 1F hexadecimal range value                      Axx = RF power attenuation, 00 max to 0A min (10 dB less than max)                      lxx = IAG RF power attenuation, 00 max to 0F min (15 dB less than max)</p> <p>If you enter RF settings using command #642NN, the display command for RF output frequency, F is "Fxx" and indicates use of the backward-compatible frequency entry method.</p>

**Table D-3 MPRR Commands Listed Alphabetically (continued)**

Command Name	Code	Reader Message
<b>RF timeout = infinite set</b>	<b>693F</b>	<b>Done</b>
RF timeout set N = 0–F (always expired, 4,8,12,20,24,32, 48,60,92,152,300,452,600,752 ms, infinite)	693N	Done
RF transceiver FPGA version display	510	RF FPGA VER = XX.XX
RF transceiver I filter chip version display	511	FIL IC I VER = XX.XX
RF transceiver Q filter chip version display	512	FIL IC Q VER = XX.XX
RF0 filter status display	530	RF0S Ux V0 U0 = one ID separation U1 = two ID U2 = transmit all
SeGo disable	484	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
SeGo enable	485	Done if MPRR model supports this tag protocol. Error if tag protocol is unsupported.
Selected check tag option display	551	CTAG 0 (fixed)
<b>Serial number set</b> <b>S...S = ASCII string</b> <b>(maximum length of 6</b> <b>characters)</b>	<b>695S...S</b>	<b>Done</b>
<b>Software flow control enable</b>	<b>6141</b>	<b>Done</b>
<b>Status change reports disable</b>	<b>820</b>	<b>Done</b>
<b>Stop bit use one</b>	<b>1010</b>	<b>Done</b>
Stop bit use two	1011	Done
Tag ID separation select four	4103	Done
<b>Tag ID separation select one</b>	<b>4100</b>	<b>Done</b>
Tag ID separation select three	4102	Done
Tag ID separation select two	4101	Done

**Table D-3 MPRR Commands Listed Alphabetically (continued)**

Command Name	Code	Reader Message
Tag translation mode status display	534	<i>TT &lt;0 to 1&gt;</i> 0 = tag translation mode disabled 1 = tag translation mode enabled
<b><i>Time and date appended</i></b>	<b>302</b>	<b><i>Done</i></b>
Time and date display	22	Time and date
Time and date not appended	300	Done
Time set	20	Done
Uniqueness reset	440	Done
<b><i>Uniqueness time-out set to 2 minutes</i></b>	<b>441</b>	<b><i>Done</i></b>
Uniqueness time-out set to 15 seconds	442	Done
Uniqueness time-out set to 30 seconds	443	Done
Valid ID code select four	4203	Done
<b><i>Valid ID code select one</i></b>	<b>4200</b>	<b><i>Done</i></b>
Valid ID code select three	4202	Done
Valid ID code select two	4201	Done
Version display	505	Model [model] Ver [ver no.] SN [serial no.]

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## Compatible Tag Information

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## Compatible Tag Information

*This appendix gives helpful information about the tags that are compatible with the Multiprotocol Rail Reader (MPRR).*

### Tag Configurations

Table E-1 lists the TransCore Super eGo<sup>®</sup> (SeGo) protocol tags that are compatible with the MPRR.

**Table E-1 SeGo Protocol Tags**

Tag	Tag Type	Power Source	Number of 6-bit ASCII Characters <sup>a</sup>	Number of 128-Bit Frames <sup>a</sup>	Special Features
AT5118	Rail	Beam	20	1	Very thin, flexible, multi-layer lamination
			10	1/2	
AT5133			20	1	Very thin, flexible, multi-layer lamination, tamper detection
			10	1/2	
AT5549			20	1	Water-resistant, exterior-mounted
			10	1/2	

a. These fields apply to eATA-programmed tags only. Contact TransCore for information regarding tags programmed with these features.

Table E-2 lists most ATA tag models that are compatible with the MPRR.

**Table E-2 ATA Protocol Tags**

Tag Model Number	Tag Type	Power Source	Number of 6-Bit ASCII Characters	Number of 128-Bit Frames	Special Features
AT5110	Transportation	Beam	20	1	915 MHz frequency, metal external install
AT5112	Access control, transportation	Beam	10	1/2	915 MHz frequency, metal external install

Table E-2 ATA Protocol Tags (continued)

Tag Model Number	TagType	Power Source	Number of 6-Bit ASCII Characters	Number of 128-Bit Frames	Special Features
AT5114	Access control, transportation	10-yr battery	10	1/2	Multifrequency, metal external install
AT5125	Transportation	Beam	20	1	915 MHz frequency; high-temperature chemical-resistant case, metal external install
AT5510	Transportation	10-yr battery	20	1	Multifrequency, metal external install
AT5704	Transportation	External	4608	256	Multifrequency, dynamic tag, metal external install
AT5707	Transportation	8-yr battery	40 <sup>a</sup>	2	915 MHz frequency, dynamic tag, metal external install

a. If desired, in place of 40 six-bit ASCII characters, the AT5707 can support up to 34 seven-bit ASCII characters.

### Tag Data Formats

Tags are programmed at the TransCore factory with the tag model number, date of manufacture, and data format. Contact TransCore for special order entry procedures for the format that applies to your system. The following four tag data formats can be used:

- 10-character alphanumeric ASCII — Four alphanumeric characters are fixed and can be used to identify either the dealer or the user. The remaining six positions are numeric and should be unique for each tag issued. For example, the entry ACME000001 might be specified as the first tag on the order entry form from ACME Rail Lines.
- 20-character alphanumeric ASCII — Four alphanumeric characters are typically fixed and the remaining 16 positions are numbered sequentially.
- AAR/ISO — For requirements for this format, refer to ISO 10374 and the most recent version of *Association of American Railroads Standard for Automatic Equipment Identification*.



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