

## **JANUS® MULTI-PROTOCOL READER 2.3**

### **OPERATIONS AND MAINTENANCE MANUAL**

**DOCUMENT: UM 360467-100**

**REVISION: M**

**DATE: March 6, 2023**

#### **Deliverable Document – Internal Approval Page**

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### **OPERATIONS AND MAINTENANCE MANUAL**

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**Kapsch TrafficCom:**

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**FCC License Notice:**

This equipment emits RF signals. In order to operate this equipment the customer must obtain a separate FCC Part 90 Site license for each location. In addition, the FCC ID component identification **JQU802295A, or JQU802295A-A** must appear on a label on the front of the RF Modules installed in these Readers.

The power output of a module at ambient ( $P_{out(amb)}$ ) shall be constrained using internal or external Tx attenuation so that the following is satisfied:

$$P_{out(amb)} \leq 43.77 \text{ dBd} - G_{fund};$$

Where  $G_{fund}$  is the net gain from antenna connector on the RF module to the antenna radiated signal. The antenna gain is expressed in **dBd**.

The Power output from the amplifier assembly of a module plus external amplifier at ambient ( $AmpOut(amb)$ ) shall be constrained using module internal TX attenuation so that the following are both satisfied:

$$AmpOut(amb): \leq 39 \text{ dBm}; \text{ and}$$

$$AmpOut(amb): \leq 43.77 \text{ dBmd} - G_{fund};$$

where  $G_{fund}$  is the net gain at fundamental frequency from the antenna connection on the amplifier assembly to the antenna radiated signal where the antenna gain is expressed in **dBd**.

The net gain at the second harmonic from the antenna connection on the amplifier assembly to the antenna radiated signal shall be:

$$G_{2nd} \leq G_{fund} - 14\text{dB}.$$

**Note:** This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

**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 radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their expense.

**Changes or modifications not expressly approved by Kapsch TrafficCom could void FCC compliance and the authority to operate the equipment.**

**Note:** IEC 60950-1 and/or EN60950-1, First Edition, Information Technology Equipment – Safety – Part 1: General Requirements require that this equipment must be located in a RESTRICTED ACCESS LOCATION (RAL). Only authorized personnel can have access to the

**MODEL 802295A-A PART 2 of 2 RF AMPLIFIER ASSEMBLY**

**The amplifier is only approved for use with the corresponding module (part 1 of this model)**

**115VAC – 230VAC, 2A, 60Hz**

**SOFTWARE/FIRMWARE Note**

**The current software set is identified in the Software Release document.**

The active Reader software and firmware version is displayed in the Reader browser interface.

**FACTORY SUPPORT SERVICE**

For Return Material Authorization (RMA) numbers please telephone: 905 624-3020.

**For Kapsch Service information and other requests please FAX: 905 624-4572.**

**NOTICE**

The information presented in this document is current although it is subject to change. As such, **Kapsch TrafficCom** assumes no liability on behalf of the USER with respect to interpretation based on the use of this information

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**Kapsch TrafficCom**

has patented or has patents pending on critical design features of the item or items described herein. Contact Kapsch TrafficCom for all queries regarding patents.

## Document Revision Control

Version Date	Revision	Editor	Changes
Mar 6/23	M	E. Rolo	ECN 23005 Updates to warnings and Cautions to move the RF exposure statements from a caution to a warning. Pages 19 and 20
Mar 28/22	L	B. Mac	ECN 22021 revised address for US office
Oct 18/18	K	E. Rolo	ECN18040 Updates for PSM rating change from 115VAC operation to 115-230VAC operation.
Nov 16/17	J	E. Rolo	ECN 17092 Updated screen shots related to HOT tag programming. Added information on antenna Gain and MRFMS output power.
August 23/17	I	E. Rolo	ECN 17063 Updated screen shots to align with the latest version of the software and identify the version. -Updated name of manual to be consistent throughout. -Updated FCC frequencies by protocol and their use in a frame sequence. -Updated antenna placement and restrictions. -Clarified THs and AHs definitions. -Updated command and controls section for 6C changes and RxR. -Added a section for Configuration via the Web Interface. -Added a section for 6C write configuration. -Added a section to explain the "Dummy Frame" -Added detail concerning antenna mounting. -Clarified CRA and IR operation.
May 8/17	H	E. Rolo	ECN 17035 Update to Section "Installing RF Cables" to add requirement to tape the circulator to ensure the circulator and connections are water tight.
Feb 14/17	G	E. Rolo	ECN 17005 Update to Sections "Performing lane Tuning" and Installing a lane kit", clarifications about two TDM channels active in the same time slot.



Version Date	Revision	Editor	Changes
Dec 9/16	F	E. Rolo	ECN 16092 Update to the Copyright statement and the footer to support distribution without the need for a NDA.
Nov 17/16	E	E. Rolo	ECN 16085 Update Section 5, The Synchronization Circuit – to provide a better explanation of the purpose of Synchronization.
2016-06-17	D	E. Rolo	ECN 16047 Section 2 update the operation of the MRFM-S and CTM (CGC, MC) functions Section 4 Update the operation of the MRFM-S and correct number of ORT lanes per reader.
2016-04-27	C	E. Rolo	ECN16040 Correct LC ICD to ICD 360467-121 Add LC ICD to Reference Documents Lane Kit Installation added wording about staggered antenna preferred when using non-TDM protocol.
2015-05-27	B	E. Rolo	Initial Release

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# **1. ABOUT THIS MANUAL**

The JANUS® Multi-Protocol Reader 2.3 Operations and Maintenance Manual consists of two main parts :

- Operations
- Maintenance

Sections and subsections within these main parts are used to present theoretical as well as practical and procedural information. See the table of contents for more details on each section.

This manual is the main reference document used during training. Training is provided by Kapsch TrafficCom for the following personnel.

- Operations
- Installations
- Maintenance
- Service

This manual is also used as a reference by Kapsch TrafficCom for its service-certified technical service personnel in the field once training has been completed.

This version of the manual is current to and uses screens and information pertaining to software version 2017jun23a-MPR2na (2017jun23a-MPR2na.en.sign). Earlier versions may not support all control parameters and features shown or described, while later versions may have additional features and control parameters.

## **Technical Background**

Personnel must have an electrical/electronic technical background, understanding of toll and RF, and some prior experience using web browsers.

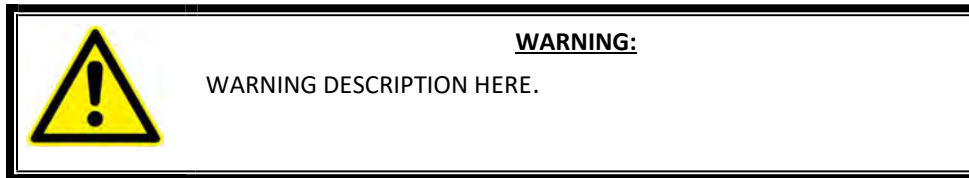
## **Assumptions**

A redundant JANUS® Multi-Protocol Reader 2.3 used for Electronic Toll Collection (ETC) is assumed throughout the manual.

## Warnings and Cautions

### Warnings

Warnings indicate a risk of bodily harm and include a symbol indicating the type of injury risked.



The following warnings appear in the manual:



AN IMPROPERLY GROUNDED READER COULD RESULT IN ELECTRIC SHOCK. ENSURE A HIGH CURRENT EARTH GROUND CONNECTION IS ESTABLISHED BEFORE CONNECTING SUPPLY POWER TO THE READER.



THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.



THE MRFM-S MAY BECOME HOT UNDER NORMAL OPERATING CONDITIONS. ENSURE THE MRFM-S HAS COOLED DOWN OR WEAR GLOVES WHEN HANDLING THE MRFM-S.



THE PSM MAY BECOME HOT UNDER NORMAL OPERATING CONDITIONS. ENSURE THE PSM HAS COOLED DOWN OR WEAR GLOVES WHEN HANDLING THE PSM.



EXPOSED HIGH VOLTAGE IS PRESENT IN THE PSM. ENSURE THAT THE POWER SWITCH IS SET TO THE OFF POSITION AND THAT THE AC INPUT POWER CORD IS DISCONNECTED BEFORE REMOVING THE PSM.



INSTALLING A FUSE OF THE WRONG TYPE OR RATING MAY CAUSE A FIRE. ENSURE A TIME-LAG FUSE RATED FOR 10A, 250VAC IS INSTALLED.



KEEP AT LEAST 100 CM AWAY FROM THE RADIATING FACE OF THE ANTENNA WHEN THE RF MODULE IS CONNECTED AND OPERATING.

### Cautions

Cautions indicate a risk of damage to equipment or loss of data.



**CAUTION:**

Caution description here.

The following cautions appear in the manual:

Improper modification of configuration parameters may adversely affect system operation. The default values may not be appropriate for the specific application. It is the system integrator's responsibility to tailor the configuration parameters to the specific operating environment.

Both CTMs in a redundant Reader must be properly configured. Each CTM has its own browser interface and is configured independently. Ensure any configuration changes made to one CTM are applied to the other CTM.

Log file formats are not under ICD control and the format may change without prior notification. Log files are for diagnostic purposes only and are not guaranteed to be maintained in non-volatile storage.

Excessive bending or kinking can damage the RF feedline cables. Do not excessively bend or kink the RF feedline cables when installing them between the antennas to the Reader enclosure.

Removing a powered CTM from the Reader rack can damage the CTM. Before removing a CTM from the Reader, ensure that power on the affected side of the Reader is turned off, i.e. the power switch on the PSM is in the off position, or the PSM AC input power cord is disconnected.

To avoid damaging the modules, ensure that the connector on the module is properly aligned with the connector on the DSM back plane before the module is securely plugged into the DSM.

Activating inactive factory software/firmware on a running system is not recommended. The factory software/firmware may not be appropriate for the specific application.

During software/firmware activation (typically less than 60 seconds), the Reader will switch over to the other side to process and report transactions, regardless of the position of the mode switch on the SPM module. Ensure that the other side is running normally and all lane controller links are functioning. The Reader will be unable to process or report transactions if it is unable to switch over to the other side.

During software/firmware activation (typically less than 60 seconds), a non-redundant Reader is unable to process or report transactions.

The factory default configuration should not be restored on a running Reader. The factory software/firmware may not be appropriate for the specific application. Save the current Reader configuration before resetting the Reader configuration to the factory default.

## Conventions used in this manual

The following information is provided to the user to aid in understanding and readability.

Highlighting and callouts are used in the guide to indicate importance, or to indicate a change to the user.

Example:

Bolding of words is used in the following cases:

To indicate that an action is required (example: Click the **Next** button.)

To indicate a main menu item and/or a menu option (example: From the **Tag Programming** screen, select the **Enable TMP** check box.

When required, tables listing screen fieldnames and/or column headings and their definitions or meanings are placed below selected screens to aid in understanding technical terms.

Decision tables are used when procedures have more than one option from which to choose.

Example:

IF you logged into an account that ...	THEN ...
has <b>User Admin</b> permissions,	navigate to the <b>Change Password</b> tab on the <b>User Management</b> page. Go to step 3.
does NOT have <b>User Admin</b> permissions,	from ANY page, click <b>Change Password</b> in the navigation sidebar. <b>Result:</b> The <b>User Management Change Password</b> page appears. Go to step 3.

The terms **Tag**, **Transponder** and **On-board Unit** or **OBU** are interchangeable in this manual.

The terms **IAG** or **TDM** are interchangeable in this manual when referring to screens or the TDM protocol.

## How to use this manual

The JANUS® Multi-Protocol Reader 2.3 Operations and Maintenance Manual requires no special instructions on how to use it.

Topics can be found in the Table of Contents at the beginning of the manual to help with navigation.

If an online version of the guide is used, both the Table of Contents topics, and page and subject cross-references within the body of the document are hyperlinked to their associated subject matter.

This Manual covers the following Reader Models:

802260-101, 802260-102, 802260-103, 802260-104, 802260-105, 802260-106, 802260-107, 802260-701, 802260-702, 802260-703, 802260-704, 802260-705, 802260-706, and 802260-707.

# OPERATING INSTRUCTIONS



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## 2. OVERVIEW

### Introduction

The JANUS® Multi-Protocol Reader 2.3 (MPR 2.3) is part of the Electronic Toll Collection (ETC) Subsystem. Toll collection is the primary use of the Reader.

### Overview of the MPR 2.3 Electronic Toll Collection (ETC) Subsystem

The MPR 2.3 Reader can interact with both active and passive OBUs.

#### *Active OBU*

For an active OBU, overhead antennas send out RF signals. As a vehicle equipped with an active OBU approaches a toll zone, the OBU receives an RF signal from the antenna. The OBU then starts transmitting data, which is received by the antenna and passed on to the Reader via an MRFM-S module. The Reader processes and logs the OBU data, and then sends the information to the Lane Controllers (LCs). The Reader can also send data back to the OBU, such as an updated toll account balance.

#### *Passive OBU*

For a passive OBU, the antenna sends out a command or a continuous wave via an RF signal. As a vehicle equipped with a passive OBU approaches a toll zone, the OBU receives an RF signal from the antenna. **If commanded**, the OBU then starts transmitting data, which is received by the antenna and passed on to the Reader via an MRFM-S module. The Reader processes and logs the OBU data, and then sends the information to the Lane Controllers (LCs). The Reader can also send data back to the OBU, such as an updated toll account balance.

The MPR 2.3 is factory configured to enable all protocols.

For an in-depth description of protocols and the MPR 2.3 ETC Subsystem, see Theory of Operations page 155.

### JANUS MPR 2.3 system components

Figure 2-1: A Redundant Reader shows a rack equipped with eight Smart MRF modules (MRFM-S).

A Lane Kit consists of:

- An antenna (see Figure 2-2)

- An MRFM-S( ② in Figure 2-1: A Redundant Reader)

Two feedline adapter cables

One Circulator

One Circulator adapter cable. (3'5" for 902-904MHz, 3'3" for all other frequencies)

The redundant Reader consists of:

**Note:** Numbers in the list below refer to those associated with Figure 2-1: A Redundant Reader. The DSM, and CFM are not shown in the figure.

One rack and Distribution Module ❶

Two Controller Modules (CTM) ❸, each equipped with an internal Main Controller (MC) and one Channel Group Controller (CGC)

Two Configuration Modules (CFMs) attached directly to the DSM

One Synchronization Port Module (SPM) ❹

Two Lane Port Modules (LPM) ❺

One secondary Power Supply Module (PSM) ❻

One primary Power Supply Module (PSM) ❼

AC Power cords for the PSM's ❽

**Note:** Non-redundant Readers contain one CTM, one CFM, one LPM, and one PSM. For an illustration of a non-redundant reader, see Appendix C.

Additional installation components required are:

Two RF cables from Reader to Circulator (type N male to type N female)

Sealing tapes for RF connectors exposed to weather

Lightning arrestors

Optional Ethernet switch modules (ESMs)

Sync and inter-reader Ethernet cabling (if required)

Ethernet cables if ESMs used

300 CFM fan tray for operation above 131°F (55°C)

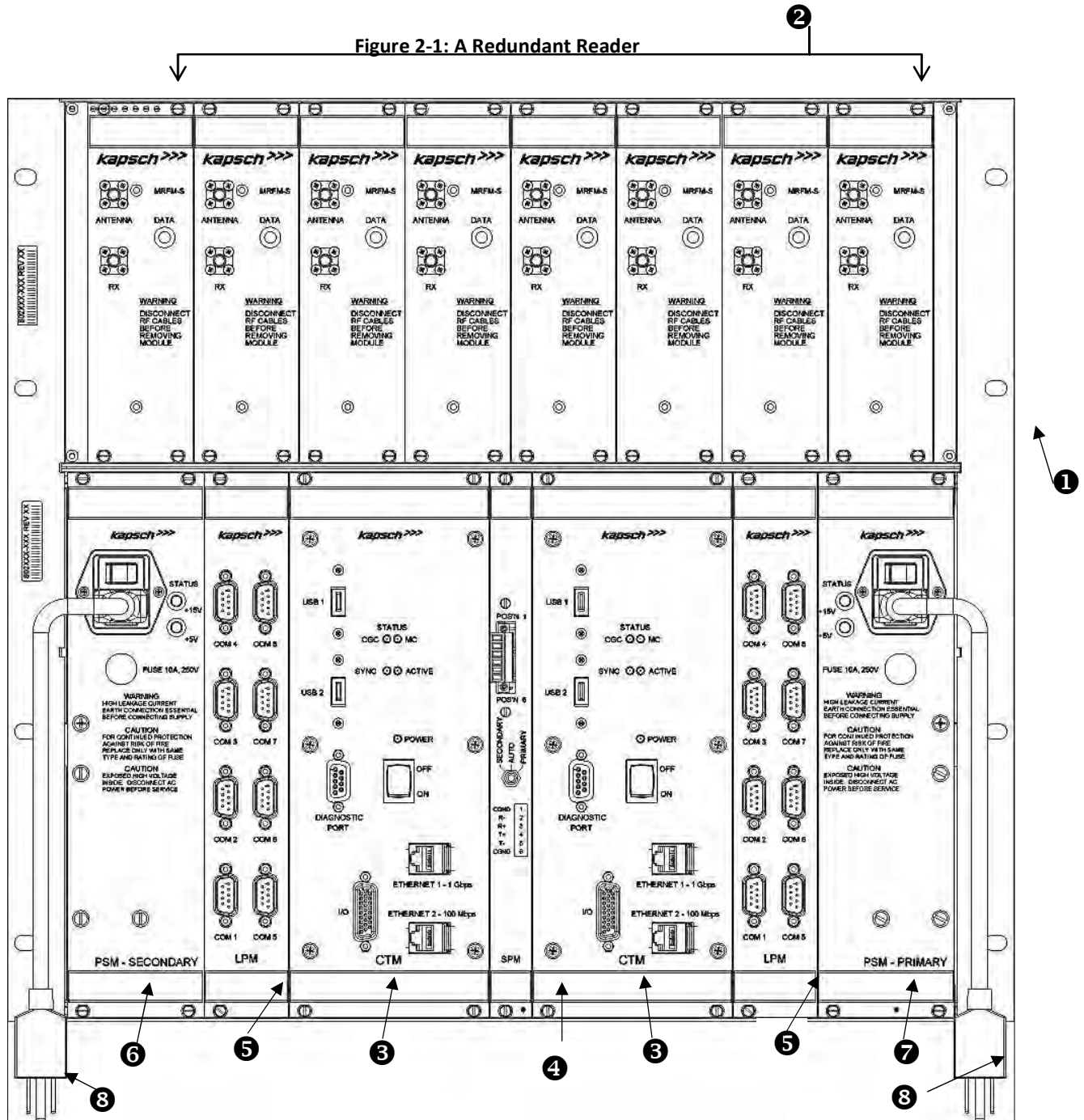
Additional Site requirements are:

Cabinet with AC power, grounding, including reader ground bar,

Mounting structure for antenna

Ethernet or Serial cables to connect to the lane Controller(s)

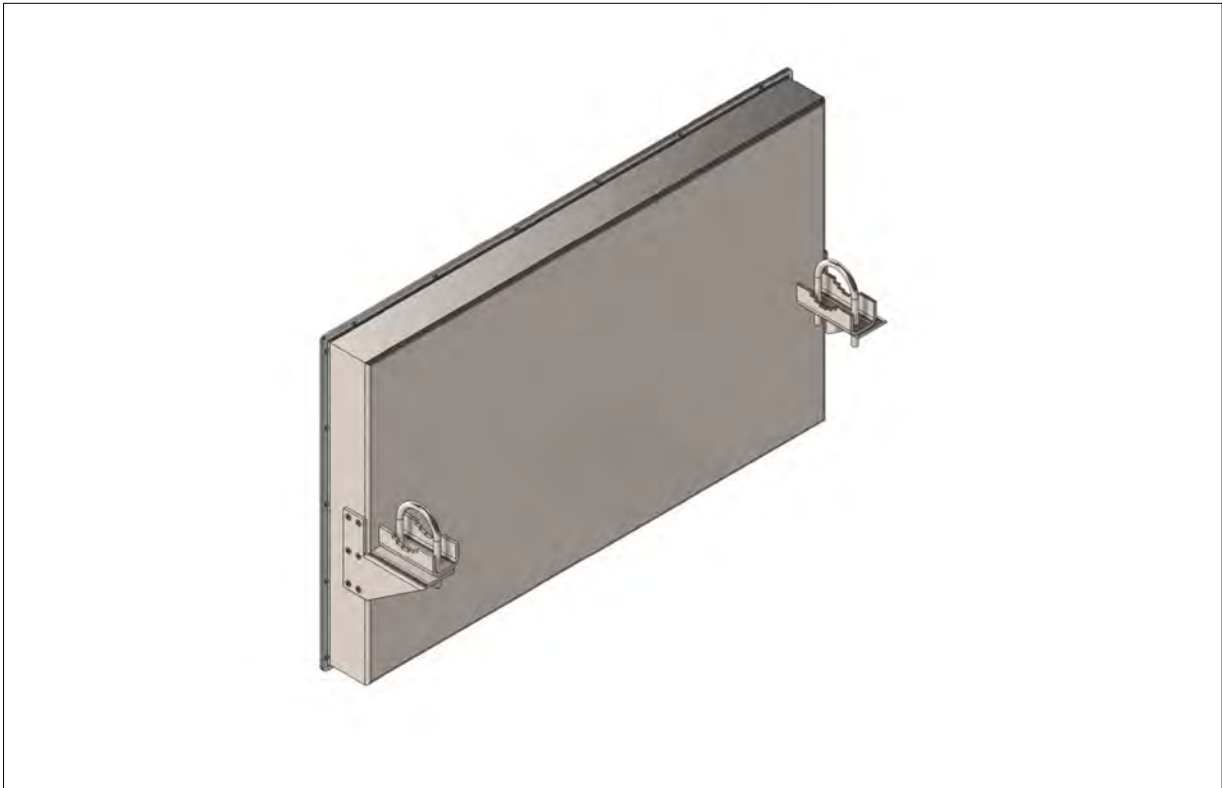
Figure 2-1: A Redundant Reader



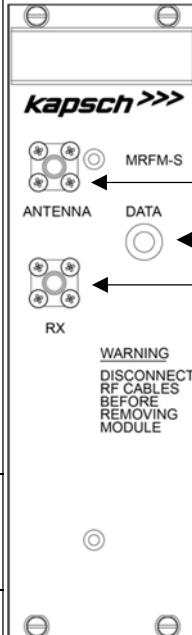
## Antenna

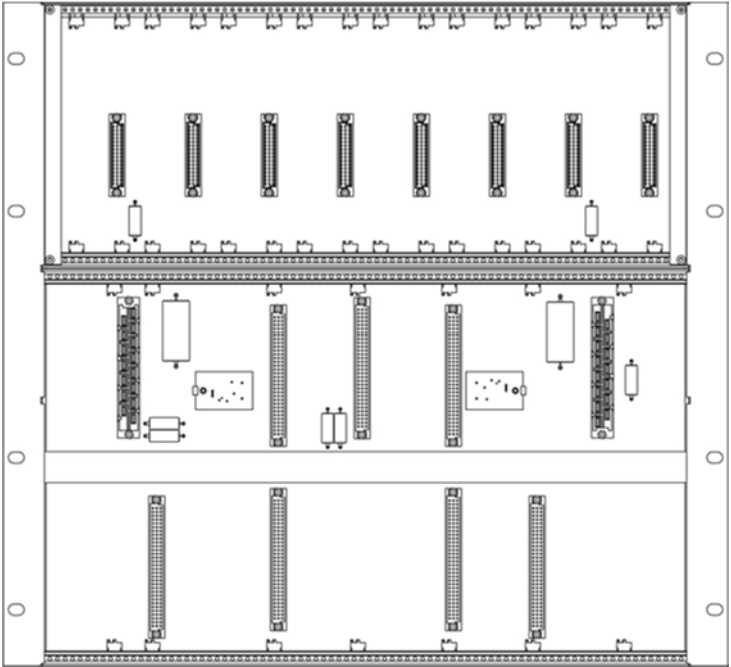
The antenna sends and receives RF signals to and from the vehicle On Board Units (OBUs). The IAG 3 antenna is recommended for the MPR 2.3 reader. See Antenna Specifications, page 258 for more details. Figure 2-2 shows an illustration of the IAG 3 antenna, the recommended antenna for the Multi-protocol Reader.

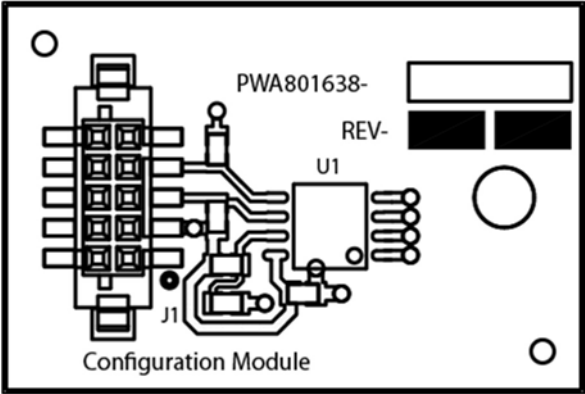
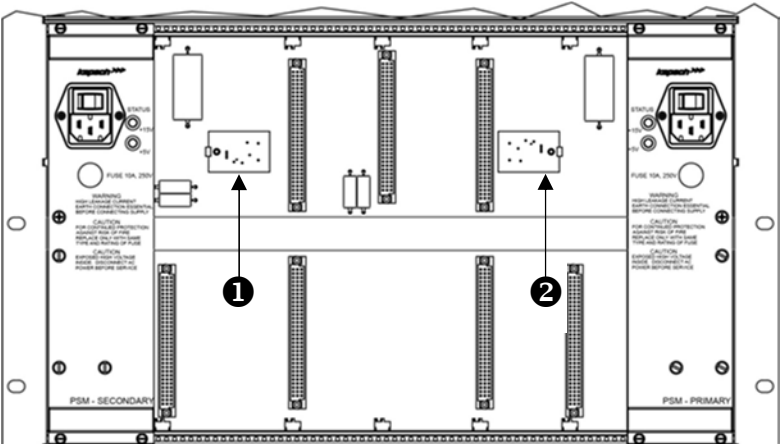
**Figure 2-2: IAG 3 Antenna**



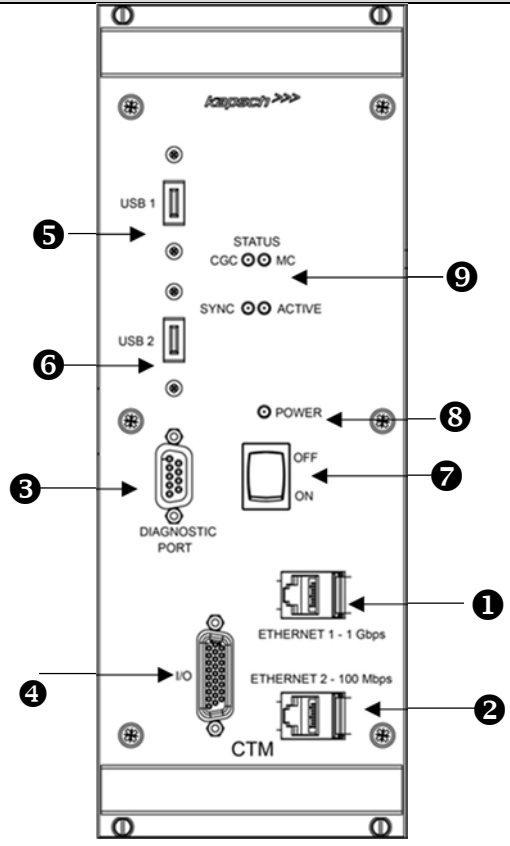
## Module Descriptions

Smart Multi-protocol RF Module (MRFM-S)	
<b>Function</b> <p>Executes frame functions triggered by command or configuration messages and timing signals received from the CTM via the DSM.</p> <p>Executes the over-air aspects for a protocol within each frame, generating the analog RF signal that is sent to the OBU via the antenna.</p> <p>Receives the analog RF signal collected from the OBU via the antenna and recovers the data content from the over-air protocol messages.</p> <p>Reports the recovered data and status information as messages that are sent to the CTM via the DSM.</p> <p>Output Power = 33dBm <math>\pm</math> 0.6dBm</p>	
<b>Units per Reader</b> <p>One MRFM-S for each antenna. A maximum of 8 MRFM-S per Reader.</p>	
<b>Redundant</b> <p>No</p>	
<b>Normal State</b> <p>The DATA LED ❶ illuminates solid green when RF is being transmitted.</p>	
<b>Connections</b> <p>The MRFM-S module supports bi-static output configurations.</p> <p>In bi-static output configurations, both connections ❷ and ❸ are each connected by an RF cable to the antenna.</p>	

Distributions Module (DSM) and Rack		
<b>Function</b>	The DSM is the back plane of the Reader rack.	
<b>Units per Reader</b>	One DSM and one Rack	
<b>Connections</b>	<p>The MRFM-S, PSM, LPM, CTM, and SPM modules slide into the Rack and connect to the DSM.</p> <p>The CFMs attach directly to the DSM.</p>	

Configuration Module (CFM)		
<b>Function</b>	Stores the Reader configuration file so that the Reader configuration is retained when the CTMs fail or are removed.	
<b>Units per Redundant Reader</b>	One CFM on the secondary side ❶, One CFM on the primary side ❷	
<b>Connections</b>	<p>The CFMs attach directly to the DSM in the secondary location ❶ and the primary location ❷.</p> <p>CFMs should not be swapped between readers or within the reader.</p>	



Control Module (CTM)		
<b>Function</b>	<p>Contains the Reader processor (MC), the Channel Group Controller module (CGC).</p> <p>Allows the CTM to be reset with the CTM ON/OFF switch <b>7</b>.</p> <p>Controls when the RF modules are interrogated.</p>	
<b>Units per Redundant Reader</b>	<p>One CTM on primary side,</p> <p>One CTM on secondary side</p>	
<b>Normal State</b>	<p>The POWER LED <b>8</b> illuminates green when the CTM is on and is receiving power from the PSM.</p> <p>The STATUS LEDs <b>9</b> illuminate green to indicate SYNC is functional, CTM is active, CGC is functional and MC is functional.</p> <p>See Table 6-1 for more information on CTM LED indicators.</p> <p>If the Primary CTM configuration is changed, the Secondary CTM becomes active and the Primary CTM becomes inactive. To switch the Primary CTM to active, manual intervention is required.</p>	
Connections	Port	Function
	ETHERNET 1 - 1 Gbps <b>1</b>	One option for connecting a service laptop directly to the Reader,. or, for creating a network to connect the Readers and LCs together.

Control Module (CTM)		
	ETHERNET 2 – 100 Mbps ②	For connecting several Readers together to create an Inter-Reader (IR) network, or for connecting a service laptop when Ethernet 1 is connected to the Lane Controller.
	DIAGNOSTIC PORT ③	A second option for connecting a service laptop directly to the Reader. The browser interface cannot be accessed from this port.
	I/O ④	Reserved for future use.
	Port	Function
	USB 1 ⑤	A third option for connecting a service laptop, via an Ethernet adapter, directly to the Reader, or for saving the Reader configuration to a flash drive, or for automatically or manually copying the Reader log files to a flash drive.
	USB 2 ⑥	

**CTM MC**

The MC is a single-board computer that runs the Reader software. The MC is mounted in the CTM.

**CTM CGC**

The CGC handles the communications between the MC and the RF modules. It also handles the serial communications between the reader and the Lane Controller via the serial connections on the LPM. The CGC is mounted in the CTM.

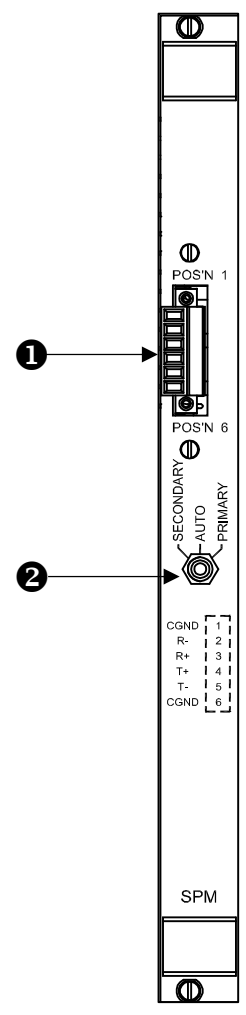
The CGC hardware supports the following functions.

- Controls the protocol frame timing for each protocol
- Handles inter-reader frame synchronization
- Provides hardware interface for redundancy operation
- Provides hardware interface for supporting up to eight (8) MRFM-S

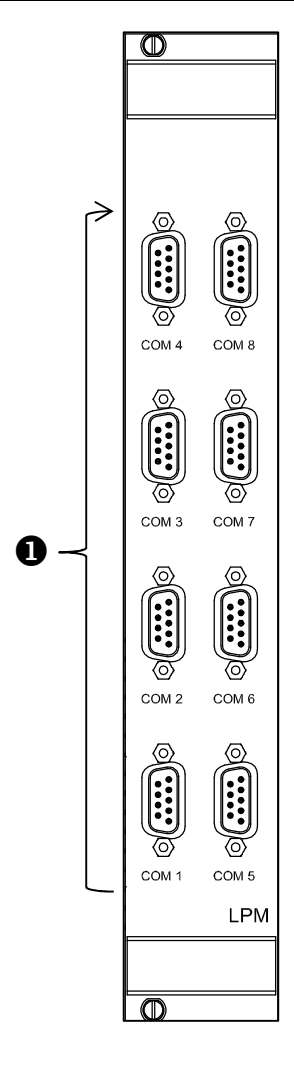
Provides in-system program capability via the Master interface, for software/firmware and hardware configuration where applicable

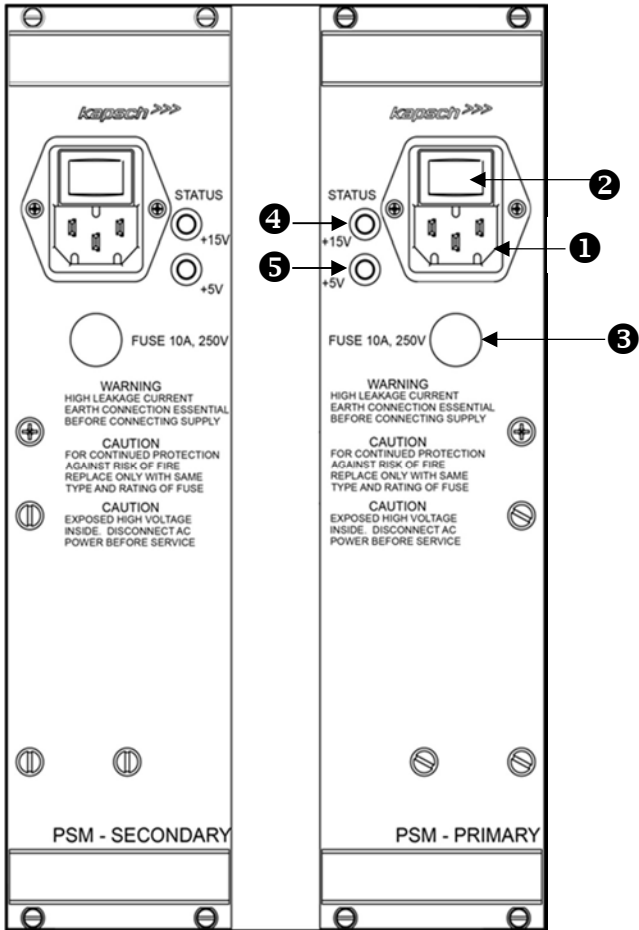
Provides connections for eight Lane Controller Ports

Provides pass-through provisional connections for the Host Port .

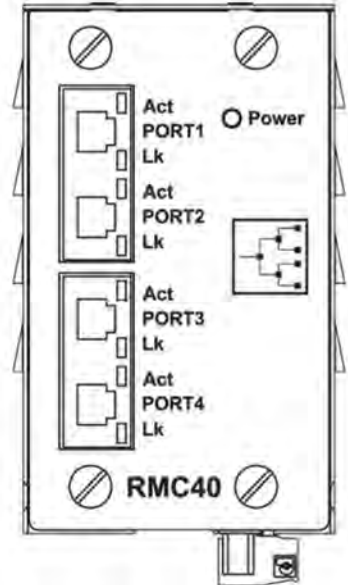
Synchronization Port Module (SPM)		
<b>Function</b>	<p>Sends out the status of the Reader (ready or busy) to the other Readers in the synchronization network.</p> <p>Signals to the CTM when all other Readers in the synchronization network are ready.</p> <p>Allows the switchover mode to be set to SECONDARY—AUTO—PRIMARY by the Redundancy Mode switch ② on the SPM.</p>	
<b>Units per Redundant Reader</b>	One	
<b>Normal State</b>	N/A (no status indicators on module)	
<b>Connections</b>	The SPM terminal block ① is connected to the other Readers in the synchronization network via the sync terminal block hub.	

### Lane Port Module (LPM)

<b>Function</b>	Provides a serial interface between the LCs and CTM. All OBU Data processing is done by the CTM.	
<b>Units per Redundant Reader</b>	One LPM on primary side, One LPM on secondary side	
<b>Normal State</b>	N/A (no status indicators on module)	
<b>Connections</b>	The Reader can send real-time OBU transactions to the LCs via the eight serial ports <b>1</b> on the LPM. The LC can also update the Reader configuration via these ports.	

Power Supply Module (PSM)		
<b>Function</b>	<p>Provides DC power to the modules in the Reader rack.</p> <p>Allows each side (primary or secondary) to be powered <b>on</b> and <b>off</b> via a power switch ②.</p>	
<b>Units per Redundant Reader</b>	<p>One secondary PSM on the secondary side</p> <p>One primary PSM on the primary side</p> <p>The secondary and primary PSMs are not interchangeable since they are mirror images of each other. The secondary PSM is keyed to insert in the leftmost rack slot and the primary PSM is keyed to insert in the rightmost rack slot.</p>	

Power Supply Module (PSM)		
Normal State	<p>A +15V STATUS LED <b>④</b> illuminates green to indicate that 15V DC is being supplied to the Reader.</p> <p>A +5V STATUS LED <b>⑤</b> illuminates green to indicate that 5V DC is being supplied to the Reader.</p>	
Connections	<p>A power cable plugs into a socket <b>①</b> to supply 115 to 230VAC to the PSMs. Each PSM is equipped with a replaceable 10A fuse <b>③</b>.</p>	

Ethernet Switch Module (ESM) (Optional)		
<b>Function</b>	<p>Can connect an IR network with up to three Readers for Open Road Tolling (ORT) applications via the Ethernet 2 port on the CTMs. The IR network is used to improve the accuracy of the voting that determines the lane assignment between Readers covering adjacent lanes.</p> <p>Can connect an LC network with all Readers to a Lane Controller and host computer via the Ethernet 1 port on the CTMs. The host computer can be used to access the browser interface for each Reader CTM in the network.</p> <p>The Ethernet switch Module, if used, shall be mounted in a reader cabinet.</p>	
<b>Units per Redundant Reader</b>	Two per Ethernet network	
<b>Normal State</b>	See the manufacturer's documentation for details.	
<b>Connections</b>	See the manufacturer's documentation for details.	

### The CTM web interface

You can use a service laptop equipped with a web browser to access the CTM web interface, shown below.

**Note:** Depending on the permissions given a user by the administrator, the menu can offer different options. For instance, the menu in brackets is what an administrator would see.

After entering your user name and password, you can monitor and configure the Reader depending on the permissions assigned to your user account.

Each CTM has its own browser interface. Changing configuration settings while connected to the primary CTM, for example, does not change the configuration settings for the secondary CTM.

**Note:** Any changes applied to one CTM in a redundant Reader must then be applied to the other CTM.



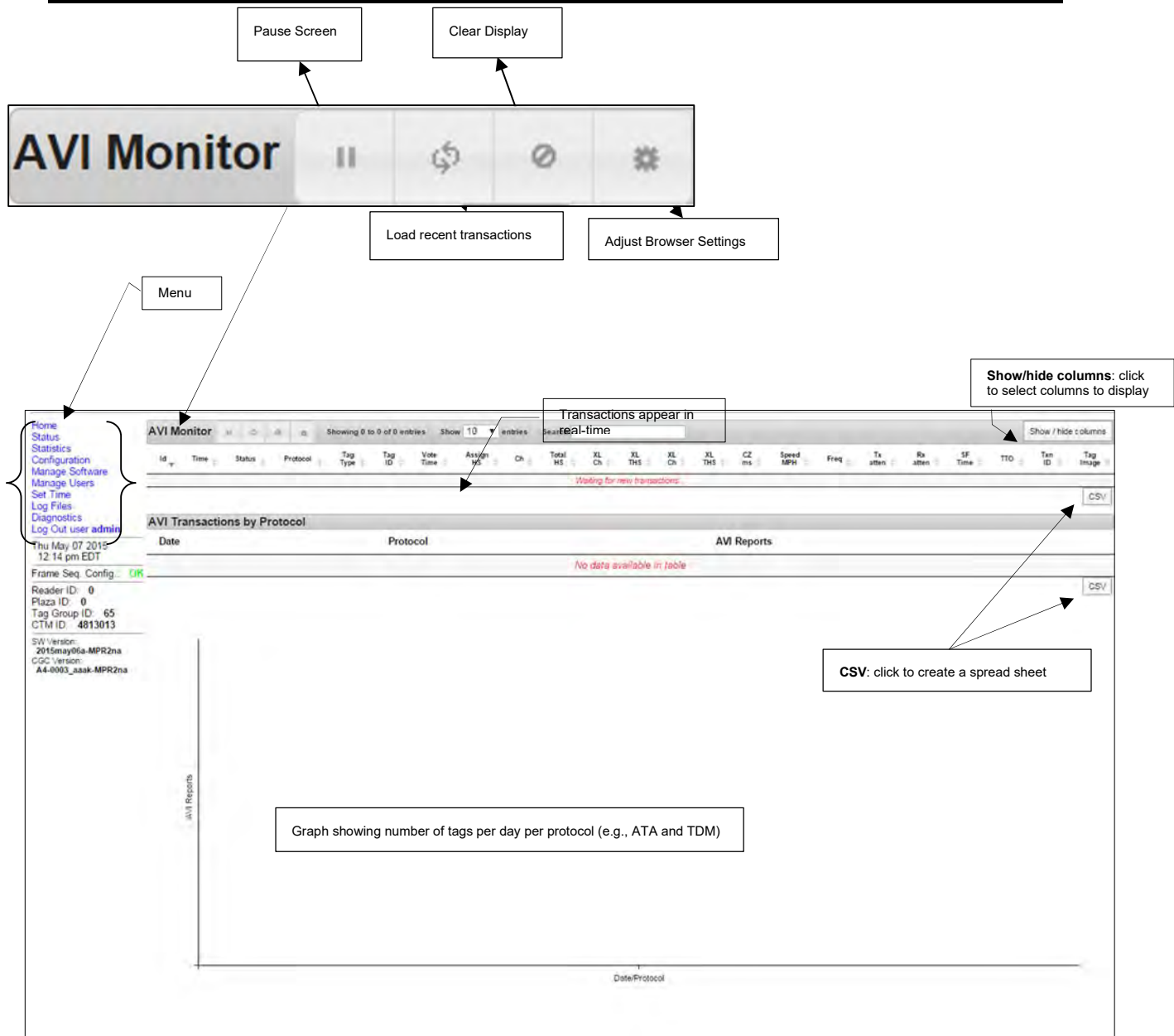


Table 2-1: CTM web interface menu

Option	Description
Home	Select to display the Home page in the CTM web interface. The Home page provides an at-a-glance view of transactions happening in real time and transactions by protocol.
Status	Select to display the Status page. This page monitors communication, power supply, CTM status and CGC health. Also, contains a <b>System Identification</b> button to confirm which Reader CTM web interface you are viewing, and that the computer is communicating successfully.
Statistics	Select to display the Statistics page. This page is used to view Reports by channel, Low/Early Reads, and Transaction Buffering statistics.
Configuration	Select to display the Configuration page and access a variety of Reader configuration parameters.
Manage Software	Select to display the Manage Software page. This page provides access to upload and verify, activate and delete software commands. It also has a Reboot button to restart the Reader.
Manage Users	Select to display the Manage Software page. This page provides access user profiles, create new users, delete users, change permissions, change passwords.
Change Password	<b>Not seen on the Administrator's CTM screen.</b> Select to display User Management page. Limited to commands for changing passwords. Changes the password of the user currently logged into the CTM web interface. See page 46 for more information.
Set Time	Select to access the Set Time page . Use this page to Disable/Enable Network Time Protocol (NTP) access NTP servers IPv4 addresses and select a new time zone
Log Files	Select to display the <b>Log Files</b> page in the CTM web interface. Also displays the USB Logging tab and the Ethernet Logging tab.
Diagnostics	Select to access the Diagnostics for the Reader. Use for the following Diagnostics: <ul style="list-style-type: none"> <li>• Static and Dynamic Margin Maps (<b>Note:</b> Only accessible to Kapsch web user)</li> <li>• Displaying transactions as they occur</li> <li>• Serial port loop-back test</li> </ul>
Log out	Select to quit session and log out of the system.

### 3. OPERATING PROCEDURES

**CAUTION:**

Improper modification of configuration parameters may adversely affect system operation. The default values may not be appropriate for the specific application. It is the system integrator's responsibility to tailor the configuration parameters to the specific operating environment, with the aid of the Kapsch Operations Group.

**CAUTION: Redundant Reader**

Both CTMs in a redundant Reader must be properly configured. Each CTM has its own browser interface and is configured independently. Ensure any configuration changes made to one CTM are applied to the other CTM, as required.

#### Starting up the Reader

This procedure outlines the correct way to power on and boot up a Reader.

Prerequisites: PSM power switches set to the off (0) position.

1. CTM ON/OFF switches set to OFF.
2. Set the **Redundancy Mode** switch on the SPM to **AUTO**.
3. Set the secondary and primary PSM power switches to the **on** (I) position.

**Result:** The +15V STATUS LED and the +5 STATUS LED on the PSMs illuminate solid green.

4. Set the CTM ON/OFF switch to the ON position, and wait for the CTM to complete its power up cycle (approximately 120 Seconds).


**Result:** The POWER LED illuminates green. The STATUS LEDs illuminate green to indicate SYNC is functional, CTM is active, CGC is functional and MC is functional.

**Note:** If any CTM STATUS LEDs indicate an abnormal state, (see Table 6-1: CTM LED states explained on page 203) perform the necessary troubleshooting procedure. See Troubleshooting Methodology on page 201 for more information.

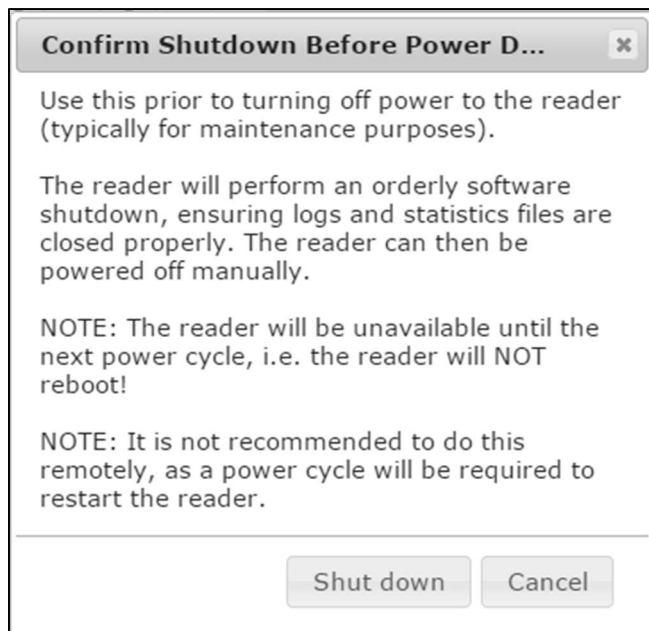
## Shutting down the Reader

This procedure outlines the correct way to power down a Reader.

Prerequisites: None.

1. Click **Manage Software** link located on the left side panel.
2. On the Manage Software page, click the  icon.

**Result:** The following dialog appears.



3. Click the **Shut down** button.
4. When the Reader has completed an orderly software shut down set both CTM ON/OFF switches to OFF.
5. Set both PSM power switches to the **off** (0) position.

## Manually switching a Reader to the redundant side

The Reader can be manually switched between the primary and secondary sides. This is necessary, for example, when recovering a Reader back to the Primary side when automatic recovery is not enabled or prior to performing operations on one side like software update.

Prerequisites: Ensure no faults exist on the side being activated.

1. Set the SPM redundancy mode switch to either SECONDARY or PRIMARY, as applicable.

**Result:** The ACTIVE LED on the CTM of the selected side illuminates green, indicating the selected side is active.

**Note 1:** If the redundancy mode switch is set to PRIMARY, the Reader stays in Primary mode and does not switch operation to the secondary side unless the primary side fails.

**Note 2:** If the switch is set to SECONDARY, the Reader stays in Secondary mode and does not switch operation to the primary side unless the secondary side fails.

## Connecting a service laptop to the Reader

You can use a service laptop to access the CTM web interface by connecting directly to the ETHERNET 1 port.

### *Changing the service laptop IP address*

1. In Windows, go to **Start → Settings → Control Panel → Network Connections → Local Area Connection → Properties → Internet Protocol (TCP/IP) → Properties**.
2. Select **Use the following IP address**, then enter the IP address using the Reader network number in the first three fields (ex. 192.168.1.\_) followed by a unique host number in the fourth field.
3. Enter 255.255.255.0 in the subnet mask and leave the default gateway blank.

### *Testing the connection to the reader*

1. In Windows, go to **Start → Run**.
2. Type 'ping', followed by the ETHERNET 1 port IP address or the USB adapter address, depending on what the laptop is connected to.

**Note:** Ping response times are less than 2ms on average.

3. Click **OK**.

**Result:** Several replies from the Reader IP address display momentarily in a DOS window. You are ready to access the CTM web interface (see Accessing the CTM web interface page 43).

**Note:** If a reply is not received during the test, check the cable, connections, and IP addresses, then repeat step 1.

## Accessing the CTM web interface

The CTM web interface monitors and configures the CTM.

**Prerequisites:** A service laptop connected to Ethernet 1 or USB-to-Ethernet adapter accessing the CTM web interface.

1. Launch the web browser on the computer.

**Note:** You can use recent versions of any popular browser.

**ATTENTION:** When using certain versions of Internet Explorer, you may experience missing strings of text when a CTM screen displays. Press Control and F5 (CtrlF5) simultaneously. This action clears the buffer and refreshes the screen.

**Note:** The default IP address of the primary and secondary CTM ETHERNET 1 port is 192.168.1.50. The IP address may change during installation.

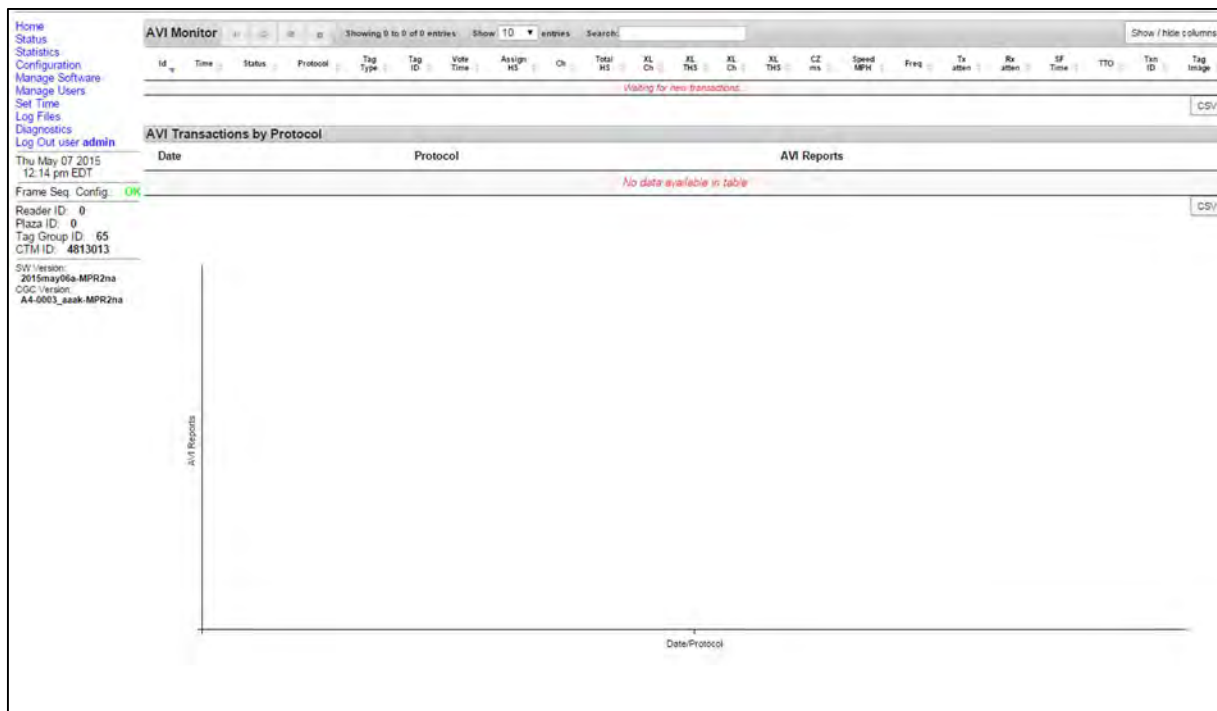
2. Consult the record of system IP addresses to determine the correct IP address. See Appendix A.
3. In the address bar of the web browser, type: **https://** followed by the IP address of the ETHERNET 1 Port or USB-to-ethernet port adapter.
4. Use the following decision table to continue the procedure.

IF ...	THEN ...
you click the <b>Login</b> button and a dialog box requesting a username and password appears,	go to step 5.
a 403 Forbidden error message appears,	ensure the IP address entered in the address bar is correct and that the IP address is preceded by <b>https://</b> <b>Note:</b> When you connect to the Reader with the laptop for the first time accept the secure certificate before continuing.
a web browser message indicating there is a connection problem appears,	confirm that the IP address entered in step 3 is the correct record of system IP addresses.
a security warning appears	follow the instructions the web browser provides.

**Note:** Usernames and passwords are case-sensitive.

5. Enter your username and password.

**Result:** The following **Home** page appears.



6. Click the **Status** link located on the left panel.

**Result:** The following Status page appears.

Communications	Power Supply Modules	RF Modules	Miscellaneous Information
Main Controller	Down		
Serial Link	Disabled	Up	
Inter-Reader Ethernet Link			
Lane Controller	Down	Down	Down
Serial Link	Down	Down	Down
Lane Controller Ethernet Link	Up	Disabled	Disabled
Dual-Destination Lane Controller Ethernet Link	Disabled	Disabled	Disabled
Tertiary-Destination Lane Controller Ethernet Link	Disabled	Disabled	Disabled
CTM-to-CTM Synchronization Status	Disabled		
Reader-to-Reader Synchronization Status	Up		

7. Select the **Miscellaneous Information** tab.

**Result:** The following screen appears.

Communications	Power Supply Modules	RF Modules	Miscellaneous Information
CTM Position	Primary		
Active State	<span style="background-color: green; color: black;">Active</span>		
CGC Health Status	<span style="background-color: green; color: black;">Operational</span>		
Board	LB735		
Other side CTM Presence	<span style="background-color: gray; color: black;">Absent</span>		
Other Side Config Compare	<span style="background-color: red; color: black;">Different</span>		
Front-panel Switch Position	Auto		
CFM Status	<span style="background-color: green; color: black;">present</span>		
Frame Seq. Config.	<span style="background-color: green; color: black;">OK</span>		
Lane Tuning Mode	<span style="background-color: green; color: black;">Disabled</span>		
Super Frame Time [incl. overhead] (us)	100832		
<input type="button" value="System Identification"/>			

- Click the **System Identification** button to confirm which Reader CTM web interface you are viewing, and that the computer is communicating successfully.

**Result:** The MC LED of the CTM flashes: **green – red – amber – green** three times to indicate communication.

## Logging out of the CTM web interface

Logging out of the CTM web interface terminates the connection between the service laptop and the CTM web interface.

**Prerequisites:** A service laptop is connected to the Reader through the Ethernet 1 port or a USB-to-Ethernet adapter and has access the CTM web interface.

- Click **Log Out** from the navigation side bar.

**Result:** You are immediately logged out from the CTM web interface.

## Changing your password

Any user can change their own password, although the procedure is different for users with **User Admin** permissions. This procedure outlines how to change a password for users with **User Admin** permissions and for those without.



**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

1. Login to the user account that requires a password change.
2. Use the following decision table to continue the procedure.

IF you logged into an account that ...	THEN ...
has <b>User Admin</b> permissions,	navigate to the <b>Change Password</b> tab using the <b>Manage Users</b> selection on the left sidebar. Go to step 3.
does NOT have <b>User Admin</b> permissions,	from ANY page, click <b>Change Password</b> in the navigation sidebar. <b>Result:</b> The <b>User Management Change Password</b> page appears. Go to step 3.

3. Enter your new password in the **New Password** and **Confirm New Password** fields.
4. Click the **Submit** button.

**Result:** Your password is now changed

5. If, after you have changed your password, an authentication window appears, enter your user name and new password to return to the browser interface.

## Resetting a forgotten password

If a user forgets their password, the password can be cleared by another user with **User Admin** permissions. The Reader accepts any password from the user until the password is changed. This procedure requires two users; a user with **User Admin** permissions and the user requiring a reset password.

**Prerequisites:** The user clearing the password must have **User Admin** permissions.

**Note:** The User Administrator should ensure that the user sets a new password after the password is cleared. Otherwise, the Reader will continue to accept any password for that user account.

1. Navigate to the **User Management** tab on the User Management page.
2. Use the following decision table to continue the procedure.

IF you logged into an account that ...	THEN ...
has <b>User Admin</b> permissions,	go to step 3 and continue to step 5.
does NOT have <b>User Admin</b> permissions,	go to step 6 and continue to step 8.

3. Click the corresponding **Clear Password** button of the user whose password needs resetting.

4. Click **Yes** to confirm.
5. Log out (see Logging out of the CTM web interface, page 46).
6. Select **Change Password** from the navigation sidebar.
7. Enter your user name and compose a password.  
**Note:** This password does not become your new password.
8. Change your password (see Changing your password on page 46).

**Result:** Your password resets.

## Configuring the Reader to recover automatically to the primary side

The Reader is configured to automatically activate the primary side once a failure causing a switchover to the secondary side has cleared.

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

**Note:** You must have **Advanced User** permissions.

1. Set the SPM redundancy mode switch to the **AUTO** position.
2. From the CTM web **Home** page, select the **Configuration** link on the left panel of the screen.
3. Click the **General** tab.
4. Select the **Auto Recovery To Prime** check box if it is not already selected.

**Example:** The following **Configuration** page is shown.

Site Name:		3-Port ORT WIC Setup - SEC-BLK
Ethernet 1 (LC 1Gbps) IP Address:		148.198.224.62
Ethernet 1 (LC 1Gbps) Subnet Mask:		255.255.0.0
Ethernet 2 (RIF 100Mbps) IP Address:		192.168.0.52
Reader IP Address:		192.168.0.151
USB Adapter or Bluetooth IP Address:		192.168.2.50
Default Gateway IP:		0.0.0.0
Suppress Non-IAG Tags:	<input type="checkbox"/>	
Diagnostics Port Baud Rate:		115200
Reader configuration Auto-backup & Recovery:	<input type="checkbox"/>	
SNMP:		
SNMP Traps:	<input type="checkbox"/>	
Report Latency by Tag Type:		
0 - Interior FPT Delay [ms]		0
1 - Exterior FPT Delay [ms]		0
2 - Exterior LPT Delay [ms]		0
3 - LCD Display Delay [ms]		0
4 - Commercial Vehicle (CVO) Delay [ms]		0
5 - OBU Feedback Tag Delay [ms]		0
6 - HOT Tag Delay [ms]		0
Primary/Secondary:		
Redundant Mode:	<input type="checkbox"/>	
Dual Reporting Mode:	<input type="checkbox"/>	
Auto Recovery To Prime:	<input type="checkbox"/>	
Switchover on Ethernet (RIF Link Down):	<input type="checkbox"/>	
Reader Statistics:		
Use database:	<input type="checkbox"/>	
Database (Txns) Maximum records:		10000
Database (Summary) Retention period [7-90 days]:		30
Database (Summary) Interval [1-30 minutes]:		5
Dashboard:		
Transaction Summary dashboard:	<input type="checkbox"/>	

## Monitoring the Reader

You can monitor and gather information about the Reader from the CTM web interface using the **Status** option in the left panel of the screen.

**Note:** For all of the following procedures, a laptop or desktop computer with a monitor needs to be connected to the CTM Ethernet 1 port or a USB memory stick (flash drive) can be connected to the USB-to-Ethernet port for logging to the USB.

### Reader status

The **Status** page on the CTM web interface displays the state of the communication links, the power supply modules, and the CTM/CGC, and is useful for troubleshooting the Reader.

Communications	Power Supply Modules	RF Modules	Miscellaneous Information
Main Controller Serial Link	Down		
Inter-Reader Ethernet Link	Disabled	Up	
Lane Controller Serial Link	Down	Down	Down
Lane Controller Ethernet Link	Up	Disabled	Disabled
Dual-Destination Lane Controller Ethernet Link	Disabled	Disabled	Disabled
Tertiary-Destination Lane Controller Ethernet Link	Disabled		
CTM-to-CTM Synchronization Status	Disabled		
Reader-to-Reader Synchronization Status	Up		

## Communications

Table 3-1 lists and describes the fields in the **Communications** tab on the **Status** page.

**Table 3-1: Communications fields**

Communications tab		
Field	Status	Description
Main Controller Serial link	Up	successful link connection between redundant CTMs
	Down	link failure or disabled (always Down on non-redundant Readers)
Inter-Reader Ethernet link	Up	successful link connection
	Down	link failure
	Disabled	link not enabled
Lane Controller Serial link	Up	successful link connection between CTM (via LPM) and LC
	Down	link failure
	Disabled	link not enabled
Lane Controller Ethernet link	Up	successful link connection
	Down	link failure
	Disabled	link not enabled
Dual-Destination Lane Controller Ethernet Link	Up	successful link connection
	Down	link failure
	Disabled	link not enabled
Tertiary-Destination Lane Controller Ethernet Link	Up	successful link connection
	Down	link failure
	Disabled	link not enabled
CTM-to-CTM Synchronization Status	Down	link failure
	Up	successful link connection
	Disabled	synchronization not enabled

Communications tab		
Field	Status	Description
	Not applicable	no status
Reader-to-Reader Synchronization Status	Up	successful link connection
	Down	link failure
	Disabled	Synchronization not enabled

### Power Supply Module

Table 3-2 lists and describes the fields in the **Power Supply Module** tab on the Status page.

## Status

Communications

Power Supply Modules

RF Modules

Miscellaneous Information

5V (primary)

On

5V (secondary)

On

15V (primary)

On

15V (secondary)

On

**Table 3-2: Power Supply Module fields**

Power Supply Modules tab		
Field	Status	Description
5V (primary)	On	DC input operational
	Off	DC input failure
5V (secondary)	On	DC input operational
	Off	DC input failure

Power Supply Modules tab		
Field	Status	Description
15V (primary)	On	DC input operational
	Off	DC input failure
15V (secondary)	On	DC input operational
	Off	DC input failure

### RF Modules

Table 3-3 lists and describes the fields in the **RF Modules** tab on the Status page.

Status								
<div> <a href="#">Communications</a> <a href="#">Power Supply Modules</a> <a href="#">RF Modules</a> <a href="#">Miscellaneous Information</a> </div>								
	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
Module Presence:	Present	Unknown	Unknown	Absent	Absent	Absent	Absent	Absent
Firmware Version:	2014Mar19-1320-01	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Serial No.:	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Comm. Status:	OK	Failure	Failure	Unknown	Unknown	Unknown	Unknown	Unknown
Antenna Status:	OK	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

**Note** the RF Module status on the inactive CTM of a redundant reader may not always reflect the current module status

**Table 3-3: RF Modules fields**

RF Modules tab		
Field	Status	Description
Module Presence	Absent	Not installed
	Present	Installed
	Unknown	Status not known
Firmware Version	Date with part number shown	yyyymmdd-xxxx-xx
	Unknown	Status not known
Serial No	Unknown	Status not known

Comm Status	serial number shown	Xxxxx ( <b>Note:</b> for future use)
	Unknown	Status not known
	OK	Comm States working
Antenna Status	Failure	Fault in one or more Comm States. RF module not responding or not operating.
	OK	Receiving and/or transmitting
	Failure	Fault in receiving and/or transmitting
	Unknown	Status not known

### Miscellaneous Information

Table 3-4 lists and describes the fields in the **Miscellaneous Information** tab on the Status page.

**Status**

Communications
Power Supply Modules
RF Modules
Miscellaneous Information

CTM Position

Primary

Active State

Active

CGC Health Status

Operational

Board

LB735

Other side CTM Presence

Absent

Other Side Config Compare

Unknown

Front-panel Switch Position

Auto

CFM Status

present

Frame Seq. Config.

OK

Lane Tuning Mode

Disabled

Super Frame Time (us)

18375

System Identification

Table 3-4: Miscellaneous information fields

Miscellaneous Information tab		
Field	Status	Description
CTM Position	Primary	The CTM is installed on the primary side
	Secondary	The CTM is installed on the secondary side
Active State	Active	CTM is active
	Inactive	CTM is not active
CGC Health Status	Operational	CGC is operational
	Failed	CGC Failure
	Unknown	CGC Health status unknown
Board	Example: LB735	Provides information on the model of the single board computer (SBC) board installed.
Other Side CTM Presence	Absent, Present	Is the other side of the CTM present or absent in the chassis.
Other Side Config Compare	Communication Down; Same; Different	(BETA) Provides an indication as to configuration state of peer CTM  Communication Down (peer CTM is not running so configuration state is unknown)  Same (peer CTM configuration is identical to this CTM's configuration)  Different (peer CTM configuration is different than this CTM's configuration)
Front-panel switch position	Auto; Primary; Secondary	Auto, Primary (switch set to Primary side), Secondary (switch set to Secondary side).  For a redundant system, the switch would normally be set to Auto
CFM Status	Present	Indicates normal status
	Not Detected	Indicates a problem; call Kapsch Service
Frame Seq. Config.	Unknown	Indicates whether or not the last attempted frame configuration contains errors. If an error is indicated, consult the event/trouble logs for more detailed information.
	OK	
	Warning	
	Error	
	CGC Cfg. Failure	
Lane Tuning Mode	Disabled	'Disabled' is normal status (running toll)
	Enabled	"Enabled" is not normal status (not running toll)
Super Frame Time (µs)	Numerical read	Reader timing information In microseconds



***RF Channel Statistics***

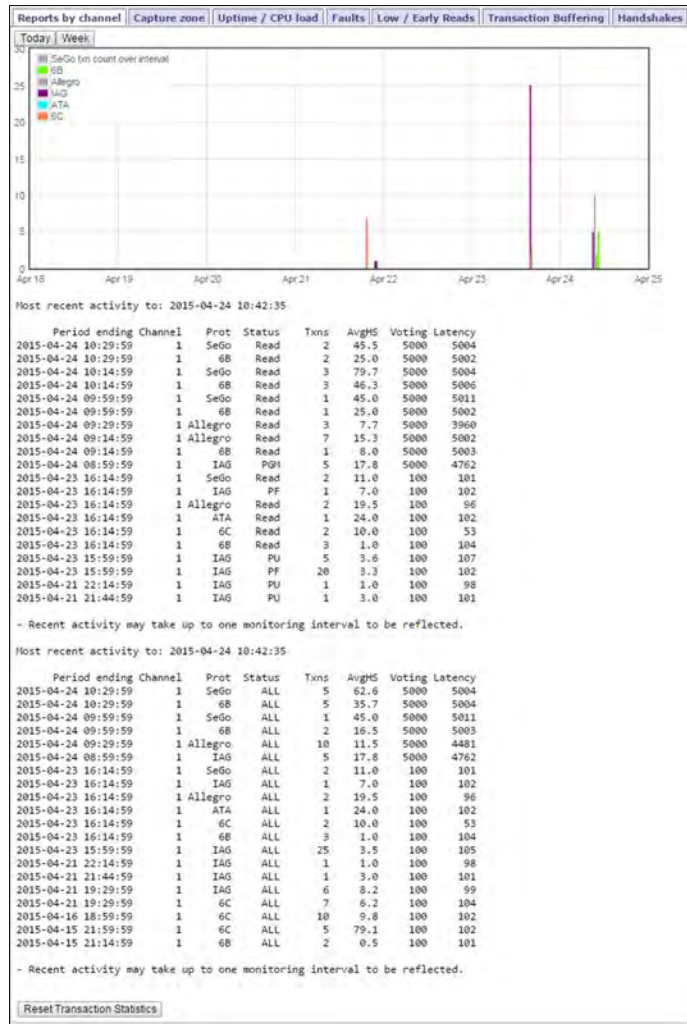
The **Statistics** page displays performance information for each MRFM-S channel. The statistics displayed do not update automatically as transactions occur. Update the statistics with the latest data by navigating away from, and then returning to the **Statistics** page, or by refreshing/reloading your browser window.

Updates to the statistics pages commence when the Reader begins processing OBU transactions after startup.

Statistics continue being appended until the system is either stopped and re-started, rebooted, or the **Reset Transaction Statistics** button is clicked, which sets the statistics values to zero and updates commence again.

***Reports by channel***

This screen lists and graphs reports on channel activity.



You can reset the values of the report by clicking the **Reset Transaction Statistics** button.

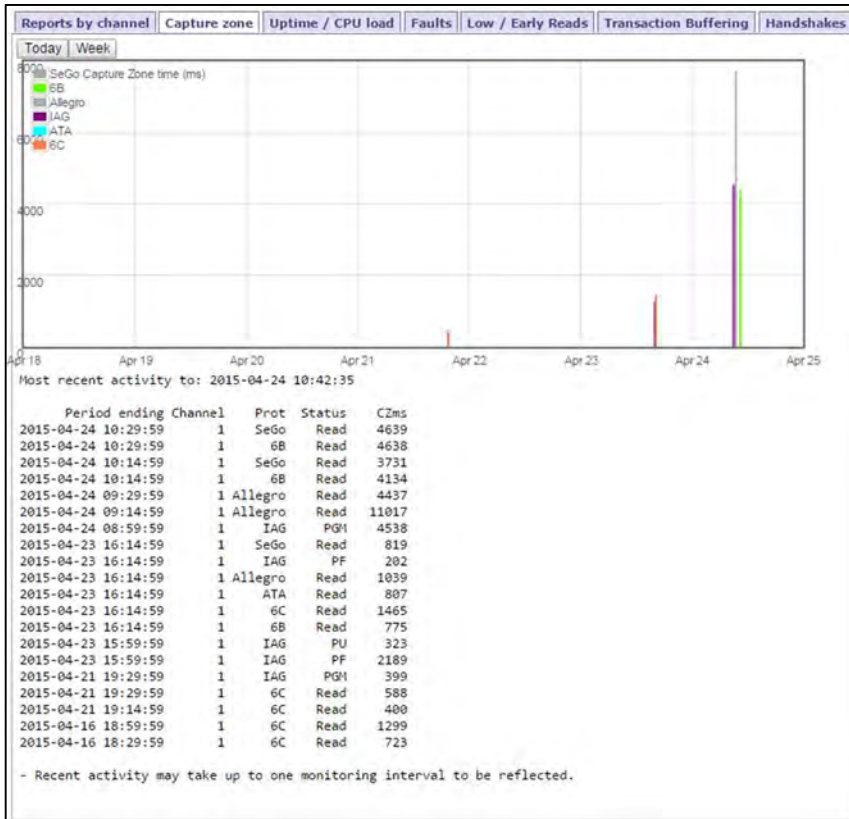
**Table 3-5: Reports by Channel**

Reports by Channel tab	
Field	Description
Period ending	The date and time that the statistics in the browser window were updated. Navigate away from and then return to the <b>Statistics</b> page, or refresh/reload your browser screen to update the statistics.

Reports by Channel tab	
Field	Description
Channel	The RF Channel that the statistics in that row represent.
Prot	Protocol being used by the Reader
Status	AVI Report Status (e.g., PGM, PU, PF, Read)
Txns	The number of transactions performed in a period
AvgHS	The average number of handshakes over the total transactions with the primary or secondary side active
Voting	Average voting: time over period
Latency	The average latency time to report transactions

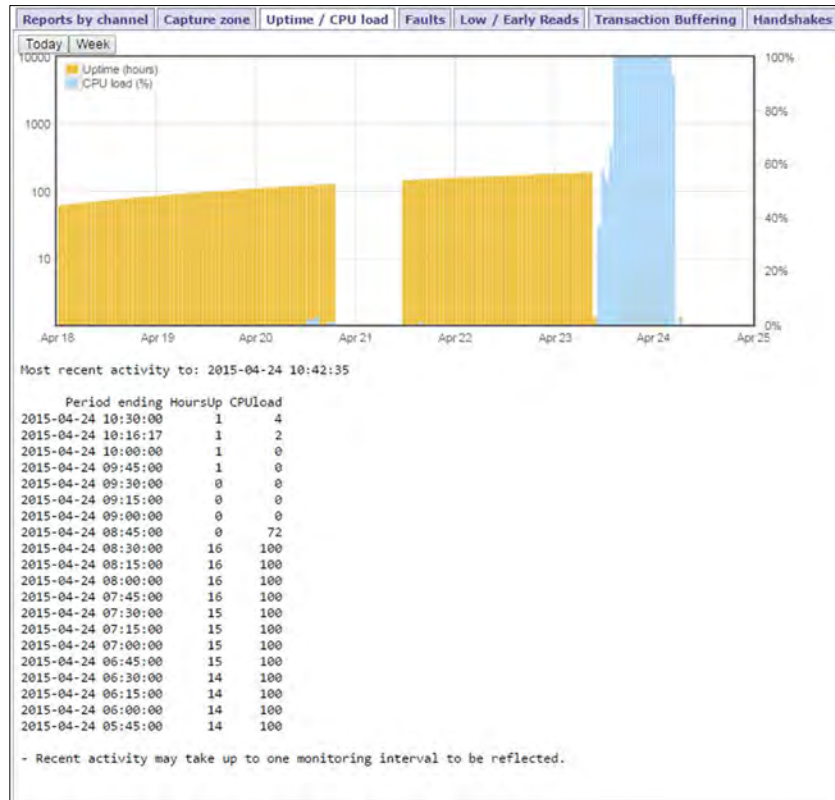
**Capture zone**

This screen shows a report of the various tags and their capture zones in a day-to-day chart and a listing.



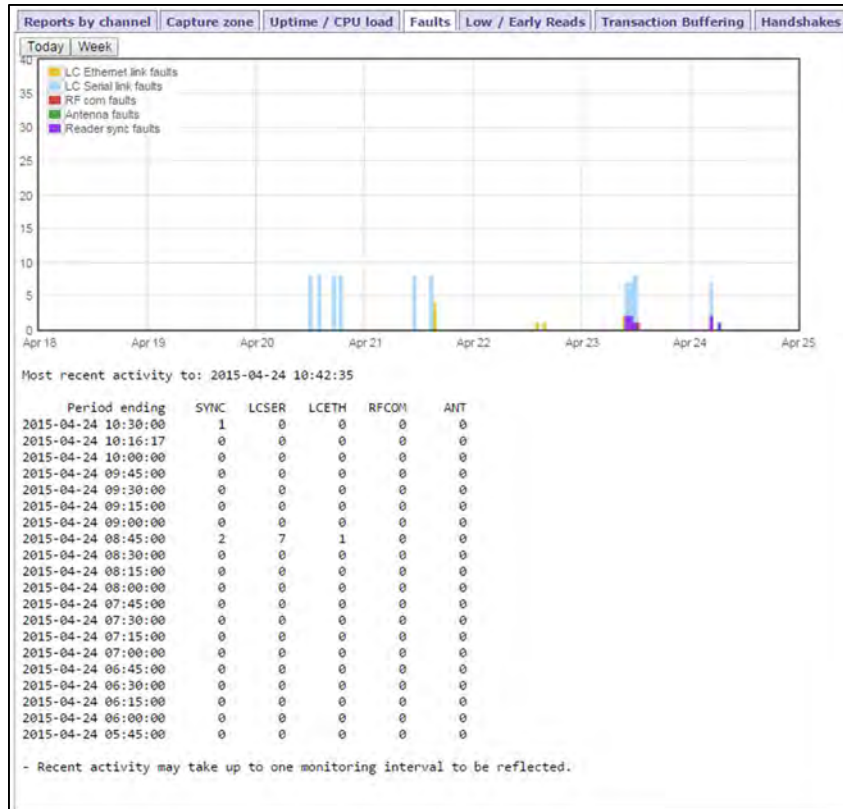
### Uptime / CPU load

This report lists and graphs the date and time of the reader activity measured in HoursUp and the number of CPU Loads involved.



### Faults

This screen lists and graphs faults and reports them by type according to a color code.



### Low / Early Reads

This screen reports low and early reads through a number of parameters. See Table 3-7 for more information.

Reports by channel

Capture zone

Uptime / CPU load

Faults

Low / Early Reads

Transaction Buffering

Handshakes

Early read logic impact on voting: DISABLED

Early Read statistics (gap spec: 50 - 10000 ms, post gap HS ratio: 50%)

Channel	ERead	DelayRq	AvgHs	MaxHs	Last transaction				
					Txn	GapHs	PreHs	PostHs	HSratio
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0

low reads 0, avg gap 0 ms, last gap 0 ms @ Sun Jan 0 00:00:00 1900

**Transaction Buffering**

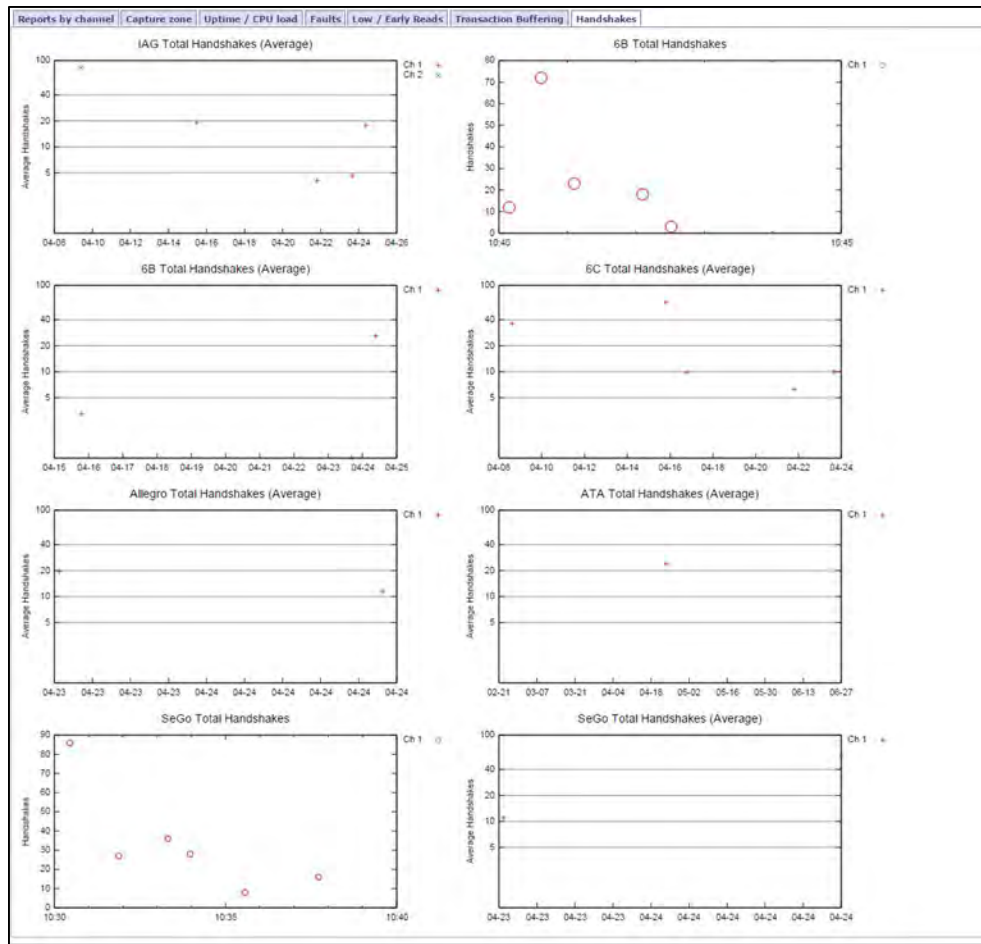
Transaction buffering shows the user how much each channel is using for buffering. The following screen shows an example.

Reports by channel	Capture zone	Uptime / CPU load	Faults	Low / Early Reads	Transaction Buffering	Handshakes
<input type="button" value="Delete Buffered Transactions"/>						
Total buffered: 0						
Channel 1:	buffered 0					
Channel 2:	buffered 0					
Channel 3:	buffered 0					
Channel 4:	buffered 0					
Channel 5:	buffered 0					
Channel 6:	buffered 0					
Channel 7:	buffered 0					
Channel 8:	buffered 0					

**Note:** Each side reports transactions that occurred while being active.

**Handshakes**

Handshakes shows the average number of handshakes that occur daily. The following screen shows an example.



## Continuously logging transactions to a USB flash drive

This procedure outlines how to have transaction log files automatically saved and continuously updated on a USB flash drive.

Prerequisites: A USB flash drive is inserted into one of the CTM USB ports.

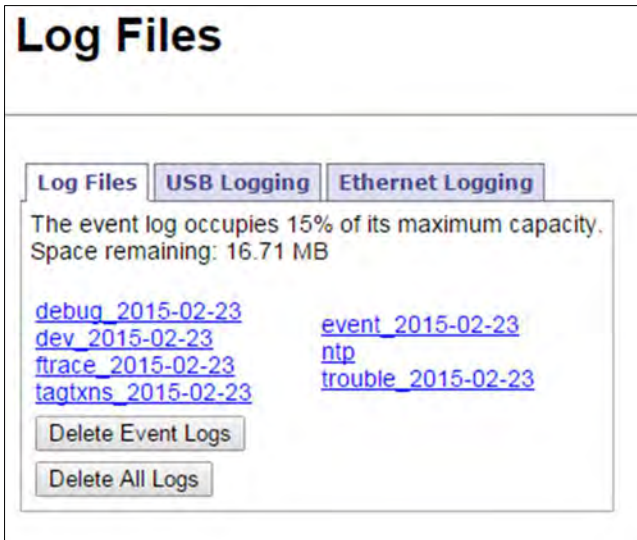
Connect the service laptop to Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **View Log Files** and **Manage Log Files** permissions.

1. Select the **Log Files** link on the left side panel of the screen.

**Result:** The following **Log Files** page appears.





2. Click the **USB Logging** tab.

**Result:** The following screen appears.



3. Click the **Start Logging to USB Device** button.

**Result:** The following screen message appears.



4. Click the **Yes** button.

**Result:** The following screen message appears.



**Note 1:** The USB Logging changes its display from Disabled to Enabled, and USB Device Status remains at Available to indicate that a connection between the Reader and the USB flash drive and log files can get copied and updated to the USB device in real-time when required.

**Note 2:** You can click the **Copy Log Files to USB device** button if you just want to copy the present list of log files to the USB device.

## Continuously logging transactions using the Ethernet

This procedure outlines how to have transaction log files automatically saved and continuously updated through an Ethernet connection.

**Prerequisites:** An Ethernet connection is plugged into the laptop.

Connect the service laptop to the Reader Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **View Log Files** and **Manage Log Files** permissions.

1. Select the **Log Files** link on the left side panel of the screen.
2. Click the **Ethernet Logging** tab.

**Result:** The following screen appears.

## Log Files

**Log Files** USB Logging Ethernet Logging

Ethernet Logging:  
Destination IP/Port:  
0.0.0.0 Port:  
0

Ethernet Protocol:  
☒ tcp  
☐ udp

Select Logs:  
☐ trouble  
☐ tag  
☐ event  
☐ developer  
☐ debug  
☐ fifo

3. Enable the Ethernet Logging checkbox.
4. Enter a Destination IP address and Port.
5. Select the appropriate Ethernet Protocol.
6. Select the required logs.

**Example:** The following example screen is shown.

## Log Files

**Log Files** USB Logging Ethernet Logging

Ethernet Logging:  
Destination IP/Port:  
178.111.111.111 Port:  
0

Ethernet Protocol:  
☒ tcp  
☐ udp

Select Logs:  
☒ trouble  
☐ tag  
☒ event  
☒ developer  
☐ debug  
☐ fifo

## Configuration via Web

The reader provides the ability to configure the reader operation via the web interface. There are multiple configuration screen tabs available, each with multiple parameter settings. A list of settings available and their function is provided in **Commands and controls**, see page 84.

The tabs listed in Table 3-6 are available in configuration. It is recommended that the following order is used in setting a new configuration to ensure all necessary parameters are set:

- General
- Lane Assignment
- Tag Programming
- Channel and Group
- Frame Sequence and Protocol Tabs
- LC tabs

**Note** The parameters available in some screens, or the ability to change them, in some cases are dependent on enabling settings in other screens first.

The Frequency and RF Attenuation settings are often set on site as part of lane tuning.

Prerequisites: Connect the service laptop to the Reader Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

1. Select the **Configuration** link on the left side panel of the screen.

**Result:** The following screen appears.

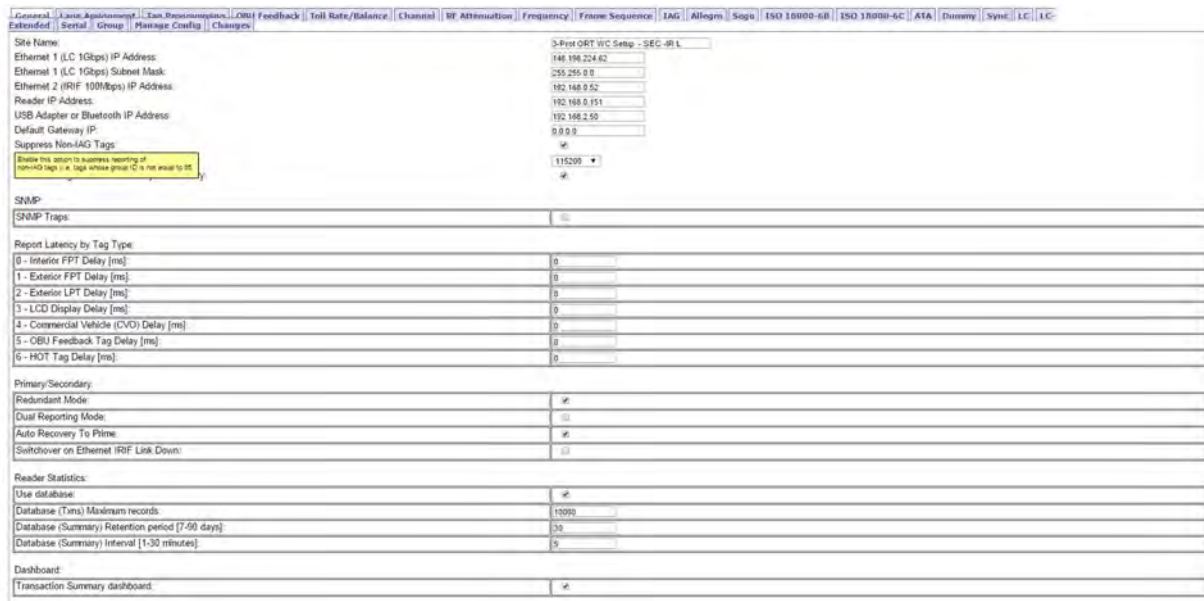


Table 3-6: Configuration tabs

Tabs	Function
General	Reader command interface settings, redundancy and statistics configuration. Also latency adjustment for compatibility with older readers.
Lane Assignment	Defines means of channel voting and inter-reader voting mechanisms, see <b>Lane Assignment</b> , page 190
Tag Programming OBU Feedback Toll Rate/Balance	Define what programming (write) operations take place on TDM and 6C protocols. See <b>Programming</b> tags, page 69.
Channel Group	Declare MRFM-S assigned status and some voting parameters, see <b>MRFM-S (Channel) configuration</b> , page 68
RF Attenuation Frequency	Set TX frequency, power and RX sensitivity individually by protocol and channel
Frame Sequence IAG Sego ISO 18000-6C 6B ATA Allegro Sync Dummy	Used to define the over the air protocol order and synchronization reference point and enable or disable reader-reader sync. See <b>Multi-protocol tag acquisition sequence building</b> , page 74
LC LC Extended Serial	Defines the interface parameters to send messages to Lane Controller(s) and messages to be reported to the Lane Controller(s)
Manage Config	Allows configurations to be saved, loaded and also provides change record and comparison with redundant CTM. See Configuration management, page 241

### MRFM-S (Channel) configuration

The presence or absence of MRFM-S modules in the rack and their assigned status is provided by the **Channel** tab. Select this tab and declare the MRFM-S state of each physical slot in the reader.

This tab also defines key voting parameters such as (voting) Group ID (for Group tab) and voting time.

The following screen is shown as an example.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]	2000	4000	100	100	100	100	100	100
Dynamic Voting Control	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼

Set RF State of all channels to the same configuration as channel:

Set voting time / dynamic voting of all channels to the same configuration as channel:

The group tab permits selection of independent tag timeouts for each (voting) Group ID. The following screen is shown as example

	Group #0	Group #1	Group #2	Group #3	Group #4	Group #5	Group #6	Group #7
Transponder Timeout [s]	1	100	100	100	100	100	100	100

### Frequency and Time Multiplexing

In any toll site involving multiple simultaneous transmitting antennas either frequency division or time division between adjacent transmitting antennas is required. The required spacing and re-use guidelines are discussed in **Installing a Lane Kit**, page 175 and in Appendix B FCC Approved Channel Frequencies and Selection, page 277, which provides detail on FCC permitted frequencies and ERP.

The TDM time sequence is controlled by the TDM Tab as part of the Multi-Protocol Acquisition Sequence (MPATS), see Multi-protocol tag acquisition sequence building, page 74

#### Frequency Selection

Select the **Frequency** tab and choose the desired operation frequency for each channel and FDM protocol.

**Note1:** There should be at least a **2.5 MHz separation** between adjacent channels both on channels in a reader and between adjacent channels of adjacent readers.

**Note2:** The FCC allowed frequencies are RF Module model and protocol specific. See Appendix B



**Note3:** Normally the frequency selected will be the same for all FDM protocols on a channel

**Note4:** The TDM and Allegro frequencies cannot be selected

**Result:** The following screen is shown as an example (6B and 6C protocols in use in 5 channel configuration).

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
JAG Frequency [MHz]	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼
Allegro Frequency [MHz]	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼	915.75 ▼
SeGo Frequency [MHz]	911.50 ▼	914.00 ▼	916.50 ▼	919.00 ▼	913.00 ▼	902.50 ▼	902.50 ▼	902.50 ▼
ISO 18000-6B Frequency [MHz]	911.50 ▼	914.00 ▼	916.50 ▼	919.00 ▼	913.00 ▼	902.50 ▼	902.50 ▼	902.50 ▼
ISO 18000-6C Frequency [MHz]	911.50 ▼	914.00 ▼	916.50 ▼	919.00 ▼	913.00 ▼	902.50 ▼	902.50 ▼	902.50 ▼
ATA Frequency [MHz]	911.50 ▼	914.00 ▼	916.50 ▼	919.00 ▼	913.00 ▼	902.50 ▼	902.50 ▼	902.50 ▼
Dummy (CW) Frequency [MHz]	902.50 ▼	902.50 ▼	902.50 ▼	902.50 ▼	902.50 ▼	902.50 ▼	902.50 ▼	902.50 ▼

## RF Attenuation

The transmit power is programmable individually by protocol and channel by setting the TX attenuation. Similarly the receive sensitivity can be adjusted individually by protocol and channel by controlling the RX attenuation.

Select the **RF Attenuation** tab and choose the desired attenuation for each channel and FDM protocol.

**Result:** The following screen is shown as an example.

General		Asset Assignment	Tax Data Parameters (COM)	Feedback	Toll Rate/Balance	Channel	RF Attenuation	Frequency	Frame Sequence	JAG	Allegro	SeGo	ISO 18000-6B	ISO 18000-6C	ATA	Dummy	Sync	LC	LC				
Extended		Serial	Group	Manage Config	Changes																		

## Programming tags

The Reader can write data to a tag as it passes through a toll plaza. The following procedures outline how to enable tag programming and how to configure the data that is written to the tags.

1. Select the **Tag Programming** tab.

**Result:** The following screen appears.

Extended	Serial	Group	Manage Config	Changes	Feedback	Toll Rate/Balance	Channel	RF Attenuation	Frequency	Frame Sequence	IAQ	Allegro	Sego	ISO 18000-6B	ISO 18000-6C	ATA	Demom	Sync	LC	LC
Lane Number:					1		2		3		4		5		6		7		8	
Plaza ID:					11															
Agency ID:					123															
6C Read-Only Mode:					<input type="checkbox"/>															
6C Try-To-Program Timeout [sec]:					10															
6C Agency ID (decimal):					1234															
IAQ Read-Only Mode:					<input type="checkbox"/>															
Traffic Management Programming (TMP)																				
Enable TMP:					<input type="checkbox"/>		R/W													
Toll Collection Programming (TCP)																				
Enable TCP:					<input type="checkbox"/>		R/W													

### Configuring TDM tag programming for Traffic Management Applications

1. From the **Tag Programming** screen, select the **Enable TMP** check box.
2. Select the **Reader ID** check box to enable writing the Reader ID to tags.
3. Enter a unique Reader ID.
4. Select the **TM Date/Time** check box to write the Reader TM time to tags.

**Example:** The following screen is shown.

Lane Number:					1		2		3		4		5		6		7		8	
Plaza ID:					123															
Agency ID:					5															
6C Read-Only Mode:					<input checked="" type="checkbox"/>															
IAQ Read-Only Mode:					<input type="checkbox"/>															
Traffic Management Programming (TMP):																				
					<input type="checkbox"/>		R/W													
Enable TMP:					<input checked="" type="checkbox"/>															
Reader ID:					<input checked="" type="checkbox"/>		2													
TM Date/Time					<input checked="" type="checkbox"/>															
Toll Collection Programming (TCP):																				
					<input type="checkbox"/>		R/W													
Enable TCP:					<input type="checkbox"/>															

**Note:** Reader ID is required to support Badger Style CRA operation.

### Configuring TDM tag programming for Toll Collection applications

1. From the above **Tag Programming** screen, select the **Enable TCP** check box.

**Result:** The following screen appears.



Kapsch	Kapsch.no2	Module	Tuning	General	Lane Assignment	Lane Programming	OBU Feedback	Toll Rate/Balance	Channel	RF Attenuation	Frequency	Frame			
Sequence	IAG	Allegro	Sego	ISO 18000-6B	ISO 18000-6C	ATA	Dummy	Sync	LC	LC-Extended	Serial	Group	Manage Config	Changes	Compare
Lane Number:	1 2 3 4 5 6 7 8														
Plaza ID:	0														
Agency ID:	0														
6C Read-Only Mode:	<input checked="" type="checkbox"/>														
IAG Read-Only Mode:	<input type="checkbox"/>														
Traffic Management Programming (TMP):															
	R/W														
Enable TMP:	<input checked="" type="checkbox"/>														
Reader ID:	<input checked="" type="checkbox"/> 0														
TM Date/Time	<input checked="" type="checkbox"/>														
Toll Collection Programming (TCP):															
	R/W														
Enable TCP:	<input checked="" type="checkbox"/>														
Plaza ID	<input checked="" type="checkbox"/>														
Agency ID	<input checked="" type="checkbox"/>														
Transaction Number Programming:	<input checked="" type="checkbox"/> Reprogram with 16 bit sequential transaction number														
OBU Feedback	<input type="checkbox"/>														
Toll Rate / Balance Adjustment	<input type="checkbox"/>														
TC Date/Time	<input checked="" type="checkbox"/>														
RW Format	<input checked="" type="checkbox"/>														
Lane Number	<input checked="" type="checkbox"/>														
HOT (High-Occupancy Toll) Lane:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>														

**Note:** If not already enabled, check and configure the Plaza ID before enabling OBU feedback. The Plaza ID field is not accessible once OBU feedback is enabled.

2. Enter the **Plaza ID** and **Agency ID** in the fields at the top of the screen.
3. Select the **Transaction Number Programming** check box to choose how the Reader determines the toll transaction number.
4. Click the **Transaction Number Programming** drop-down box.

**Result:** The following screen appears.

Kapsch	Kapsch.no2	Module	Tuning	General	Lane Assignment	Lane Programming	OBU Feedback	Toll Rate/Balance	Channel	RF Attenuation	Frequency	Frame			
Sequence	IAG	Allegro	Sego	ISO 18000-6B	ISO 18000-6C	ATA	Dummy	Sync	LC	LC-Extended	Serial	Group	Manage Config	Changes	Compare
Lane Number:	1 2 3 4 5 6 7 8														
Plaza ID:	123														
Agency ID:	5														
6C Read-Only Mode:	<input checked="" type="checkbox"/>														
IAG Read-Only Mode:	<input type="checkbox"/>														
Traffic Management Programming (TMP):															
	R/W														
Enable TMP:	<input type="checkbox"/>														
Toll Collection Programming (TCP):															
	R/W														
Enable TCP:	<input checked="" type="checkbox"/>														
Plaza ID	<input checked="" type="checkbox"/>														
Agency ID	<input checked="" type="checkbox"/>														
Transaction Number Programming:	<input checked="" type="checkbox"/> Don't reprogram transaction field														
OBU Feedback	<input type="checkbox"/> Don't reprogram transaction field														
Toll Rate / Balance Adjustment	<input type="checkbox"/> Reprogram with 16 bit random number														
TC Date/Time	<input type="checkbox"/> Reprogram with 16 bit sequential transaction number														
RW Format	<input checked="" type="checkbox"/>														
Lane Number	<input checked="" type="checkbox"/>														
HOT (High-Occupancy Toll) Lane:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>														

5. Select the desired transaction numbering calculation from the drop-down box.

6. The following checkboxes should appear checked; if not, make sure you check them.

- TC Date/Time
- RW Format
- Lane number

7. Select the **OBU Feedback** check box to enable OBU (tag) feedback.

8. Assign a Lane Number to each RF channel.

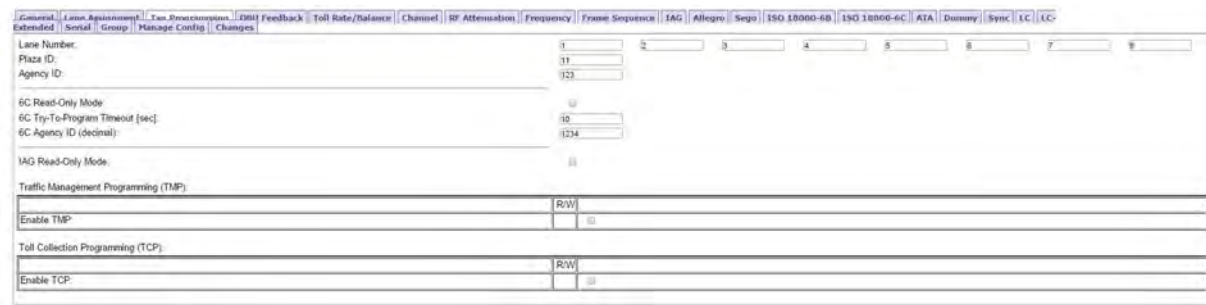
**Note:** When a transaction occurs between an OBU and a channel, the Lane Number specified here will be used when recording the transaction in OBU memory.

### Configuring 6C tag programming for Toll Collection applications

The Reader can write data to a 6C tag as it passes through a toll plaza. The following procedures outline how to enable tag programming and how to configure the data that is written to the tags.

1. Select the **Tag Programming** tab.

**Result:** The following screen appears.



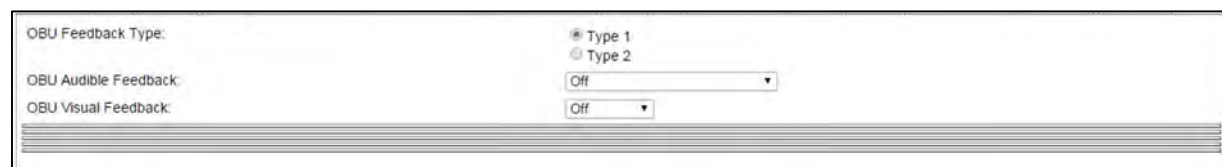
2. Enter the 6C **Agency ID** in the field on the screen.

### Configuring OBU Feedback

If OBU Feedback is selected as enabled in the TDM Toll Collection tab it is necessary to set up the OBU feedback settings

1. Select the **OBU Feedback** tab.

**Result:** The following screen appears.



2. Select either **Type 1** or **Type 2** feedback.
3. Select the desired audible feedback to control OBU beeping when a transaction occurs.

4. Select the desired visual feedback to control OBU LED flashing when a transaction occurs.

### **Configuring Toll charges**

If Toll rate/balance adjustment is selected as enabled in the TDM Toll Collection tab it is necessary to set up the Toll Charge settings

The Reader can deduct toll charges from a toll/balance OBU (tag) based on a number of parameters. BAT 1 tolling deducts charges based on the vehicle type and the lane the vehicle is in when it passes through the toll plaza. BAT 2 tolling deducts charges based on distance by determining the toll plazas the vehicle entered and exited on the highway.

Prerequisites: You must have **Advanced User** permissions.

#### **BAT 1 tolling (deducting charges based on lane and vehicle type)**

1. Select the **Configuration** link on the left side panel of the screen.
2. Select the **Toll/Rate Balance** tab and select **BAT 1 - Fixed Toll** as the TRBA BAT Processing Type.

**Result:** The following screen appears.

TRBA BAT Processing Type:		<input checked="" type="radio"/> BAT 1-Fixed Toll <input type="radio"/> BAT 2-Variable Toll	
BAT 1 - Fixed Toll Parameters:			
Toll Rate Table Select:	<div><div>1</div><div>1</div><div>1</div><div>1</div><div>1</div><div>1</div><div>1</div><div>1</div></div>		
Enforce Adjustment ID Checking:	<input type="checkbox"/>		

3. Select one of four Toll Rate Tables for each channel, which determines the charge for the lane associated with each channel.
4. Select the **Enforce Adjustment ID Checking** check box to limit how frequently the balance can be updated.

#### **BAT 2 tolling (deducting charges based on entry and exit location)**

1. Select the **Configuration** link on the left side panel of the screen.
2. Select the **Toll Rate/Balance** tab
3. Select **BAT 2 - Variable Toll** as the TRBA BAT Processing Type.

**Result:** The following screen appears.

TRBA BAT Processing Type:		<input type="radio"/> BAT 1-Fixed Toll <input checked="" type="radio"/> BAT 2-Variable Toll	
BAT 2 - Variable Toll Parameters:			
Entry / Exit Reader:	<div><div><input checked="" type="radio"/> Entry Reader <input type="radio"/> Exit Reader</div></div>		
Enforce Adjustment ID Checking:	<input type="checkbox"/>		

**Note:** For Readers at entry locations, select Entry Reader; for Readers at exit locations, select Exit Reader.

4. Select the **Enforce Adjustment ID Checking** checkbox to limit how frequently the balance can be updated.

## Multi-protocol tag acquisition sequence building

Multi-protocol acquisition sequence (MPTAS) building, also referred to as Frame Sequence building, allows the user to customize over the air protocol sequences that a Reader or a network of Readers can use to identify, register, and track multiple protocols in a toll environment.

### *Modular approach*

The modular design approach for multi-protocol acquisition sequences allows for the following specializations.

- Balanced weighting between all protocols regardless of TDM or FDM division
- The inclusion of parallel TDM channel firing sequences.
- Protocol synchronization

The MPTAS is configured using the **Frame Sequence** tab to define the time order over the air of protocols and other operations, and individual tabs for protocols that each define what operations are executed within that protocol's frame and which channels are employed for that protocol. The MPTAS continually repeats over the air.

**Note 1:** The MPTAS defines the repeating protocol time sequence that will be followed by the reader, irrespective of the assigned MRFM-S status in the Channel tab.

**Note 2** For an RF Module to participate in a protocol it must both be enabled for that protocol in the applicable protocol tab and also set to Active or Guard in the Channel tab. .

**Note 3:** It is possible to create a sequence with channels and timeslots assigned for MRFM-S that are not populated or active in the reader. This often occurs and is required when synchronizing two readers with different number of channels populated as the time structure of the MPTAS needs to be the same on both readers.

**Note 4:** For a MPTAS for a TDM only reader, a minimum of three channels must be configured in the IAG protocol tab to run TDM only.

To create a MPTAS

1. Select the **Configuration** link on the left side panel.
2. Select the **Frame Sequence** tab.

**Result:** The following screen appears.

Update Frame Sequence Config.

Clear Frame Sequences

	Seq. #1	Seq. #2	Seq. #3	Seq. #4	Seq. #5	Seq. #6	Seq. #7	Seq. #8	Seq. #9	Seq. #10
Sequence (1-10):	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾
	Seq. #11	Seq. #12	Seq. #13	Seq. #14	Seq. #15	Seq. #16	Seq. #17	Seq. #18	Seq. #19	Seq. #20
Sequence (11-20):	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾	Empty ▾

- Click the dropdown under Seq #1.

**Result:** The following screen is shown as an example.

	Seq. #1	Seq. #2	Seq. #3	Seq. #4
Sequence (1-10):	<div>           IAG ▾            Empty            Dummy_1            Dummy_2            Dummy_3            Dummy_4            Sync_1            Sync_2            Sync_3            Sync_4            IAG            Allegro            For Future Use            SeGo            6B            6C            ATA            For Future Use         </div>	Empty ▾	Empty ▾	Empty
		Seq. #12	Seq. #13	Seq. #14
Sequence (11-20):		Empty ▾	Empty ▾	Empty

- Select the required option
- Repeat this sequentially for each Seq# (frame) in order to build up a sequence.

**Note 1:** To build a MPTAS (Frame Sequence), work from left to right starting in the first frame. To change or delete frames from a sequence, you must always start with the last frame and work towards the left.

**Note 2:** The maximum number of actively transmitting frames (Seq#'s) must be kept to 8 or less. Note Sync frames and Dummy frames that do not transmit are not counted.

- Select the options required under each individual frame type tab for Seq# types selected
- Then click the **Update Frame Sequence Config.** button.

**Note 1:** The reader will not change any of the currently executing protocols until the **Update Frame Sequence Config.** button has been clicked. The changes will be lost unless this is clicked.

The following three diagrams show examples of different **Flexible Over the Air Multi-Protocol Tag Acquisition Sequences** that can be selected using the modular approach.

**Figure 3-1: Example: Flexible Over the Air Multi-Protocol Tag Acquisition Sequence (Balanced Protocol Weighting)**

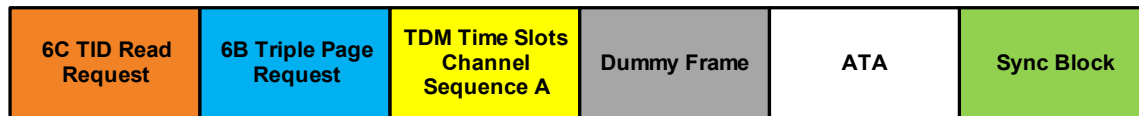


<b>Channel Sequence A</b> IAG Read Only TDM Slot 1: CH1 + CH5 TDM Slot 2: CH3 TDM Slot 3: CH2+CH4 TDM Slot 4: CH6+ CH7
---

**Figure 3-2: Example Flexible Over the Air Multi-Protocol Tag Acquisition Sequence (6B Weighted)**



**Figure 3-3: Example Flexible Over the Air Multi-Protocol Tag Acquisition Sequence with Dummy Frame**



### Reader-supported protocols

The Reader supports the following protocols.

- TDM
- Allegro
- SeGo
- ISO-6B
- ISO-6C
- ATA

### Dummy frame

A dummy frame is a software configurable time interval or block that the operator can insert in the firing sequence. A dummy frame can be configured in one of the following two ways.

Constant carrier is applied at the desired frequency and TX attenuation is enabled through the web interface. The receivers are turned off.

Both the transmitter and receiver are turned off.

### Reader MTPAS synchronization

The reader synchronizes air transmission timing to its own channels and to the redundant CTM, as well as to other readers, if these readers are on the sync network and correctly enabled. To support reader sync at least 1 Sync frame must be declared. For more information see page 161.

#### Sync frame

The reader executes the synchronization function wherever a sync frame has been inserted in the firing sequence. This allows for flexibility between inter-reader and multi-protocol synchronization, and also . allows for syncing to older versions of readers.



**ATTENTION:** When syncing newer versions of readers with older versions of readers, an advanced knowledge of sync configuration is required. Therefore, it is recommended that Kapsch Service be consulted, as boundaries and limits of variables may not be the default and will need to be reconfigured

### MPTAS Synchronization rules

When building a multi-protocol tag acquisition sequence (MPTAS) where readers are required to be synchronized, the following rules must be followed to avoid errors or warnings.

Only one sync block may be used when only 1 or 2 protocol sequences are enabled in the multi-protocol sequence.

If **2 or more** sync blocks are used in the multi-protocol acquisition sequence, one of the blocks must be enabled to **Skip-on-Sync**.

With multiple sync blocks in an MPTAS, they should each be different (e.g. Sync\_1, Sync\_2) to ensure correct alignment.

The sequences on the readers must be the same or at least have the same time length(s) between sync block(s). Dummy frames may be used to achieve this if the sequences are different.

### How to build a tag acquisition sequence

Two examples are provided, one using a single protocol and no sync, while the other is a multi-protocol sequence with sync.



A service laptop is connected to the **ETHERNET 1** port of the Reader and a browser is activated.

**Note 1:** To build a MPTAS (Frame Sequence), work from left to right starting in the first frame. To change or delete frames from a sequence, you must always start with the last frame and work towards the left.

**Example 1: TDM only, read/write operation, eight (8) lane plaza, not synced to another Reader.**

**Note 1:** To use the sequence over the air it also necessary to set channels to Active or Guard in the **Channel** tab, and to set appropriate attenuations for each channel

**Note 2 :** To support read/write operation it is necessary to configure the TDM programming configuration, see Programming tags, page 69

The following tabs will be used to create the MPTAS

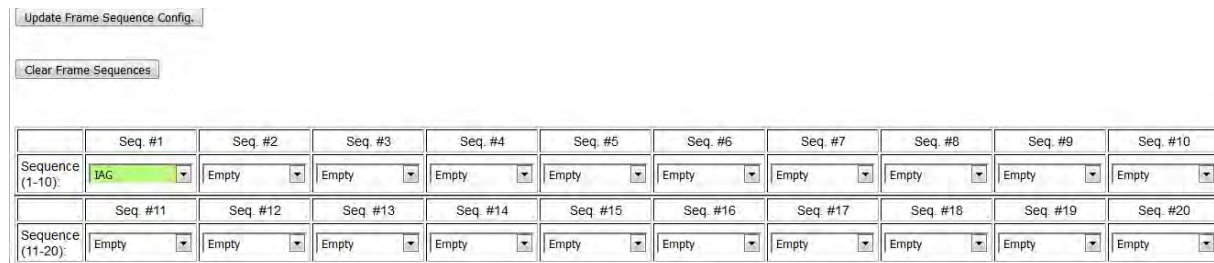
**Frame sequence** tab: Seq #1 set to TDM, all others set to empty

**TDM** tab: Channels 1 to 8 enabled sequentially in slots 1 to 8

The detailed steps are as follows

1. Select the **Configuration** link on the left side panel.
2. Select the **Frame Sequence** tab.

**Result:** The following screen appears.



	Seq. #1	Seq. #2	Seq. #3	Seq. #4	Seq. #5	Seq. #6	Seq. #7	Seq. #8	Seq. #9	Seq. #10
Sequence (1-10):	IAG	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty
	Seq. #11	Seq. #12	Seq. #13	Seq. #14	Seq. #15	Seq. #16	Seq. #17	Seq. #18	Seq. #19	Seq. #20
Sequence (11-20):	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty

3. Click the dropdown under Seq #1.

**Result:** The following screen is shown as an example.



4. Select the required option and then click the **Update Frame Sequence Config.** button.

[illegible]

- Note:** For a MPTAS for a TDM only reader, a minimum of three channels must be configured in the IAG protocol tab to run TDM only.

General
Loss Adjustment
Can. Prescription
Extended
Serial
Group
Message Config
Changes
Feedback
Self Rate/Balance
Channel
RF Attenuation
Frequency
Frame Sequence
IAG
Allregs
Sege
ISO 18000-6B
ISO 18000-6C
ATA
Dumms
Sync
LC
LC-

Update Frame Sequence Config

Clear IAG Timerslots

RoR Autoread

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
IAG Timeslot Config	<input checked="" type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input checked="" type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input checked="" type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input checked="" type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input checked="" type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8

- Click the **Update Frame Sequence Config.** button.

**Example 2: TDM, 6C (6CTOC compliant), and 6B, two (2) Lane ORT with Shoulders (five (5) channels) with five (5) channel scan) and synchronization between readers**

**Note 1:** To fully use the sequence over the air it is also necessary to set channels 1-5 to Active or Guard in the **Channel** tab, and to set appropriate attenuations for each channel

**Note 2:** For the FDM protocols it is also necessary to set up channel frequencies for each channel, see Frequency Selection, page 68

**Note 3 :** To support read/write operation it is necessary to configure the programming configuration, see Programming tags, page 69

The following tabs will be used to create the MPTAS

**Frame sequence** tab: Seq #1 set to TDM, Seq#2 set to 6B, Seq#3 set to SYNC\_1 and Seq#4 set to 6C, all others set to empty.

**TDM** tab: Channels 1 to 5 enabled sequentially in slots 1-5.

**6B** tab: Enable Channels 1 to 5 and select the appropriate Tag Read mode from the pull down menu. Enable Dual Tag Preamble.

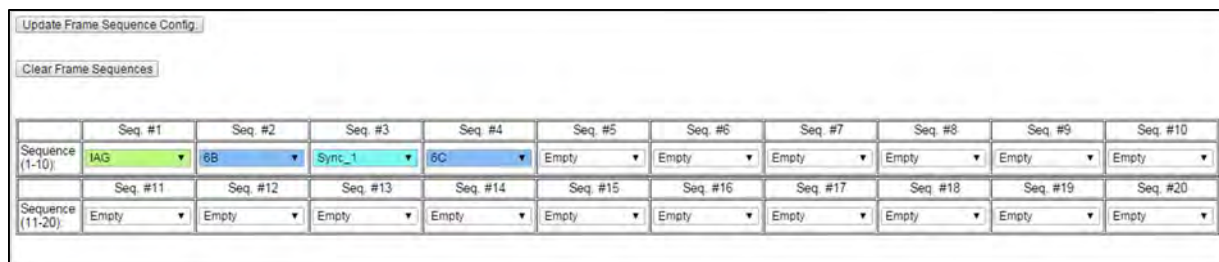
**6C** tab: Enable Channels 1 to 5 and select the appropriate Tag Read mode and over-air tag masking from the pull down menus.

**Sync** tab: Set the Reader-Reader sync parameters.

The detailed steps are as follows

- Select the **Configuration** link on the left side panel.
- Select the **Frame Sequence** tab and set Seq #1 to TDM, Seq#2 to 6B, Seq#3 to SYNC\_1 and Seq#4 to 6C. Set all others to **Empty**.

**Result:** The following screen is shown as an example.



	Seq #1	Seq #2	Seq #3	Seq #4	Seq #5	Seq #6	Seq #7	Seq #8	Seq #9	Seq #10
Sequence (1-10)	IAIG	6B	Sync_1	6C	Empty	Empty	Empty	Empty	Empty	Empty
	Seq #11	Seq #12	Seq #13	Seq #14	Seq #15	Seq #16	Seq #17	Seq #18	Seq #19	Seq #20
Sequence (11-20)	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty

- Select the **TDM** tab and enable slots 1 to 5 sequentially. Click the **Update Frame Sequence Config.** button.

**Result** The following screen is shown as an example.

General | Load & Save Config | Tag Parameters | DB | Feedback | Toll Rate/Balance | Channel | RF Attenuation | Frequency | Frame Sequence | IAG | Allegro | Sequ | ISO 18000-6B | ISO 18000-6C | ATA | Dummy | Sync | LC | IC

Extended | Serial | Group | Manage Config | Changes

Update Frame Sequence Config.

Create IAG Timeslots

Rdft Autoread

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
IAG Timeslot Config	<input checked="" type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input checked="" type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input checked="" type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input checked="" type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8	<input type="checkbox"/> Slot 1 <input type="checkbox"/> Slot 2 <input type="checkbox"/> Slot 3 <input type="checkbox"/> Slot 4 <input type="checkbox"/> Slot 5 <input type="checkbox"/> Slot 6 <input type="checkbox"/> Slot 7 <input type="checkbox"/> Slot 8

- Select the **ISO-18000-6B** tab. Enable slots 1 to 5 and then click the **ISO-18000-6B Read Mode** dropdown menu to choose the desired option. Check the **Dual Tag Preamble** checkbox.
- Click the **Update Frame Sequence Config.** button.

**Result:** The following screen is shown as an example.

Update Frame Sequence Config.

ISO 18000-6B Read Mode: Standard (UID Only)

6B Data Rate [kbps]: 40

Enable 6B GROUP\_SELECT: ☐

Initial CW Time [us]: 1200

Dual Tag Preamble: ☒

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
ISO 18000-6B Timeslot Config	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input type="checkbox"/> Enable	<input type="checkbox"/> Enable	<input type="checkbox"/> Enable

- Select the **ISO-18000-6C** tab. Check slots 1 to 5 to enable, and then click the **ISO 18000-6C Read Mode** dropdown menu to choose the desired option. Click the **Update Frame Sequence Config.** button.

**Result:** The following screen is shown as an example.

Update Frame Sequence Config.

Clear ISO 18000-6C Masks

ISO 18000-6C Read Mode: EPC + UM

Enable Multi-Tag Support: ☒

ISO 18000-6C Mask Select: Custom

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
ISO 18000-6C Custom Mask Select	<div> <div>Mask 1</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> </div>				<div> <div>Mask 2</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> <div>None</div> </div>			
ISO 18000-6C Timeslot Config	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input checked="" type="checkbox"/> Enable	<input type="checkbox"/> Enable	<input type="checkbox"/> Enable	<input type="checkbox"/> Enable

- Select the **Sync** tab and set the Sync parameters.

**Result:** The following screen is shown as an example.

Reader-to-Reader Sync. Enable: <input checked="" type="checkbox"/>				
Sync. Recovery Attempt Limit: <input type="text" value="0"/>				
	Sync_1	Sync_2	Sync_3	Sync_4
Enable Custom Sync Timing:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sync. Search Time (us):	<input type="text" value="100"/>			
Sync. Recovery Time (ms):	<input type="text" value="23"/>			
Sync. Frame Start Delay (us):	<input type="text" value="0"/>			
Sync. Delay (ns):	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Enable Sync-On-Skipped-Sync Sequencing:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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## Commands and controls

Table 3-7 lists and describes the commands and controls that can be deployed in the various Configuration screens that are available to a user.

**Note1:** In the table, 0 = Disable, 1 = Enable

**Note2:** Prmtr Name is the parameter name in the text configuration file that can be saved or loaded to reader, see Saving the Reader configuration, page 241

**Note3:** The parameters available in some screens, or the ability to change them, in some cases are dependent on enabling other settings in the same screens first.

**Note4:** The parameters available in some screens, or the ability to change them, in some cases are dependent on enabling settings in other screens first.

**Table 3-7: Commands and Controls**

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Home	In the navigation side bar: Click <b>Home</b> .	Anyone	N/A	N/A	N/A	Displays the <b>Main Page</b> in the CTM web interface. Used to return to the main page.
Status	In the navigation side bar: Click Status.	Anyone	N/A	N/A	N/A	Displays the <b>Status</b> page in the CTM web interface. Used to monitor communication, power supply, CTM status and CGC health See System Identification for more explanation of the button.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Statistics	In the navigation side bar: Click Statistics.	Anyone	N/A	N/A	N/A	Displays the <b>Statistics</b> page in the CTM web interface. Used to view Reports by channel , Low/Early Reads, Transaction Buffering statistics. <b>Note:</b> The Reset Transaction Statistics button is used to start a new statistical record.
Configuration	In the navigation side bar: Click Configuration.	anyone	N/A	N/A	N/A	Displays the <b>Configuration</b> page in the CTM web interface. Used to access a variety of Reader configuration parameters.
Manage Software	In the navigation side bar: Click Manage Software	user with <b>Manage Software</b> permissions	N/A	N/A	N/A	Displays the <b>Manage Software</b> page in the CTM web interface. Used to access upload and verify, activate, and delete software commands and the Reboot button to reboot the Reader.
Manage Users	In the navigation side bar: Click Manage Users.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	Displays the <b>User Management</b> page in the CTM web interface Used to access user profiles, create new users, delete users, change permissions, change passwords.
Change Password	In the navigation side bar: Click Change Password.	user WITHOUT <b>User Admin</b> permissions	N/A	N/A	N/A	Displays a <b>User Management</b> page limited to commands for changing passwords Changes the password of the user currently logged

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Set Time	In the navigation side bar: Click Set Time.	anyone	N/A	N/A	N/A	Displays the <b>Set Time</b> page in the CTM web interface Disables/Enables Network Time Protocol (NTP) access NTP servers IPv4 addresses and select a new time zone
Log Files	In the navigation side bar: Click Log Files.	user with <b>View Log Files</b> permission	N/A	N/A	N/A	Displays the <b>Log Files</b> page in the CTM web interface. Also displays the USB Logging tab and the Ethernet Logging tab.  views, manages or copies log files, depending on user permissions



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Diagnostics	In the navigation side bar: Click Diagnostics.	user with Advanced User permissions	N/A	N/A	N/A	Displays the Diagnostic Page in the CTM web interface Used for the following Diagnostics: <ul style="list-style-type: none"><li>• Static and Dynamic Margin Maps (Note: Only accessible to Kapsch web user)</li><li>• Displaying transactions as they occur</li><li>• Serial port loop-back test</li></ul>

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Log Out	In the navigation side bar: Click <b>Log Out</b> .	anyone	N/A	N/A	N/A	Immediately logs the current user out of the CTM web interface  Used to log out of the CTM web interface
System Identification	From the Miscellaneous Information tab on the Status page: Click the System Identification button.	anyone	N/A	N/A	N/A	Causes the CTM MC LED to flash green-red-amber-green three times  Used to confirm which CTM web interface is being viewed and that the computer is successfully communicating with the CTM

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Reset Transaction Statistics	From the Reports by channel tab on the Statistics page: Click Reset Transaction Statistics button	user with Advanced User permissions	N/A	N/A	N/A	Sets all statistical values at 0  Used to allow statistics to be tracked from a known starting point.
General Tab						
Site Name	From the <b>General</b> tab on the <b>Configuration</b> page: Type a Reader name in <b>Site Name</b> text.	anyone	SITENM	no default value	String length: 32	Sets the site name used in the log file strings and is used in the name of the configuration files  <b>Highly recommend</b> to enter a descriptive name, as this name is used in various log files. Used to identify which Reader the log files and configuration files originated from
Ethernet 1 (LC 1Gbps) IP Address	From the <b>General</b> tab on the <b>Configuration</b> page: Type an ETHERNET 1 port IP address in <b>Ethernet 1 (LC 1Gbps) IP Address</b> field..	anyone	LETHIF	192.168.1.50	N/A	Sets the IP address of the Lane Controller Ethernet interface  Used to specify an appropriate ETHERNET 1 IP address when configuring an LC network

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Ethernet 1 (LC 1Gbps) Subnet mask	From the <b>General</b> tab on the <b>Configuration</b> page: Type the subnet mask address in the <b>Ethernet 1 (LC 1Gbps) Subnet Mask</b> field	anyone	LETHNM	255.255.255.0:0	N/A	Initializes this field to a subnet mask for sites that utilize subnet addressing.  Required by sites that utilize subnet addressing.
Ethernet 2 (IRIF 100Mbps) IP Address:	From the <b>General</b> tab on the <b>Configuration</b> page: Type an ETHERNET 2 port IP address in the <b>Ethernet 2 (IRIF 100Mbps) IP Address</b> field..	anyone	PRIMIP	192.168.0.50 Primary 192.168.0.51 Secondary	N/A	Used to assign a unique IPv4 address (e.g. 192.168.0.50) to the right hand side (prime) side of the reader.  Used to specify an appropriate ETHERNET 2 IP address when configuring an IR network. Note: This address should be provided by the SI network planner.
IP Address	From the <b>General</b> tab on the <b>Configuration</b> page: Type an IP address in <b>IP Address</b> .	user with <b>Advanced User</b> permissions	SCNDIP	192.168.0.51	N/A	Sets a unique IP address to the secondary side of the reader.  Assigns a unique IPv4 address (e.g. 192.168.0.51) to the secondary side of the reader. Note: This address should be provided by the SI network planner.
Reader IP address	From the <b>General</b> tab on the <b>Configuration</b> page: Type a Reader IP address in <b>Reader IP Address</b> field	user with <b>Advanced User</b> permissions	READIP	10.0.0.50.0	N/A	Sets the IP address for the Reader  Used to specify a unique IP address for the Reader when configuring an IR network

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
USB Adapter IP or Bluetooth IP Address	From the <b>General</b> tab on the <b>Configuration</b> page: Type an IP address in the <b>USB Adapter IP Address</b> field	user with <b>Advanced User</b> permissions	USB_IP	192.168.2.50	N/A	Sets the IP address for the USB-to-Ethernet adapter connected to one of the CTM USB ports  Only needed if a USB to Ethernet or Bluetooth dongle is anticipated to be plugged in to one of the USB ports. Assign an IPv4 address to this interface.  <b>Note:</b> Please do not use a USB-to-Ethernet and Bluetooth dongle at the same time
Default Gateway IP	From the <b>General</b> tab on the <b>Configuration</b> page: Type an IP address in the <b>Default Gateway IP Address</b> field	Anyone  <b>Note:</b> Initialize this field to a IPv4 address if IP traffic needs to be routed via a gateway.	DFGWIP	0.0.0.0	N/A	Tells the Reader the default gateway IP address of the gateway device  Used to allow the Reader on a network to connect to a larger network (such as the Internet) via a gateway device (such as a router)
Suppress Non-TDM Tags	From the <b>General</b> tab on the <b>Configuration</b> page: Select Suppress Non-TDM Tags check box	anyone	NONIAG	1	0 - 1	<b>Disabled:</b> All transactions are reported  <b>Enabled:</b> Suppresses reporting of OBUs not matching the TDM protocol Group ID with which the Reader is provisioned  Used to prevent incompatible report formats from being sent to the LC

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Diagnostics Port Baud Rate	From the <b>General</b> tab on the <b>Configuration</b> page: Select a baud rate from the <b>Diagnostics Port Baud Rate</b> drop-down box	anyone	DIAGBD	115200	9600 19200 38400 57600 115200	Sets baud rate of DIAGNOSTICS PORT on the CTM Used to establish a baud rate for connecting a service laptop computer to the Reader via the CTM DIAGNOSTICS PORT
Reader configuration Auto-backup & Recovery	From the <b>General</b> tab on the <b>Configuration</b> page: Select the <b>Reader configuration Auto-backup &amp; Recovery</b> checkbox to enable (if necessary).	anyone	CNF_BU	1	0 - 1	Enables or disables backup of configuration parameters on compact flash. If enabled the reader can auto-recover from NV configuration checksum failures on startup and avoid a reset to factory defaults.
Report Latency by Tag Type						
0 - Interior FPT Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>0-Interior FPT Delay</b> field	user with <b>Advanced User</b> permissions	LYCTL0	0	0-5000	Sets report delay time in milliseconds for Interior FPT OBUs (Type 0) Used to slow down the transaction report of Type 0 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
1 - Exterior FPT Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>Exterior FPT Delay</b> field	user with <b>Advanced User</b> permissions	LYCTL1	0	0-5000	Sets report delay time in milliseconds for Exterior FTP OBUs (Type 1).  Used to slow down the transaction report of Type 1 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing
2 - Exterior LPT Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>Exterior LPT Delay</b> field..	user with <b>Advanced User</b> permissions	LYCTL2	0	0-5000	Sets report delay time in milliseconds for Exterior LPT OBUs (Type 2).  Used to slow down the transaction report of Type 2 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing
3 - LCD Display Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>LCD Display Delay</b> field..	user with <b>Advanced User</b> permissions	LYCTL3	0	0-5000	Sets report delay time in milliseconds for LCD Display OBUs (Type 3).  Used to slow down the transaction report of Type 3 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing
4 - Commercial Vehicle (CVO) Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>Commercial Vehicle (CVO) Delay</b> field..	user with <b>Advanced User</b> permissions	LYCTL4	0	0-5000	Sets report delay time in milliseconds for CVO OBUs (Type 4).  Used to slow down the transaction report of Type 4 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
5 - OBU Feedback Tag Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>OBU Feedback Tag Delay</b> field..	user with <b>Advanced User</b> permissions	LYCTL5	0	0-5000	Sets report delay time in milliseconds for Feedback OBUs (Type 5).  Used to slow down the transaction report of Type 5 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing
6 - HOT Tag Delay [ms]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter a time (in milliseconds) in the <b>HOT Tag Delay</b> field..	user with <b>Advanced User</b> permissions	LYCTL6	0	0-5000	Sets report delay time in milliseconds for HOT OBUs (Type 6).  Used to slow down the transaction report of Type 6 OBUs to the LC for those legacy sites where the LC is expecting BADGER Reader timing.
Primary/Secondary						
Redundant Mode	From the <b>General</b> tab on the <b>Configuration</b> page: Select the <b>Redundant Mode</b> check box..	user with <b>Advanced User</b> permissions	RDNDNT	1 (Redundant Mode enabled)	0 -1	<b>Disabled:</b> Reader does not attempt to switch to redundant side when a failure occurs.  <b>Enabled:</b> Reader attempts to switch to redundant side when a failure occurs (depending on configuration)  Used to enable the Reader to automatically switch over to the redundant side when a failure occurs.



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Dual Reporting Mode	From the <b>General</b> tab on the <b>Configuration</b> page: Select the <b>Dual Reporting Mode</b> check box..	user with <b>Advanced User</b> permissions	DUALRP	Dual Reporting Mode disabled	Dual Reporting Mode disabled Dual Reporting Mode enabled	Sets Reader to Dual Reporting mode Used to gather reports from both the primary and secondary sides of the Reader.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Auto Recovery To Prime	From the <b>General</b> tab on the <b>Configuration</b> page: Select the Auto Recovery To Prime check box.	user with <b>Advanced User</b> permissions	A_RCVR	Auto Recovery to Prime Enabled	0-1	<b>Disabled:</b> Reader does not attempt to recover to Primary side when failure clears. <b>Enabled:</b> Reader automatically attempts to recover to Primary side when a Primary failure clears. To enable the Reader to automatically switch back to the primary side once a primary side failure has cleared.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Switchover on Serial Link Down	From the <b>General</b> tab on the <b>Configuration</b> page: With Serial communications enabled, select the <b>Switchover on Serial Link Down</b> check box.	user with <b>Advanced User</b> permission	SOSERL	0	0-1	<p><b>Disabled:</b> switchover does not occur when the Serial link is down.</p> <p><b>Enabled:</b> Enable means switch-over to secondary side if the reader determines a serial link to the lane controller is down. Has no meaning on secondary side.</p> <p><b>Note:</b> If enabled, you MUST also disable all unused COM ports (see SERIAL tab) as well as unused LC destinations (see LC tab).</p>
Switchover on Ethernet LC Link Down	From the <b>General</b> tab on the <b>Configuration</b> page: With Ethernet LC communications enabled, select the <b>Switchover on Ethernet LC Link Down</b> check box.	user with <b>Advanced User</b> permissions	SO_ETH	0	0-1	<p><b>Disabled:</b> switchover does not occur when the Ethernet LC link is down.</p> <p><b>Enabled:</b> to enable the Reader to switchover from the primary side to the secondary side when an Ethernet link to the LC is down.</p>

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Switchover on Ethernet IRIF Link Down	From the <b>General</b> tab on the <b>Configuration</b> page: With Ethernet LC communications enabled, select the <b>Switchover on Ethernet IRIF Link Down</b> check box.	user with <b>Advanced User</b> permissions	SOIRIF	0	0-1	<b>Disabled:</b> switchover does not occur when the Ethernet IRIF link is down. <b>Enabled:</b> Enable means switch-over if a connection to an adjacent reader over the Ethernet interface is down.
<b>Reader Statistics</b>						
Use database	From the <b>General</b> tab on the <b>Configuration</b> page: Select the Use Database checkbox or leave it unselected	user with <b>Advanced User</b> permissions	STATDB		0-1	If checked (enabled) the reader uses non-volatile database for statistics for all protocols. If unchecked (disabled), use legacy volatile counters.
Database (Txns) Maximum records	From the <b>General</b> tab on the <b>Configuration</b> page: Enter the appropriate quantity in the <b>Database (Txns) Maximum records</b> field	user with <b>Advanced User</b> permissions	SDBMAX	10000	100 - 50000	Use to indicate the quantity of transaction records. Maximum statistics database record count. Suggest 10,000 records for typical use. Note: Higher values increase CPU load.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Database (Summary) Retention period [7–90 days]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter the appropriate quantity in the <b>Database (Summary) Retention period [7–90 days]</b> field	user with <b>Advanced User</b> permissions	SDSRET	30	7 - 90	Use to specify how many days transaction summary data is retained.
Database (Summary) Interval [1–30 minutes]	From the <b>General</b> tab on the <b>Configuration</b> page: Enter the appropriate quantity in the <b>Database (Summary) Interval [1–30 minutes]</b> field	user with <b>Advanced User</b> permissions	SDSINT	15	1 - 30	Generates transaction summary records into database at specified time interval. Values below 5 minutes for testing only. May be automatically adjusted by reader based on load and retention period  Generates transaction summary records into database at specified time interval.
<b>Dashboard</b>						
Transaction Summary dashboard	From the <b>General</b> tab on the <b>Configuration</b> page: Select the <b>Transaction Summary dashboard</b> checkbox or leave it unselected	user with <b>Advanced User</b> permissions	DSHTXN	1	0-1	Show a transaction summary dashboard on the home page, including a daily tag transaction count by tag protocol.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Lane Assignment tab						
TDM 6B 6C Allegro ATA SeGo	From the Lane Assignment tab on the Configuration page:  Select <b>First to Read/Program</b> , <b>Majority</b> , or <b>Interpolated</b> from the Lane Assignment Algorithm box.	user with <b>Advanced User</b> permissions	VTALGO VTAG6B VTAG6C VTAGAG VTAGAA VTAGSG	Majority	First to read/program Majority Interpolated	Runs the selected tag (channel) assignment algorithm.  Sets which algorithm is used for determining OBU lane assignment between channels.  Majority and interpolated voting make channel assignment decision based on handshake count from each channel at time of voting (and post-voting)  Interpolated voting uses a weighting algorithm to make the decision.
Interpolated Handshake Equalization Ratio (%)	From the Lane Assignment tab on the Configuration page:  Select <b>Interpolated</b> from the Lane Assignment Algorithm box. When <b>Interpolated Handshake Equalization Ratio (%)</b> field appears, enter a value in the field.	user with <b>Advanced User</b> permissions	HSEQR	25	1-100	Assigns a numerical value to the Handshake equalization ratio field used in interpolated voting. Used in interpolated voting.
Multiple Cooperating Readers						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Communication Method	From the Lane Assignment tab on the Configuration page: Select <b>Disabled</b> , <b>Badger-style CRA</b> , or <b>Ethernet</b> from Communication Method drop-down box.	user with <b>Advanced User</b> permissions	MULTRD	0	0 (Disabled) Badger-Style CRA Ethernet	<p><b>Disabled:</b> Reader is not set to communicate with other Readers.</p> <p><b>Badger-Style CRA:</b> Voting between Readers relies on writing to TDM tags.</p> <p><b>Ethernet:</b> Voting between Readers relies on communicating between readers on IR network.</p> <p>Sets how Readers communicate when determining lane assignments between multiple Readers</p>
Cross-Reader Reporting	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with Badger-style CRA or Ethernet communication method enabled: Select <b>Disabled</b> , <b>Report All</b> , or <b>Report Non-Zero</b> from the Cross-Reader Reporting drop-down box.	user with <b>Advanced User</b> permissions	CRARPT	0	0 Report All Report Non-Zero	<p><b>Disabled:</b> Reader is not set to communicate with other Readers.</p> <p><b>Report All</b> results in all transactions being sent to the LC</p> <p><b>Report Non-Zero</b> informs the LC of suppressed transactions</p> <p>To set which transactions are sent to LC in multi-reader configurations</p>

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
IRIF Timeout [ms] (make sure the TTO values of all IRIF readers are the same)	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with Ethernet communication method enabled:  Enter a time, in milliseconds, in the <b>IRIF Timeout</b> field.	user with <b>Advanced User</b> permissions	IRIFTO	50	30-5000	Sets IRIF timeout time  Sets the threshold for determining an IR network problem and enable a switchover if enabled
Enable Left Reader	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with Ethernet communication method enabled:  Select the <b>Enable Left Reader</b> check box.	user with <b>Advanced User</b> permissions	LEFTRD	0	0-1	<b>Disabled:</b> Reader does not coordinate voting with Reader covering lanes to the left.  <b>Enabled:</b> Reader coordinated lane assignment voting with Reader covering lanes to the left.  Tells this Reader if there is another Reader in the IR network that is covering ORT lanes that are to the left of the lanes this Reader is covering.
Left Reader IP	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with the Left Reader enabled,  Enter the IP address of the left Reader in the <b>Left Reader IP</b> field.	user with <b>Advanced User</b> permissions	LEFTIP	0,0,0,0,50	N/A	Informs the Reader what the IP address is of the Reader covering lanes to the left of this Reader.  To provide the Reader with the IP address of the left Reader in the IR network.



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Enable Right Reader	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with Ethernet communication method enabled:  Select the <b>Enable Right Reader</b> check box.	user with <b>Advanced User</b> permissions	RGHTRD	0	0-1	<b>Disabled:</b> Reader does not coordinate voting with Reader covering lanes to the right.  <b>Enabled:</b> Reader coordinated lane assignment voting with Reader covering lanes to the right.  Tells this Reader if there is another Reader in the IR network that is covering ORT lanes that are to the right of the lanes this Reader is covering.
Right Reader IP	From the <b>Lane Assignment</b> tab on the <b>Configuration</b> page, with the Right Reader enabled,  Enter the IP address of the right Reader in the <b>Right Reader IP</b> field.	user with <b>Advanced User</b> permissions	RGHTIP	0,0,0,0,50	N/A	Informs the Reader what the IP address is of the Reader covering lanes to the right of this Reader.  To provide the Reader with the IP address of the right Reader in the IR network
TDM Early Read check (improves programming rate)						
Enable Early Read Logic	From the Lane Assignment tab on the Configuration page, check the Enable Early Read Logic checkbox	user with <b>Advanced User</b> permissions	EREAD_	0	0 - 1	Can improve TDM programming success rate by detecting early reads and delaying voting according to the extent (i.e., time gap) of the early read.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Max Delay (ms)	From the Lane Assignment tab on the Configuration page,	user with <b>Advanced User</b> permissions	ERDMAX	1000	1 - 1000	Specifies the maximum time in milliseconds allowed to delay voting
Min Gap Size (ms)	From the Lane Assignment tab on the Configuration page,	user with <b>Advanced User</b> permissions	ERDGAP	50	1 - 10000	An early read Specifies the minimum allowed gap size
Voting Delay Gap Scaling Factor (%)	From the Lane Assignment tab on the Configuration page,	user with <b>Advanced User</b> permissions	ERDVSF	100	0 - 500	Specifies the voting delay scaling factor to apply
Minimum Post Gap HS Ratio (0-100%)	From the Lane Assignment tab on the Configuration page,	user with <b>Advanced User</b> permissions	ERDHSR	50	0 - 100	Specifies the minimum post gap to cumulative HS ratio (e.g. 50% means at least half of the HS on any channel must be after the RF gap).
TDM Low Read Logic						
Enable Low Read Logic	From the Lane Assignment tab on the Configuration page, check the Enable Low Read Logic checkbox.	user with <b>Advanced User</b> permissions	LWREAD	0	0 - 1	Delays voting if a long RF gap right before voting is detected.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Max Delay (ms)	From the Lane Assignment tab on the Configuration page	user with <b>Advanced User</b> permissions	LRDMAX	1000	1 - 10000	Specifies the maximum time in milliseconds allowed to delay voting
Min Gap Size (ms)	From the Lane Assignment tab on the Configuration page	user with <b>Advanced User</b> permissions	LRDGAP	50	1 - 10000	Specifies the minimum allowed gap size
Voting Delay Gap Scaling Factor (%)	From the Lane Assignment tab on the Configuration page.	user with <b>Advanced User</b> permissions	LRDVSF	100	0 - 500	Specifies the voting delay scaling factor to apply
Tag Programming tab						
<b>Lane Number</b> (channel assignment)	From the Tag Programming tab on the Configuration page:  With <b>Lane Number R/W</b> enabled, enter a value from 0 to 31 in each channel number field.	anyone	RFLNUM	Per-instance defaults. Instance:0 value:1 instance:1 value:2 . . . instance:30 value:31	0-31	Assigns a lane number to each channel. <b>ATTENTION:</b> this field should be used with care as the value may not reflect the channel on which the tag was reported.  To indicate in OBU data which lane an OBU was in when a transaction occurred.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Plaza ID	From the Tag Programming tab on the Configuration page:  With <b>Plaza ID</b> enabled, enter a numeric Plaza ID.	anyone	PID____	0	0-127	Sets Plaza ID  To keep a record in OBUs of the Plaza ID
Agency ID	From the Tag Programming tab on the Configuration page:  With <b>Agency ID</b> enabled, enter a numeric Agency ID.	anyone	AID____	0	0 - 127	Sets the agency ID  To keep a record in OBUs of the agency ID
6C Read-Only Mode	From the Tag Programming tab on the Configuration page:	anyone	6CROLY	1	0-1	Controls whether the reader writes or does not write to 6C tags.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
6C Try-To-Program Timeout [sec]	From the Tag Programming tab on the Configuration page: Ensure <b>6C Read-Only Mode</b> checkbox is unchecked. Enter time quantity in seconds in the <b>6C Try-To-Program Timeout [sec]</b> field	anyone	6C_TTP	500	0-4294967295	Specifies, in seconds, the duration after which additional programming attempts will be made with an existing 6C tag.
6C Agency ID (Decimal)	From the Tag Programming tab on the Configuration Page: Ensure <b>6C Read-Only Mode</b> checkbox is unchecked. Enter a numeric Agency ID.	anyone	6C_AID	0	0 - 4095	Sets the agency ID To keep a record in OBUs of the agency ID
TDM Read-Only Mode	From the Tag Programming tab on the Configuration page:	anyone	RDONLY	0	0-1	Controls whether the reader writes or does not write to TDM tags.
Traffic Management Programming (TMP)						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Enable TMP	From the Tag Programming tab on the Configuration page: Enable the <b>Enable TMP</b> checkbox	anyone	TMP__	1	0-1	Enable means write a timestamp and Reader ID in transponder memory. Disabled means the reader does not update those fields.
Reader ID	From the Tag Programming tab on the Configuration page: Enable or disable the <b>Reader ID</b> checkbox.	anyone	rw_RID	1	0-1	Determines whether or not to program the TM-DATA reader ID field of the tag's R/W area
Reader ID	From the Tag Programming tab on the Configuration page: Enter a value in the <b>Reader ID</b> field. <b>Note:</b> Make sure a unique Reader ID is used when there are multiple readers at a plaza.	anyone	RID__	0	min: 0 max: 4095	Use to enter a value which is written into the transponder if either Traffic Management or Cross Reader Algorithm (Classic) is enabled.
TM Date/Time	From the Tag Programming tab on the Configuration page: Either enable or disable the TMP checkbox.	anyone	rwTMDT	1	0-1	Determines whether or not to program the TM-DATA date/time fields of the tag's R/W area

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
TM Date/Time	From the Tag Programming tab on the Configuration page: With TMP enabled, select <b>TM Date/Time</b> .	anyone	TMDTTM	0	0-1	<b>Disabled:</b> the Reader date and time is not written to OBUs <b>Enabled:</b> the Reader date and time is written to OBUs to keep a record in OBUs of the TM transaction time
Toll Collection Programming (TCP)						
Enable TCP	From the Tag Programming tab on the Configuration page: With the <b>Read-Only Mode</b> check box cleared, select the <b>Enable TCP</b> check box.	anyone	TCP____	1	0-1	<b>Disabled:</b> Reader is not permitted to update toll collection fields in OBUs. <b>Enabled:</b> Reader is permitted to update toll collection fields in OBUs. To control if toll collection fields can be written to OBUs and to access TCP settings in the Tag Programming tab.
R/W Enable Plaza ID	From the Tag Programming tab on the Configuration page: With TCP enabled, select the <b>Plaza ID</b> check box.	anyone	rw_PZID	N/A	N/A	Enables Plaza ID to be written to OBUs. To write Plaza ID to OBUs and access the Plaza ID field.
Agency ID (enable)	From the Tag Programming tab on the Configuration page: With TCP enabled, select the <b>Agency ID</b> check box.	anyone	rw_AID	1	0-1	Enables Agency ID to be written to OBUs. To write the agency ID to OBUs and access the Agency ID field.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Transaction number programming (enable)	From the Tag Programming tab on the Configuration page:  With TCP enabled, select the <b>Transaction number programming</b> check box.	anyone	rw_TXN	1	0-1	Enables a Transaction number to be written to the OBU.  To write a transaction number to OBUs and to access the transaction number programming options.
Transaction number programming	From the Tag Programming tab on the Configuration page:  With Transaction number programming enabled, select the appropriate calculation type from the <b>Transaction number programming</b> drop-down box.	anyone	TFRM__	Reprogram with 16 bit sequential transaction number.	Don't reprogram transaction field.  Reprogram with 16 bit random number.  Reprogram with 16 bit sequential transaction number.  Reprogram with 8 bit random number and 8 bit sequential number.	Sets the way the Reader creates an OBU transaction number.  To choose how the Reader determines OBU transaction numbers.



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
OBU Feedback	<p>From the Tag Programming tab on the Configuration page:</p> <p>Select the <b>OBU feedback</b> check box.</p> <p><b>Note:</b> If the checkbox is grayed out, it is because the <b>Toll Rate/Balance Adjustment</b> checkbox is checked. Uncheck to activate the <b>OBU feedback</b> checkbox.</p>	anyone	rw_OBU	0	0-1	<p><b>Disabled:</b> programs feedback-type OBUs to not provide feedback.</p> <p><b>Enabled:</b> programs feedback-type OBUs to provide feedback.</p> <p>To configure feedback-type OBUs to notify when an ETC transaction has occurred.</p>
Toll Rate / Balance Adjustment	<p>From the Tag Programming tab on the Configuration page:</p> <p>Select the Toll Rate / Balance Adjustment check box.</p> <p><b>Note:</b> If the checkbox is grayedout, it is because the <b>OBU feedback</b> checkbox is checked. Uncheck to activate the <b>Toll Rate/Balance Adjustment</b> checkbox.</p>	anyone	rw_TRB	0	0-1	<p><b>Disabled:</b> disables the Toll Rate / Balance Adjustment function.</p> <p><b>Enabled:</b> Reader is responsible for adjusting Toll Rate and Balance in OBU.</p> <p>To allow the Toll/Rate Balance adjustment to be made by the Reader and access configuration settings.</p>

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
TC Date/Time	From the Tag Programming tab on the Configuration page: With TCP enabled, select <b>TC Date/Time</b> .	anyone	TCDTTM	0	0-1	<b>Disabled:</b> Reader Date/Time not written to OBU TC data fields. <b>Enabled:</b> Reader Date/Time written to OBU TC data fields. To keep a record in OBUs of the TC transaction time.
RW Format	From the Tag Programming tab on the Configuration page: With TCP enabled, select the <b>RW Format</b> check box.	anyone	rw__RW	0	0-1	<b>Disabled:</b> RW Format not affected. <b>Enabled:</b> Reader controls how OBU scratchpad memory is encoded. Determines how the data stored in OBU scratchpad memory is encoded.
Lane Number (enable)	From the Tag Programming tab on the Configuration page: With TCP enabled, select the <b>Lane Number R/W</b> check box, then, press Enter or select a different tab.	anyone	rwLANE	1	0-1	Enables lane number programming. To enable ability to set a specific lane number for each RF channel.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
HOT (High Occupancy Toll) lane	From the Tag Programming tab on the Configuration page:  With TCP enabled, select the <b>HOT Lane R/W</b> check box, then, select the desired lane check box.	anyone	HOT_LN	0	0 - 1	Enable HOT lane programming in a specific lane.  0 = disabled 1 = enabled  Note: Checkboxes only displayed for active/guard channels.
OBU Feedback tab						
OBU Feedback type	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page:  With <b>OBU feedback</b> enabled, select <b>Type 1</b> or <b>Type 2</b> .	anyone	OBUTYP	Type 1	Type 1 Type 2	Specifies which type of OBU feedback to employ:  <b>TYPE1</b> : all tags provide the same feedback. <b>TYPE2</b> : determine what feedback to use based on a table lookup choose one of: 0 - Type 1 1 - Type 2  To turn on and Specifies which type of feedback an OBU provides.
OBU Feedback Type 1						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
OBU Audible Feedback	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled and <b>Type 1</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	OBUAUD	Off	Off 4 cycles: 0.25s ON, 0.25s OFF 1 cycle: 1.5s ON 3 cycles: 0.5s ON, 0.2s OFF	Turns on and specifies the type of audible feedback an OBU provides.  To configure how long and how many times an OBU beeps to indicate a successful transaction.
OBU Visual Feedback	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled and <b>Type 1</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	OBUVIS	Off	Off Green: 2s Red: 2s Yellow: 2s	Turns on and specifies the type of visual feedback an OBU provides.  To configure how long and what color an OBU LED flashes to indicate a successful transaction.
OBU Feedback Type 2						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Valid Tag: Audible	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	O2VLDA	Off	Off 4 cycles: 0.25s ON, 0.25s OFF 1 cycle: 1.5s ON 3 cycles: 0.5s ON, 0.2s OFF	Specifies the audible feedback to provide for a valid tag.  To configure how long and how many times an OBU beeps to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.
Valid Tag: Visual	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	O2VLDV	Off	Off Green: 2s Red: 2s Yellow: 2s	Specifies the visual feedback to provide in the case of a valid tag.  To configure how long and what color an OBU LED flashes to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Invalid Tag: Audible	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	O2IVDA	Off	Off 4 cycles: 0.25s ON, 0.25s OFF 1 cycle: 1.5s ON 3 cycles: 0.5s ON, 0.2s OFF	Specifies the audible feedback to provide for an invalid tag.  To configure how long and how many times an OBU beeps to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.
Invalid Tag: Visual	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	O2IVDV	Off	Off Green: 2s Red: 2s Yellow: 2s	Specifies the visual feedback to provide in the case of an invalid tag.  To configure how long and what color an OBU LED flashes to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Lost/Stolen Tag: Audible	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	O2LSTA	Off	Off 4 cycles: 0.25s ON, 0.25s OFF 1 cycle: 1.5s ON 3 cycles: 0.5s ON, 0.2s OFF	Specifies the audible feedback to provide for a lost/stolen tag.  To configure how long and how many times an OBU beeps to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.
Lost/Stolen Tag: Visual	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	O2LSTV	Off	Off 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s)	Specifies the visual feedback to provide in the case of a lost/stolen tag.  To configure how long and what color an OBU LED flashes to indicate a successful transaction.  OBU feedback type 2 parameters only apply to TDM tags if a status file has been transferred to the Reader.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Low Balance Tag: Audible	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	O2LBLA	Off	Off 1 (4 cycles: 0.25s ON, 0.25s OFF) 2 (1 cycle: 1.5s ON) 3 (3 cycles: 0.5s ON, 0.2s OFF)	Specifies the audible feedback to provide for a low balance tag.  To configure how long and how many times an OBU beeps to indicate a low balance tag.
Low Balance Tag: Visual	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page: With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	O2LBLV	Off	Off Green: 2s Red: 2s Yellow: 2s	Specifies the visual feedback to provide in the case of a low balance tag.  To configure how long and what color an OBU LED flashes to indicate a low balance tag.



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Not Available / Internal Error: Audible	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page:  With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Audible Feedback</b> drop-down box.	anyone	O2NA_A	Off	Off  4 cycles: 0.25s ON, 0.25s OFF  1 cycle: 1.5s ON  3 cycles: 0.5s ON, 0.2s OFF	Specifies the audible feedback to provide for a not available / internal error.
Not Available / Internal Error: Visual	From the <b>OBU Feedback</b> tab on the <b>Configuration</b> page:  With <b>OBU feedback</b> enabled, and <b>Type 2</b> selected, select a feedback option from the <b>OBU Visual Feedback</b> drop-down box.	anyone	O2NA_V	Off)	Off)  Green: 2s  Red: 2s  Yellow: 2s	Specify the visual feedback to provide in the case of a not available / internal error
Toll Rate / Balance Adjustment tab						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Toll Rate/Balance adjustment	From the Tag Programming tab on the Configuration page: with OBU Feedback disabled, select the Toll Rate/Balance adjustment check box.	anyone	rw_TRB	0	0-1	<b>Disabled:</b> Reader does not adjust Toll Rate or Balance <b>Enabled:</b> Reader is responsible for adjusting Toll Rate and Balance in OBU. To allow the Toll/Rate Balance adjustment to be made by the Reader and access configuration settings.
TRBA BAT Processing Type	From the Toll Rate/Balance tab on the Configuration page: with <b>Toll Rate/Balance adjustment</b> enabled, select BAT 1-Fixed Toll or BAT 2-Variable Toll, then, click the Update TRBA Configuration button	anyone	TRBTYP	BAT 1-Fixed Toll	BAT 1-Fixed Toll BAT 2-Variable Toll	<b>BAT 1-Fixed Toll:</b> the Reader charges a toll based on the RF Channel(i.e. lane) and type of vehicle. <b>BAT 2 –Variable Toll:</b> the Reader charges a toll based on whether the Reader is at an entry or exit. To enable either fixed toll or variable toll charges and provide access to related toll options.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Toll Rate Table Select	From the Toll Rate/Balance tab on the Configuration page: with <b>BAT 1</b> enabled, select one of four toll rates from the <b>Toll Rate Table Select</b> drop-down box for each RF channel. click the <b>Update TRBA Configuration</b> button	anyone	TRBATS	Table 1	Table 1 Table 2 Table 3 Table 4	Sets the toll rate for each RF Channel based on the table selected.  To allow a Reader to charge different rates, depending on which lane a vehicle is in.
Entry/Exit Reader	From the Toll Rate/Balance tab on the Configuration page: with <b>BAT 2</b> enabled, select Entry Reader or Exit Reader click the <b>Update TRBA Configuration</b> button	anyone	TRBAER	Entry Reader	Entry Reader Exit Reader	<b>Entry Reader:</b> This Reader location is used as the highway entry point when calculating the toll.  <b>Exit Reader:</b> This Reader location is used as the highway exit point when calculating the toll.  To allow a Reader to charge a different rate on entry and exit.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Enforce Adjustment ID Checking	From the Toll Rate/Balance tab on the Configuration page: select the Enforce Adjustment ID Checking check box click the Update TRBA Configuration button	anyone	TRBEAI	0	0-1	<p><b>Disabled:</b> no limits on how often Reader can update OBU balance.</p> <p><b>Enabled:</b> limits how often Reader can update OBU balance.</p> <p>To set limits on how frequently the balance stored in a toll/balance OBU can be updated.</p>
Channel tab						
RF State	From the <b>Channel</b> tab on the <b>Configuration</b> page: Select one of the choices offered from the drop down menu for every appropriate channel.	anyone	RF_STS	Offline	Offline Active Guard No Module	<p>Offline means the MRFM-S module is off.</p> <p>Active means the MRFM-S module is on and reports transactions on this channel.</p> <p>Guard means MRFM-S module is on, but transactions assigned to this channel are not reported.</p> <p>No Module means there is no module expected in this position in the reader and status should not be monitored.</p> <p>Active or Guard status is applied to all protocols,</p>

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Channel Weight [%]	From the <b>Channel</b> tab on the <b>Configuration</b> page: Type the Channel Weight as a percent in the appropriate fields.	user with <b>Advanced User</b> permissions	RFWGHT	100	0-100	Enter a value from 0 to 100. At lane assignment time, the reader applies the weighting factor to all channels seeing the same transponder in a group. A channel weight of 50 means only half of the handshakes are used in comparing with adjacent channels. Typically a value other than 100 is used only for channels that straddle two physical lanes.
Group ID (voting)	From the <b>Channel</b> tab on the Configuration page: Type the (voting) Group ID in the appropriate fields.	user with <b>Advanced User</b> permissions	RFGPID	0	0-7	By default all channels are in one group, such that any cross lane reads within the group generate only one transaction. By specifying different (voting) group IDs, multiple independent capture zones can be created. This is useful for certain applications.
LPT/FME Voting time [ms]	From the <b>Channel</b> tab on the Configuration page: Type the voting time in the appropriate fields.	user with <b>Advanced User</b> permissions	LPTVTO	300	0-9999	Specifies the time after the initial entry of the transponder into the capture zone at which a VOTE report is generated. This is a trade-off between lane assignments versus latency. A value of 0 means no voting, subject to the Programming Timeout parameter. Specific to [L]icense [P]late [T]ags and (F)ront (M)ount (E)€terior tags only.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Voting Time (all other tag types) [ms]	From the <b>Channel</b> tab on the Configuration page:  Type the Voting Time for all other tag types in the appropriate fields.	user with <b>Advanced User</b> permissions	VOTETO	100	0-9999	Specifies the time after the initial entry of the transponder into the capture zone at which a VOTE report is generated. A value of 0 means no voting, subject to the Programming Timeout parameter.
Dynamic Voting Control	From the <b>Channel</b> tab on the Configuration page:  Select Disabled or Reader from the Dynamic voting control drop-down box (LC Speed and LC Ends are not supported).	user with <b>Advanced User</b> permissions	DVCTRL	Disabled	Disabled Reader LC Speed LC End	Disabled: no voting control  Reader: the Reader monitors the average time an OBU is in the capture zone and uses this time to determine an appropriate voting time.  LC Speed: not currently supported. LC End: not currently supported.  To set type of voting control.
Dynamic Voting Sample Size	From the <b>Channel</b> tab on the <b>Configuration</b> page:  With Dynamic Voting Control set to Reader, enter the desired number of samples.	user with <b>Advanced User</b> permissions	DVSPSZ	20	1-50	Sets the sample size used in the Dynamic Voting Calculation.  To configure the Dynamic Voting Control calculation. The number entered here is the number of previous transactions used when calculating the average voting time.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Dynamic Voting Threshold [%]	From the <b>Channel</b> tab on the <b>Configuration</b> page: With Dynamic Voting Control set to Reader, enter the voting threshold percentage in the <b>Dynamic Voting Threshold</b> field.	user with <b>Advanced User</b> permissions	DVTHSD	20	5-100	Sets the voting threshold percentage  To configure when the average Voting time is adjusted. The Voting time will only be updated when the Reader determines the percent change is larger than the threshold entered here.
Dynamic Voting Capture Zone Span Multiplier	From the <b>Channel</b> tab on the <b>Configuration</b> page: With Dynamic Voting Control set to Reader, enter a voting time multiplier in the <b>Dynamic Voting Capture Zone Span Multiplier</b> field.	user with <b>Advanced User</b> permissions	DVCZTM	2	1-5	Sets the Capture Zone Span Time multiplier  Determines when the Reader checks for voting time updates.
RF Attenuation tab						

TDM Rx Attenuation [dB]	From the RF Attenuation tab on the Configuration page: Select the appropriate fields and enter attenuation	user with <b>Advanced User</b> permissions	TA6RX1	0	0 - 31	Provides the default base-line protocol Rx/Tx Attenuation settings
TDM Tx Attenuation [dB]			TA6TX1			
Allegro Rx Attenuation [dB]			TA6RX2			
Allegro Tx Attenuation [dB]			TA6TX2			
SeGo Rx Attenuation [dB\			FA6RX1			
SeGo Tx Attenuation [dB]			FA6TX1			
			FA6RX2			
			FA6TX2			
			FA6RX3			
			FA6TX3			
			FA6RX4			
			FA6TX4			
			DA6TX1			
Frequency tab						



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
TDM Frequency [MHz]	From the <b>Frequency</b> tab on the <b>Configuration</b> page, select the required protocol and then specify the frequency.	user with <b>Advanced User</b> permissions	IAGFRQ	15	0 - 27	Specifies the protocol frequencies
Allegro Frequency [MHz]			ALGFRQ	15		
SeGo Frequency [MHz]			SGOFRQ	0		
ISO 18000-6B Frequency [MHz]			I6BFRQ	0		
ISO 18000-6C Frequency [MHz]			I6CFRQ	0		
ATA Frequency [MHz]			ATAFRQ	0		
Dummy (CW) Frequency [MHz]			DUMFRQ	0		
Frame Sequence tab						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Sequence (1-10) Sequence (11-20)	From the Frame Sequence tab on the Configuration page:	user with <b>Advanced User</b> permissions	N/A	Empty	Empty Dummy_1 Dummy_2 Dummy_3 Dummy_4 Sync_1 Sync_2 Sync_3 Sync_4 TDM Allegro SeGo 6B 6C ATA	Specifies the Frame Sequence Slot protocol/function. Used to specify the protocol firing and/or the Synchronization Sequence of the Reader.
TDM tab						
TDM Timeslot Config.	From the <b>TDM</b> tab on the <b>Configuration</b> page: Select the required Channel # and slot.	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Specifies the channel/slot firing sequence for the TDM frame sequence timeslot.
RxR Autoread	From the <b>TDM</b> Tab on the <b>Configuration</b> Page: Select if RxR is enabled.	user with <b>Advanced User</b> permissions	RxRARD	0	0-1	Specifies the TDM transactions as either RPV or RxR format.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Allegro tab						
Allegro Timeslot Config.	From the <b>Allegro</b> tab on the <b>Configuration</b> page: Select the required Channel # and slot.	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Specifies the channel/slot firing sequence for the Allegro frame sequence timeslot.
SeGo tab						
SeGo Timeslot Config	From the <b>SeGo</b> tab on the <b>Configuration</b> page Enable the required Channel #	user with <b>Advanced User</b> permissions	N/A	0	0 – 1 (for Ch# 1 - 8)	Specifies the channel/slot firing sequence for the SeGo frame sequence timeslot.
ISO 18000-6B tab						
ISO 18000-6B Read Mode:	From the <b>ISO 18000-6B</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	N/A	Standard (UDI only)	Standard (UDI only) eATA read – Single-page mode (UDI+eATA) eATA read – 3-page mode (UDI+eATA)	Standard Mode reads the UID of the tag only.  Single-Page eATA Read Mode reads both the UID and the eATA data in the tag, one page at a time, per superframe, and is a legacy mode that should be used when SYNCing to legacy MPR2 readers.  3-Page eATA Read Mode is the preferred option to attempt to read all 3 pages (UID+eATA) in a single superframe scan.  Specifies what mode to use when reading ISO 18000-6B tags.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Initial CW Time (μs)	From the <b>ISO 18000-6B</b> tab on the <b>Configuration</b> page.	user with <b>Advanced User</b> permissions	N/A	400	Off 100 - 1500 (in 100 μs steps)	Specifies the initial CW time (in μs)
Dual Tag Preamble	From the <b>ISO 18000-6B</b> tab on the <b>Configuration</b> page.	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Specifies whether or not the Dual Tag Preamble is transmitted during the ISO 18000-6B frame.
ISO 18000-6B Timeslot Config	From the <b>ISO-6B</b> tab on the <b>Configuration</b> page: Enable the required Channel #.	user with <b>Advanced User</b> permissions	N/A	0	0 – 1 (for Ch# 1 - 8)	Specifies the channel/slot firing sequence configuration for the ISO 18000-6B frame sequence.
ISO 180006C tab						
ISO 18000-6C Read Mode:	From the <b>ISO-6C</b> tab on the <b>Configuration</b> page: Select ISO 18000-6C Read Mode.	user with <b>Advanced User</b> permissions	N/A	EPC only	EPC only EPC+TID	Specifies what mode to use when reading ISO 18000-6C tags.
Enable Multi-Tag Support	From the <b>ISO-6C</b> tab on the <b>Configuration</b> page: Select the Multi-Tag Support	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Enable this parameter to allow the reader to read multiple ISO 18000-6C tags in a single frame. When disabled, only one ISO 18000-6C tag may be read per frame. Enabling this parameter sets the ISO 18000-6C Q-value = 2; when disabled, the Q-value = 0.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
ISO 18000-6C Mask Select	From the <b>ISO-6C</b> tab on the <b>Configuration</b> page: Select a mask from the drop down list of available options.	user with <b>Advanced User</b> permissions	6C_MSK	0 (No Mask)	0 (No mask), 1 (Peurto Rico Mask), 2 (Custom)	Enables the use of one or more pre-programmed Masks to select specific 6C transponders to communicate with.
ISO 18000-6C Timeslot Config	From the <b>ISO-6C</b> tab on the <b>Configuration</b> page: Enable the required Channel #	user with <b>Advanced User</b> permissions	N/A	0	0 – 1 (for Ch# 1 - 8)	Specifies the channel/slot firing sequence for the ISO 18000-6C frame sequence timeslot.
ATA tab						
ATA Frame Length (ms)	From the <b>ATA</b> tab on the <b>Configuration</b> page: select enter the required number in the field.	user with <b>Advanced User</b> permissions	N/A	19.5	16.5 – 21.5 ms (in 0.5 ms steps)	Specifies the length of the ATA frame in milliseconds (ms).
ATA Hold-Off Delay Enable	From the <b>ATA</b> tab on the <b>Configuration</b> page: check the <b>ATA Hold-Off Delay Enable</b> checkbox.	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Controls whether ATA CW transmission is held off at the start of the ATA frame for a period of time in order to provide a sufficient gap in air time from the end of transmission of the previous timeslot.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
ATA Hold-Off Delay (μs)	From the <b>ATA</b> tab on the <b>Configuration</b> page: Select the <b>ATA Hold-Off Delay Enable</b> checkbox to reveal ATA Hold-Off Delay field	user with <b>Advanced User</b> permissions	N/A	600	0 - 1400 μs (in 200 μs steps)	Specifies how long the ATA CW transmission is delayed from the start of the ATA frame in order to provide a sufficient gap in air time from the previous timeslot.
ATA Timeslot Config.	From the <b>ATA</b> tab on the <b>Configuration</b> page: Enable the required Channel #	user with <b>Advanced User</b> permissions	N/A	0	0-1 (for Ch# 1 - 8)	Specifies the channel/slot firing sequence for the ATA frame sequence timeslot.
Dummy tab						
Dummy Frame Length	From the <b>Dummy</b> tab on the <b>Configuration</b> page: Enter the length in the field.	user with <b>Advanced User</b> permissions	N/A	500	1 - 32767	Specifies the duration of the Dummy timeslot. <b>Note:</b> When combined with the Dummy Frame Length Units parameter, below, the (min, max) allowable Dummy Frame Length when CW is enabled is (500 μs, 200 ms)
Dummy Frame Length Units	From the <b>Dummy</b> tab on the <b>Configuration</b> page: Select the required multiple.	user with <b>Advanced User</b> permissions	N/A	x1 μs	x1 μs x 100 μs	Specifies the units to be used when indicating the duration of the Dummy timeslot. <b>Note:</b> When combined with the Dummy Frame Length Units parameter, above, the (min, max) allowable Dummy Frame Length when CW is enabled is (500 μs, 200 ms)

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Dummy (CW) Timeslot Config.	From the <b>Dummy</b> tab on the <b>Configuration</b> page: Enable CW for the required Channel #	user with <b>Advanced User</b> permissions	N/A	0	0 – 1 (for Ch# 1 - 8)	Specifies the channel/slot firing sequence for the Dummy (CW) frame sequence timeslot.
Sync tab						
Reader-to-Reader Sync. Enable	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the Reader-to-Reader Sync Enable checkbox.	user with <b>Advanced User</b> permissions	N/A	0	0 - 1	Controls whether RF transmission is synchronized between adjacent readers.  <b>Note:</b> A sync cable to connect readers is required if Reader-to-Reader sync is to be enabled.
Sync. Recovery Attempt Limit	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the <b>Sync</b> tab, then, select the <b>Sync. Recovery Attempt Limit</b> field.	user with <b>Advanced User</b> permissions	N/A	0	0 – 100	This value specifies how many Sync Recovery Time Periods must expire before the reader will no longer search/wait for sync before firing its tag acquisition sequences independently of the reader sync network. If set to zero, the Reader will always wait for the Sync Recovery Time to expire before firing its tag acquisition sequence.
Enable Custom Sync Timing	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the Sync tab, then check the Enable Custom Sync Timing checkbox.	user with <b>Advanced User</b> permissions	N/A	0	0-1	Enables/disables custom sync timing.  <b>Note:</b> Enabling this feature allows the user to manually override the standard values of Sync. Search Time, Sync Recovery Time, and Sync. Frame Start Delay.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Sync Search Time (μs)	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the. Sync tab	user with <b>Advanced User</b> permissions	N/A	100 μs	20 - 65535 μs	Specifies how long the Sync function will search for the synchronization signal in microseconds (μs) before switching to recovery mode.
Sync Recovery Time (ms)	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the <b>Sync Recovery Time</b> checkbox	user with <b>Advanced User</b> permissions	N/A	500 ms	0 - 65535 ms	Specifies how long the Sync function will attempt synchronization recovery in the event that the sync signal is not seen during the Sync Search phase.  Note: It is recommended that this value be set to at least 125% of the total multi-protocol tag acquisition sequence.
Sync Frame Start Delay (μs)	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the.Sync tab	user with <b>Advanced User</b> permissions	N/A	0	0 us – 255 μs	This value specifies how long the Reader will delay from the rising edge of the sync pulse to the rising edge of the trigger pulse in the frame.
Sync Delay (ns)	From the <b>Sync</b> tab on the <b>Configuration</b> page: Select the.Sync tab	user with <b>Advanced User</b> permissions	N/A	0	0 - 10000ns (Note this value can only be set in 100ns steps)	This value specifies, in 100 nanosecond (ns) increments how long the Reader will wait after Reader-to-Reader synchronization has occurred before firing the next tag acquisition sequence. This value should be calculated based on the length of the Sync Cable.



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Enable Sync-on-Skipped-Sync Sequencing	From the <b>Sync</b> tab on the <b>Configuration</b> page:	user with <b>Advanced User</b> permissions	N/A	0	0-1	Enables sync-on-skipped-sync sequencing. This feature instructs the reader to search for the missing sync sequence to indicate when the protocol synchronization is to occur.  <b>Note:</b> This feature should be used when more than 3 protocols are selected in the multi-tag acquisition sequence.
LC tab						
Allow Remote LC Configuration	From the <b>LC</b> tab on the <b>Configuration</b> page: Select the Allow Remote LC Configuration check box.	user with <b>Advanced User</b> permissions	RMOTLC	1	0-1	<b>Disabled:</b> LC is not permitted to Configure Reader <b>Enabled:</b> allows the LC to configure the Reader remotely allows changes to the Reader configuration from the LC
Status message buffering	From the <b>LC</b> tab on the <b>Configuration</b> page: Enable or disable the <b>Status message buffering</b> checkbox.	user with <b>Advanced User</b> permissions	LcStBf	0	0-1	If enabled, instructs the Reader to buffer status messages in the event of a communications link loss with the Lane Controller.  N/A
LC Ethernet TCP-Socket Local Port	From the <b>LC</b> tab on the <b>Configuration</b> page: keep the default value if necessary.	user with <b>Advanced User</b> permissions	LcEtPn	default: 6666	min: 1024 max: 65535	Use to select the local TCP Protocol Port Number that the Reader will listen on to accept incoming TCP connections from the Lane Controller.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
LC Ethernet TCP-Socket Timeout	From the <b>LC</b> tab on the <b>Configuration</b> page: With at least one RF Channel configured to send data to the LC via Ethernet, type a time, in milliseconds, in the <b>LC Ethernet TCP-Socket Timeout</b> check box.	user with <b>Advanced User</b> permissions	LcEtTo	500	100-5000	Sets the timeout for a response from the LC via the LC Ethernet network.  To determine if there is an Ethernet communication problem between the Reader and the LC.
Send Heartbeat Messages	From the <b>LC</b> tab on the <b>Configuration</b> page: Select the Send Heartbeat Messages check box.	anyone	LCHTBT	1	0-1	<b>Disabled:</b> No heartbeat messages are sent to LC. <b>Enabled:</b> causes the Reader to send heartbeat messages to the LC via serial link.  To detect communication problems between the Reader and the LC in the absence of OBU data.
Heartbeat Interval	From the <b>LC</b> tab on the <b>Configuration</b> page: With heartbeat messages enabled, enter a time, in seconds, in the <b>Heartbeat Interval</b> check box.	anyone	LCHBTM	2	1-30	Sets the serial port heartbeat message interval to configure how often heartbeat messages are sent from the Reader to the LC.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Use RFP-Compliant Message Format	From the <b>LC</b> tab on the <b>Configuration</b> page: Select the Use RFP-Compliant Message Format check box.	user with <b>Advanced User</b> permissions	RfpMsg	0	0-1	Enables the RFP-compliant message format allows the Reader to report transactions to the LC in the new E-ZPass-specified format.
Toll Rate / Balance Adjustment Tag Report Format:	From the <b>LC</b> tab on the <b>Configuration</b> page:	user with <b>Advanced User</b> permissions	TrLcFm	Toll Rate / Balance Adjustment Format	Toll Rate / Balance Adjustment Format TDM Standard Format	Specifies what format to use when issuing reports for Toll Rate / Balance Adjustment tags to the Lane Controller.  Set to ' <b>TRBA Format</b> ' to issue reports to the Lane Controller using the Toll Rate / Balance Adjustment Format.  Set to ' <b>TDM Standard Format</b> ' to issue reports to the Lane Controller using the TDM Standard format.
ATA Transponder Data Format	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	AtaFmt	8-bit ASCII HEX	8-bit ASCII HEX 8-bit ASCII Alphanumeric	Specifies the type of ATA report formatting to employ
Report Filtering						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
ATA Tag Report Filtering/Threshold:	From the LC tab on the Configuration page, select the ATA Tag Report Filtering/Threshold checkbox	user with <b>Advanced User</b> permissions	ATAFLT	0	Disabled 0 Enabled:1 Read Enabled:2 Reads Enabled:3 Reads	Use this option to perform filtering of ATA tag reports (Voting, Post Capture) based on a set handshake count threshold.  Sets the minimum number of ATA tag reads that must occur on any given channel before a given tag is processed and/or reported to the Lane Controller.  Set appropriately, this feature can help reduce the incidence of ATA 'Phantom' reads/reports.
Verify ATA Data CRC:	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	ATAVDC	1	0-1	If enabled, instructs the Reader to perform a CRC validation check on the received ATA data. If the incoming data does not pass the CRC check, handshake messages,  <b>Note:</b> if enabled, may be flagged as invalid, or suppressed entirely.
Reporting						
Voting Report	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	VOTRPT	per-instance defaults: TDM: enabled all others: disabled	0-1	Used to choose to send a voting report
Generate Initial Report	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	INIRPT	0	0-1	Used to choose to send or not to send an initial report the first time a new tag is seen

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Raw Handshake Report	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	RAWRPT	per-instance defaults: TDM: disabled all others: enabled	0-1	Used to send a handshake to the LC for every tag read
Generate Post-Capture-Zone Report	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	PCZRPT	0	0-1	Used to choose to generate and potentially send a post-capture-zone report
Generate Estimated-Vehicle-Speed Report	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	EVS RPT	0	0-1	Used to choose to generate and send an Estimated Vehicle Speed report
Minimum Speed Report sample count	From the <b>LC</b> tab on the <b>Configuration</b> page	user with <b>Advanced User</b> permissions	EVSMSS	1	1 - 10	The reader sets the ZC field in EVS Report to 9999 when the sample count is less than the specified minimum.
Destination	From the <b>LC</b> tab on the <b>Configuration</b> page: Select the <b>Serial</b> and/or <b>Ethernet</b> check box for each RF channel	anyone	LCDEST	1	0 - 15	<b>Serial:</b> sets channel to communicate with the LC by a serial connection <b>Ethernet:</b> sets channel to communicate with the LC by an Ethernet connection sets how individual RF channels communicate with the LC

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Serial Port	From the <b>LC</b> tab on the <b>Configuration</b> page: With serial communications enabled, select the appropriate LPM COM Port from the <b>Serial Port</b> drop-down	anyone	LCSERL	per-instance defaults: instance:0 value:0 instance:1 value:1 instance:2 value:2 instance:3 value:3 instance:4 value:4 instance:5 value:5 instance:6 value:6	0 - 7	Specifies the physical serial port on which to send transaction reports.  <b>Note:</b> Channels can report on separate serial ports, or can be multiplexed onto a single serial port. to configure which LPM COM Port sends data for a specific MRFM-S channel
Destination IP Address	From the <b>LC</b> tab on the <b>Configuration</b> page:	anyone	LCIPPT	N/A	N/A	This specifies the destination IP address and port.
Dual Destination IP Address	From the <b>LC</b> tab on the <b>Configuration</b> page:	anyone	LC2IPP	N/A	N/A	this specifies the Dual Destination IP address and port.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Tertiary Ethernet Destination IP Address (IREADs only)	From the <b>LC</b> tab on the <b>Configuration</b> page:	anyone	LC3IPP	N/A	N/A	this specifies the Tertiary Destination IP address and port. <b>Note:</b> Only IREADs are sent over this link.
LC-Extended tab						
Status Reports	From the LC-extended tab on the Configuration page:	anyone	EIR_SR	0	0-1	Specifies which Extended Information values are to be included in Status Reports sent to the Lane Controller.
Transaction Reports (Initial-Read, Voting, Post-Capture, Est.Veh.Speed)	From the LC-extended tab on the Configuration page:	anyone	EIR_TN	0	0-1	Specifies which Extended Information values are to be included in Transaction Reports (Initial Read, Voting, Post-Capture, and/or Estimate Vehicle Speed) reports sent to the Lane Controller.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Raw Handshake Reports	From the LC-extended tab on the Configuration page	anyone	EIR_RH	0	0 - 31	Specifies which Extended Information values are to be included in Raw Handshake reports sent to the Lane Controller.
Serial tab						
LC Retry Timeout	From the <b>Serial</b> tab on the <b>Configuration</b> page: Enter a time, in milliseconds, in the <b>LC Retry Timeout</b> field.	user with <b>Advanced User</b> permissions	PROTO	1000	50-1000	Sets the LC retry timeout to set the time that the Reader waits for LC confirmation before resending data . (Serial link only)
Serial Port State	From the <b>Serial</b> tab on the <b>Configuration</b> page: Select the <b>Serial Port State</b> check box for the required LPM COM port.	anyone	COM_ST	1	0-1	<b>Disabled:</b> LCM COM port disabled <b>Enabled:</b> LCM COM port enabled to communicate with LC to enable or disable communications on each LPM COM port
Baud Rate	From the <b>Serial</b> tab on the <b>Configuration</b> page: With the Serial Port State enabled, select the desired <b>Baud Rate</b> from the drop-down box.	anyone	COM_BR	19200	9600 19200 38400 57600 115200	sets the LPM baud rate for individual COM ports to configure the LPM baud rate on a port by port basis



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Data Bits	From the <b>Serial</b> tab on the <b>Configuration</b> page: With the Serial Port State enabled, select the desired <b>Data Bits</b> from the drop-down box.	anyone	COMBTZ	8	5 6 7 8	sets the LPM data bits for individual COM ports to configure the LPM data bits on a port by port basis
Parity	From the <b>Serial</b> tab on the <b>Configuration</b> page: With the Serial Port State enabled, select the desired <b>Parity</b> from the drop-down box.	anyone	COMPTY	None	None Even Odd	sets the LPM parity for individual COM ports to configure the LPM parity on a port by port basis
Stop Bits	From the <b>Serial</b> tab on the <b>Configuration</b> page: With the Serial Port State enabled, select the desired <b>Stop Bits</b> from the drop-down box.	anyone	COMSTP	1	1-2	sets the LPM stop bits for individual COM ports to configure the LPM stop bits on a port by port basis
Serial tab						

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Transponder Timeout	From the <b>Group</b> tab on the <b>Configuration</b> page: Enter a time, in seconds, in the <b>Transponder Timeout</b> field.	anyone	GRPTTO	300	1-300	set the transponder timeout time to set the amount of time an OBU must be out of a capture zone before communication with the OBU is reported as a new transaction
Manage Config tab						
Save Config	From the Manage Config tab on the Configuration page: Click the <b>Save Config</b> button.	anyone	N/A	N/A	N/A	Saves a configuration file. <b>Note:</b> Different ways of saving the file appear, depending on the browser you use, to allow Reader configuration file to be saved. The file can then be reloaded later or used to configure other Readers
<b>Upload Config</b> (Update the reader configuration WITHOUT modifying the Ethernet 1 (LC 1Gbps) networking/IP information)	From the Manage Config tab on the Configuration page: With the correct configuration file displayed in the Filename field above, click the upper <b>Upload Config</b> button.	anyone	N/A	N/A	N/A	Uploads the selected configuration file to the Reader without overwriting the IP addresses to upload a saved Reader configuration without changing the IP address settings

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
<b>Upload Config</b> (Update the entire reader configuration)	From the Manage Config tab on the Configuration page:  With the correct configuration file displayed in the Filename field above, click the bottom <b>Upload Config</b> button.	anyone	N/A	N/A	N/A	Uploads the selected configuration file to the Reader including any IP addresses to upload a saved Reader configuration
Reset Parameters to Default Values	From the Manage Config tab on the Configuration page:  Click the bottom Reset Parameters to Default Values button.	anyone	N/A	N/A	N/A	restores all Reader configuration settings to the factory default values except for the IP address to reset the Reader configuration, usually while performing specific field service tests
Upload File	From the <b>Manage Software</b> page:  Click the <b>Upload File</b> button.	user with <b>Manage Software</b> permissions	N/A	N/A	N/A	uploads a software/firmware version to upload a software/firmware version to the Reader so it can be activated
Reboot	From the <b>Manage Software</b> page:  Click the <b>Reboot</b> button.	user with <b>Manage Software</b> permissions	N/A	N/A	N/A	reboots the Reader to remotely reboot a Reader

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Activate	From the <b>Manage Software</b> page: Click the <b>Activate</b> button.	user with <b>Manage Software</b> permissions	N/A	N/A	N/A	activates the selected software/firmware version to deactivate the software/firmware version currently running and activate a new version once the new version has been uploaded to the Reader
<b>Delete</b> (software/firmware)	From the <b>Manage Software</b> page: Click the <b>Delete</b> button.	user with <b>Manage Software</b> permissions	N/A	N/A	N/A	deletes the selected software/firmware version to delete an inactive, non-factory software/firmware version that is no longer required to free up space for newer versions
Change Permissions	From Manage Users, then on the User Management page: Click the <b>Change Permissions</b> button.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	enables any permission changes to add or remove permissions for a given user
Clear Password	From Manage Users, then on the User Management page: Click the <b>Clear Password</b> button.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	clears a user's password to allow a user to create a new password if they have forgotten their existing password
Delete (user)	From the Manage Users, then on the User Management page: Click the <b>Delete</b> button.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	deletes a user to remove users who no longer require access to the CTM web interface

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Create New User	From the Manage Users, then on the User Management page: Click the <b>Create New User</b> button.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	Creates a new user.
<b>Submit</b> (new password)	From the Change Password tab on the User Management page: Click the <b>Submit</b> button.	user with <b>User Admin</b> permissions	N/A	N/A	N/A	Submits a new password Changes the password of the user currently logged into the CTM web interface
Network Time Protocol	From the <b>Set Time</b> page: select Disable or Enable, then, Click the Update NTP Settings button.	user with <b>Advanced User</b> permissions	NTP__	0	0-1	Enables or disables setting the Reader time via an NTP server to ensure readers are time synced to a time server
NTP Server 1, 2, 3 and 4	From the <b>Set Time</b> page: enter three different valid NTP server IP address in the <b>NTP Server</b> fields, then, Click the Update NTP Settings button.	user with <b>Advanced User</b> permissions	NTP__1 NTP__2 NTP__3 NTP__4	N/A	N/A	Sets the NTP server IP addresses Provides the Reader with four NTP servers it can access to accurately maintain time with other Readers in an IR network.

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
NTP peers 1, 2, 3, 4, 5	From the <b>Set Time</b> page:	user with <b>Advanced User</b> permissions	NTPPR1 NTPPR2 NTPPR3 NTPPR4 NTPPR5	N/A	N/A	
Current Time Zone Display	From the <b>Set Time</b> page:	User with <b>Advanced User</b> permissions	T_ZONE	N/A	N/A	Displays current time zone
New Time Zone Control	From the <b>Set Time</b> page:	User with <b>Advanced User</b> permissions	N/A	N/A	N/A	Adds a new time zone from a list
Set Time	From the <b>Set Time</b> page: enter the date and time in the format MMDDYY<sp>HHMMSS, then, Click the <b>Set Time</b> button.	anyone	N/A	N/A	N/A	Manually sets the Reader time

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Delete Event Logs	From the <b>Log Files</b> tab on the <b>Log Files</b> page: Click the <b>Delete Event Logs</b> button.	user with View Log Files and Manage Log Files permissions	N/A	N/A	N/A	Deletes all event logs Frees up memory for more logs
Delete All Logs	From the <b>Log Files</b> tab on the <b>Log Files</b> page: Click the <b>Delete All Logs</b> button.	user with View Log Files and Manage Log Files permissions	N/A	N/A	N/A	Deletes all logs Frees up memory for more logs
Copy Log Files to USB disk	From the <b>USB Logging</b> tab on the <b>Log Files</b> page: Click the Copy Log Files to USB disk button.	user with View Log Files and Manage Log Files permissions	N/A	N/A	N/A	Copies all log files to a USB flash drive inserted in an CTM USB port. Saves a copy of the Reader log files for analysis or for backup
Start Logging to USB disk	From the <b>USB Logging</b> tab on the <b>Log Files</b> page: Click the Start Logging to USB disk button.	user with View Log Files and Manage Log Files permissions	N/A	N/A	N/A	Continuously copies log files as they are created and updated to a USB flash drive inserted in an CTM USB port to automatically create a backup copy of all logs

Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Ethernet Logging (enable)	From the <b>Ethernet Logging</b> tab on the <b>Log Files</b> page: Select the <b>Ethernet</b> check box, then, click the <b>Update Ethernet Logging Configuration</b> button.	user with View Log Files and Manage Log Files permissions	ETHLOG	0	0-1	<b>Disabled:</b> No Ethernet logging <b>Enabled:</b> the Reader sends a copy of log files to a destination computer via the ETHERNET 1 port can remotely access log files Use this option only under the recommendation of Kapsch Service.
Destination IP/Port	From the <b>Ethernet Logging</b> tab on the <b>Log Files</b> page: Enter the IP address and port number of the computer to receive log files, then, click the <b>Update Ethernet Logging Configuration</b> button.	user with View Log Files and Manage Log Files permissions	ELDTIP	0.0.0.0.0	N/A	Provides the IP address and port of the computer to receive log files to allow the Reader to know the IP address of a remote computer so log files can be sent
Ethernet Protocol	From the <b>Ethernet Logging</b> tab on the <b>Log Files</b> page: Select either TCP or UDP, then, click the <b>Update Ethernet Logging Configuration</b> button.	user with View Log Files and Manage Log Files permissions	ELPROT	TCP	TCP UDP	<b>TCP:</b> use TCP protocol for sending log files via Ethernet <b>UDP:</b> use UDP protocol for sending log files via Ethernet to choose an Ethernet protocol that focuses on speed (UDP) or quality of data (TCP)



Command	How to execute	Who can execute	Prmtr. Name	Default Value	Prmtr. Range	Purpose of command
Select Logs	From the <b>Ethernet Logging</b> tab on the <b>Log Files</b> page:  Select the check boxes of the log files to be sent, then, click the <b>Update Ethernet Logging Configuration</b> button.	user with View Log Files and Manage Log Files permissions	ELLOGS	trouble	trouble tag event developer debug fifo	Sets which log files are sent via Ethernet to select only the log files you want to receive
<b>Perform Tests</b> (serial comms)	From the Diagnostics Page:  Select the LPM COM port to be tested from the <b>Test Enable/Disable</b> drop-down box, then, click the <b>Perform Test(s)</b> button.	user with <b>Advanced User</b> permissions	N/A	N/A	N/A	tests the specified LPM serial port to ensure that a specified LPM port is functioning properly when troubleshooting communication problems with the LC

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# MAINTENANCE INSTRUCTIONS

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## 4. THEORY OF OPERATIONS

This section offers a more detailed overview of the Reader components than the introductory overview provided in Overview Section 2 page 24.

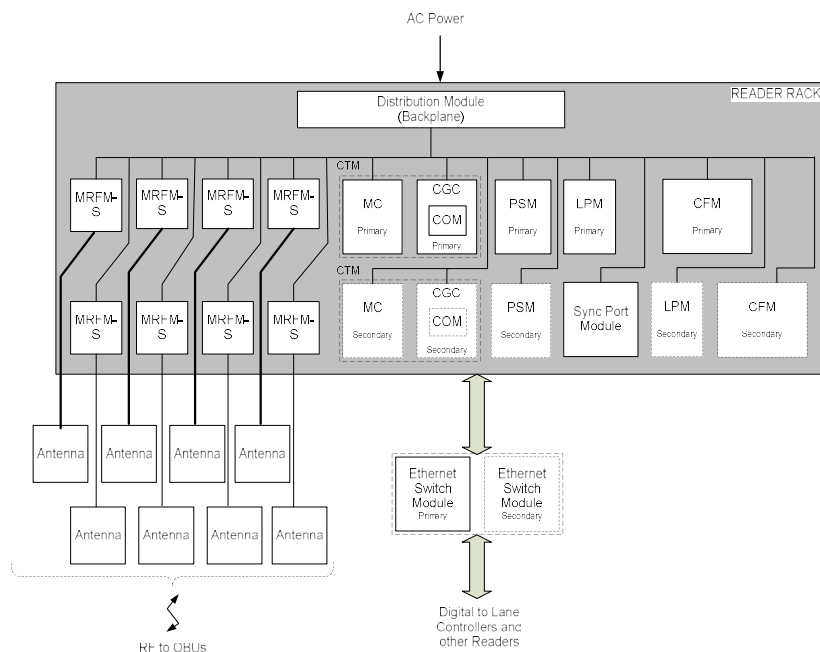
Multi-protocol Readers can communicate with both active and passive OBUs. The Reader uses a combination of **Time Division Multiplexed** (TDM) and **Frequency Division Multiplexed** (FDM) periods to read active and passive OBUs respectively.

Each MRFM-S and antenna pair, referred to as a channel, creates an RF capture zone on the roadway. The antennas are usually situated to create overlapping capture zones between channels. One reader can support up to 8 channels. When required, multiple readers can be synced together to support additional channels.

The reader processes the OBU information and provides transaction reports to the Lane Controller interfaces. When required, the reader can write data to the OBU.

A block diagram for a redundant reader is shown below in Figure 4-1. A redundant reader includes a redundant PSM, LPM, CFM, and CTM (A CTM consists of both a Single Board Processor and CGC card)

**Figure 4-1: Reader Block Diagram**



**Active OBUs**

Active OBUs are battery powered and transmit a signal to the Reader antennas. As a vehicle equipped with an active OBU approaches a toll plaza, the OBU receives a trigger signal from the Tx antenna. The OBU then starts transmitting data, which is received by the Rx antenna.

The MRFM-S decode the active OBU signal and passes the data to the CTM, which processes and logs the OBU data and then sends the information to the Lane Controllers (LCs). The Reader may also send data back to the active OBUs, such as an updated toll account balance.

**Passive OBUs**

Passive tags are not battery powered and cannot transmit a signal. As a vehicle equipped with a passive OBU approaches the antenna, the OBU receives a transmit signal from the antenna. This signal is then reflected from the passive OBU back to the antenna. The reflected signal is uniquely modulated by each passive OBU, allowing the OBU to be identified.

The MRFM-S decodes the passive OBU signal and passes the data to the CTM which processes and logs the OBU data and then sends the information to the Lane Controllers (LCs). The Reader may also send data back to the active OBUs, such as an updated toll account balance.

**Capture zones**

The capture zone is the area of antenna RF coverage. An antenna can communicate with an OBU once the OBU enters the antenna's capture zone. These capture zones and the number of antennas required per lane varies depending on the site and/or lane configuration.

**Note:** Where Kapsch is responsible installation and tuning, installation on sites and lanes is assessed by Kapsch Personnel prior to deployment in order to validate customer expectations and performance.

**Multi-protocol RF Module Smart**

The Multi-protocol RF Module Smart (MRFM-S) can handle **multiple passive tag protocols**; 6B (ISO 18000-6 Type B), 6C (ISO 18000-6 Type C), ATA (10374/ATA/AAR S-918), SeGo and Allegro, as well as the **active protocol** TDM.

The MRFM-S design includes a software command for adjusting the transmitter peak output power.

**ATTENTION:** When installing or replacing an MRFM-S, the lane should be re-tuned.

The MRFM-S transmits recovered OBU data as messages to the CGC. After the messages are processed by the CTM, a transaction message is normally sent to the LC.

## Power Supply Module (PSM)

The PSM AC mains power requirement is 95-230VAC (60Hz+/-2 Hz) at 10A max input current.

The PSM is field replaceable and provides:

- A power switch and a 10A fuse
- +5V and +15V DC power outputs
- +5V and +15V LEDs to indicate power supply output status

In the redundant configuration, both the primary and secondary PSMs are normally powered on. The primary PSM provides power to the primary CTM and the secondary PSM provides power to the secondary CTM. Both PSMs share the RF module load.

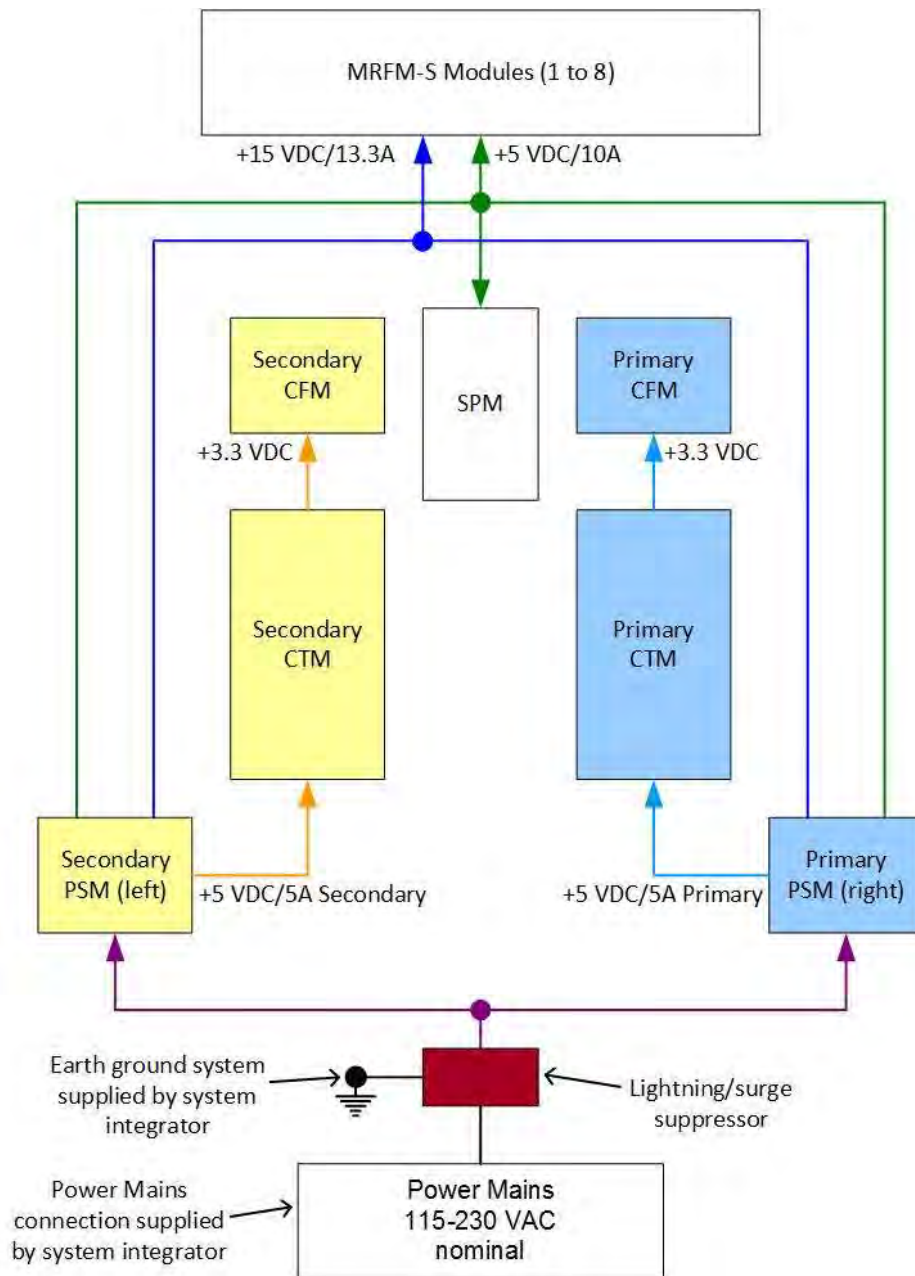
In the event of failure of one PSM, an automatic switchover will occur and the redundant PSM provides all the power for the RF module load.

The PSMs are not interchangeable. The Primary and Secondary power supplies have different part numbers; a result of being physical mirror images of each other.

Each PSM has a mains power fuse on the front panel: Time lag, 10 A @ 250 V, UL rated.

The power supply distribution is shown in Figure 4-2, page 158.

Figure 4-2: Reader Power distribution



**Note:** Lightning/surge suppressor supplied by system integrator.



## Lane Controller Port Module (LPM)

The LPM provides the serial communications connections between the CTM and the LC. The LC serial communication signals travel to/from the CTM CGC board via the Distribution Module (DSM) to the LPM serial port connectors. The LPM provides the 8 serial port connectors and integrated lightning protection. The LPM is field replaceable.

The MPR 2.3 is factory configured to support either an RS-232 or RS-422 interface. The data rate is configurable to standard rates up to 115.2 kbps.

Normally, each MRFM-S channel is assigned a unique LPM COM port; however, the MRFM-S channels can be multiplexed by assigning multiple RF channels to one LC serial port, as necessary.

For a description of the serial interface protocol and file formats exchanged between a Lane Controller and a Reader, refer to ICD 360467-121.

## Sync Port Module (SPM)

The SPM provides a pathway for synchronization signals to and from both primary and secondary CTM MC boards via the DSM to the SPM 6-terminal block connector where the synchronization STAR network cables connect. The SPM is field replaceable.

A 4-Wire RS422 electrical connection at the front panel terminal block connects the SPM to the synchronization network.

There are no active components installed on the SPM.

A three-position toggle switch mounted on the SPM provides Auto, Primary and Secondary redundancy mode control signals via the DSM to the CTM.

## Controller Module (CTM)

The CTM performs the Reader's transaction level processing for data received from and sent to the OBUs. The CTMs may be swapped without having to save the configuration file since the configuration data is stored in the CFMs mounted on the DSM.

The CTM as a whole unit is field replaceable.

### **Main Controller (MC)**

The MC is an off-the-shelf EBX form-factor industrial single-board computer. This unit contains the CPU, memory and I/Os and is used to run the Reader software.

The MC receives recovered OBU information from its associated CGC and performs a lane assignment for each tag passing through the system via voting logic. It communicates with the LCs to report tag transactions, accepts configuration messages, and provides status messages via a legacy LC serial interface and/or an LC Ethernet interface. It detects and reports faults and can perform a switchover. It offers Reader configuration via a browser interface, storage for transaction buffering, event logging, and tag transaction and performance monitoring. It also supports remote software downloads. It provides Inter-Reader communications with up to two other Readers, saves Reader configuration parameters to the primary and secondary CFM, manages the OBU Account Status file, and keeps log files for OBU transactions, system events, and trouble reports.

For a description of the ethernet interface protocol and file formats exchanged between a Lane Controller and a Reader, refer to ICD 360467-121.

#### ***Channel Group Controller Module (CGC)***

The CGC is used as a scheduler, message buffer, and a controller. It schedules when the MRFM-S operates, routes configuration data from the MC to the MRFM-S, and routes message data from the MRFM-S to the MC. It also manages timing synchronization between readers and CTMs.

### **Configuration Module (CFM)**

The CFM is a field replaceable PWA board. These non-volatile memory cards store the Reader configuration file. They are field-replaceable without using any tools.

### **Distribution Module (DSM)**

The DSM provides interconnections between the plug-in modules in the Reader rack. It is not field-replaceable.

The DSM:

- Provides locations for all plug-in Reader modules and the Lane Kit RF modules
- Distributes DC power from the PSMs to the necessary modules in the Reader rack
- Carries RF data and control signals between primary and secondary CTMs and all MRFM-Ss
- Carries synchronization and redundancy mode signals between primary and secondary CTMs and the SPM
- Carries data between primary and secondary CTMs and primary and secondary CFMs

- Carries data between primary and secondary CTMs and primary and secondary LPMs

## Multiple reader synchronization

Readers must be synchronized under the following conditions.

- If they have overlapping capture zones,
- If they are connected in an IR network
- If Reader-to-Reader RF interference is present.

Sync is recommended for installations that are less than 600 feet apart. For distances above this up to the sync cable maximum distance (1500 ft) tests for in-band interference should be carried out to ensure no Reader-Reader interference occurs.



**ATTENTION:** To avoid interference and loss of data between adjacent reader, readers must be synced.

Tests should be carried out under live traffic conditions to ensure that RF signal reflections that come off moving vehicles do not cause interference.

If Reader-to-Reader RF interference exceeds the in-band limits then the Readers must be synchronized

### ***CTM-to-CTM synchronization in Redundant Reader.***

The following requirements apply to synchronization between Primary and Secondary CTMs.

Synchronization between Primary and Secondary CTMs (intra-reader sync) occurs whenever the reader is configured for redundancy.

**Note:** CTM-to-CTM will not sync if the Reader-to-Reader sync is not achieved.

Loss of CTM synchronization does not affect the synchronization of readers connected in a network (Reader-to-Reader synchronization).

A redundant reader currently operating on the Primary CTM does not fall into the Reader-to-Reader Sync Recovery routine if synchronization is lost on the Secondary CTM and vice versa.

If synchronization is lost between CTMs, a loss of redundant sync signal is reported.

### ***Reader-to-Reader synchronization***

Reader-to-Reader synchronization requires the following programmable options on the web interface:

- Synchronization Search Time (maps to sync frame timeout in MPR2)
- Synchronization Delay (new feature not supported in MPR2 used for cable delays)
- Synchronization Frame Start Delay

Sync Recovery Time (currently hardcoded default 20ms in MPR2)

Sync Recovery Attempt Limit (new feature not supported in MPR2)

Sync on Skipped Sync Frame

**Note:** Reader-to-Reader Sync Recovery occurs on a loss of synchronization with the external reader network.

### ***Synchronization search time***

Synchronization search time indicates how long the reader waits for reader to reader sync before falling into synchronization recovery.

If the reader detects synchronization prior to the expiry of this timer, it exits search mode and performs one of the following actions.

- Falls into Synchronization Delay if programmed

- Falls into synchronization frame start delay if programmed

- Begins firing its multi-protocol acquisition sequence.

### ***Synchronization delay***

Synchronization delay indicates how long the reader holds its sync driver low after synchronization has occurred. This feature is used to calibrate out cable length delays.

If the reader detects that the sync bus is driven high prior to the expiry of this delay, the reader exits delay mode and performs one of the following actions.

- Sets its driver high and falls into synchronization frame start delay if programmed

- Sets its driver high and begins firing its multi-protocol tag acquisition sequence.

### ***Synchronization frame start delay***

Synchronization frame start delay programs how long the Reader waits after Reader-to-Reader sync has occurred. Its internal driver is set to a high state before firing the next frame and/or multi-protocol tag acquisition sequence.

### ***Sync recovery time***

Sync recovery time is a programmable variable that indicates how long the reader searches/waits for synchronization on the reader network before firing its multi-protocol tag acquisition sequence. It is recommended that this value be programmed at least 125% of the total multi-protocol tag acquisition sequence.

If the reader detects that the sync bus is driven high prior to the expiry of this time, the reader exits recovery mode, sets its driver high and begins firing its multi-protocol tag acquisition sequence.

**Sync recovery attempt limit:**

Sync recovery attempt limit is used to indicate how many Sync Recovery Time periods must expire before the Reader no longer searches/waits for synchronization before firing its tag acquisition sequence independent of the reader network. A loss of reader synchronization message will be transmitted via the lane controller interface.

If this limit is programmed with a zero (0) value, the Reader will always wait for Sync Recovery Time to expire before firing its sequence.

**Sync-on-skipped-sync frame**

Sync-on-skipped-sync frame is used when more than 3 protocols are selected in the multi-protocol tag acquisition sequence. A two sequences-skip is used to indicate where the sequence starts.

How Reader synchronization operates at the toll location

After interrogating all of the assigned MRFM-S slots in the rack, each Reader will provide a 'sync ready' signal on its SPM terminal block. Only when the configuration parameter **Enable Reader –to-Reader Sync** checkbox is selected under the SYNC tab does synchronization occur. See page 184 for instruction how to enable sync.

As busy Readers become ready they will not send any more RF trigger signals until the sync bus indicates that all Readers are ready. Once the last Reader in the network generates its ready signal, all Readers on the sync bus simultaneously generate OBU trigger pulses starting with the RF module in slot 1. This can be seen in the truth table shown below for synchronization circuit consisting of two Readers.

**Table 4-1: Boolean Logic Truth Table for Synchronization of two Readers**

Reader 1 sync port Tx	Reader 2 sync port Tx	Reader 1 or 2 sync port Rx
0 ( <i>ready</i> )	0 ( <i>ready</i> )	0 ( <i>ready</i> )
0 ( <i>ready</i> )	1 ( <i>busy</i> )	1 ( <i>busy</i> )
1 ( <i>busy</i> )	0 ( <i>ready</i> )	1 ( <i>busy</i> )
1 ( <i>busy</i> )	1 ( <i>busy</i> )	1 ( <i>busy</i> )

The truth table above demonstrates the following rule of synchronization operation:

The sync bus will only be in the ready state when all Readers in the group are in the ready state.

The last Reader to acquire a ready state controls the system synchronization. Most of the time (greater than 95%), the sync bus will be in the busy state. If operating correctly, the sync bus will normally be in the ready state for about 100  $\mu$ sec.

## Transaction Buffering

Transactions from OBUs, are processed by the CTM. When a Reader CTM loses communications with a Lane Controller (LC), the Reader buffers OBU transactions and error messages (up to a combined total of 1,000,000) in non-volatile memory (i.e., buffered messages will not be lost during power interruptions or Reader resets). When the memory is full, new transactions overwrite the oldest buffered transactions. The memory available for buffering is shared by all RF channels.

When the communication link between an LC and the Reader is re-established, the Reader begins to upload the buffered transactions to the LC. The Reader will pause uploading buffered transactions to the LC to report any new transactions as they occur. Buffered transaction reporting resumes after the new transactions have been reported. Messages from the LC will continue to be acknowledged and acted upon during the upload process.

## Log files

The log files for OBU transactions are saved on the CTMs Compact Flash. Once space is filled on the respective memory partition, the oldest file from the same file type is deleted to create memory space for the new data.

A listing of the main log file types appears below. Other log files that may be present are for Kapsch TrafficCom use only.

**Table 4-2: List of Available Log Files**

Log File Type	Description
tagtxns_YYYY-MM-DD	Daily tag Transaction log.
event_YYYY-MM-DD	Daily event log files. Event log contain a periodic report of system health and transaction count totals.

Log File Type	Description
trouble_YYYY-MM-DD	Trouble Log. Content lists any unusual system anomaly (e.g. switchover).

**Transaction logs****CAUTION:**

Log file formats are not under ICD control and the format may change without prior notification. Log files are for diagnostic purposes only and are not guaranteed to be maintained in non-volatile storage.

Each transaction can generate multiple report for a transaction. Which reports are provided depend on the selection of reports in the LC tab. The report types and the fields they contain described in Table 4-3.

Table 4-3: List of Fields in a Transaction Log Report

Field	Description
IREAD	Optional initial read report when transponder first enters capture zone. Informational report
VOTE	Transaction report at voting time
POST	Optional post-capture zone report if lane assignment or programming status has changed. Informational report
An	Antenna number (present only if in interpolated lane assignment mode)
Master Set	The set of three (3) inter-Reader channels that have the most tag reads (C = center Reader, L = left Reader, R = right Reader). Present only if in interpolated lane assignment mode or when IR network is enabled.
Zone	Sub-zone information (a – f). (Present only if in interpolated lane assignment mode)
Ch	Channel number. Indicates the assigned channel (1-8). Channel 1 corresponds to the leftmost RF module in the RF rack.
St	Transaction status. Pgm indicates successful transponder programming. PU indicates transponder programming status is Unknown (tag left zone before verify could complete). PF indicates transponder was not programmed successfully. Read indicates the Reader is in read only mode. CrossR indicates an informational report (not a transaction).
Txn	Transaction number. Note that transaction numbers may appear to skip when using 2 or more Readers with Ethernet connection between them.



Field	Description
Ag	Agency ID of transponder in capture zone.
Sn	Serial number of transponder in capture zone.
Ahs	The number of handshakes (Reads) that occurred on the assigned channel up to voting time. (note RPVs currently count as 1)
THs	<p>For a TDM Transaction:</p> <p>The total number of handshakes (Reads) that occurred on the assigned channel for the previous TDM transaction on the same RF channel. (Note RPVs currently count as 1). A value of 00 is reported after reset or power-up. A value greater than 99 is indicated as 99.</p> <p>For a Non-TDM Transaction:</p> <p>The total number of handshakes (Reads) that occurred on the assigned channel for the previous non-TDM transaction on the same RF channel. A value of 00 is reported after reset or power-up. A value greater than 99 is indicated as 99.</p>
GUARD	Shown for a transaction assigned to a RF channel set to Guard. These transactions will always show !LC to indicate that no report for the LC is generated. Tag programming is disabled for Guard channels.
?LA	In a POST report, indicates that a lane assignment change was detected between the voting time report and the post time report. May be an indication that voting time is not optimal.
?PS	In a POST report, indicates that a programming status change was detected between the voting time report and the post time report.
>LC	>LC indicates transaction is to be reported to lane controller (connection present or not). Only appears on the Active CTM
!LC	!LC indicates transaction is suppressed (e.g. GUARD lane or CrossR transactions or CTM is Inactive).
Cx-HS	HS tag handshakes seen up to voting/post time on the MasterSet center Reader. <b>Note:</b> Does not appear unless there is inter-reader communication.
Lx-HS	HS tag handshakes seen up to voting/post time on the MasterSet left Reader. <b>Note:</b> Does not appear unless there is inter-reader communication.
Rx-HS	HS tag handshakes seen up to voting/post time on the MasterSet right Reader. <b>Note:</b> Does not appear unless there is inter-reader communication.

### Event Logs

The event log is generated to record any reader events or changes (for example, if the power supply status changes). During service, the technician should first examine the event log files to see if there are any reported events with the reader.

The following list depicts the possible sources of event messages found in the event log.

Changes to the reader configuration  
Changes to the reader configuration at power up  
Reader status changes, such as PSM status, etc.  
Reader faults detected

### **Trouble Logs**

Unusual Reader issues generate trouble logs (for example, if a switchover has occurred). During service, the technician should first examine these trouble log files to see if there are any reported issues with the Reader.

Examine the **Log Files** page for instances of one or more trouble <date> file in the list of log files.

A typical report in a trouble log is:

```
2010-05-31T10:52:35.723+00:00 [1ab3_5] SYNCR: Reader SYNC lost
```

**Note:** As an alternative, Kapsch Service can remotely connect to the Reader and examine the trouble log to quickly identify and resolve any issues. It is up to the system administrator or integrator to determine when to grant Kapsch Service remote access to the LC network IP addresses.

The following list depicts the possible sources of trouble messages found in the **trouble <date>** file.

- No detection of a CFM backplane memory module.
- The Status file integrity check fails. Possible cause: there may be data for up to 40 million OBUs in a Status file.
- The Reader software forced a switchover on detection of:
  - Failed CGC health
  - Failed serial LC link (when enabled). Possible cause: a fault external to the Reader
  - Failed Ethernet LC link (when enabled). Possible cause: a fault external to the Reader
  - Failed Ethernet inter-Reader link (when enabled). Possible cause: a fault external to the Reader

## 5. INSTALLATION

### Introduction

The Reader is shipped with the required power, communications, and logic modules. The Lane Kits are supplied separate from the Reader.

An antenna, an MRFM-S, a feedline cable adapter, and a circulator comprise a Lane Kit.

After the equipment is installed, the Reader must be configured via the CTM browser interface. After configuration is complete, the Reader configuration needs saving (see Saving the Reader configuration, page 241) for future reference.

The toll agency and/or system integrator must select the configuration and setup that is suitable for the application and the desired system performance.

#### **CAUTION:**



Improper modification of configuration parameters may adversely affect system operation. The default values may not be appropriate for the specific application. It is the system integrator's responsibility to tailor the configuration parameters to the specific operating environment.


#### **CAUTION: Redundant Reader**



Configure both CTMs in a redundant Reader. Each CTM has its own browser interface and is configured independently. Ensure any configuration changes made to one CTM are applied to the other CTM, as required.

## The earth ground system

**WARNING:**



AN IMPROPERLY GROUNDED READER COULD RESULT IN ELECTRIC SHOCK. ENSURE A HIGH CURRENT EARTH GROUND CONNECTION IS ESTABLISHED BEFORE CONNECTING SUPPLY POWER.

The system integrator supplies the earth ground system for the Reader mains power as per the IEEE 142-2007 standard, particularly; *chapter 5: Sensitive Electronic Equipment Grounding*; and *chapter 3* pertaining to lightning protection; and all other chapter sections describing bonding applications.

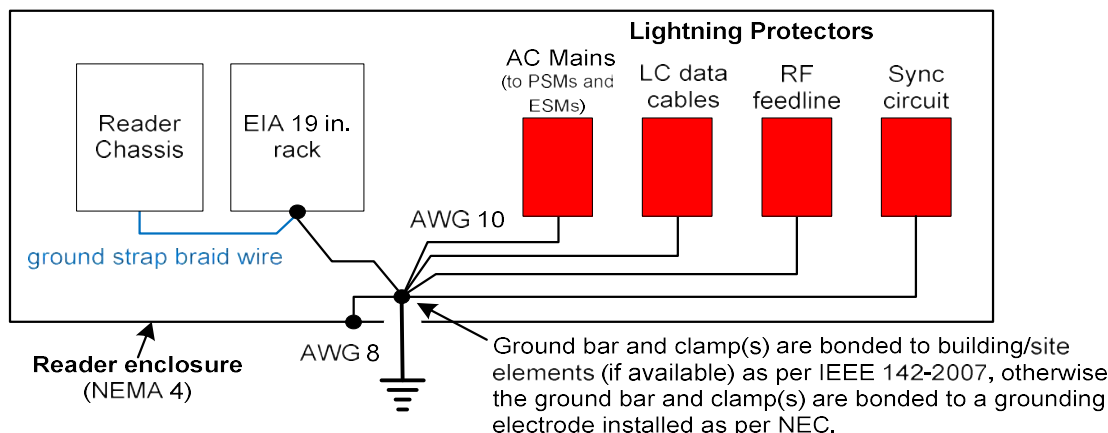
The system integrator is responsible for ensuring that grounding and power conforms to local regulatory and safety requirements. The recommendations herein are those ensuring bad grounding does not degrade the reader performance.

In accordance with IEEE 142-2007 all of the following building/site elements (if available) must be bonded together:

- Metal frame of the building (if effectively grounded)
- Metal underground water pipe
- Ground ring, concrete encased electrode

The Reader ground bar (supplied by the system integrator) is bonded to the above-mentioned elements. If none of these elements are available on site, only then a grounding electrode is installed as per NEC to which the Reader ground bar is bonded. The Reader components ground wires are then connected to the ground bar clamps as shown in Figure 5-1.

Lightning arrestors should be installed on the interfaces where lightning induced surges can occur.

**Figure 5-1: Earth Ground System (with recommended lightning protectors shown)**

**Note:** The toll plaza installation may not have a NEMA 4 enclosure. The earth ground system and all other ground connections to Reader components at the toll plaza are identical to those shown in the figure below.

## Lightning protectors

**Note:** It is the system integrator's responsibility to determine the necessity of installing lightning/surge protection equipment between the data inputs and the earth ground system at the Lane Controller (LC).

**Table 5-1: Locations for the Installation of Lightning Protectors**

Location required	Schematic Figure number
In-line with antenna RF feed	Figure 5-1: Earth Ground System (with recommended lightning protectors shown), page 171
PSM power	Figure 5-2: AC Mains, page 173
LC Data inputs	Figure 5-3: LC Data Cable installation, page 174
ESM power	Figure 5-10: Synchronization circuit schematic for three Readers, page 183
Synchronization circuit	Figure 5-10: Synchronization circuit schematic for three Readers, page 183

## Installing the Reader hardware

Prerequisites: The Reader cabinet is commissioned and the earth ground system has been installed as per IEEE 142-2007, see the earth ground system on page 170.

Install the AC receptacle for the Reader mains power connections within three (3) feet of the front of the Reader.

**Note:** When handling Reader modules and hardware, always follow accepted Electrostatic Discharge (ESD) practices and standards.

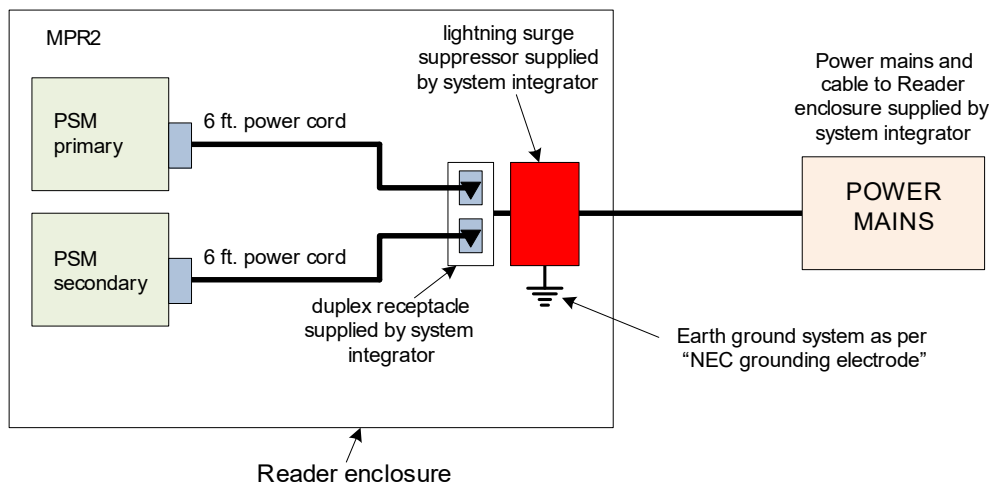
1. Using clip nuts, mount the Reader in the EIA 19-inch rack in a NEMA 4 cabinet.
2. Connect the EIA 19-inch rack ground lug to earth ground:
3. Connect one end of a braided ground strap to the ground lug on the EIA 19-inch rack.
4. Neatly position the ground strap along the Reader and apply a light film of tuner lube to the ground lug on the rear of the Reader rack to ensure good grounding contact.
5. Secure the other end of the braided ground strap to the Reader ground lug.



**CAUTION:**

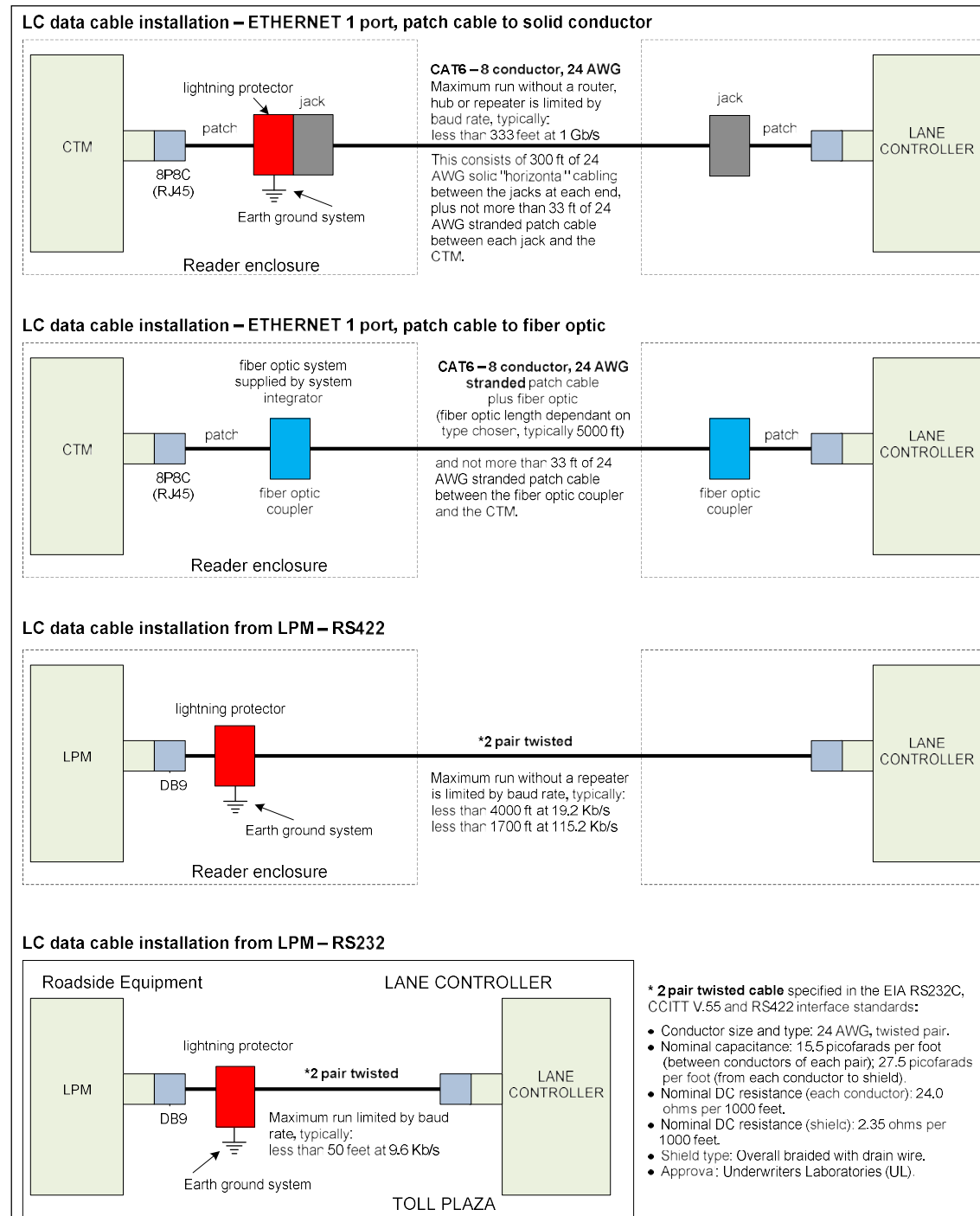
To avoid damaging the modules, ensure that alignment of both the connector on the module and the connector on the DSM (back plane) is correct before securely plugging the module into the DSM.

6. Install the Reader modules in the Reader, ensuring the modules seat properly in their sockets. The installation of the MRFM-S is outlined in Installing a Lane Kit on page 175.
7. Install the power cords for the primary and secondary PSMs. Appropriate lightning/surge protection equipment should be installed between the power mains input and the earth ground system at the Reader, see Figure 5-2 on page 173.

**Figure 5-2: AC Mains**

Connect the appropriate cables from the Reader to the LC as shown in Figure 5-3 on page 174.

Figure 5-3: LC Data Cable installation





## Installing a Lane Kit

### Installing an Antenna

1. The antenna mounts on a frame using 2-inch diameter galvanized pipe clamps. For 12 ft wide lanes position the center antenna at lane center of the defined lane. For ORT applications with 12 ft wide lanes, the straddle antenna must be at the midpoint between the left and right antennas. Note straddle min/max measurements in Table 5-2.
2. Orient the weep holes down, such that the radome is facing oncoming traffic.
3. Using a tilt meter, measure the road pitch and cross lane slope directly under each IAG antenna. Record the results.
4. Using a tilt meter, align each antenna plate to the tilt angle specified in Table 5-2, in relation to the road pitch measured in step 3 (e.g., If the road pitch is 2 degrees, and the antenna tilt must be 15 degrees, mount the antenna at 17 or 13 degrees depending on the pitch of the road.)
5. Ensure that the height of the antenna at the center of the radiating face of the antenna as tilted falls within the height range given Table 5-2. Please contact Kapsch Technical Service when considering mounting the antennas outside the specified heights.
6. Adjust the roll angle of the antenna equal to 0 degrees with respect to the cross lane slope obtained in step 3.
7. For TDM-only protocol, an ORT antenna installation may be all antennas (IAG 1 or IAG 2 or IAG 3) inline across the roadway as shown in Figure 5-5.
8. For TDM protocol, and/or ISO18000-6C protocol (read only) only, an ORT antenna installation may be all antennas (IAG 3 only) inline across the roadway as shown in Figure 5-5. However for the highest performance a staggered antenna configuration is always recommended when using any protocol other than TDM.
9. For all passive protocols (other than ISO18000-6C read only) an ORT antenna installation must be all antennas (IAG 3 only) staggered across the roadway as shown in Figure 5-6.

**Table 5-2: Antenna mounting and lane configuration**

Antenna	Application	Lane Width	Height	ORT Tilt (off horizontal)	Straddle (min/max c to c)
IAG-3	ORT or Plaza	12 ft. (3.65 m.)	17 ft. (5.18 m) ±1 ft. (0.31 m)	10 deg.	5.5 ft.(1.68 m)/6.5ft.(1.98 m)
IAG-1	ORT or Plaza	12 ft. (3.65 m.)	16 ft. (4.88 m) ±1 ft. (0.31 m)	10 deg.	5.5 ft.(1.68 m)/6.5ft.(1.98 m)
IAG-2	ORT	12 ft. (3.65m)	15 ft. (4.57m) ±1 ft. (0.31 m)	10 deg.	5.5 ft.(1.68 m)/6.5ft.(1.98 m)

**Figure 5-4: Generic IAG3 Mounting Dimension Information**

This figure shows the general relationship between the mounting pipe and the antennas. The current antenna drawing should be obtained for Kapsch for accurate dimensions.

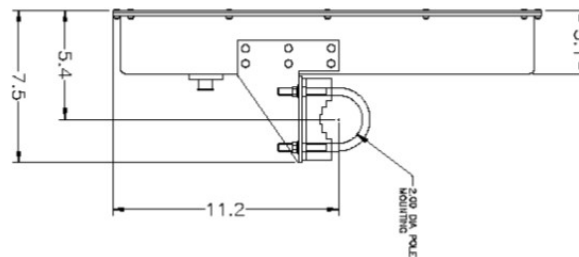
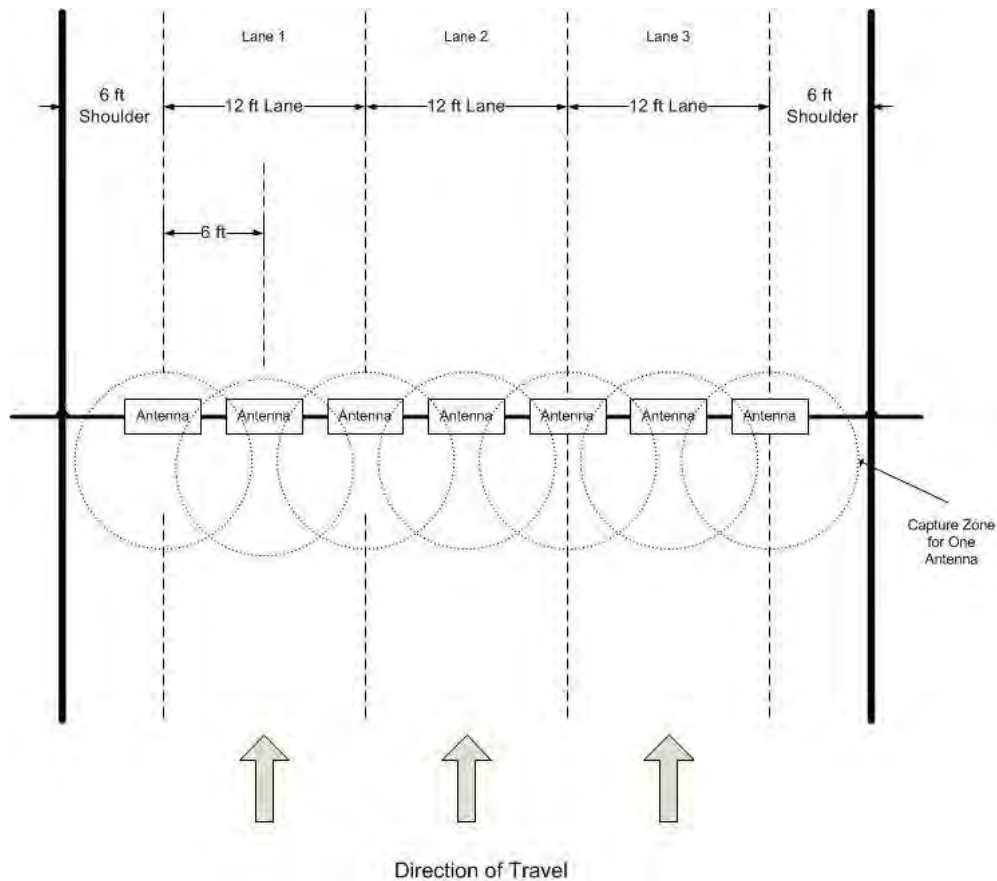
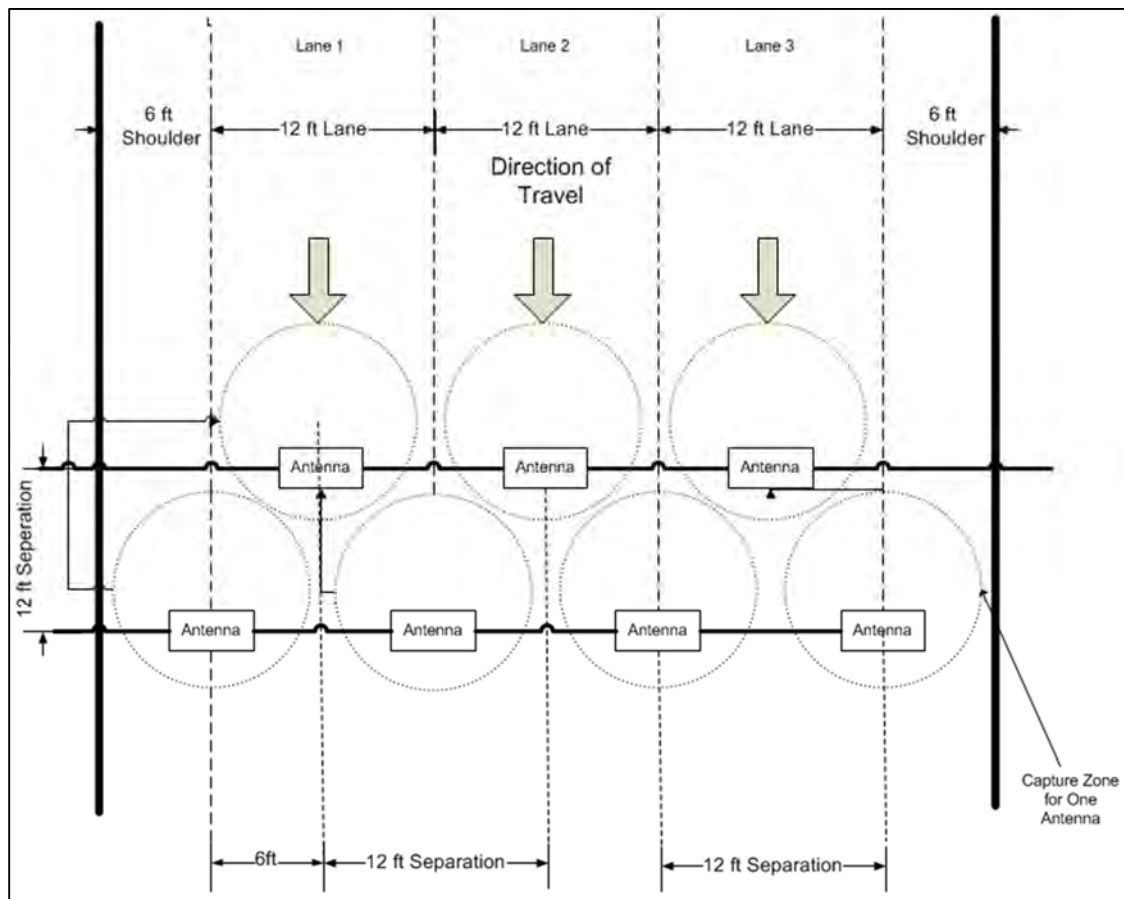
**Figure 5-5: Inline ORT Antenna Installation**

Figure 5-6: Staggered ORT Antenna Installation



The JANUS reader system and antennas in the lane kits are optimized for applications using 12 foot lane widths. The antenna placement requirements and support for this and other lane widths are as follows.

The lane centerline is the mid-point between the lane markings.

The antenna bore site should be on the lane centerline and lane markings.

Physical lane widths below 12 ft. (3.66 m) are not an issue provided the separation between lane centers is 12 ft. or greater.

- If separations are below this there is a higher risk of reports from multiple lanes for the same tag. Note the use of the voting algorithms will correctly assign the tag to the correct lane). There may also be some reduction in the read performance for passive protocols.

If the physical lane width exceeds 15 ft.(4.57 m), the lane should be treated as a multi-lane free flow configuration and multiple lane kits used per lane. The antenna spacings should be kept at 12 ft separation in each row.

The same FDM channel frequency should not be used on adjacent lanes, including straddle and shoulder lanes (recommended at least 24 ft. separation between in-line antennas and 21 ft for staggered antennas).

**NOTE:** It is preferable to use more frequencies where possible to minimize inter-channel interference due to FDM.

Two TDM channels that are configured active in the same time slot should not be used on adjacent lanes, including straddle and shoulder (recommended at least 24 feet separation between in-line antennas and 21 ft for staggered antennas).

**NOTE:** It is preferable to use the minimum number of TDM slots to minimize the (repeating) time length of the MPTAS and maximize handshake count.

#### ***Along track alignment***

The capture zone created by an antenna is a function of tuning, tilt angle, antenna used, height and reflective properties of the site. There is no single value that can be used to define the alignment of the antenna center to the capture zone. As a guideline nominally 75% of the Capture zone is in front of the antenna center.

#### ***Multiple readers***

Where multiple readers are on a site, the following additional guidelines apply:

The readers must be synchronized and running the same MPTAS configuration, or compatible MPTAS configurations.

#### ***Installing the MRFM-S modules***

**Note:** MRFM-S modules can be replaced while the Reader is powered on and the DSM energized.



#### **CAUTION:**

To avoid damaging the modules, ensure that alignment of both the connector on the module and the connector on the DSM (backplane) is correct before securely plugging the module into the DSM.

1. Insert the required number of MRFM-S Modules into the Reader and secure in place.
2. Label the front panel of each MRFM-S Module with the corresponding lane number and antenna type.

#### ***Installing the RF cables***



#### **CAUTION:**

Excessive bending or kinking can damage the RF feedline cables. Do not excessively bend or kink the RF feedline cables while fishing them through the rigid conduit from the antenna to the Reader enclosure.

1. Place the RF feedline cable(s) in position. Use an appropriate cable type (coaxial or Heliax) to ensure the RF feedline cable does not produce a signal loss greater than permitted, see Appendix A RF Cable Specification. Use flexible cable (LMR400 preferred) for the short feedline cable between the circulator and the antenna
2. Using tie wraps, create a service loop of 6 ft. at both ends of the RF feedline cable(s). Trim the excess cable length.
3. Install spiral wraps on the RF feedline cable(s) where necessary to protect it from abrasion.
4. Using marker tie wraps and label sets, label the Reader end of each RF feedline (ex. TX Lane 1 or RX Lane 1), each antenna RF feedline (ex. Tx lane 1 or Rx lane 1).
5. Attach the N-Type male connector to the antenna end of the RF feedline cable(s) . Firmly crimp the male connector.

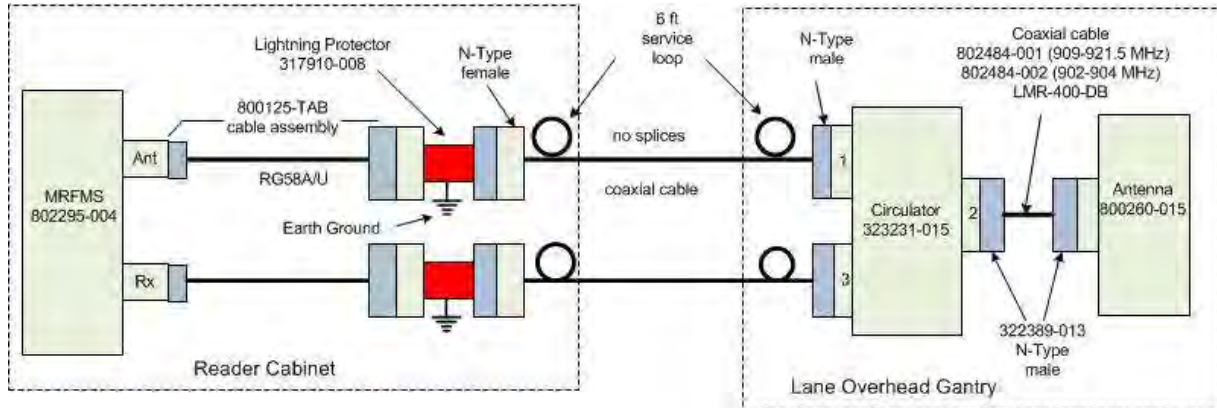
#### **For Bi-Static Operation**

1. See Figure 5-7: RF Cable Installation Schematic Bi-Static Operation
2. Using a 10in-lb torque wrench, connect the first RF feedline cable to the Circulator (Port 1). Using self-amalgamating tape, wrap the connection and the circulator to ensure water cannot enter.
3. Using a 10in-lb torque wrench, connect the second RF feedline cable to the Circulator (Port 3). Using self-amalgamating tape, wrap the connection and the circulator to ensure water cannot enter.
4. Using a 10in-lb torque wrench, connect a third (39 inch long) RF feedline cable to the Circulator (Port 2). Using self-amalgamating tape, wrap the connection and the circulator to ensure water cannot enter.
5. Using a 10in-lb torque wrench, connect the other end of the third (39 inch long) RF feedline cable that is connected to Port 2 of the Circulator, to the antenna. Using self-amalgamating tape, wrap the connection to ensure water cannot enter.
6. Attach the N-Type female connector to the reader end of the first RF feedline cable. Firmly crimp the female connector.
7. Using a 10in-lb torque wrench, connect the other end of the first RF Feedline cable that is connected to Port 1 of the Circulator, to the RF Adaptor Cable (800125-001), that will be connected to the "Antenna" Port of the MRFM-S.
8. Attach the N-Type female connector to the reader end of the second RF feedline cable. Firmly crimp the female connector.
9. Using a 10in-lb torque wrench, connect the other end of the second RF Feedline cable that is connected to Port 3 of the Circulator, to the RF Adaptor Cable (800125-001), that will be connected to the "RX" Port of the MRFM-S.
10. Using an SMA wrench, connect each RF Adapter Cable(s) (800125-001) SMA connector to the assigned MRFM-S module port(s).
11. Tie all RF Adapter cables neatly and label both ends of each adapter cable.
12. Secure the service loop portion of the feedline to the antenna-mounting bracket using the tie wraps. Do not severely bend or kink the RF feedline cable.

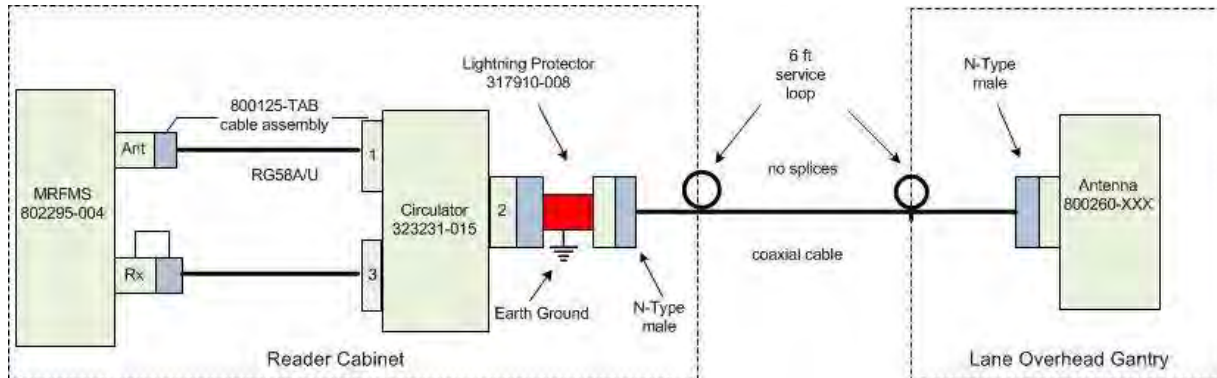
**Note:** For a TDM and/or 6C protocol configuration (i.e., no other passive protocols), the Circulator can be located in the cabinet with the reader and one RF feedline cable is connected between port 2 of the Circulator and the antenna. Ports 1 and 3 of the circulator are then connected to the RF modules using the RF Adaptor Cables (800125-001).

**Note:** The circulators are weather resistant, but should be entirely wrapped in self-amalgamating tape to ensure a water tight seal.

**Figure 5-7: RF Cable Installation Schematic Bi-Static Operation**



**Figure 5-8: RF Cable Installation Schematic Bi-Static TDM Only Operation**



## Use of the RF amplifier

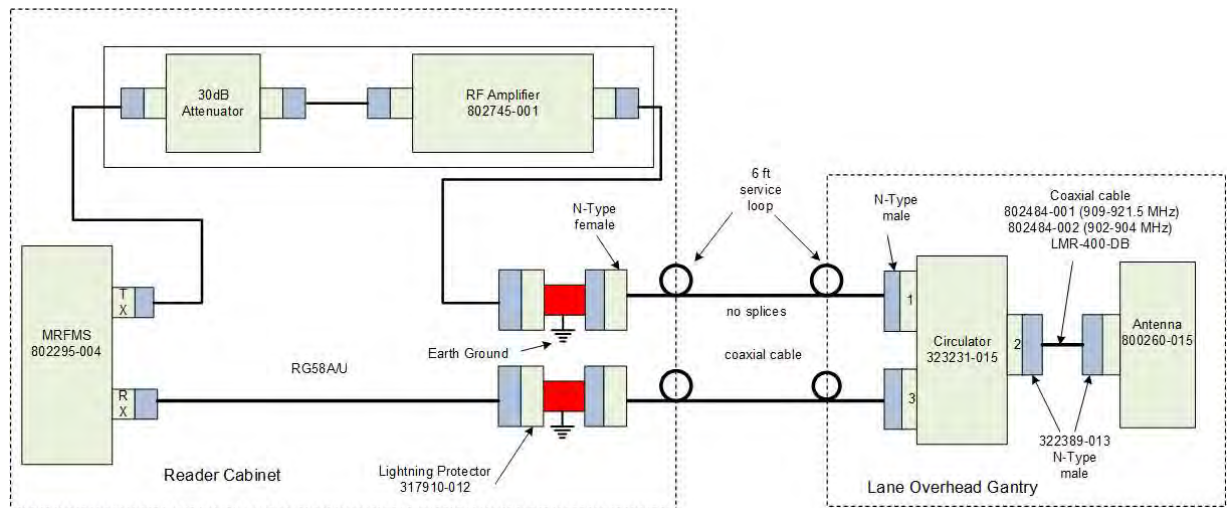
The maximum cable loss and associated maximum cable length, as defined in the RF Cable Specifications on page 259, is based on the output power of the MRFM-S module and the sensitivity of



the transponders. When the site specific application exceeds the limits defined on page 259, an amplifier assembly can be used to effectively increase the output power of the MRFM-S module an additional 6dB. This 6dB is then used to increase the maximum cable loss permitted as defined on Page 259.

Use of this amplifier should be reviewed with Kapsch personnel before implementation. Figure 5-9 shows a typical installation that includes the use of the power amplifiers.

**Figure 5-9: RF Cable Installation Schematic Bi-Static Operation with RF Amplifier**



## Performing Lane Tuning

Lane Tuning consists of selecting the frequencies to be used on the channels and setting the attenuation for the channels to control the ERP of the reader. These are configured using the web interface. It is recommended that Kapsch Services perform lane tuning to properly configure a site. If the integrator/operator wishes to perform the lane tuning, the following guidelines apply.

The same FDM channel frequency should not be used on adjacent lanes, including straddle and shoulder (recommended at least 24ft. separation between antennas for in-line antennas, 21ft (18ft lateral) between antennas for staggered antennas).

Two TDM channels that are configured active in the same time slot should not be used on adjacent lanes, including straddle and shoulder (recommended at least 24 feet separation between antennas, 21ft (18ft lateral) between antennas for staggered antennas).

The TX attenuation should be adjusted to obtain capture zones nominally 8 to 12 ft. (1.83 to 2.44 m.) along direction of vehicle traffic.

**ATTENTION:** When installing or replacing a MRFM-S, RF cables, circulator, or antenna, the lane must be re-tuned.

## The Synchronization circuit

Synchronization is required between readers located within reader-reader interference range, or which have overlapping or near-adjacent capture zones, or which may have RF signal reflections (interference) due to any one or combination of varying vehicle sizes, varying traffic patterns or fixed site terrain features. The sync feature eliminates interference between the readers that might otherwise reduce system performance. The synchronization circuit connects SPMs together in a star network. The CTM does the synchronization of the RF module interrogation.

Prerequisites: Sync hub terminal block mounted in a location central to the Readers.

**Note 1:** The exact location of this terminal block should be marked on a site map to aid system maintenance.

- Readers arranged so that no Reader is farther than 1500 ft. (457.2 m.) from the sync hub terminal block
- Readers arranged so that the total synchronization network cable length is no greater than 2000 ft. (609.6m.).
- No more than six (6) Readers in the synchronization circuit

**Note 2:** It is recommended that each synchronization cable have two or more spare conductors to support future service repair calls.

### Installing a synchronization circuit

1. Connect the Readers to the Sync hub terminal block as in Figure 5-10 on page 183.

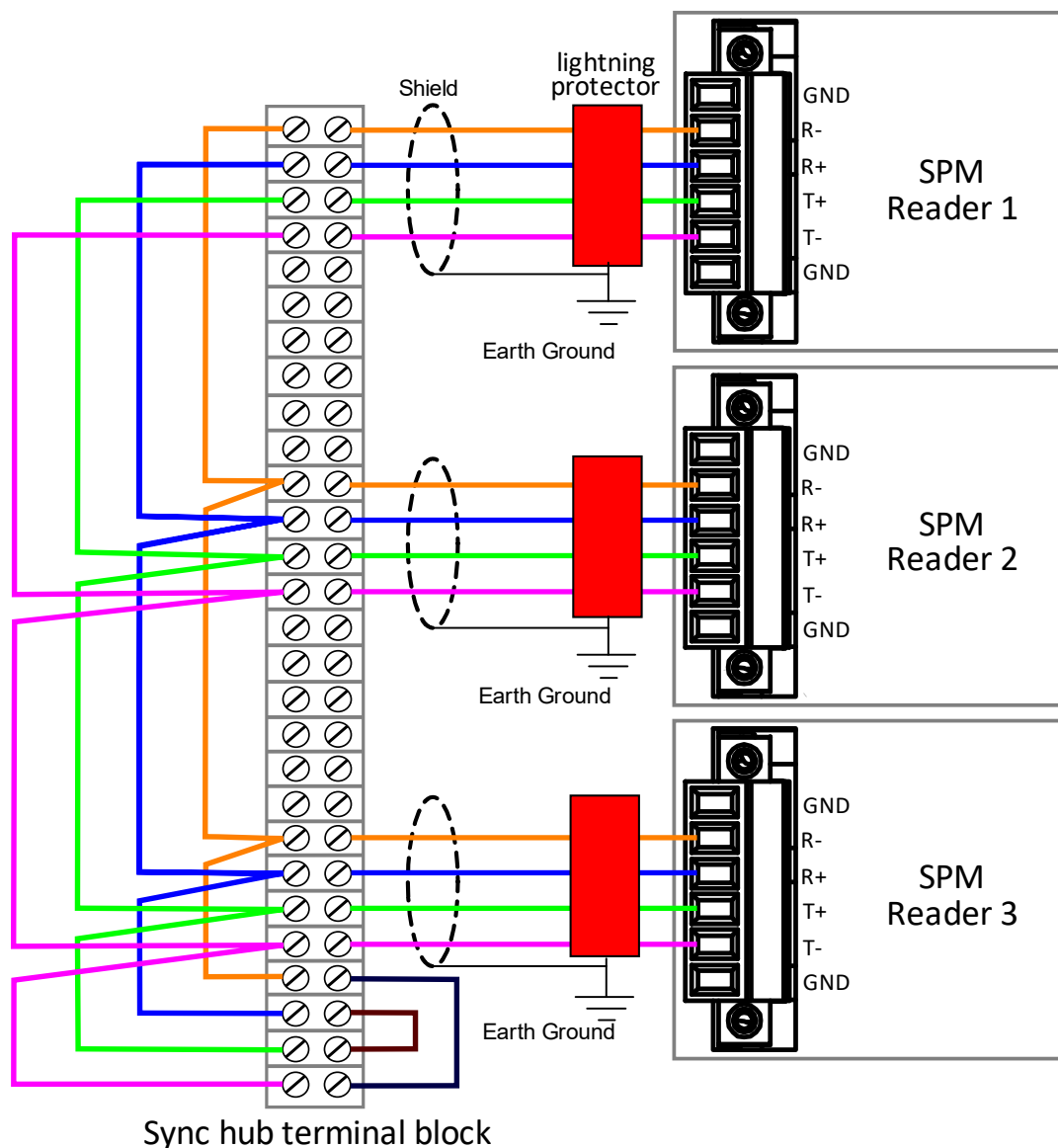
**Attention:** Ensure that cables do not connect from the GND terminal on the SPM to the Sync hub terminal block, as this can create a ground loop and affect synchronization performance.

**Note:** Before you continue, you will need to gain access to the CTM web interface through a computer or service laptop connected to the Ethernet 1 port or the USB port of the Reader. See the following procedures for more information.

- Connecting a service laptop to the Reader on page 43
- Changing the service laptop IP address on page 43
- Testing the connection to the reader on page 43
- Accessing the CTM web interface on page 43



Figure 5-10: Synchronization circuit schematic for three Readers



**Note:** Up to six (6) Readers can be added to a synchronization circuit.

#### **Synchronization between MPR 2.3 Readers**

All Readers in a synchronization circuit must be configured correctly for synchronization to work.

### Configuring synchronization

Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface.

See the following procedures for more information.

- Connecting a service laptop to the Reader on page 43
- Changing the service laptop IP address on page 43
- Testing the connection to the reader on page 43
- Accessing the CTM web interface on page 43
- Synchronization rules on page 77

**Note:** Reader synchronization is also enabled remotely by the LC if the Remote LC Configuration is enabled.

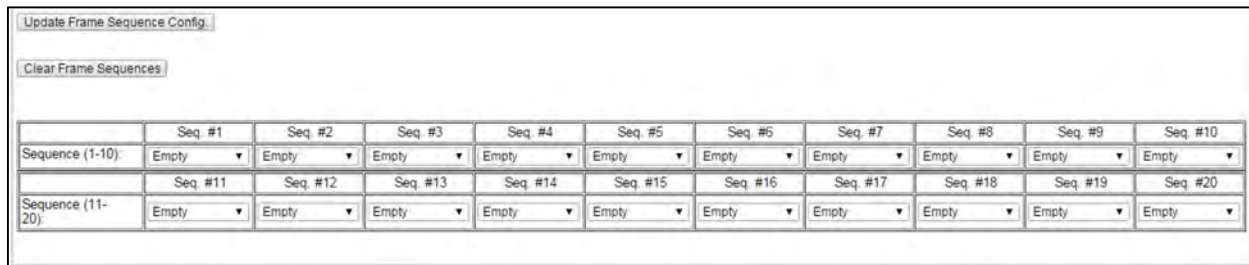
**Example:** TDM only 2 Lane ORT with Shoulders (5-Channel scan) and synchronization.

- **Frame sequence** tab: Seq #1 set to TDM, Seq#2 set to Sync\_1, all others set to empty
- **Sync** tab: Sync enabled and Sync\_1 set. Verify the Sync parameters.

**Note:** The following procedure indicates how to compose the given example.

1. Select the **Configuration** link on the left side panel.
2. Select the **Frame Sequence** tab.

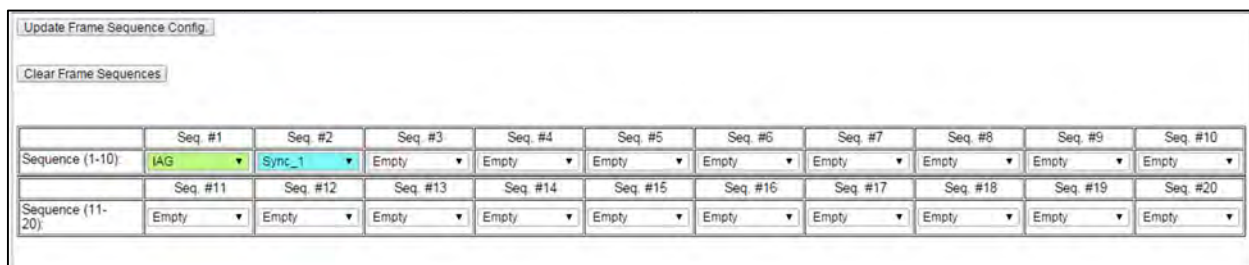
**Result:** The following screen appears.



	Seq #1	Seq #2	Seq #3	Seq #4	Seq #5	Seq #6	Seq #7	Seq #8	Seq #9	Seq #10
Sequence (1-10):	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty
	Seq #11	Seq #12	Seq #13	Seq #14	Seq #15	Seq #16	Seq #17	Seq #18	Seq #19	Seq #20
Sequence (11-20):	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty

3. Set sequence tab: Seq #1 set to TDM; Seq #2 set to Sync 1. Set all remaining Seq #'s to EMPTY if not already indicated and then click the **Update Frame Sequence Config.** button.

**Result:** The following screen is shown as an example.



	Seq #1	Seq #2	Seq #3	Seq #4	Seq #5	Seq #6	Seq #7	Seq #8	Seq #9	Seq #10
Sequence (1-10):	IAG	Sync_1	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty
	Seq #11	Seq #12	Seq #13	Seq #14	Seq #15	Seq #16	Seq #17	Seq #18	Seq #19	Seq #20
Sequence (11-20):	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty	Empty

4. Select the **Sync** tab and set the Sync parameters.

**Result:** The following screen is shown as an example.

Reader-to-Reader Sync. Enable: <input checked="" type="checkbox"/>					
Sync. Recovery Attempt Limit: 0					
		Sync_1	Sync_2	Sync_3	Sync_4
Enable Custom Sync Timing:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sync. Search Time (us):	100				
Sync. Recovery Time (ms):	23				
Sync. Frame Start Delay (us):	0				
Sync. Delay (ns):	0	0	0	0	0
Enable Sync-On-Skipped-Sync Sequencing:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

## The Ethernet Network

These are general instructions for using Ethernet Switch Modules (ESMs) to create an Inter-Reader (IR) Ethernet network or a Lane Controller (LC) Ethernet network.

### Installing an Ethernet network

Prerequisites: ESMs mounted according to the manufacturer's instructions.

1. Use CAT 6 Ethernet cables to connect the components in the Ethernet network together as shown in the examples in Figure 5-10. Consult the ESM manufacturer's instructions for more details.

**Figure 5-11: Schematic of a three-Reader IR network**

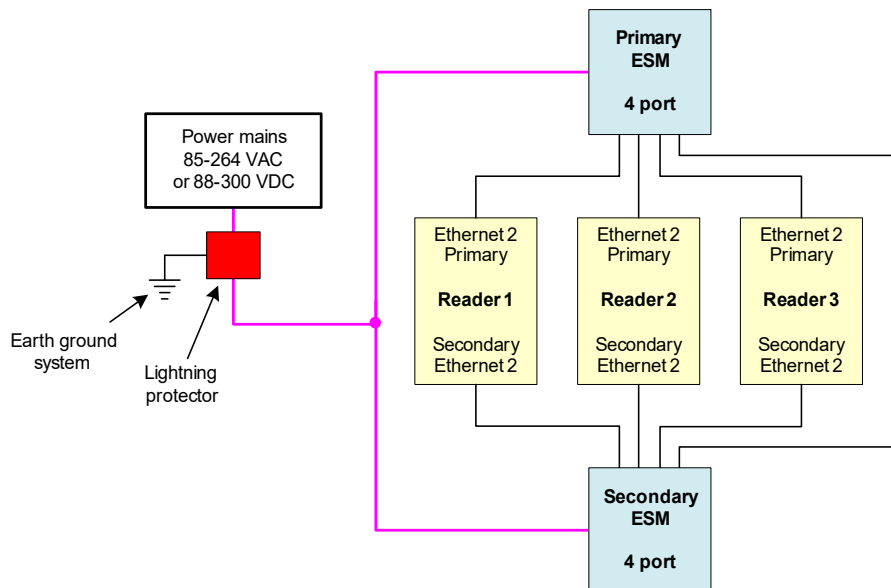
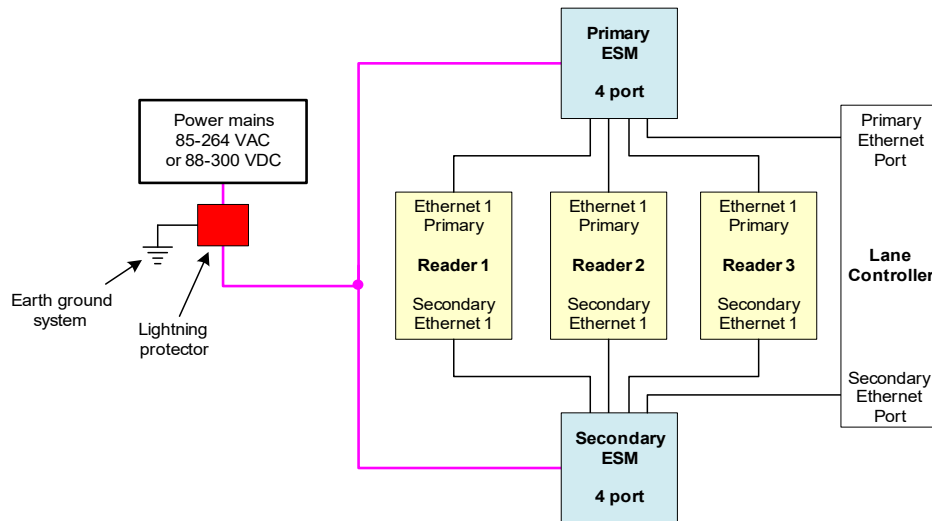


Figure 5-12 Schematic of a three-Reader LC network



## Reader connections to the LC via the LPM serial ports

Each of the RF channels has an associated serial port on the LPM that connects to an LC.

### Configuring reader connections

The following steps provide information on configuring the reader connections to the LC via the LPM serial ports.

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43. You must have **Advanced User** permissions.

1. Determine your Reader's communications protocol. It will be either RS-232 or RS-422.
2. Select the **Configuration** link on the left side panel.
3. Click the **LC** tab.

**Result:** The following screen appears.

Allow Remote LC Configuration:	<input checked="" type="checkbox"/>
Status Message Buffering:	<input type="checkbox"/>
Initial Read Report (IREAD) Message Buffering:	<input type="checkbox"/>
LC Ethernet TCP-Socket Local Port:	8888
LC Ethernet TCP-Socket Timeout [ms]:	500
Heartbeat Message:	
Send Heartbeat Messages:	<input type="checkbox"/>
Reporting Formats:	
Use RFP-Compliant Message Format:	<input type="checkbox"/>
Toll Rate / Balance Adjustment Tag Report Format:	Toll Rate / Balance Adjustment Format ▼
Reporting:	
	IAG 6B 6C Allegro ATA SeGo
Voting Report:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Generate Initial Report:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Raw Handshake Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Generate Post-Capture-Zone Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Generate Estimated-Vehicle-Speed Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Ch #1 Ch #2 Ch #3 Ch #4 Ch #5 Ch #6 Ch #7 Ch #8
Destination:	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet
Destination IP Address:	0.0.0.0 Port: 0
Set destination IP addresses of all LCs to be same as <input type="text"/> Duplicate	

4. In the **Destination** row, select the **Serial** check box for each RF channel that will communicate with the LC via an LPM COM Port.

**Example:** The following screen shows an example of the assignments.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
Destination:	<input checked="" type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input checked="" type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input checked="" type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input checked="" type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input checked="" type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet
Serial Port:	COM1 ▼	COM2 ▼	COM3 ▼	COM4 ▼	COM5 ▼			
Set destination IP addresses of all LCs to be same as <input type="text"/> Duplicate								

5. From the **Serial Port** dropdowns, select an LPM port for each RF channel to use to communicate with the LC.

**Note 1:** By default, RF Channel 1 communicates with the LC via LPM COM 1, RF Channel 2 communicates with the LC via LPM COM 2 and so on, up to RF Channel 8. Do not enable both serial and Ethernet LC.

**Note 2:** More than one RF Channel can communicate via one LPM COM port, if necessary.

6. Click the **Serial** tab on the **Configuration** page.

**Result:** The following screen appears.

LC Retry Timeout [ms]:	1000
	COM1 COM2 COM3 COM4 COM5 COM6 COM7 COM8
Serial Port State:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Baud Rate:	19200 ▼
Data Bits:	8 ▼
Parity:	None ▼
Stop Bits:	1 ▼

7. Ensure all the COM Ports selected in step 5 are enabled by selecting the corresponding **Serial Port State** check box.
8. Select the **Baud Rate**, **Data Bits**, **Parity**, and **Stop Bits** to match the LC communication settings.

**Example:** An example of what your screen may look like after selection.

LC Retry Timeout [ms]:	1000							
	COM1	COM2	COM3	COM4	COM5	COM6	COM7	COM8
Serial Port State:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Baud Rate:	19200 ▼	19200 ▼	19200 ▼	19200 ▼	19200 ▼	19200 ▼	19200 ▼	19200 ▼
Data Bits:	8 ▼	8 ▼	8 ▼	8 ▼	8 ▼	8 ▼	8 ▼	8 ▼
Parity:	None ▼	None ▼	None ▼	None ▼	None ▼	None ▼	None ▼	None ▼
Stop Bits:	1 ▼	1 ▼	1 ▼	1 ▼	1 ▼	1 ▼	1 ▼	1 ▼

Refer to the Configuring the Reader to switch over automatically when an LC link is down procedure on page 235 to configure the Reader to switch over when the connection from the LPM to the LC is down.

## Reader connections to the LC and Inter-Reader via Ethernet

### Reader IP addresses

Each ethernet port in an IR or LC network must have a unique IP address. The IP addresses should be set as required for the site network topology. Default reader IP addresses are:

Primary and secondary Ethernet 1 port: **192.168.1.50**

Primary side Ethernet 2 port: **192.168.0.50**

Secondary side Ethernet 2 port: **192.168.0.51**

### Setting the reader IP addresses

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

**Note:** A secure record of the IP addresses should be maintained to aid network troubleshooting. The primary and secondary Ethernet 1 IP addresses will be required if requesting remote assistance from Kapsch Service.

1. Select the **Configuration** link on the left side panel.
2. Assign an IP address to the parameter **Ethernet 1 (LC 1Gbps) IP Address** so that the Primary CTM is accessible on the LC network, if necessary.
3. Assign an IP address to the parameter **Ethernet 2 (IRIF 100Mbps) IP Address** so that the Primary CTM is accessible on the IR network, if necessary.
4. Assign an IP address to the parameter **Reader IP Address** for both primary and secondary CTMs on a given Reader so that the Reader is accessible on the IR network, if necessary. This IP address is the same for both CTMs in a Reader.



5. Assign an IP address to the parameter **USB Adapter or Bluetooth IP Address** if a USB adapter is being used to connect a CTM USB port to an Ethernet network.
6. Assign the gateway IP address to the parameter **Default Gateway IP** so that the Reader can communicate via a gateway device such as a router, if necessary.
7. Repeat steps 1 through 6 for the secondary CTM.

### Configuring an LC Ethernet network

The Reader data can also be sent to the LC via an Ethernet network. Note the data can be sent to up to 3 Ethernet destinations

Prerequisites: The service laptop connects to the port and the CTM web accessed. . Refer to Connecting a service laptop to the Reader, page 43. You must have **Advanced User** permissions.

1. Select the **Configuration** link on the left side panel.
2. Click the **LC** tab.
3. In the **Destination** row, select the **Ethernet** check box for each RF channel that will communicate with the LC via Ethernet.

**Result:** The following screen appears.

Allow Remote LC Configuration:		<input checked="" type="checkbox"/>						
Status Message Buffering:		<input type="checkbox"/>						
Initial Read Report (IREAD) Message Buffering:		<input type="checkbox"/>						
LC Ethernet TCP-socket Local Port:		8888						
LC Ethernet TCP-socket Timeout [ms]:		500						
Heartbeat Message:								
Send Heartbeat Messages:		<input type="checkbox"/>						
Reporting Formats:								
Use RFP-Compliant Message Format:		<input type="checkbox"/>						
Toll Rate / Balance Adjustment Tag Report Format:		Toll Rate / Balance Adjustment Format ▼						
Reporting:								
	IAG	6B	6C	Allegro	ATA	SeGo		
Voting Report:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Generate Initial Report:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Raw Handshake Report:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Generate Post-Capture-Zone Report:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Generate Estimated-Vehicle-Speed Report:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
Destination:	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet
Destination IP Address:	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0
Set destination IP addresses of all LCs to be same as <input type="text"/> <input type="button" value="Duplicate"/>								

4. Enter the LC IP address and Port number for each RF channel.
5. If all the RF channels will be communicating with the LC at the same IP address, enter the number of a configured channel in the field beside the **Duplicate** button and then click **Duplicate**.

**Result:** All RF channels selected to communicate over Ethernet will now have the same destination LC IP.

**Note:** When setting the LC Retry Timeout, consider the baud rate used to communicate with the LC and the processing speed of the LC to avoid false failure reports.

- Enter a time, in milliseconds (ms), in the **LC Ethernet TCP-Socket Timeout** field.

**Note:** If an LC does not respond within this time, the Reader will consider Ethernet communications to the LC to be down and could trigger a switchover, depending on the redundancy settings.

### Configuring the Ethernet 1 IP address via the Diagnostic Port

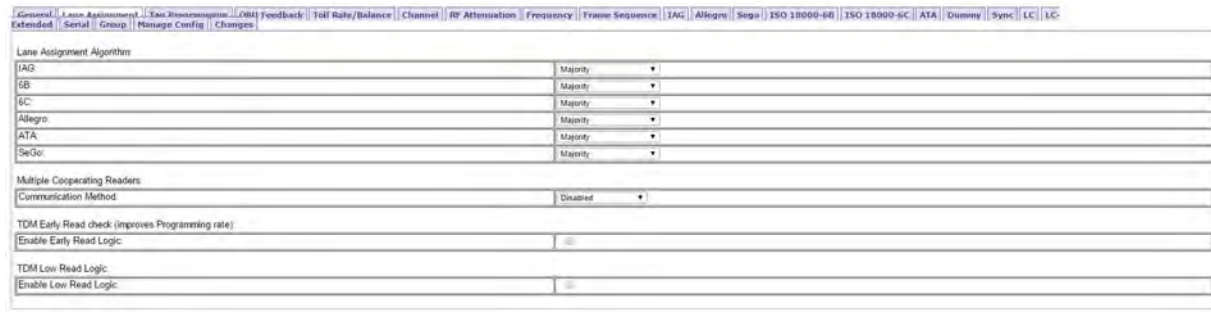
**Attention:** Contact Kapsch Service to set the ETHERNET 1 port IP address via the Diagnostic Port if the IP address has been lost or cannot be determined.

## Lane Assignment

The reader can perform lane assignment (voting) to identify the most probable lane in which the OBU resides. This is used when producing VOTE or POST messages to the Lane Controller. The settings for voting method and voting communication are defined on the Lane Assignment tab, shown below.

- Select the **Configuration** link on the left side panel.
- Click the **Lane Assignment** tab.

**Result:** The following screen appears.



Lane Assignment Algorithms	
IAQ	Majority
SB	Majority
SC	Majority
Allegro	Majority
ATA	Majority
SeGo	Majority

Multiple Cooperating Readers	
Communication Method	Disabled

TDM Early Read check (improves Programming rate): ☐

Enable Early Read Logic: ☐

TDM Low Read Logic: ☐

Enable Low Read Logic: ☐

The Lane Assignment algorithm block allows the voting method to be individually selected for each protocol.

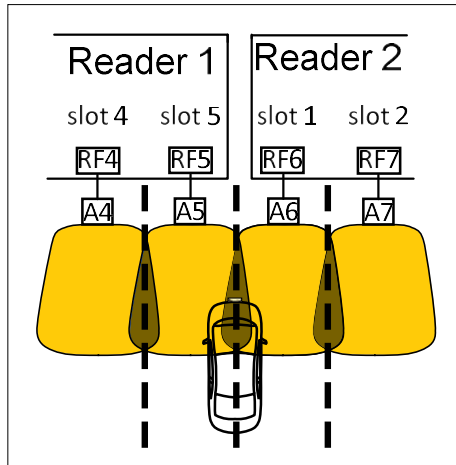
The voting methods are defined in Commands and controls, page 84.



### Multiple Reader Lane Assignment

ORT lanes allow OBUs to cross multiple capture zones which may cross between readers. The Readers should assign an OBU to one RF channel to prevent duplicate transactions.

**Figure 5-13: Two Readers communicating with one OBU**



#### **Selecting the correct communication method between reader**

The communication method determines how Readers communicate with each other to share information for determining lane assignments. This is important for situations similar to that shown in Figure 5-13, where, to assign the OBU to a lane, Reader 1 and Reader 2 need to share handshaking information. The available communication methods are:

**Badger-Style CRA:** there is no physical link between the Readers, such as an IR Network. Instead, the first Reader to contact an OBU, programs the OBU. All other Readers that subsequently contact the OBU recognize it was recently programmed and ignore the OBU.

**Note:** CRA only works on the TDM protocol when it is write enabled.

**Note:** The Reader ID number on the Tag Programming tab must be different for each reader.

**Note:** The Plaza ID number on the Tag Programming tab must be the same for each reader.

**Note:** The readers must be time synchronized

**Note:** The transponder timeout, set in the Group tab on the Configuration page, must be greater than the time difference between all Reader clocks in the network.

**Ethernet:** An IR Ethernet network connects the Readers together and handshaking information is shared between Readers. The Readers assign the OBU to one channel and all other transaction reports from other Readers are suppressed.

**Note:** The Reader ID number on the Tag Programming tab must be different for each reader.

**Note:** The Plaza ID number on the Tag Programming tab must be the same for each reader.

**Note:** The readers must be time synchronized

**Note:** The transponder timeout, set in the Group tab on the Configuration page, must be greater than the time difference between all Reader clocks in the network.

**Note:** Multiple (voting) group IDs are not supported across multiple Readers.

### Configuring Lane Voting over an Inter-Reader (IR) network

This procedure allows you to configure the Reader correctly to ensure accurate lane assignment and to prevent duplicate reports.

**Prerequisites:** Connect the service laptop to the Reader Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface. And select the Lane Assignment tab.

Refer to Connecting a service laptop to the Reader, page 43. You must have **Advanced User** permissions.

1. On the Lane Assignment tab select **Ethernet** from the **Communication Method** drop-down box.

**Result:** The following screen appears.

Lane Assignment Algorithm:	
IA/G:	Majority ▼
GB:	Majority ▼
GC:	Majority ▼
Allegro:	Majority ▼
ATA:	Majority ▼
SeGo:	Majority ▼
Multiple Cooperating Readers:	
Communication Method:	Ethernet ▼
Cross-Reader Reporting:	Disabled ▼
IRIF Timeout (ms) make sure the TTC values of all IRIF readers are the same	50
Enable Left Reader:	<input type="checkbox"/>
Enable Right Reader:	<input type="checkbox"/>

**Configure how multiple transactions are reported to the LC in IR network:**

To send one transaction report per OBU to the LC without informing the LC of suppressed reports, select **Disabled** from the **Cross-Reader Reporting** drop-down box.

To send all transaction reports (one per reader) for an OBU to the LC, select **Report All** from the **Cross-Reader Reporting** drop-down box.

To send one transaction report per OBU to the LC and also inform the LC of suppressed reports, select **Report Non-zero** from the **Cross-Reader Reporting** drop-down box.

**Configuring the IR network topology**

It is necessary to tell the readers cooperating on the IR network about each other via the configuration settings.

Each reader can communicate to one reader on its “Left” and one reader on its “Right”. Each can be separately enabled. The reader on which the network settings are being entered is the “Center” from its own perspective but will be Left or Right reader to the adjacent readers.

**Left Reader:** The Left Reader is the reader whose highest channel number antenna is adjacent to the antenna with the lowest channel number on the Center Reader.

**Right Reader:** The Right Reader is the reader whose lowest channel number antenna is adjacent to the antenna with the highest channel number on the Center Reader.

**Note:** While the MPR2.3 supports separating the antenna position from the channel order, in order to use IR the antenna order must be matched to channel order and run from left to right (or right to left) in the IR cooperating readers.

Both the primary and secondary CTM in a redundant reader must be assigned the same IP in the IR network. This ensures switch-over between the two happens transparently to other readers in the same network.

**Note:** A single (voting) Group ID must be used in each reader

**Note:** The transponder timeout values for the (voting) Group IDs must be the same across all readers.

**Note:** The transponder timeout, set in the Group tab on the Configuration page, must be greater than the time difference between all Reader clocks in the network.

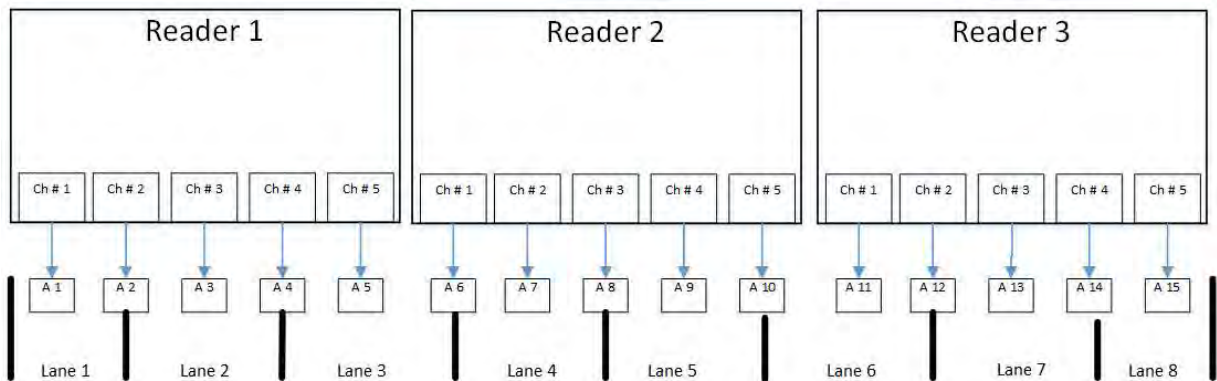
**Note:** The protocol and tag programming settings must be the same on each reader for the protocols involved in the IR network

**Note:** A reader restart is usually required when the IR network configuration is completed on all readers

The following example shows how to configure the IR network based on where the Reader sits in the site.

**Example:** Reader 1 in Figure 5-14 has a Reader on its right (Reader 2) but no Reader on the left. Reader 2 in Figure 5-14 has a Reader on its right (Reader 3) and a Reader on its left (Reader 1). Reader 3 in Figure 5-14 does not have a Reader on its right but has one on its left (Reader 2).

**Figure 5-14: Three readers covering one direction of wide lane ORT traffic**



1. Select a set of unique IP addresses, one per reader for the IR Network.
2. Set the **Reader IP Address** on the **General** tab to the chosen address for the reader.

**Note:** The Reader IP Address applies to the whole Reader and not individual Ethernet ports. You can view the Reader IP address in the General tab of the Configuration page.

3. Select the **Lane Assignment** tab
4. On the Lane Assignment tab select **Ethernet** from the **Communication Method** drop-down box.

**Result:** The following screen appears.

Lane Assignment Algorithm:	
IAG:	Majority ▼
EB:	Majority ▼
EC:	Majority ▼
Allegro:	Majority ▼
ATA:	Majority ▼
SeGo:	Majority ▼
Multiple Cooperating Readers:	
Communication Method:	Ethernet ▼
Cross-Reader Reporting:	Disabled ▼
IRIF Timeout [ms] make sure the TTC values of all IRiF readers are the same	50
Enable Left Reader:	<input type="checkbox"/>
Enable Right Reader:	<input type="checkbox"/>

5. If there is a Reader on the left, select the **Enable Left Reader** check box. Thus for this example this must be done on both Reader 2 and Reader 3 (reader 2 is left reader to Reader 3)
6. Enter the Reader IP Address of the left Reader.
7. Press Enter or select a different tab.

8. If there is a Reader on the right, select the **Enable Right Reader** check box. Thus for this example this must be done on both Reader 1 and Reader 2 (reader 3 is right reader to Reader 2)
9. Enter the Reader IP Address of the right Reader.
10. Press Enter or select a different tab.
11. To set the Reader to switchover when an IR link is down, see the Configuring events that cause a switchover procedure, page 234.

To ensure correct operation it is also necessary to:

12. Configure **Tag Programming** (see Programming on page 69) ensuring that:
  - TMP and TCP are enabled
  - The Plaza IDs of all Readers at the plaza match
  - The Reader ID for each Reader is different. Note to change the reader ID you must enable TDM write and Traffic Management Mode
13. Configure the Reader clocks in the IR network to have the same time (see NTP Server, page 246).
14. From the **Channel** tab on the **Configuration** page, ensure all channels covering one direction of traffic have the same (voting) Group ID.

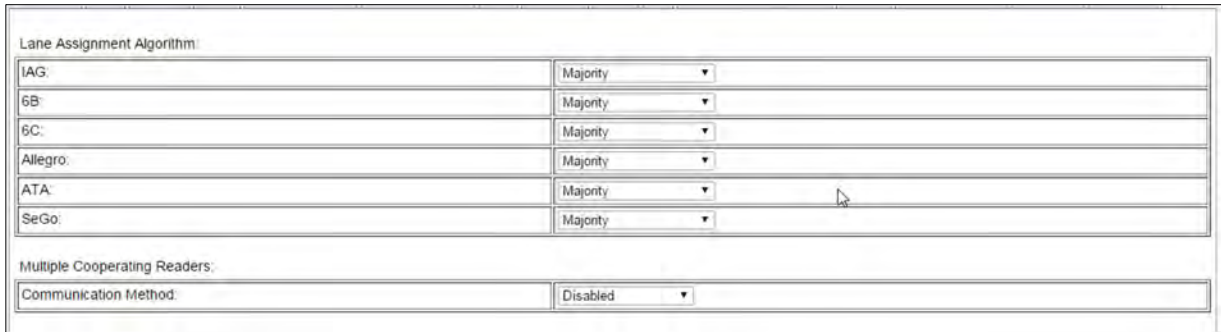
### Configuring Badger-style Cross Reader Algorithm (CRA) communication

Prerequisites: Connect the service laptop to the Reader Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43.

1. Select the **Configuration** link on the left side panel.
2. Click the **Lane Assignment** tab.

**Result:** The following screen appears.



Lane Assignment Algorithm:	
IA.G:	Majority
6B:	Majority
6C:	Majority
Allegro:	Majority
ATA:	Majority
SeGo:	Majority

Multiple Cooperating Readers:	
Communication Method:	Disabled

3. Select **Badger-Style CRA** from the **Communication Method** drop-down box.

**Result:** The following screen appears.

Lane Assignment Algorithm:	
IAG:	Majority ▼
EB:	Majority ▼
EC:	Majority ▼
Allegro:	Majority ▼
ATA:	Majority ▼
SeGo:	Majority ▼
Multiple Cooperating Readers:	
Communication Method:	Badger-Style CRA ▼
Cross-Reader Reporting:	Disabled ▼

4. Configure how multiple transactions are reported to the LC:
  - To send one transaction report per OBU to the LC without informing the LC of suppressed reports, select **Disabled** from the **Cross-Reader Reporting** drop-down box.
  - To send one transaction report per OBU to the LC and also inform the LC of suppressed reports, select **Report Non-zero** from the **Cross-Reader Reporting** drop-down box.

To ensure correct operation it is also necessary to:

5. Configure **Tag Programming** (see Programming on page 63) ensuring that:
  - TMP and TCP are enabled
  - the Plaza IDs of all Readers at the plaza match
  - the Reader ID for each Reader is different
6. the **Channel** tab on the **Configuration** page, ensure all channels covering one direction of traffic have the same (voting) Group ID.
 

**Note:** Multiple (voting) group IDs are not supported across multiple Readers.
7. Set the Reader clocks to within 2 seconds of the same time (either Manually setting the Reader time and date procedure on page 247, or via the LC) or use NTP to time synchronize if there is an NTP server on the LC network.

**Note:** The transponder timeout, set in the Group tab on the Configuration page, must be greater than the time difference between all Reader clocks in the network.

### Selecting the Voting Algorithm

**Prerequisites:** Connect the service laptop to the Reader Ethernet 1 port or via USB-to-Ethernet adapter to access the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43.

Majority: The OBU is assigned to the channel with the most handshakes.

Interpolated: The Reader determines which set of three adjacent channels has the highest handshake count. The OBU is then assigned to the channel within this set with the most handshakes.

**Note:** Interpolated only work if channels are in numerical sequence across a roadway.

1. Select the **Configuration** link on the left side panel.
2. Click the **Lane Assignment** tab.

**Result:** The following screen appears.

Lane Assignment Algorithm:	
IAQ:	Majority ▼
SB:	Majority ▼
SC:	Majority ▼
Allegro:	Majority ▼
ATA:	Majority ▼
SeGo:	Majority ▼
Multiple Cooperating Readers:	
Communication Method:	Disabled ▼

3. Select either **Majority** or **Interpolated** from the drop-down box of the required protocol located in the **Lane Assignment Algorithm** box.

**Note:** If **Interpolated** is selected from the drop-down box, channels with handshake counts that differ less than the Handshake Equalization Ratio will be considered to have an equal handshake count since the difference is not considered significant.

4. If **Interpolated** was selected in step 3, enter a percentage in the **Handshake Equalization Ratio** field.

### Configuring Voting Time

Manually setting a voting time gives a fixed voting time to each channel. Dynamic voting time allows the Reader to calculate and base the voting time on the average capture zone span time (the average time it takes for OBUs to pass through a capture zone).

#### *Manually set the voting time for a channel*

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

1. Select the **Configuration** link on the left side panel.
2. Click the **Channel** tab.
3. In the **Dynamic Voting Control** row, select **Disabled** from the drop-down menu.

**Result:** The following screen appears.



	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

- In the **LPT/FME Voting Time** field enter a voting time in milliseconds, to set the voting time for LPT and FME OBUs.
- In the **Voting Time (all other tags)** field enter a voting time in milliseconds, to set the voting time for all OBUs that are not LPT or FME.
- Click on the **Group** tab.

**Result:** The following screen appears.

NOTE: Inter-reader operation and grouping are not mutually compatible. Do not simultaneously enable grouping and inter-reader operation.

	Group #1	Group #2	Group #3	Group #4	Group #5	Group #6	Group #7	Group #8
Transponder Timeout [s]:	1	300	300	300	300	300	300	300
Programming Timeout [ms]:	100	100	100	100	100	100	100	100

- Enter a time, in seconds (s), in the **Transponder Timeout** field  
**Note:** This specifies an amount of time a transponder must be away from a capture zone before it is reported again as a new transaction when it is detected.
- Repeat steps 4 through 7 to individually configure the other channels, or enter the number of a configured channel in the field beside the **Duplicate** button on the Channel screen.
- Click the **Duplicate** button to configure automatically the remaining channels.

#### **Allowing the Reader to calculate the optimum voting time using Dynamic Voting Control**

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

- Select the **Configuration** link on the left side panel.
- Click the **Channel** tab.

**Result:** The following screen appears.



	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

- Set the **Dynamic Voting Control** to **Reader** to allow the Reader to automatically set the voting time by calculating the average capture zone span time.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Reader ▼	Reader ▼	Reader ▼	Reader ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼
Dynamic Voting Sample Size:	20	20	20	20				
Dynamic Voting Threshold [%]:	20	20	20	20				
Dynamic Voting Capture Zone Span Multiplier:	2	2	2	2				

- Enter a sample size in the **Dynamic Voting Sample Size** field.

**Note 1:** This is the number of previous transactions the Reader includes when calculating the average capture zone span time.

**Note 2:** The Reader calculates the capture zone span time after each OBU transaction. The Reader will not update the Dynamic Voting Time unless the capture zone span time changes more than the Dynamic Voting Threshold percentage.

- Enter a percentage in the **Dynamic Voting Threshold** field.

### Configuring Channel Weight for straddle antennas

The handshake count of straddle channels (channels 2 and 4 in Figure 5-15) typically have less weight assigned to them than non-straddle channels (channels 1, 3, and 5 in Figure 5-15).

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

- Select the **Configuration** link on the left side panel.
- Click the **Channel** tab.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

2. Enter a percentage in the **Channel Weight** field for each channel.

**Result:** The following screen appears.

**Note:** A channel weight of 100% means the full handshake count is considered at voting time, while a channel weight of 50% means only half the handshake count is considered at voting time.

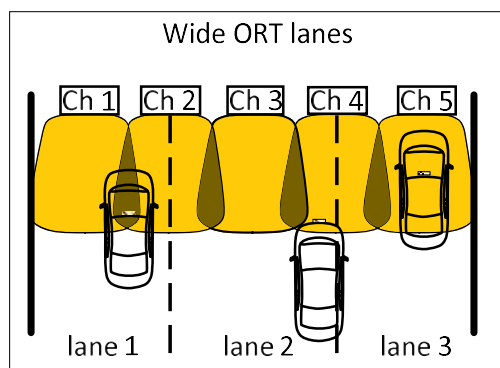
	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
Channel Weight [%]:	100	50	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	2000	3000	0	0	0	0	0	0
Voting Time (all other tag types) [ms]:	6000	2000	0	0	0	0	0	0
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

**Figure 5-15: Three Wide ORT lanes with two straddle antennas**



## 6. TROUBLESHOOTING AND TESTING

### Troubleshooting Methodology

Troubleshooting trees are provided for resolving the most common Reader issues. A **Test and Replace** methodology is used for servicing the Reader system. The general steps are:

1. **Test** all symptoms that may have attributed to the reported system fault. Use the following suggestions to reveal faults:
  - Examine the Reader status on the Reader browser STATUS page (see Reader status, page 49).
  - Examine the RF channel statistics (page 55).
  - Examine the trouble log files for any reported issues with the Reader (page 167).
  - Observe the status LEDs on the Reader front panel (see LED Status, page 203).

**Replace** a suspected faulty component.

**Continue** with symptom testing and component replacement until there are no fault symptoms.

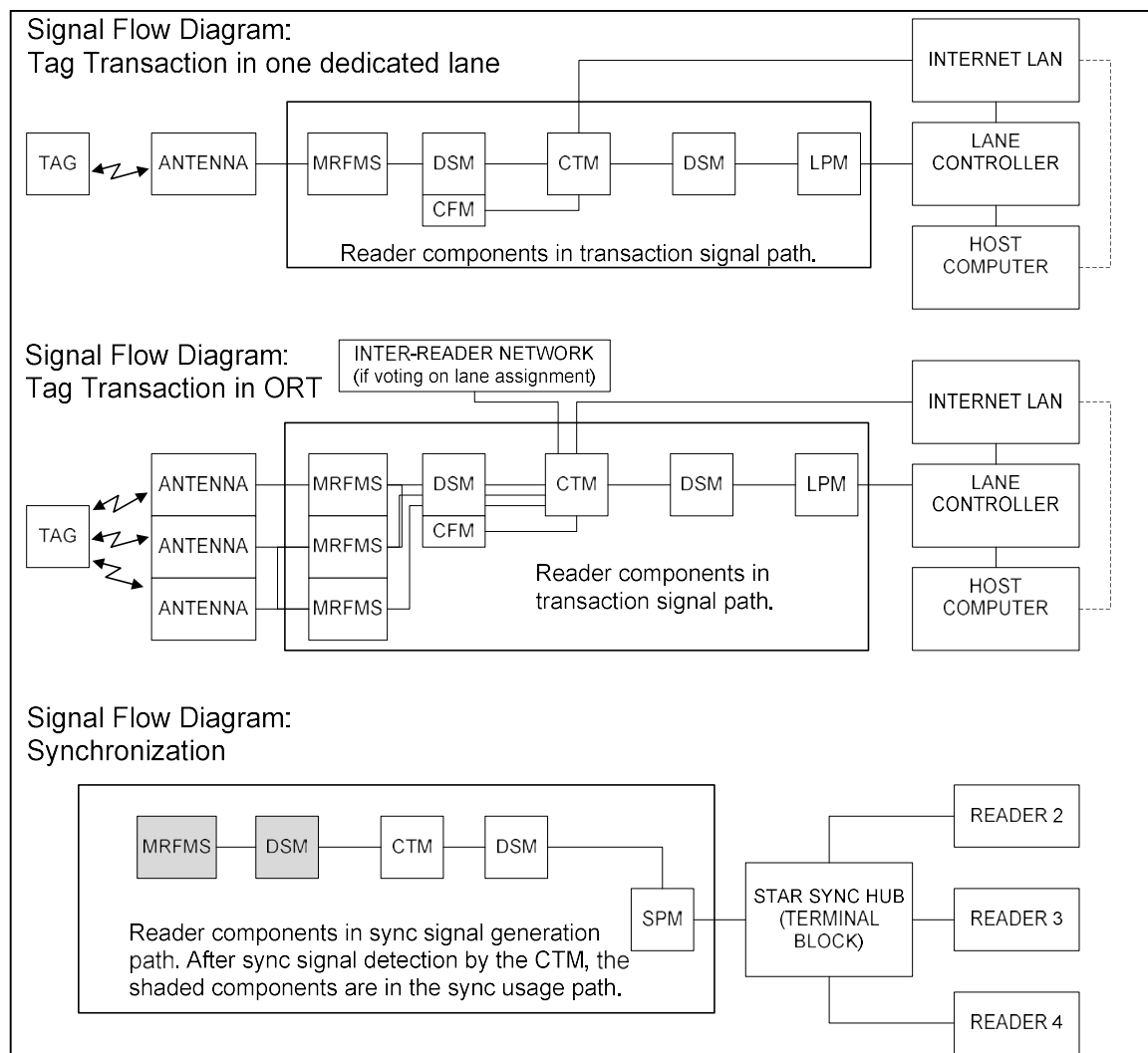


Figure 6-1: Signal Flow Diagrams

## LED Statuses

The following table gives an overview of all the LEDs on the Reader. See the Troubleshooting Trees beginning on page 206 to resolve any issues.

**Table 6-1: CTM LED states explained**

CTM LEDs			
LED	State	Meaning	
CGC	solid green	CGC is functional	
	solid red	CGC has failed	
	solid amber	CGC suspended (i.e., Frame Sequence empty)	
MC	solid green	MC is functional	
	solid red	MC has failed	
SYNC	On the 'Active' CTM	solid green	Reader is synchronized with other readers on the sync network.
		flashing red	Reader out of sync with other readers on the sync network, or,
			No activity detected from other readers on the sync network
		flashing green/orange	Reader is out of sync with other readers on the sync network and attempting recovery
		off	Synchronization is disabled
	On the 'Inactive' CTM	solid green	The inactive side is in sync with the Active side
		flashing red	The inactive side is out of sync with the Active side, or no activity is detected by the active side on the internal sync line.

CTM LEDs		
LED	State	Meaning
	flashing green/orange	The inactive Side is out of Sync with Active side and is attempting recovery.
	off	N/A
ACTIVE	solid green	The CTM is active and in control. This indicates if the primary or secondary side is active.
	solid red	The CTM is not active
POWER	solid green	CTM is receiving power from PSM
	off	CTM is not receiving power from PSM, or,
		CTM reset switch is OFF
ACTIVITY (Ethernet 1)	flashing green	Data is being transmitted via the Ethernet 1 port
	off	Data is not being transmitted via the Ethernet 1 port
ACTIVITY (Ethernet 2)	flashing green	Data is being transmitted via the Ethernet 2 port
	off	Data is not being transmitted via the Ethernet 2 port

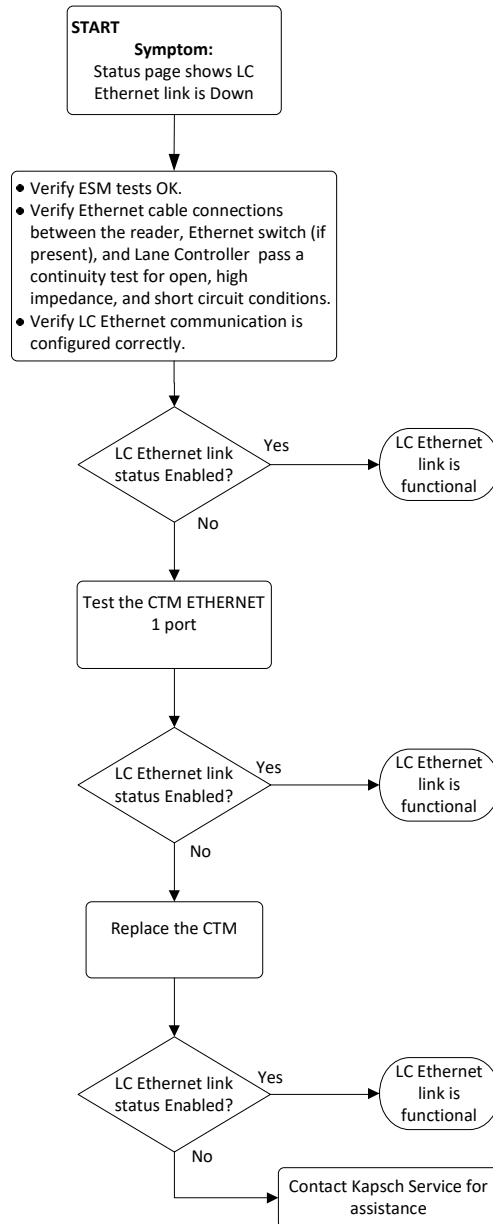
Table 6-2: PSM LED states explained

PSM LED		
LED	State	Meaning
+15 STATUS	solid green	PSM is supplying +15VDC via DSM
	off	PSM is not supplying +15VDC

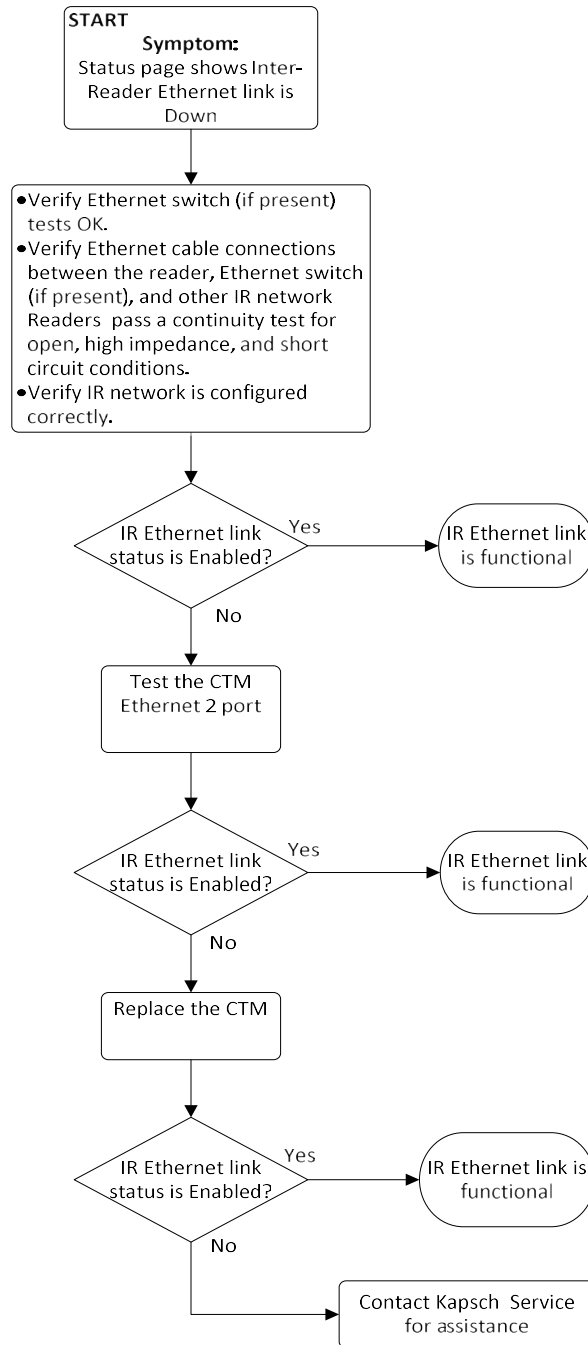
PSM LED		
LED	State	Meaning
+5 STATUS	solid green	PSM is supplying +5VDC via DSM
	off	PSM is not supplying +5VDC

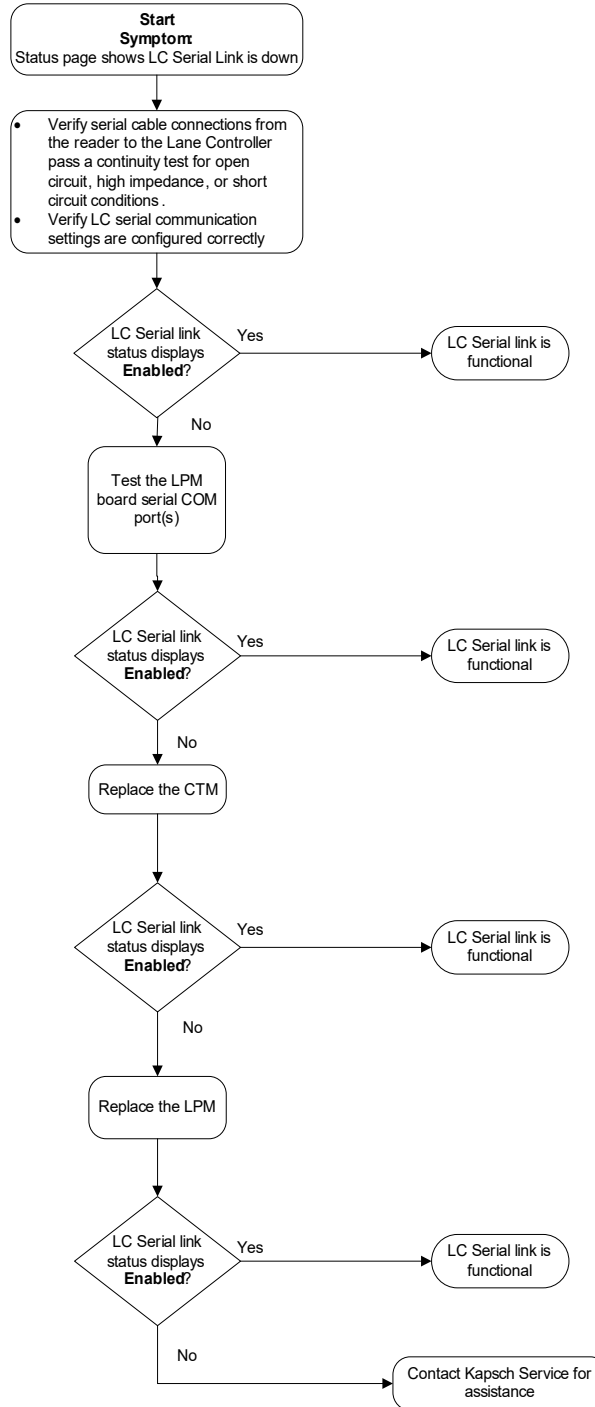
Table 6-3: MRFM-S LED states explained

MRFM-S LED		
LED	State	Meaning
DATA	solid green	MRFM-S is functional
	off	MRFM-S is not enabled

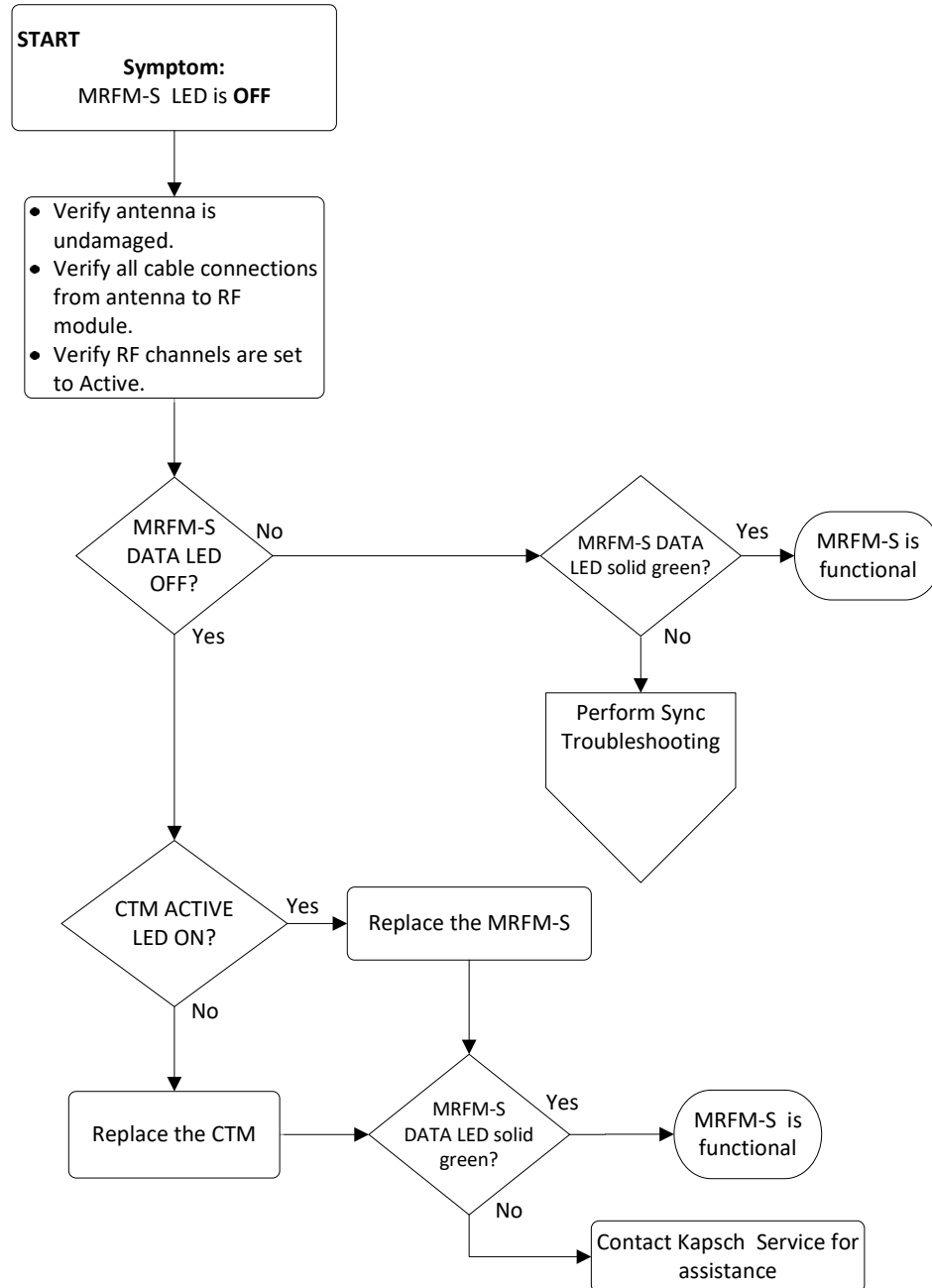
**Troubleshooting tree: LC Ethernet 1 Port communications not working**



**Troubleshooting tree: Ethernet 2 Port communications not working**

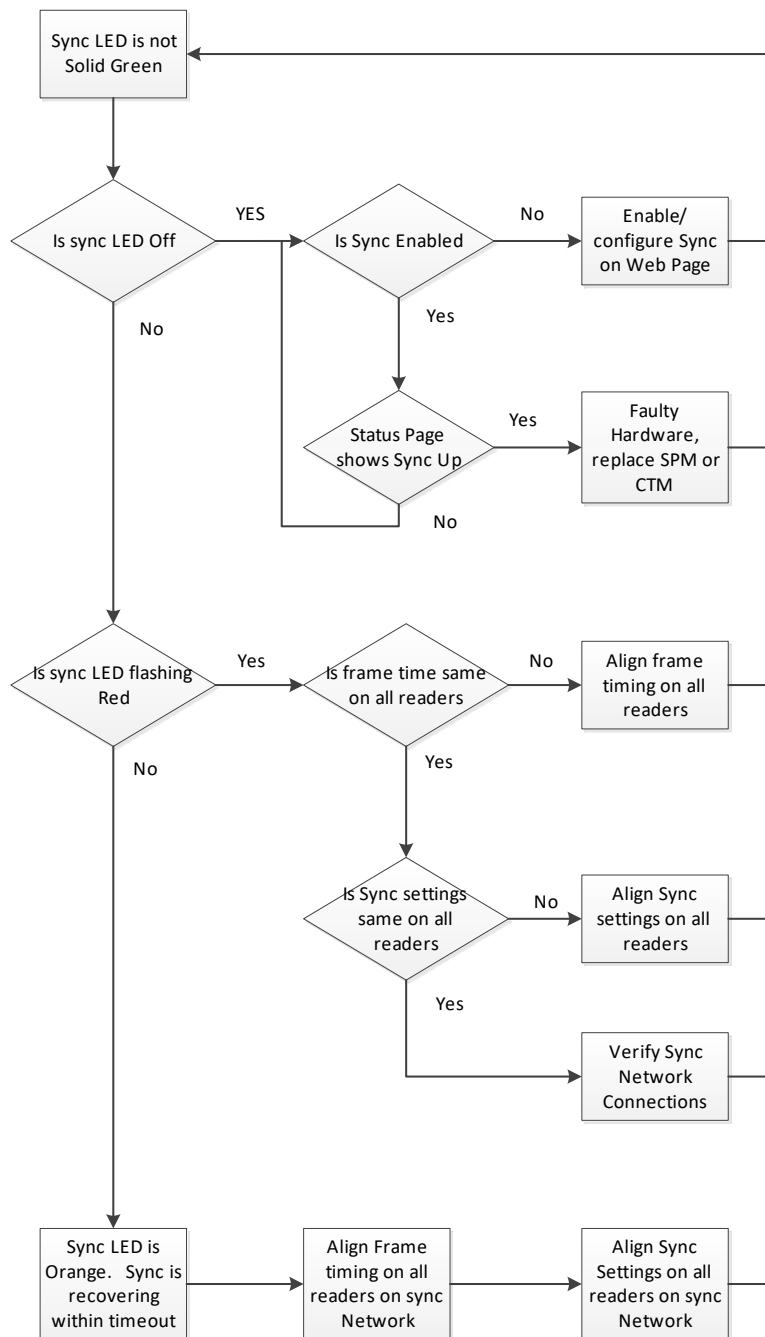
**Troubleshooting tree: LPM Serial Port communications not working**

## Troubleshooting tree: MRFM-S not working

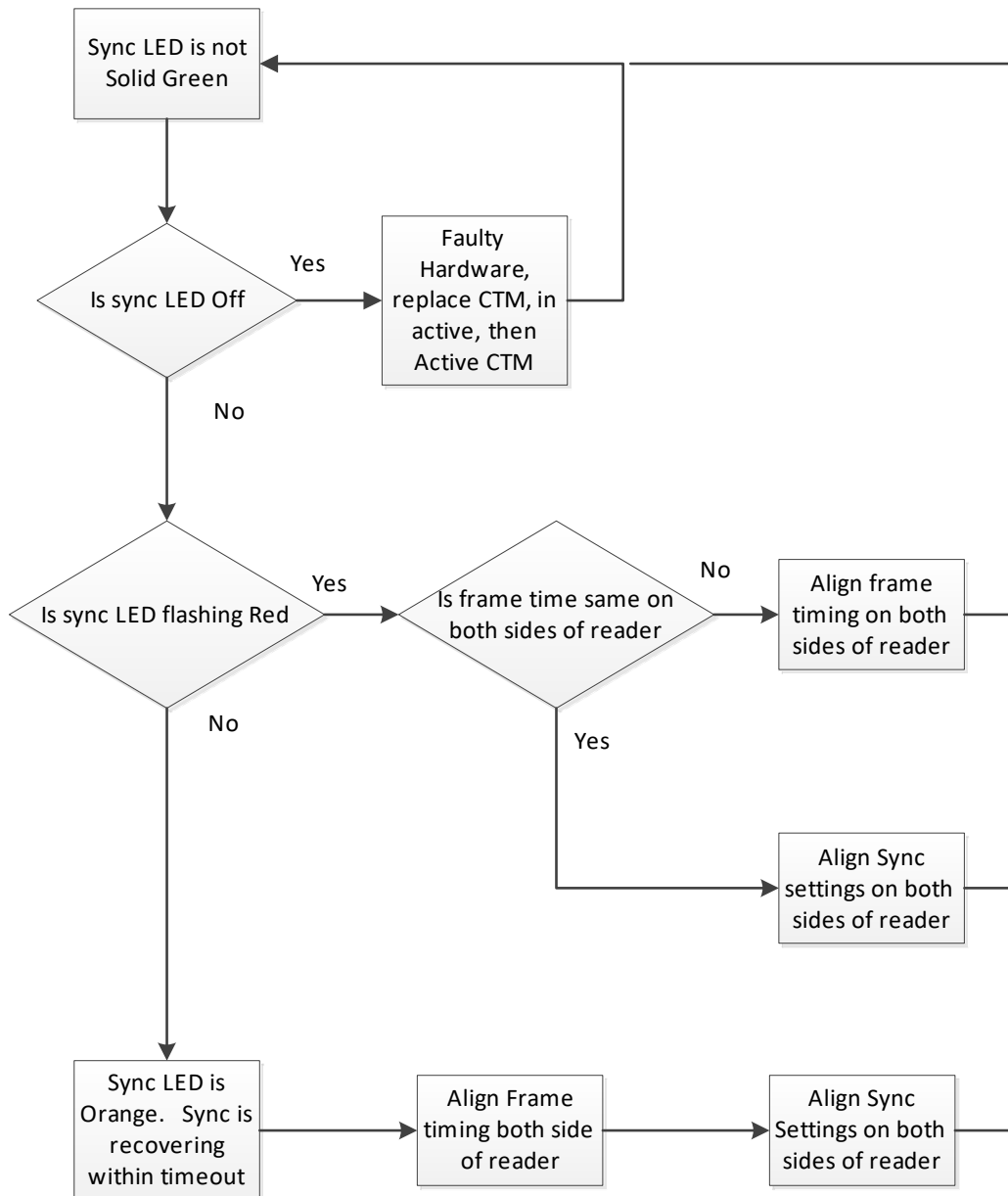


## Troubleshooting tree: Synchronization not working

## Active CTM



## In - Active CTM



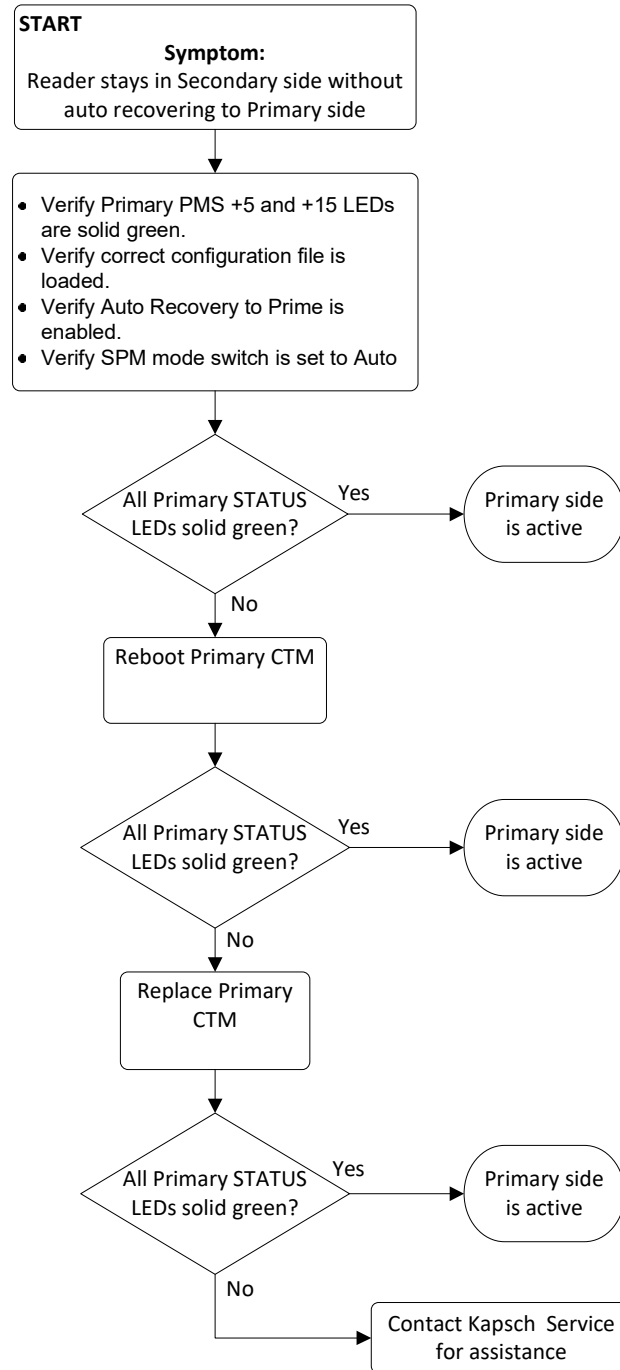
**Constant busy state on sync bus**

A Reader that erroneously holds the sync bus in a BUSY state causes all other Readers connected to the bus to time-out while waiting for the READY state. As a result, all of their CTM SYNC LEDs will be flashing red. Disconnect each Reader one at a time from the sync hub until the fault clears then reconnect each Reader in the order of removal until the fault reappears. Service each faulty Reader.

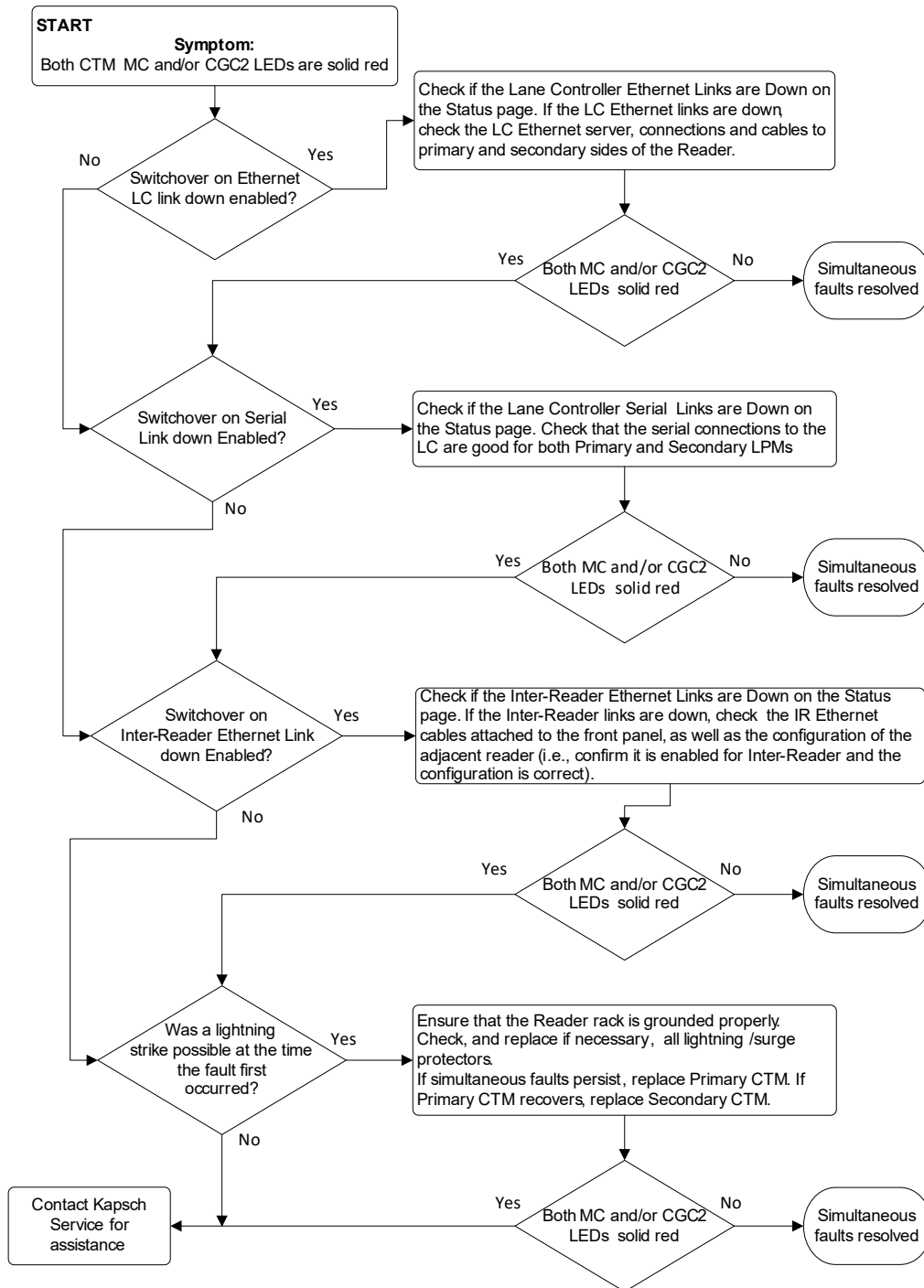
**Sync board Failure Indicator for incomplete cable connections**

The CTM SYNC LED will flash steadily red if there is no activity on the Rx port on the terminal block of the SPM (R+ and R- on the connector). If both transmit and receive connections are cut off from the sync hub the indicator will flash red. If only the transmit connection is disconnected and there are other Readers in the synchronization network, the CTM SYNC LED stays green.

## Troubleshooting tree: Reader does not automatically switch back to Primary side after fault recovery



## Troubleshooting tree: Simultaneous faults on Primary and Secondary CTMs





## Identifying failures on the primary and/or secondary side

Primary and/or Secondary side failure is indicated by any of the following conditions:

- Ethernet LC link down, as indicated on the Reader browser Status page.
- Ethernet IR network link down, as indicated on the Reader browser Status page.
- Primary CTM MC or CGC LEDs are red
- Serial LC link down, as indicated on the Reader browser STATUS page

Primary side failure is indicated by any of the following conditions

- SPM switch is in PRIMARY position: primary CTM ACTIVE LED is red
- SPM switch is in AUTO position: primary CTM ACTIVE LED is red

Secondary side failure is indicated by any of the following conditions:

- SPM switch in any position: secondary MC or CGC LEDs are red
- SPM switch is in SECONDARY position: secondary CTM ACTIVE LED is red
- SPM switch is in AUTO position: primary CTM ACTIVE LED is red and secondary CTM ACTIVE LED is red.

## Events that cause an automatic switchover

Table 6-4 outlines the situations that can cause an automatic switchover and what settings need to be configured for the trigger to be enabled.

**Table 6-4: Switchover triggers**

Event	Cause	Enabling
Failed CGC Health	The Reader continuously monitors the CGC health and forces a switchover if health fails.	Automatic

Event	Cause	Enabling
Failed Serial Lane Controller Link	<p>The Reader forces a switchover when an enabled serial link from the LPM to the LC has been interrupted. Usually a downed link is due to external conditions.</p> <p>Only the lack of OBU transactions in outgoing messages to the LC allows a downed link to be detected. To detect serial cable issues in the absence of OBU transactions, the operator must enable Heartbeat messages</p>	<p>Must enable Switchover on Serial Link Down from <b>General</b> tab on <b>Configuration</b> page</p> <p>Must set LC Retry Timeout from <b>Serial</b> tab on <b>Configuration</b> page</p> <p>Set Heartbeat messages from <b>LC</b> tab on <b>Configuration</b> page</p>
Failed Ethernet Lane Controller Link	<p>The Reader forces a switchover when an enabled Ethernet link has failed. Usually a downed link is due to external conditions.</p> <p>A downed link is detected regardless of whether OBU transactions are being generated or not.</p>	<p>Must enable Switchover on Ethernet LC Link Down from <b>General</b> tab on <b>Configuration</b> page</p> <p>User must set LC Ethernet TCP-Socket Timeout from <b>LC</b> tab on the <b>Configuration</b> page</p>
Failed Inter-Reader Ethernet Link	The Reader continuously checks the link status of the IR network and forces a switchover if it fails.	User must set IRIF Timeout from <b>Lane Assignment</b> tab on <b>Configuration</b> page
Reader Software Update	During activation of a different firmware version, the Reader switches automatically to the redundant side if the redundant side is running and has no switchover conditions present. If the redundant side is not functioning, the Reader warns the operator of potential revenue loss and allows the operator to either continue or abort the update.	Automatic

Event	Cause	Enabling
Lane Controller Reboot	The lane controller protocol allows it to send a reboot request to the Reader. The Reader switches to the redundant side if the redundant side is running and has no switchover conditions present. If the redundant side is not functioning, the reboot is ignored.	User must enable Remote LC <b>Configuration</b> from <b>LC</b> tab on <b>Configuration</b> page
Web Interface Reboot	The web interface provides a reboot button. The Reader switches automatically to the redundant side if the redundant side is running and has no switchover conditions present. If the redundant side is not functioning, the Reader warns the operator of potential revenue loss and allows the operator to either continue or abort the reboot.	Automatic
Reboot using CTM ON/OFF switch	When the CTM ON/OFF switch is manually switched from ON to OFF, the Reader will automatically switch over	Automatic when the switch on the CTM is manually set to OFF
Test Tag failure	When the number of RF channels with failed test tag reaches the set threshold, the Reader will switch over to the redundant side if the redundant side is running and has no switchover conditions present. If the redundant side is not functioning, the test tag failure is ignored.	User must enable Test Tag State for each RF channel from the <b>Test Tag</b> tab on the <b>Configuration</b> page

## Reader recovery actions

For certain failures, the Reader will automatically initiate the recovery actions outlined in Table 6-5.

Table 6-5: Failures and the Reader Recovery Actions they trigger

Failure	Reader Recovery Action
CGC Health failure	reinitializes CGC on failed side
Serial LC link down	re-attempts connection on failed side once every second
Ethernet LC link down	re-attempts connection on failed side once every second or up to 10 seconds based on load
Inter-Reader Ethernet link down	switches to Badger style CRA on failed side to re-attempt connection

## Testing the CTM Ethernet 1 port

This test verifies that a CTM Ethernet 1 port is working properly.

Prerequisites: A service laptop.

1. Connect a service laptop directly to CTM Ethernet 1 port being tested (see Connecting a service laptop to the Reader, page 43).

**Note:** Ensure that you can access the CTM web interface with the service laptop (see Accessing the CTM web interface, page 43). This confirms the Ethernet port is functional.

## Testing an LPM COM port

This test verifies that an LPM port is working properly and requires a simple loop-back connector.

Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43. You must have Advanced User permissions.

**Note:** All OBU transactions on this port are buffered while the LC is disconnected from the LPM ports to perform the test.

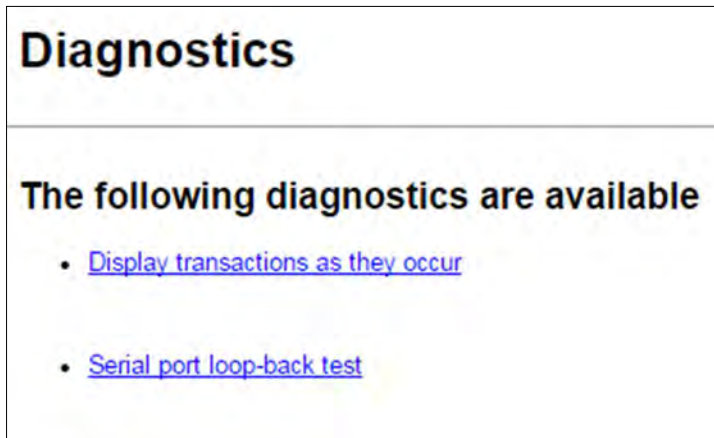
1. Disconnect the serial cable from the LPM COM port being tested.

**Note:** The LPM is either RS-232 or RS-422. The loop-back test will only work if the appropriate loop-back connector is used.

2. Connect the appropriate loop-back connector to the COM port. In the RS-232 loop-back connector, the Tx and Rx signals are connected. In the RS-422 loop-back connector, the Tx+ and Rx+ signals are connected and the Tx- and Rx- signals are connected. The LPM RS-232 pin outs are shown on page 256; the LPM RS-422 pin outs are shown on page 257.

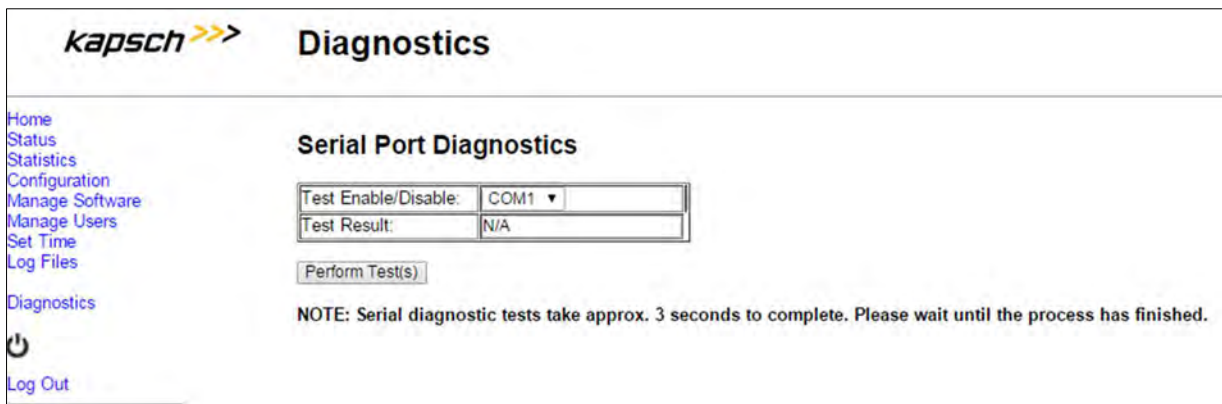
3. Select the **Diagnostics** link on the left side panel of the CTM web interface.

**Result:** The following screen appears.



4. Select the Serial port loop-back test link.

**Result:** The following screen appears.



5. Select the **LPM COM** port from the **Test Enable/Disable** drop-down box.
6. Click the **Perform Test(s)** button.

**Result:** The test result displays.

7. If the test passes, the LPM COM port is functional.
8. If the test fails, ensure the correct loop-back connector was used, then, replace the CTM and repeat steps 4 and 6.
9. If the test fails again, record under what conditions the LPM failed.
10. Replace the LPM.
11. Return failed LPM under the RMA agreement.

## Testing the Synchronization Circuit

This first part of this test checks the functionality of one Reader's SPM. The second part of this test checks the Synchronization wiring from one Reader's SPM to the synchronization circuit terminal block

Prerequisites: At least one RF module installed in the Reader. Both Primary and Secondary CTMs have the same configuration; synchronization enabled

### Testing the SPM and CTM

1. Disconnect the Synchronization circuit wiring from the SPM terminal block
2. Using two short jumper wires connect Tx+ to Rx+ and Tx- to Rx- on the SPM terminal block, leaving the GND terminals unconnected (see SPM terminal block connections, page 256).
3. If the SYNC LED on both CTM's illuminates solid green, the SPM and CTM's are functioning properly.
4. Reconnect the synchronization circuit to the SPM terminal block.

### Testing the Synchronization hub cabling

1. If the SYNC LED on the CTM does not illuminate solid green with a functional SPM and CTM connected to the Synchronization circuit, the problem is with the wiring between the SPM and the synchronization hub terminal block.

## Testing the MRFM-S slots

The following test is to verify that all MRFM-S slots in the upper portion of the Reader rack are functional.

Prerequisites: Connect the service laptop to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43. One functional MRFM-S is installed in the RF slot 1 of the Reader rack.

**Note:** All eight channels in a Frame Sequence configuration must be enabled to fire, otherwise this test will not work.

1. Select the **Configuration** link on the left side panel.
2. Click the **Channel** tab.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

- Set Ch# (where the RF module is installed) to **Active**.
- Ensure that the DATA LED on the RF module illuminates solid green.
- From the **Channel** tab on the **Configuration** page, select **Offline** from the **RF State** drop-down box.
- Ensure that the DATA LED on the RF module is off.
- Move the RF module to the next slot and repeat steps 1 and 5.

## 7. MAINTENANCE PROCEDURES

**WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

**CAUTION:**

Improper modification of configuration parameters may adversely affect system operation. The default values may not be appropriate for the specific application. It is the system integrator's responsibility to tailor the configuration parameters to the specific operating environment.

**CAUTION: Redundant Reader**

Both CTMs in a redundant Reader must be properly configured. Each CTM has its own browser interface and is configured independently. Ensure any configuration changes made to one CTM are applied to the other CTM, as required.

### Corrective maintenance procedures

**Note:** When removing or installing ESD sensitive equipment always follow the accepted practices for ESD protection.

The **inspect, clean, and system re-test** methodology is used for all system maintenance. This type of maintenance consists of the following general steps.

1. Inspect all Reader sub-system components and connections.
  - Inspect the PSM fuses; they should not appear darkened or burned.
  - Make sure that all plug-in components are properly seated in their mating connectors.

Determine if the components and/or connections require cleaning. To clean component assemblies, use a portable vacuum cleaning tool with a non-conductive tip/brush. To clean component connector contacts, use a contact cleaner spray that does not contain a trichloroethylene based solvent or a Freon® based propellant.



**Attention:** Pre-authorized lane closure is required if the MRFM-S modules need to be cleaned.

If cleaning is required:

2. Activate the side of the Reader not being cleaned (see Manually switching a Reader to the redundant side page 42).
3. Power down the side of the Reader to be cleaned.
4. Clean the components and connections and then Power up and activate this Reader side.
5. Power down the remaining Reader side.
6. Clean the components and connections then Power up and activate, if necessary, this Reader side.
7. Test all system functions (see Troubleshooting and Testing, page 201).

## Preventive maintenance procedures and scheduling

**Attention:** Only Kapsch Service-trained service maintenance personnel are to perform these tasks.

Once a year:

1. Perform RF measurements to verify the cables and MRFM-S. It is recommended a commercial off-the shelf instrument is used which supports Cable Analyzer Testing, to show faults inside cables, and Voltage Network Analysis, to verify connection integrity and end to end connectivity and gain.
2. Verify module output power and power at antenna using a commercial off-the shelf spectrum analyzer.

### **With power off:**

1. Inspect and clean the Reader cabinet as needed, depending on the site environmental conditions, such as contamination by dust. As a minimum, inspect and clean the cabinet interior and components once per year.
2. Inspect the antenna waterproofing and ensure that any seal is secure.
3. Inspect the antenna weep hole. Remove any dust, dirt or other obstructions.
4. Check ground connectivity for exterior ground connection to reader system ground

**Attention:** Pre-authorized lane closure is required before continuing with this procedure.

**Note:** For each channel, go into the web interface and disable the channel to be tested.

1. Disconnect and inspect in-line lightning suppressor.
2. Disconnect and inspect the exterior RF feedline cable and connectors exposed to the elements.
3. If corrosion is visible, replace the corroded connector and, if necessary, cut out the entire corroded portion of the feedline cable. The antenna may require replacement if the mating female connector is corroded.
4. When reconnecting connectors after inspection is complete, discard and replace self-amalgamating tape.

Every 4 1/2 years:

**Note:** The CMOS battery is not field-replaceable.

1. Replace the CTM CMOS battery.

**Note:** If a Kapsch TrafficCom maintenance agreement is in place, the CTM needing a new battery can be replaced by a spare CTM. The CTM is then sent to Kapsch Service to have its battery replaced.

## MRFM-S replacement

The Reader does not need to be shut down to replace an MRFM-S.

**Prerequisites:** Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.



**WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.



**WARNING:**

THE MRFM-S MAY BECOME HOT UNDER NORMAL OPERATING CONDITIONS. ENSURE THE MRFM-S HAS COOLED DOWN OR WEAR GLOVES WHEN HANDLING THE MRFM-S.

### Removing an MRFM-S

1. Select the **Configuration** link on the left side panel of the CTM web interface.
2. Click the **Channel** tab.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

- From the **Channel** tab on the **Configuration** page, set the **RF State** of the active MRFM-S to **Offline**.

**Note:** Disconnect the RF cable(s) from the MRFM-S appropriate port.

- Loosen the screws securing the MRFM-S module to the Reader rack, and then remove the MRFM-S from the Reader.

### Installing an MRFM-S



#### CAUTION:

To avoid damaging the modules, ensure that the connector on the module is properly aligned with the connector on the DSM back plane before the module is securely plugged into the DSM.

- Insert the MRFM-S module into the Reader. Tighten the screws to secure the MRFM-S to the Reader rack.
- Connect the RF cable(s) to the MRFM-S appropriate port and tighten with a proper torque wrench.
- Select the **Configuration** link on the left side panel of the CTM web interface.
- Click the **Channel** tab.
- Set the the **Offline** MRFM-S channels back to **Active**.
- Verify the DATA LED illuminates solid green.
 

**Note:** If the DATA LED does not illuminate solid green, see Troubleshooting tree: MRFM-S not working, page 209.
- Verify module output power and power at antenna using a commercial off-the-shelf spectrum analyzer.
- Ensure the RF channel is capturing OBU data (see Troubleshooting tree: MRFM-S not working page 209).

## Antenna replacement

**Note:** The Reader does not need shutting down to replace an antenna.

Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

### Removing an antenna

1. Select the **Configuration** link on the left side panel of the CTM web interface.
2. Click the **Channel** tab.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]:	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]:	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]:	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼

Set RF State of all channels to the same configuration as channel:

Set voting time / dynamic voting of all channels to the same configuration as channel:

3. Set the the MRFM-S connected to the antenna to **Offline**.
4. Remove the antenna.

### Installing an antenna

1. Install the antenna (see Installing an Antenna, page 175).
2. Select the **Configuration** link on the left side panel of the CTM web interface.
3. Click the **Channel** tab.
4. Set the **Offline** MRFM-S back to **Active**.
5. Verify the DATA LED illuminates solid green.
6. Verify module output powers and power at antenna using a commercial off-the shelf spectrum analyzer .
7. Ensure the MRFM-S is capturing OBU data.

## RF cable or connector replacement

**Note:** The Reader does not need shutting down to replace an RF cable or connector.

Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface.

### Removing RF cable/connector

1. Select the **Configuration** link on the left side panel.

- Click the **Channel** tab.

**Result:** The following screen appears.

	Ch #1	Ch #2	Ch #3	Ch #4	Ch #5	Ch #6	Ch #7	Ch #8
RF State:	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼	Active ▼
Channel Weight [%]	100	100	100	100	100	100	100	100
Group ID:	0	0	0	0	0	0	0	0
LPT/FME Voting Time [ms]	300	300	300	300	300	300	300	300
Voting Time (all other tag types) [ms]	100	100	100	100	100	100	100	100
Dynamic Voting Control:	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼	Disabled ▼

Set all RF channels to: Active ▼ Set

Set RF State of all channels to the same configuration as channel:  Duplicate

Set voting time / dynamic voting of all channels to the same configuration as channel:  Duplicate

- Set the **RF State** of the MRFM-S whose cable or connector is being replaced to **Offline**.
- Remove the RF cables or connectors.

### Installing an RF cable/connector

Prerequisites: Self-amalgamating tape for connections. Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 43.

- Install the RF cables or connectors.
- Apply new self-amalgamating tape to the connections.
- Select the **Configuration** link on the left side panel of the CTM web interface.
- Click the **Channel** tab.
- Set the **Offline** MRFM-S **RF State** back to **Active**.
- Verify that the DATA LED illuminates solid green.
- Verify module output powers and power at antenna using a commercial off-the shelf spectrum analyzer.
- Ensure the MRFM-S is capturing OBU data.

## CTM replacement



### **WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

**CAUTION:**

Removing a powered CTM from the Reader rack can damage the CTM. Before removing a CTM from the Reader, ensure that power on the affected side of the Reader is turned off, i.e. the power switch on the PSM is in the off position, or the PSM AC input power cord is disconnected.

**Removing a CTM**

1. Switch the Reader over to the side with the CTM that is **not** being replaced (see Manually switching a Reader to the redundant side, page 42).
2. Set the PSM powering the CTM being replaced to the **off** position.
3. Label and then disconnect any communication cables connected to the CTM.
4. Remove the faulty CTM from the Reader rack.

**Installing a CTM****CAUTION:**

To avoid damaging the modules, ensure that the connector on the module is properly aligned with the connector on the DSM back plane before the module is securely plugged into the DSM.

1. Install a new CTM in the Reader Rack.
2. Reconnect the communication cables to the CTM.
3. Set the PSM and CTM to the **on** position.
4. Switch the Reader to the new CTM side (see Manually switching a Reader to the redundant side, page 42).
5. If the CTM is in an IR network, reboot the CTM (see Rebooting the CTM, page 233).

## SPM replacement

**WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

### ***Removing an SPM***

1. Without disconnecting any of the sync wiring from the SPM terminal block, disconnect the SPM terminal block from the SPM.
2. Remove the SPM from the Reader rack.

### ***Installing an SPM***

**CAUTION:**

To avoid damaging the modules, ensure that the connector on the module is properly aligned with the connector on the DSM back plane before the module is securely plugged into the DSM.

1. Install a new SPM in the Reader Rack.
2. Reconnect the SPM terminal block.
3. Test the SPM (see Testing the Synchronization Circuit, page 220).

## LPM replacement

**WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

### ***Removing an LPM***

1. Switch the Reader over to the side with the LPM that is not being replaced (see Manually switching a Reader to the redundant side, page 42).
2. Remove the faulty LPM from the Reader rack.



**Installing an LPM**

1. Install a new LPM in the Reader rack.
2. Switch the Reader back over to the new LPM side (see Manually switching a Reader to the redundant side, page 42).
3. Test all the LPM COM ports (see Testing an LPM COM port, page 220).

**PSM replacement****WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

**WARNING:**

THE PSM MAY BECOME HOT UNDER NORMAL OPERATING CONDITIONS. ENSURE THE PSM HAS COOLED DOWN OR WEAR GLOVES WHEN HANDLING THE PSM.

**WARNING:**

EXPOSED HIGH VOLTAGE IS PRESENT IN THE PSM. ENSURE THAT THE POWER SWITCH IS SET TO THE OFF POSITION AND THAT THE AC INPUT POWER CORD IS DISCONNECTED BEFORE REMOVING THE PSM.

**Removing a PSM**

1. Switch the Reader over to the side with the PSM that is not being replaced (see Manually switching a Reader to the redundant side, page 42).
2. Set the PSM power switch to the off position.
3. Remove the faulty PSM from the Reader rack.



**Installing a PSM****CAUTION:**

To avoid damaging the modules, ensure that the connector on the module properly aligns with the connector on the DSM back plane before the module is securely plugged into the DSM.

1. Install a new PSM in the Reader Rack.
2. Set the power switch of the new PSM to the on position.
3. Ensure that the new PSM +5 and +15 LEDs illuminate solid green.
4. Switch the Reader back over to the new PSM side (Manually switching a Reader to the redundant side, page 42).

**CFM replacement****WARNING:**

THE MODULES MAY HAVE SHARP EDGES. HANDLE THE MODULES CAREFULLY. WHENEVER POSSIBLE, USE A MODULE EXTRACTION TOOL TO REMOVE A MODULE.

**Removing a CFM**

1. If possible, save the configuration file of the CFM being replaced (see Saving the Reader configuration, page 241).
2. Remove the CTM on the side of the faulty CFM (see CTM, page 227).
3. While pushing on plastic clips, pull CFM straight out from DSM.

**Installing a CFM**

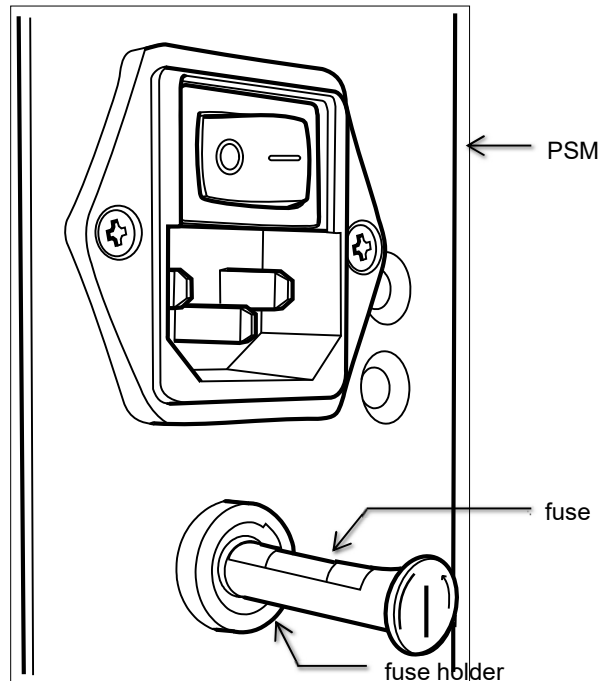
1. Push CFM straight into connector on DSM until an audible click is heard.
2. Install the CTM removed in step 2 (see CTM, page 227).
3. Load the configuration file saved in step 1 to the new CFM (see Uploading a saved configuration, page 242), or locate and upload the latest saved Reader configuration.

## Replacing a PSM fuse

**WARNING:**

INSTALLING A FUSE OF THE WRONG TYPE OR RATING MAY CAUSE A FIRE. INSTALL A TIME LAG FUSE RATED FOR 10A.

1. Set the PSM power switch to the off position.
2. Disconnect the AC power cord.
3. Using a flat-tipped screwdriver, rotate the fuse holder counter-clockwise 180 degrees. Slide out the fuse holder as shown in Figure 7-1.



**Figure 7-1: PSM fuse and fuse holder**

4. Rotate the fuse holder clockwise to allow the old fuse to fall free of the fuse holder.
5. Place the new fuse in the fuse holder then slide the fuse holder into the PSM.
6. Using a flat-tipped screwdriver, rotate the fuse holder 180 degrees to secure the fuse holder in the PSM.

## Rebooting the CTM

This procedure outlines two ways of rebooting the CTM; using the ON/OFF switch on the CTM, and using the **Reboot** button from the CTM web interface.

Prerequisites: To reboot from the browser interface, you must have **Manage Software** permissions.

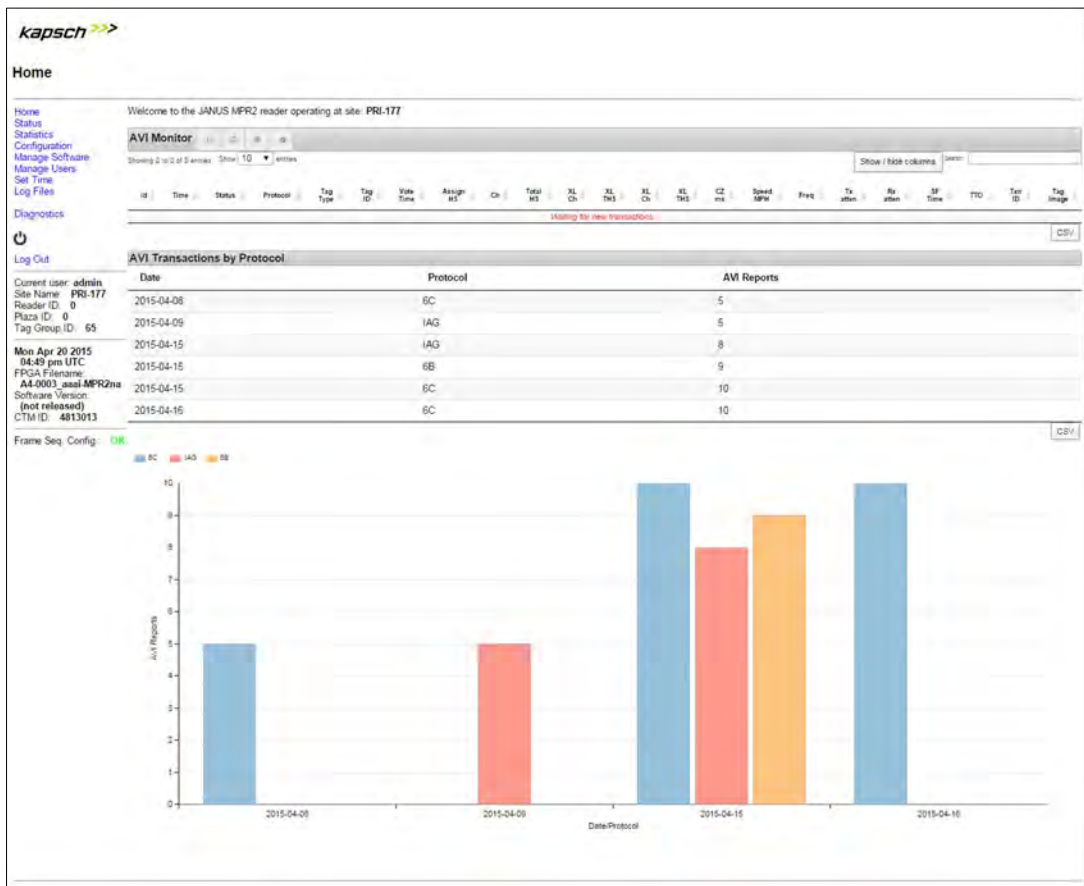
### Rebooting using CTM ON/OFF switch

1. Set the CTM ON/OFF switch to OFF.
2. After five seconds, set the CTM ON/OFF switch back to ON. The CTM POWER LEDs immediately illuminate solid green. After 90 – 120 sec., the CTM STATUS LEDs illuminate their normal state (see LED Status, page 203).

### Rebooting from the browser interface

1. Login to the CTM web Interface.

**Result:** The following **Home** page appears.



2. Select the **Manage Software** link on the left side panel of the CTM web interface.

**Result:** The following screen appears.

### Upload Software Updates:

Filename:

### Activate Software Updates:

The software update files currently occupy 83% of the maximum allocated space.  
Space remaining: 3.21 MB

Available Software Versions	Status	Actions
2016aug13a-MPR2na.en.sign	FACTORY, INACTIVE	<input type="button" value="Activate"/>
2017apr13a-MPR2na.en.sign	INACTIVE	<input type="button" value="Activate"/> <input type="button" value="Delete"/>
2017may13a-MPR2na.en.sign	INACTIVE	<input type="button" value="Activate"/> <input type="button" value="Delete"/>
2017jun23a-MPR2na.en.sign	ACTIVE	

### Software Update History:

2016-08-23T18:24:30	2016aug13a-MPR2na.en.sign
2016-09-07T18:35:12	2016aug13a-MPR2na.en.sign
2016-09-07T18:43:38	2016may17a-MPR2na.en.sign
2016-10-28T21:06:23	2016aug13a-MPR2na.en.sign
2016-11-10T21:56:43	2016nov10a-MPR2na.en.sign
2016-11-18T20:41:02	2016nov18a-MPR2na.en.sign
2017-03-16T19:26:21	2017mar16a-MPR2na.en.sign
2017-04-04T18:35:04	2017apr04a-MPR2na.en.sign
2017-04-13T16:48:54	2017apr13a-MPR2na.en.sign
2017-05-15T17:08:05	2017may13a-MPR2na.en.sign
2017-07-19T13:20:37	2017jun23a-MPR2na.en.sign

### Reboot Reader:

- Click the **Reboot** button

## Configuring events that cause a switchover

Redundant Readers need to be configured in order to:

- Determine whether the Reader switches over when there is a failure
- Determine what failures cause a switchover
- Determine if the Reader switches back to the primary side once a failure has cleared.

**Prerequisites:** The primary and secondary sides are both powered up. You must have **Advanced User** permissions to configure redundancy settings in the browser interface.

***Manually select the active side and disable switchover***



**CAUTION:**

If the primary or secondary side is forced active via the SPM redundancy mode switch and that side fails, the Reader will not switch to the other side and data could be lost.

1. Set the toggle switch on the SPM to the side to stay active, either **SECONDARY** or **PRIMARY**.

**Result:** This side is now active and no switchover will occur unless a failure occurs.

***Letting the Reader automatically choose the active side***

1. Set the SPM toggle switch to **AUTO**.

**Result:** The primary side is now active by default, until a primary failure occurs.

***Enabling the Reader to recover automatically to the primary side***

1. Select the Auto Recovery to Prime check box then click the **Update General Configuration** button.

**Result:** The Reader will now automatically switch back to the primary side once a primary failure has cleared.

***Configuring the Reader to switch over automatically when an LC link is down***

1. Select the **Configuration** link on the left side panel.
2. Click the **LC** tab.

**Result:** The following screen appears.

Allow Remote LC Configuration:	<input checked="" type="checkbox"/>							
Status Message Buffering:	<input type="checkbox"/>							
Initial Read Report (IREAD) Message Buffering:	<input type="checkbox"/>							
LC Ethernet TCP-Socket Local Port:	8888							
LC Ethernet TCP-Socket Timeout [ms]:	500							
Heartbeat Message:								
Send Heartbeat Messages:	<input type="checkbox"/>							
Reporting Formats:								
Use RFP-Compliant Message Format:	<input type="checkbox"/>							
Toll Rate / Balance Adjustment Tag Report Format:	Toll Rate / Balance Adjustment Format ▼							
Reporting:								
	IAG 6B 6C Allegro ATA SeGo							
Voting Report:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>							
Generate Initial Report:	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>							
Raw Handshake Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>							
Generate Post-Capture-Zone Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>							
Generate Estimated-Vehicle-Speed Report:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>							
	Ch #1 Ch #2 Ch #3 Ch #4 Ch #5 Ch #6 Ch #7 Ch #8							
Destination:	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet	<input type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet
Destination IP Address:	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0	0.0.0.0 Port: 0
Set destination IP addresses of all LCs to be same as <input type="text"/> Duplicate								

3. Ensure that LC communications is configured, that is, the appropriate **Ethernet** and **Serial** selections are made in the **Destinations** field.
4. Select the **Send Heartbeat messages** check box to enable sending heartbeat messaging, as required.
5. Enter a time, in seconds, in the **Heartbeat Interval** field. This number must be lower than the LC communication error threshold.
6. Click the **General** tab.

**Result:** The following screen appears.

Site Name:	Left_PRI
Ethernet 1 (LC 1Gbps) IP Address:	148.198.225.177
Ethernet 1 (LC 1Gbps) Subnet Mask:	255.255.0.0
Ethernet 2 (IRIF 100Mbps) IP Address:	192.168.0.53
Reader IP Address:	10.0.0.51
USB Adapter or Bluetooth IP Address:	192.168.2.50
Default Gateway IP:	0.0.0.0
Suppress Non-IAG Tags:	<input type="checkbox"/>
Diagnostics Port Baud Rate:	115200
Reader configuration Auto-backup & Recovery:	<input checked="" type="checkbox"/>
Report Latency by Tag Type:	
0 - Interior FPT Delay [ms]:	0
1 - Exterior FPT Delay [ms]:	0
2 - Exterior LPT Delay [ms]:	0
3 - LCD Display Delay [ms]:	0
4 - Commercial Vehicle (CVO) Delay [ms]:	0
5 - OBU Feedback Tag Delay [ms]:	0
6 - HOT Tag Delay [ms]:	0
Primary/Secondary:	
Redundant Mode:	<input checked="" type="checkbox"/>
Dual Reporting Mode:	<input type="checkbox"/>
Auto Recovery To Prime:	<input checked="" type="checkbox"/>
Switchover on Ethernet LC Link Down:	<input type="checkbox"/>
Reader Statistics:	
Use database:	<input checked="" type="checkbox"/>
Database (Txns) Maximum records:	10000
Database (Summary) Retention period [7-90 days]:	30
Database (Summary) Interval [1-30 minutes]:	15
Dashboard:	
Transaction Summary dashboard:	<input checked="" type="checkbox"/>

7. Select the **Switchover on Serial Link Down** and/or **Switchover on Ethernet LC Link Down** check box, as required.

**Note:** When setting the LC Retry Timeout, consider the baud rate used to communicate with the LC and the processing speed of the LC to avoid false failure reports.

8. If **Switchover on Serial Link Down** is enabled, from the **Serial** tab on the **Configuration** page, enter a time, in milliseconds, in the **LC Retry Timeout** field. If an LC does not respond within this time, the Reader will consider serial communications to the LC to be down and will trigger a switchover if the SPM redundancy mode switch is in **AUTO**.
9. If **Switchover on Ethernet LC Link Down** is enabled, enter a time, in milliseconds, in the **LC Ethernet TCP-Socket Timeout** text box. If an LC does not respond within this time, the Reader will consider Ethernet communications to the LC to be down and could trigger a switchover if the SPM redundancy mode switch is in **AUTO**.

#### **Configuring the Reader to switch over when the Ethernet IR link is down**

**Prerequisites:** Multiple Reader communication method set to Ethernet in the **Lane Assignment** tab of the **Configuration** page.

1. Select the **Configuration** link on the left side panel.
2. Click the **General** tab.
3. Select the **Switchover on Ethernet IRIF Link Down** check box.



4. From the **Lane assignment** tab on the **Configuration** page, enter an **IRIF timeout**, in milliseconds, in the **IRIF** text box.

**Result:** The Reader now continuously checks the IRIF link and switches over whenever a downed Ethernet IRIF link is detected.

## Software Management

### New software/firmware

Periodically, Kapsch Service will release a new version of the Reader software (and firmware) in a single file. The software names indicate the year, month, day, and revision number of the release.

This procedure outlines how to upload the new software/firmware to the Reader so it can then be activated.

### Uploading new firmware

**Prerequisites:** A service laptop containing a copy of the latest software/firmware is connected Ethernet 1 or to the Reader web interface.

You must have **Manage Software** permissions.



#### **CAUTION:**

On a redundant Reader, ensure that the redundant side has no fault conditions and all lane controller links are functioning

1. Select the **Manage Software** link from the left panel of the screen.

**Result:** The following Software Update page appears.



**Upload Software Updates:**

Filename:

**Activate Software Updates:**

The software update files currently occupy 83% of the maximum allocated space.  
Space remaining: 3.21 MB

Available Software Versions	Status	Actions
2016aug13a-MPR2na.en.sign	FACTORY, INACTIVE	<input type="button" value="Activate"/>
2017apr13a-MPR2na.en.sign	INACTIVE	<input type="button" value="Activate"/> <input type="button" value="Delete"/>
2017may13a-MPR2na.en.sign	INACTIVE	<input type="button" value="Activate"/> <input type="button" value="Delete"/>
2017jun23a-MPR2na.en.sign	ACTIVE	

**Software Update History:**

2016-08-23T18:24:30	2016aug13a-MPR2na.en.sign
2016-09-07T18:35:12	2016aug13a-MPR2na.en.sign
2016-09-07T18:43:38	2016may17a-MPR2na.en.sign
2016-10-28T21:06:23	2016aug13a-MPR2na.en.sign
2016-11-10T21:56:43	2016nov10a-MPR2na.en.sign
2016-11-18T20:41:02	2016nov18a-MPR2na.en.sign
2017-03-16T19:26:21	2017mar16a-MPR2na.en.sign
2017-04-04T18:35:04	2017apr04a-MPR2na.en.sign
2017-04-13T16:48:54	2017apr13a-MPR2na.en.sign
2017-05-15T17:08:05	2017may13a-MPR2na.en.sign
2017-07-19T13:20:37	2017jun23a-MPR2na.en.sign

**Reboot Reader:**

- Note:** Ensure that the new software version is more recent than the active software version
2. Check the **Space remaining** to ensure there is enough Reader memory to load the new software.
  3. If there is not enough Reader memory, delete an older, inactive version of the software (see Deleting software, page 241).
  4. Click the **Browse** button to select the new software file saved on the computer.
  5. Click the **Upload and Verify Software Update** button, then click **Yes** to confirm.

**Result:** The software file will upload from the computer to the Reader. After the software has finished uploading to the Reader, the software appears in the table of available software versions as INACTIVE.

**Note:** To begin using the new software, activate the software (see Activating new software).

**Activating new software**

The currently active software version becomes inactive once another software version is activated.

The following procedures outline the steps for activating an inactive software version stored on the Reader.

Prerequisites: You must have **Manage Software** permissions.

The primary and secondary sides of the Reader are running normally.

The required software is uploaded to the Reader (see New software/firmware , page 238).

**CAUTION:**

Activating inactive factory software/firmware on a running system is not recommended. The factory software/firmware may not be appropriate for the specific application.

**CAUTION: Redundant Reader**

During software/firmware activation (typically less than 60 seconds) the Reader will switch over to the other side to process and report transactions, regardless of the position of the mode switch on the SPM module. Ensure that the other side is running normally and all lane controller links are functioning. The Reader will be unable to process or report transactions if it is unable to switch over to the other side.

**CAUTION: Non-Redundant Reader**

During software/firmware activation (typically less than 60 seconds), a non-redundant Reader is unable to process or report transactions.

**On the Primary side:**

1. Save the current configuration file, (see Saving the Reader configuration, page 241).
2. From the **Manage Software** page, identify the inactive software version to be activated in the software version table.
3. Click the corresponding **Activate** button to activate the software. Click to acknowledge there will be a delay before the software becomes active.
4. If necessary, restore the configuration file saved in step 1 (see Uploading a saved configuration, page 242).

**On the Secondary side:**

1. Repeat steps 1 through 4 for the secondary side, ensuring the same software version is active for the primary and secondary side.

**Deleting software**

The Factory software and active software cannot be deleted. This procedure outlines the steps for deleting an inactive software version stored on the Reader.

Prerequisites: You must have Manage Software permissions.

1. From the **Manage Software** page, identify the inactive software version to be deleted in the software version table.
2. Click the corresponding **Delete** button.
3. Click **Yes** to confirm.

**Result:** The software will be deleted and will no longer appear in the software version table.

## Configuration management

**Saving the Reader configuration**

Each CTM has a unique configuration file stored on its CFM. This configuration file can be downloaded and saved to a computer. Use a saved configuration file to do the following.

- Quickly configure another Reader requiring the same or similar configuration.
- Restore the Reader to a known configuration.
- Troubleshoot problems by comparing the current configuration to past configurations.

This procedure outlines the steps for saving the Reader configuration to a service laptop which is logged into a CTM.

Prerequisites: A service laptop connected to the Reader Ethernet 1 or via a USB-to-Ethernet adapter that accesses the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43.

1. Click the **Configuration** link on the left side panel.
2. Click the **Manage Config** tab on the **Configuration** page.

**Result:** The following screen appears.



Save config to file:  ☐ as HTML?

Upload config file:  No file chosen

Update the reader configuration *WITHOUT* modifying the networking/IP information:

Update the entire reader configuration:

Reset config to defaults:

3. Click the **Save config** button to save the new configuration.


**Note:** Different ways to save the configuration file appear depending on the web browser you use.

### Uploading a saved configuration

Uploading a saved configuration will overwrite the current Reader configuration. There are two options for uploading a saved configuration: updating all configuration settings except for the IP settings, or updating all configuration settings including the IP settings.

**Prerequisites:** A service laptop connected to the Reader Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. A version of the configuration file to be loaded is saved on a service laptop connected to the Reader.



**CAUTION:**

Improper modification of configuration parameters may adversely affect system operation. The default values may not be appropriate for the specific application. It is the system integrator's responsibility to tailor the configuration parameters to the specific operating environment.

1. From the **Manage Config** tab on the **Configuration** page, click the **Browse** button to locate the configuration file on the service laptop to be uploaded.
2. If uploading all configuration settings to the Reader without changing the IP addresses settings, click the first **Upload Config** button.
3. If uploading all configuration settings to the Reader, including the IP addresses, click the second **Upload Config** button.

### Resetting the Reader configuration to the factory default

Certain field service tests use the factory default configuration. This procedure outlines how to restore the factory default values without changing the Reader IP addresses.

**Prerequisites:** A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. Save the current Reader configuration, see Saving the Reader configuration, page 241.

**CAUTION:**

The factory default configuration should not be restored on a running Reader. The factory software/firmware may not be appropriate for the specific application. Save the current Reader configuration before resetting the Reader configuration to the factory default.

1. Click on the **Configuration** link on the left side panel of the CTM web Interface.
2. Click the **Manage Config** tab.

**Result:** The following screen appears.

Save config to file:  as HTML?

Upload config file:  No file chosen

Update the reader configuration *WITHOUT* modifying the Ethernet 1 (LC 1Gbps) networking/IP information:

Update the entire reader configuration:

Reset config to defaults:

3. Click the **Reset Parameters to Default Values** button.

**Result:** All configuration values, except for the Reader IP addresses, will change to the factory defaults.

## Administration

User administration permissions are needed when a new user account needs to be created, when an account needs to be changed, or deleted. The user can be given access to any combination of the five following access areas.

- User
- Advanced user
- Manage Software
- User admin
- Manage log files

### **Creating a new user**

This procedure outlines how to create a new user account, create a password, and set the user permissions.

**Prerequisites:** A service laptop connected to either the Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **User Admin** permissions.

1. Click on the **Manage Users** link on the left side panel

**Result:** The following screen appears.

User Name	User Admin	Software Management	View Log Files	Manage Log Files	Advanced User	Actions
admin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
NIOP	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="Change Permissions"/> <input type="button" value="Clear Password"/> <input type="button" value="Delete"/>

2. A **Create New User** form will appear on the **User Management** tab.
3. Click the **Create New User** button.

**Result:** The following screen appears.

## User Management

### Create New User:

User Name:

Password:

Confirm Password:

#### Access Control

User Administration? ☐ Enabled ☒ Disabled  
 Software Update? ☐ Enabled ☒ Disabled  
 View Log Files? ☐ Enabled ☒ Disabled  
 Manage Log Files? ☐ Enabled ☒ Disabled  
 Advanced User? ☐ Enabled ☒ Disabled

4. Enter a unique user name in the **User Name** text box.
5. Enter the new user's password in the **Password** and **Confirm Password** text boxes.
6. Select **Enabled** for any of the five access areas to give the user the appropriate permissions.
7. Click **Submit** to create the new user account and return to the **User Management** tab.

**Note:** If you decide not to create the user at this time, click Cancel to return to the User Management tab



### Changing a user's access permissions

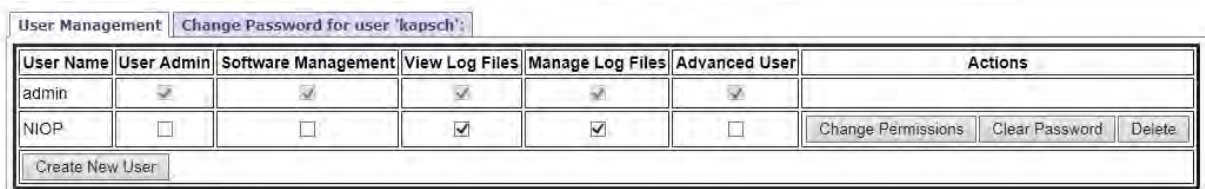
A user's access permissions are set when the user account is created. As a user's responsibilities change, they may need access to more or fewer areas of the Reader configuration. This procedure outlines how to change the access permissions of an existing user.

Prerequisites: A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **User Admin** permissions.

1. Click on the **Manage Users** link on the left side panel

**Result:** The following screen appears.



User Name	User Admin	Software Management	View Log Files	Manage Log Files	Advanced User	Actions
admin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
NIOP	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Change Permissions Clear Password Delete

Create New User

2. Identify the user whose access permissions need changing.
3. Select the corresponding check box to give access to a particular area; clear the corresponding check box to deny access.

**Note:** If you navigate away from the User Management page before clicking the **Change Permissions** button, the access changes are not saved.

4. After the appropriate access changes are made, click the user's corresponding **Change Permissions** button.

**Result:** The following screen appears.



## User Management

Confirm 'change' for user 'Rookie':

Are you sure that you want to 'change' for user 'Rookie'?

Yes No

5. Click **Yes** to confirm.

**Result:** The user access permissions update.

### Deleting a user

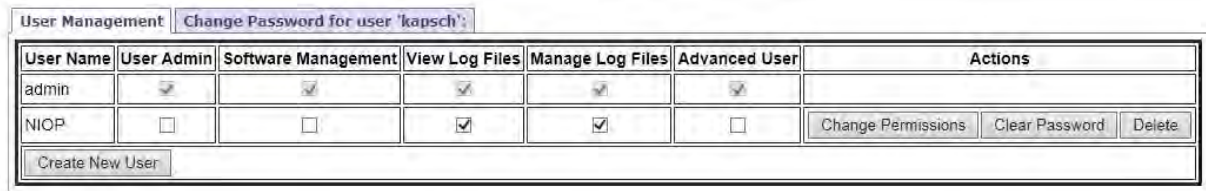
**Note:** A deleted user will no longer be able to access the CTM web interface.

Prerequisites: A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **User Admin** permissions.

1. Click on the **Manage Users** link on the left side panel.

**Result:** The following screen appears.



User Name	User Admin	Software Management	View Log Files	Manage Log Files	Advanced User	Actions
admin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
NIOP	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Change Permissions Clear Password Delete

Create New User

2. Click the corresponding **Delete** button.

**Result:** A dialog box appears for delete confirmation.

3. Click **Yes** to confirm.

#### Verifying a computer is communicating with a specific CTM

**Note:** This test verifies the CTM that is being communicated with while using the web interface.

Prerequisites: A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43.

## NTP Server

Readers can use NTP servers to accurately regulate the time of all Readers. This procedure outlines how to enable NTP time synchronization, set IP addresses for the NTP servers, and select the time zone for display purposes.

**Note:** NTP time sync can be used when a single reader is in use, as well as multiple readers.

#### Using an NTP Server to synchronize the clocks of Readers

Prerequisites: The Reader must be on a network connected to the Internet. A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

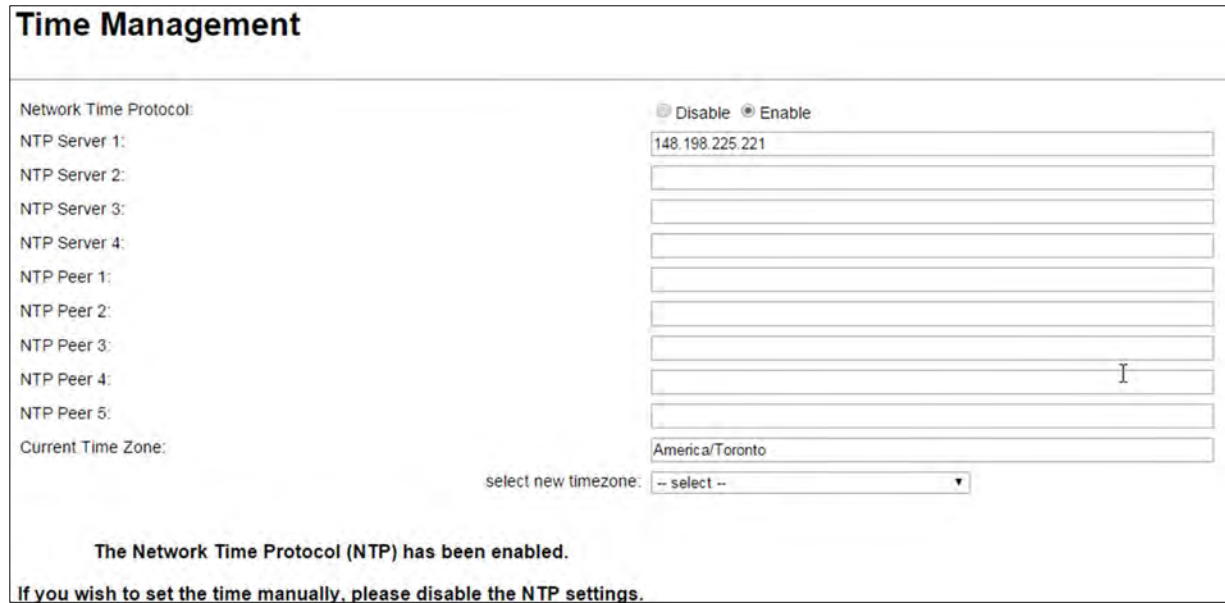
Refer to Connecting a service laptop to the Reader, page 43. You must have **Advanced User** permissions.

1. Visit <http://support.ntp.org/bin/view/Servers/StratumTwoTimeServers> to see a list of NTP servers.
2. Identify an NTP server in your geographic region (the **ISO** column) that has an **OpenAccess** policy (the **AccessPolicy** column).



3. Click on the host name of the NTP server (the **HostName** column). The **ServerForm** table appears.
4. Record the IP address of the NTP server.  
**Note:** The following step is optional.
5. Repeat steps 2 through 4 to obtain a total of three (3) IP addresses, each from a different NTP server.
6. Click on the **Set Time** link on the left side panel of the CTM web interface.

**Result:** The following screen appears.



7. From the **Set Time** screen, select **Enable** to enable the Reader time updates from an NTP server.
8. Enter the three unique IP addresses recorded in step 4 in the **NTP Server 1, 2 and 3** text boxes.
9. Select the appropriate time zone from the **Time Zone** drop-down box. This is for display purposes only.
10. Click the **Update NTP Setting** button.

**Result:** The first available NTP server updates the Reader time.

#### ***Manually setting the Reader time and date***

The Reader time can be set manually when it is not part of an Inter-Reader network. This procedure outlines how to set manually the Reader time.

**Prerequisites:** A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

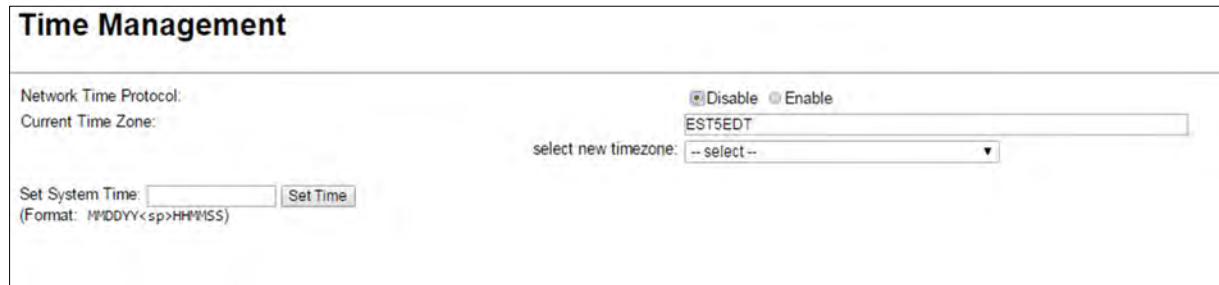
Refer to Connecting a service laptop to the Reader, page 43.

**Note:** Anyone can set the time.

1. Click the **Set Time** link on the left side of the panel.

**Note:** If Network Time Protocol is enabled, you will have to disable it to set the time manually.

**Result:** The following screen appears.



2. Select a time zone.
3. Enter a numeric value for the date and time in the **Set System Time** field. The format is 'MMDDYY<space>HHMMSS', using a 24-hour clock.
4. Click the **Set Time** button.

**Result:** The Reader updates to the time entered in the field.

## Log files

### *Logging transactions remotely via an Ethernet connection*

**Attention:** Use this function only under the direction of Kapsch Service.

### *Monitoring OBU transactions as they occur via the DIAGNOSTIC PORT*

Use the Diagnostics port to view OBU transactions as they occur. This can also be done from the CTM web interface **Diagnostics** page.

**Prerequisites:** A service laptop connected to the Reader DIAGNOSTIC PORT using PuTTY or HyperTerminal. Refer to Connecting a service laptop to the Reader, page 43.

see Using PuTTY to connect to the DIAGNOSTIC PORT, page 251, or,

see Using HyperTerminal to connect to the DIAGNOSTIC PORT, page 251.

**Note:** The operator must ensure that there is only one active connection to diag1 for any given CTM. Having more than one simultaneous diag1 connection per CTM is not supported.

1. Press the **Enter** key a few times until the command prompt is displayed.
2. At the login: prompt, enter **diag1** as the user id and **diag1** as the password.

**Note:** Any OBU transactions will be displayed as they occur.

***Saving Reader log files to a computer***

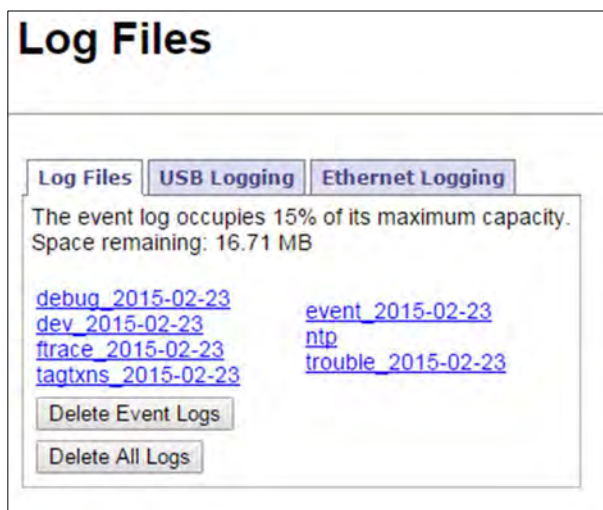
This procedure outlines how to save any log file currently saved on the Reader to a computer.

Prerequisites: A service laptop connected to Ethernet 1 or via a USB-to-Ethernet adapter accessing the CTM web interface.

Refer to Connecting a service laptop to the Reader, page 43. You must have **View Log Files** and **Manage Log Files** permissions.

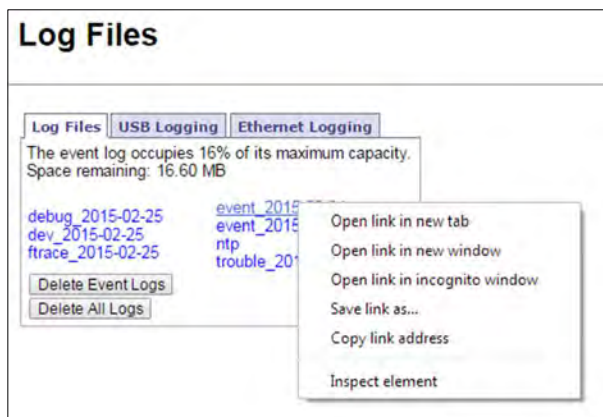
1. Select the **Log Files** link on the left side panel of the CTM web interface.

**Result:** The following screen appears.



2. Right-click on the log file you want to save from the list.

**Result:** The following screen appears.



3. Click **Save Target As...** (Internet Explorer), **Save Link As...** (Firefox), or **Save Link As...** (Chrome) as applicable.

4. In the pop-up window, select a save location, and then click the **Save** button.

**Result:** The file downloads to the computer.

***Manually saving a Reader log file to a USB flash drive***

This procedure outlines how to save any log file currently saved on the Reader to a USB memory stick.

Prerequisites: A USB memory stick is inserted into one of the CTM USB ports.

You must have **View Log Files** and **Manage Log Files** permissions.

From the **USB Logging** tab on the Log Files page:

1. Click the **Copy Log Files to USB device** button.
2. Click the **Safely Remove Hardware** and **Eject Media** icon on the taskbar tray and select **Eject USB device**.
3. Remove the USB memory stick.

## Appendix A Miscellaneous

### Using PuTTY to connect to the DIAGNOSTIC PORT

1. Launch PuTTY.
2. Select **Serial** as your Connection Type.
3. Select the computer COM port that is connected to the Diagnostic Port.
4. Enter **115200** in the **Speed** text box.
5. Click **Open**.

**Result:** The following configuration screen appears.

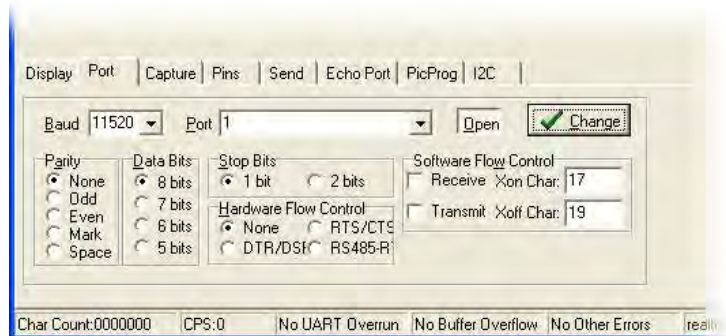


6. Press **Enter** a few times until the login prompt appears.

### Using HyperTerminal to connect to the DIAGNOSTIC PORT

1. Go to **Start → Run**.
2. Type **hypertrm**, and then click **OK**.
3. In the **Connection Description** pop-up, enter a session name and then click **OK**.
4. In the **Connect To** pop-up, select the COM port that is connected to the Diagnostic Port from the **Connect Using** drop-down box.

5. Click **OK**.



6. From the **Display** tab, select Binary from the Display As column.
7. MRFM-S data now displays in the display pane in the upper half of the **RealTerm** window.

## Accessing Documentation

You can access the documentation package for the MPR 2.3 online at <http://dds.kapsch.ca>. A Username and Password can be obtained from Kapsch Service.

The documentation package includes the following.

- Bill of Materials
- Assembly Drawings
- Schematic Drawings
- Parts Specifications (for purchased items)
- Operator and Maintenance Manuals
- Quick Start Guide
- Installation Instructions
- Training slides
- Software Design Documents: Context Diagrams, Data Flows
- As-built installation drawings (services)

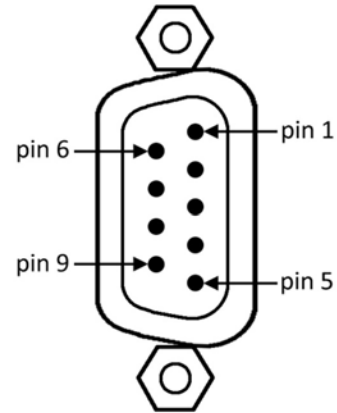
## Technical Specifications and Pin outs

JANUS® Multi-Protocol Reader 2.3 Technical Specifications		
Operation subject to FCC Site licensing (per FCC Part 90, Subpart M)		
Dimensions (excluding enclosure)		
Height = 17.5 inch	Width = 19.06 inch	Depth = 11.30 inch
Weight (excluding enclosure)		
Redundant Reader, with all slots filled: 63 lbs. (Not including MRFM-S)		
Enclosure Requirements		
NEMA 4 rated		
Operating Temperature Range		
-29.2°F to +165.2°F (-34°C to +74°C) For operation above 131°F (55°C) a 300CFM fan tray is required.		
Power Requirements		
300W @ 110VAC, UL/CSA power supply. Minimum of two, 3-prong IEC-320 receptacles (not supplied).		
PSM Ratings		
95-230 VAC, 60 +/- 2 Hz, 5A. One capable of supplying full load on redundant systems.		
Software		
Latest release available at delivery. Reader ships with default configuration settings.		
Memory Capacity		
1,000,000 buffered transactions.		
RF Channel Capacity		
Lane-based channels: maximum of 8. ORT channels: maximum of 8.		

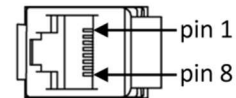
NEMA 4 Enclosure Specifications		
Kapsch TrafficCom Field Cabinet Part Numbers		
Left hinged: 800127-101		Right hinged: 800127-102
Dimension		
Height = 36 inch	Width = 30 inch	Depth = 20 inch
Enclosure Requirements		
A 6 to 8-inch clearance between the top and bottom of the Reader and enclosure.		
Located for ready maintenance access.		
Location limited by maximum RF and Synchronization cable run length.		
Construction		
-Aluminum with stainless steel components	-Neoprene gasket	
-Installed a 19-inch equipment rack for Reader mounting	-Universally keyed lock	
Penetrations		
Must not allow moisture or condensation to run onto electronics or power cables.		
Kapsch TrafficCom warranty extends to manufacturer defects as delivered but does not cover environments, locations, or penetrations that invalidate the NEMA 4 rating.		
Deference is made to any specifications used by the agency to govern NEMA 4 enclosures on its roadways.		
Grounding		
Use AWG 8 wire to connect to the earth – ground system.		



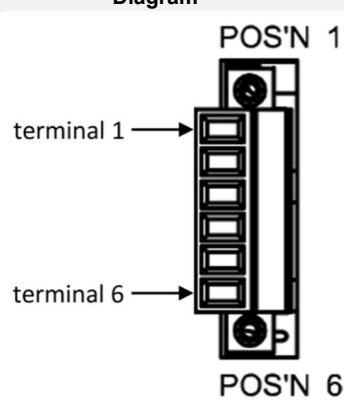
CTM Diagnostic Port pin out			
Connector Type			
Data Communications Equipment (DCE) pin assignment, 9-pin male connector.			
Lightning Suppression			
Not required.			
Pin Number	Signal	Description	Diagram
1	DCD	Carrier Detect input	
2	RXD	Receive Data input	
3	TXD	Transmit Data output	
4		n/c	
5	GND	Logic Ground	
6		n/c	
7	RTS	Request to Send output	
8	CTS	Clear to Send input	
9		n/c	



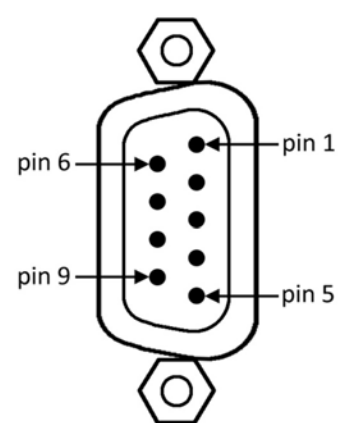
CTM Ethernet Ports 1 and 2 pin out			
Connector Type			
8 pin RJ45 female			
Lightning Suppression			
Recommended on all pins.			
Pin Number	Signal	Description	Diagram
1	BI_DA+	Bi-directional pair A +	
2	BI_DA-	Bi-directional pair A -	
3	BI_DB+	Bi-directional pair B +	
4	BI_DC+	Bi-directional pair C +	
5	BI_DC-	Bi-directional pair C -	
6	BI_DB-	Bi-directional pair B -	
7	BI_DD+	Bi-directional pair D +	
8	BI_DD-	Bi-directional pair D -	



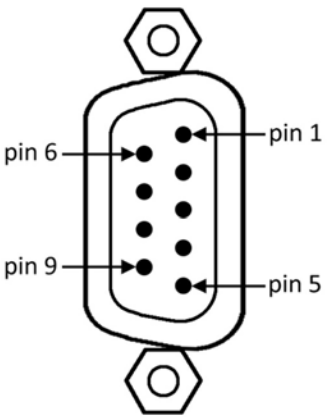
SPM terminal block connections			
Connector Type			
Terminal block			
Lightning Suppression			
Recommended for all signal wires.			
Terminal Number	Signal	Description	Diagram
1	CGND	chassis ground, shield	
2	R-	Sync Rx (RS-422 -)	
3	R+	Sync Rx (RS-422 +)	
4	T+	Sync Tx (RS-422 +)	
5	T-	Sync Tx (RS-422 -)	
6	CGND	chassis ground, shield	



LPM RS-232 COM Port pin out			
Connector Type			
Data Terminal Equipment (DTE) pin assignment, DB9			
Lightning Suppression			
Recommended on pins 2, 3, 7, 8.			
Pin Number	Signal	Description	Diagram
1	DCD	Data Carrier Detect	
2	TXD	Transmit data output	
3	RXD	Receive data input	
4	DTR	Data Terminal Ready	
5	SGND	Signal ground	
6	DSR	Data Set Ready	
7	RTS	Ready to Send	
8	CTS	Clear To Send	
9	CGND	Chassis ground	



LPM RS-422 COM Port pin out			
Connector Type			
Data Terminal Equipment (DTE) pin assignment, DB9			
Lightning Suppression			
Recommended on pins 1, 2, 3, 4.			
Pin Number	Signal	Description	Diagram
1	TXD+	Transmit data output	
2	TXD-	Transmit data output	
3	RXD+	Receive data output	
4	RXD-	Receive data input	
5	NC		
6	NC		
7	NC		
8	NC		
9	NC		



## Antenna Specifications

Antenna	IAG-1	IAG-3
P/N	800260-011	800260-015
Lane Kit #	TBC	802344-203
Description	3x3 patch	3x4 dipole array
Antenna Gain (dBi)	16 $\pm$ 1	14 $\pm$ 1
Width (inches)	34.75	34.5
Length (inches)	31.75	21.25
Thickness (inches)	2.3	3.13
Weight <sup>1</sup> (lbs)	33	19
Mounting	horizontal	horizontal
Application	standard width or ORT lane	Standard Width or ORT lane
Straddle (feet) (min/max c to c)	5.5/6.5	5.5/6.5

**Note:** Mounting information is provided as a guideline.

---

<sup>1</sup> Weight specified is applicable to the antenna structure only i.e., it does not include mounting hardware.

## Antenna Environmental Specifications

Operating Temperature: -34C to 74C

Vibration:

Frequency	Displacement
Below 1 Hz	10 inch sway
1-4 Hz	1 inch sway
4-10 Hz	0.1 amplitude
11-15 Hz	0.03 amplitude
16-25 Hz	0.02 amplitude
26-30 Hz	0.01 amplitude
31-40 Hz	0.005 amplitude
41-50 Hz	0.003 amplitude

Shock (all direction): 15 G, 11 ms saw tooth

Wind: 160 mph

Peak Displacement: 6 inches

## RF Cable Specifications

Kapsch TrafficCom recommends the following options for RF feedline cables.

Cable P/N	Manufacturer	Loss/100ft (dB)
LMR-400DB	Times Microwave	3.966
LMR-600DB	Times Microwave	2.542
LMR 900DB	Times Microwave	1.725
LDF4-50A	Andrews	2.1

The maximum cable length is limited by the permitted cable signal loss. The maximum cable signal loss is based on the protocols selected and is limited to the lowest value in the table below of all protocols enabled.

Protocol	Maximum cable loss (dB)
TDM	8
ISO18000-6C	8
ISO18000-6B	4
SeGo	4
Allegro	4
10374/ATA/AAR S-918	4

**Connectors:** Use cable assembly tools recommended by the cable manufacturer.

**Cable splicing:** No splices are allowed, must be a continuous run

**Minimum Bend Radius:** See Manufacturers recommendation

Finished connection must be weatherproofed using self-amalgamating tape

Cable that run underground or may be submersed in water must be installed in conduit with no other cables capable of inducing RFI or EMI.

## Synchronization Cable and Terminal Block specifications

An example of the wiring detail is shown in Figure 5-10: Synchronization circuit schematic for three Readers, page 183. This cable must be run in conduit and should not be run with other cables capable of inducing RFI or EMI.

Maximum Sync Cable Length

2000 feet (607 meters) max length, sum of all Readers cable segments to hub

1500 feet (457 meters) max length, any one Reader cable segment to hub

#### **Sync Cable Requirements**

Temperature: as required for operating environment

Environmental: as required for operating environment (must be waterproof if immersion is possible)

Capacitance: 30 pF/ft or less

Sync Wire: 3 twisted pairs (2 active, 1 spare), shielded, single or multiple drain

Wire gauge: 24 AWG (minimum)

#### **Sync Terminal Block**

Temperature and Environmental: as required for operating environment

Number of terminals:  $[4 \times (\text{number of Readers in the sync group}) + 4]$  e.g. 3 Readers require  $(4 \times 3) + 4 = 16$

Connection: See the example diagram of a three-Reader sync hub connection in Figure 5-10, page 183.

## **Spares and Tools**

The following table lists the recommended spares for the JANUS reader and the Lane Kits.

Part Number	Description
801638-001	Configuration module - CFM
801701-003	Lane port module, RS422 - LPM
801701-002	Lane port module, RS232 - LPM
802311-001	Power supply module, primary - PSM
802311-002	Power supply module, secondary - PSM
307865-020	Fuse, time lag, 10A, 500V, power supply main input
801693-001	Sync port module, 2-wire RS485-SPM
801693-002	Sync port module, 4-wire RS485 - SPM

Part Number	Description
801693-003	Sync port module, 4-wire RS422 - SPM
802284-004	Controller module, RS422 - CTM
802284-003	Controller module, RS232 - CTM
802344-201	Lane kit, IAG-3
800260-011	Antenna, IAG-1
800260-015	Antenna, IAG-3
800125-001	Adapter cable, RF
802295-TAB	MRFM-S module

#### Test Equipment

- Two-way radios
- Measuring device (Tape rule, Wheel)
- Lane marking materials (paint or other)
- Plumb bob (25ft. line length)
- Electronic Level (digital display)
- Tool kits, appropriate cables, connectors etc.

#### Test Vehicles

- Bucket / Lift Platform Truck
- Passenger Vehicle (Type to be determined by Kapsch Engineering)



## Reference Documents

Doc number	Title
ICD 360430-100	Interface Control Document for the Next Generation Reader External Hardware Interface
ICD 360467-121	Lane Controller Interface Control document
322704-TAB	Calibration Procedures
322710-077	Gold Transponder and Production Tester Calibration and Maintenance Procedure
801850-002	Front Mount Exterior (FME) Transponder Mounting Instructions for passenger vehicles
801850-004	G4 Interior Transponder Mounting Instructions
801850-005	Front Mount Exterior (FME) Transponder Roof Mounting Instructions for trucks and buses
801850-006	Motorcycle Front Mount Exterior (FME) Transponder Mounting Instructions
801850-008	G4F Feedback Interior Transponder Mounting Instructions
801850-012	G4 Transponder Secure Mount Bracket Mounting Instructions
801850-014	G4P Permanent Interior Transponder Mounting Instructions
801850-015	Flat Pack Transponder (FPT) Mounting Instructions
801850-016	Roof-Mount Flat Pack Transponder (FPT) Mounting Instructions for trucks and buses
801850-018	Commercial Vehicle Operator (CVO) Self-Test Transponder Mounting Instructions
801850-019	Front Mount Exterior (FME) Transponder Front Mounting Instructions for trucks and buses
801850-020	Motorcycle Flat Pack Transponder (FPT) Mounting Instructions

### **Other commercial Documents**

RuggedMC™ RMC40 Installation Guide

## Acronyms and Synonyms

Term	Meaning	Reference or example
AC	Alternating current	
AM	Amplitude modulation	
AWG	American wire gauge	
BGR	Badger	a Kapsch TrafficCom manufactured Reader assembly
BOM	Bill Of Material	A parts list identifying individual components in the assembly of a system module
BPS	Bits per second	Data rate, or transmission speed
CAT	Category	an Ethernet cable type
CF	Compact flash	a memory storage type
CFM	Configuration Module	Non-volatile storage device containing the Reader configuration
CGC	Channel Group Controller Module	PWA board to handle the Manchester encoded RF protocol between the transponder and the Reader
CGND	Chassis ground	Common grounding mechanism for components within an enclosure or chassis. Typically earth grounded. The earth ground system must comply with the U.S. National Electrical Code (NEC) requirements for a grounding electrode.
CMOS	complementary metal-oxide semiconductor	a technology for manufacturing ICs
COM	communications	ex. COM port
COM	Communication module	In the Badger Reader, the Communication module provides the RS232/RS422 interface between the Reader and the Lane Controller. Note: Replaced by the LPM in the JANUS Reader..
computer	the service laptop computer or the LC host computer	
CPS	Cycles per second	Hertz
CPU	Central processing unit	
CRA	Cross Reader Algorithm	Badger Reader legacy algorithm (tag based) used to suppress duplicate transaction reporting to the Lane Controller
CTM	Controller Module	A plug-in module containing an assembly of CGC and MC
CTS	Clear to send	RS232 pin assignment
DA	data	
DB or dB	decibel(s)	unit of measurement of RF signal strength

Term	Meaning	Reference or example
DC	direct current	
DCD	Data carrier detect	RS232 pin assignment
DCE	Data communications equipment	RS232 port configuration, transmit is pin 2
deg.	degrees	
DIN	Deutsches Institut für Normung	German national standards organization
DSM	Distribution Module	Reader's back plane carrying DC power distributions to each module and signal connectivity between modules.
DSR	Data set ready	RS232 pin assignment
DTE	Data terminal equipment	RS232 port configuration, transmit is pin 3
DTR	Data terminal ready	RS232 pin assignment
EBX	embedded board expandable form factor	compatible with legacy PC104 form factor
EIA	Electronic Industry Association	
EMI	Electromagnetic Interference	Disturbance to radio signals and electronic circuits due to undesirable B-field emissions from an external source. See also RFI.
EMP	Electromagnetic Pulse	Strong disturbance that negates the ability of all exposed electronics in the affected area.
EN	enable	
ESD	electro-static discharge	
ESM	Ethernet Switch Module	Used to create an inter-Reader network of up to 3 Readers in ORT installations, improves Voting
ETC	Electronic Toll Collection	Collection of tolls using electronic mechanisms such as RFID tags and Readers
FCC	Federal Communications Commission	
FDM	Frequency Division Multiplexing	An RF module that is able to scan multiple OBUs from the frequency being emitted by them.
FME	Front Mount Exterior	An exterior tag in a weatherproof package mounted using the front license plate mounting holes. This item replaces the LPT tag
FPGA	Field Programmable Gate Array	the FPGA file defines the bit stream
FPT	Flat Pack Transponder	An interior tag in flat package mounted on the inside of the windshield

Term	Meaning	Reference or example
GND	ground	
HS	handshake	
HTTPS	Hypertext Transfer Protocol Secure	
Hz	Hertz	Cycles per second
I/O	input/output	
IC	Integrated circuit	
ICD	Interface Control Document	Specification of the physical interface, protocol and file formats used for messages sent between two communications components.
ID	Identity or Identifier	Group ID in RF Channel configuration
IEC	International Electrotechnical Commission	
IEEE	Institute of Electrical and Electronic Engineers	Worldwide non-profit professional organization that makes voluntary, consensus-based, standards
IF	Interface	
IP	Intellectual Property or Internet Protocol	reference an asset or reference an address
IR	Inter-Reader	
IRIF	Inter-Reader interface	An Ethernet network of Readers at an ORT site
ISO	International Organization for Standardization	International standards body. Members are the national standards bodies for each country.
JRE	Java Runtime Environment	Required for some JANUS functions
LA	lane assignment	
LAN	Local Area Network	A local computer network for communication between computers
LC	Lane Controller	Controls Readers and receives data and alerts from Readers.
LCD	Liquid Crystal Display	Thin flat display device, using multi-colored pixels in front of a light source
LED	Light Emitting Diode	Used as status indicators on JANUS® Multi-Protocol Reader 2.3
LPM	Lane Controller Port Module	In the JANUS® Multi-Protocol Reader 2.3, this module provides a serial interface between the Reader and the Lane Controller
LPT	License Plate Transponder	An exterior tag in a weatherproof package mounted using the front license plate mounting holes (a legacy product now replaced by the FME)

Term	Meaning	Reference or example
MC	Main Controller	Intel-x86 based single-board computer that runs the Reader software
MRFM-S	Smart RF Module	The analog portion of the Reader and the termination point for coaxial cables from the antennas with command driven Tx and Rx attenuation.
N/A	not available	
NEC	National Electric Code	
NEMA	National Electrical Manufacturers Association	Sets standards for electrical components. Equipment enclosures with a NEMA rating meet a certain standard. NEMA-4 is generally considered watertight.
NTP	Network Time Protocol	
OBU	On Board Unit	Transponder or tag
ORT	Open Road Tolling	ETC from high speed vehicles that do not slow down and may straddle lanes
PC	Personal computer	
PF	Programming failure	transponder programming by the Reader
Pgm	Program or programmed or programming	context related usage
PID	Plaza ID	a configurable Reader parameter
PS	Power supply	
PSM	Power Supply Module	PWA board to provide AC/DC power to the Reader
PTO	Programming timeout	
PU	Programming unverified	transponder programming by the Reader
PWA	printed wiring assembly	All of the digital rack plug-in boards have PWAs
QMS	Quality management system	
R/W	Read / Write	
RAL	Restricted Access Location	Physical security enforced for safety and system integrity.
RAM	Random Access Memory	Data stored in this type of memory can be accessed in any order
Reader	JANUS® Multi-Protocol Reader 2.3	
RF	radio frequency	Broadcast band transmission frequencies

Term	Meaning	Reference or example
RFI	Radio Frequency Interference	Disturbance to radio signals and electronic circuits due to undesirable E-field emissions from an external source. See also EMI.
RFID	RF Identification	An automatic Identification methodology relying on storing and retrieving data remotely using OBUs or RFID Tags (transponders) and Readers.
RFIF	RF Interface	Internal connection from the CTM via the DSM to the RF modules
RID	Reader ID	a configurable Reader parameter
ROM	Read Only Memory	Data, such as software, in this type of storage device cannot be modified
RSE	Roadside Equipment	The collection of all AVI equipment at the roadside, including Reader, antennas, Ethernet switches, power supplies, cables and connectors. (incorrect, only includes Reader rack)
RTS	Ready to send	RS232 pin assignment
RX or Rx	receive or receiver	Communications or RF Module functions
RXD	Transmit data	RS232 pin assignment
SGND	System ground	
SMA	Sub-miniature version A	An RF connector type
SNR or S/N	Signal to noise ratio	A comparison of desired signal to the level of background noise.
SPM	Sync Port Module	PWA board to provide sync signals to the Reader via the termination network
SSH	Secure shell	
SSL	Secure sockets layer	Internet site security access via certificates
Sync	Synchronization	
TAB	Tabulation	System of indexing used for variations of assembly drawings. A drawing number ending in the suffix “-TAB” will have a list of all other variations of the drawing (can be from -001 to -999).
TC	Toll collection	a Reader application
TCP	Toll Collection Programming	Software modules used to collect tolls
TCP/IP	Transmission Control Protocol/Internet Protocol	The Internet Protocol Suite is the set of protocols used for the Internet, and other systems or Intranets
TDM	Time Division Multiplexing	An RF module that is able to scan OBUs through time sequencing by using time difference between one OBU and another.

Term	Meaning	Reference or example
TM	Traffic management	a Reader application
TMP	Traffic Management Programming	Software modules used for traffic management
TTO	Transponder timeout	
TX or Tx	transmit or transmitter	Communications or RF Module functions
TXD	Transmit data	RS232 pin assignment
UDP	User Datagram Protocol	an Internet protocol that is faster than TCP but offers no error correction
UL	Underwriter Laboratories	Underwriter Laboratories Inc.
URL	Uniform resource locator	
USB	Universal Serial Bus	Standard protocol for peripherals, enables plug-and-play
UTC	Coordinated Universal Time	the time standard used to regulate time around the world
VAC	Voltage AC	
VDC	Voltage DC	
VSWR	Voltage Standing Wave Ratio	

## Glossary

Name Term or Component	Alias or explanation
Baud Rate	Physical transmission speed: bits, or changes in state, per second
Capture Zone	An area where an OBU is detected by the MRFM-S.
Capture Zone Span Time	The amount of time it takes an OBU to pass through a capture zone.
Channel	One RF channel or one lane of traffic
Dummy frame	A time interval placeholder
Dynamic voting	<p><b>Channel</b> tab Voting algorithm. If the dynamic voting algorithm is set to anything other than "Disabled", the Reader generates a transaction report at some period in time (called the "Voting timeout") after the initial read of an OBU. The voting timeout is configured on the web interface <b>Configuration</b> page - <b>Channel</b> tab. The voting timeout is either;</p> <ol style="list-style-type: none"> <li>1. Set manually by the operator, or</li> <li>2. dynamically set according to prevailing traffic speeds on a channel-by-channel basis.</li> </ol>
Earth ground system	The earth ground system must comply with the U.S. National Electrical Code (NEC) requirements for a grounding electrode.
Express Lane - Wide	No barriers between lanes, straddle antennas required. Same as ORT
feedline	The cable that carries the RF signal to or from the antenna. Also called transmission line.
frame	one scan of an RF Channel. There can be a maximum of eight frames for one Reader
Format Incompatible report	A report sent to the Lane controller, generated when a non-TDM tag is seen by the Reader.
Host Computer	Not supplied by Kapsch TrafficCom. Computer used to monitor/control the LC within the Toll Plaza. The Reader is accessible to a Toll Plaza Host computer (if available) via the web interface.
Interpolated (Voting)	Lane Assignment tab Voting algorithm,
Inter-Reader network	An Ethernet network of Readers at an ORT site used for ORT installations having more than 8 regular-width lanes (or 5 wide lanes) in one direction
Lane assignment	The process of providing a transaction report to the lane controller, with the intent of correctly identifying the lane of travel of the transponder equipped vehicle. The overall goal is high programming success rate, high lane assignment accuracy, and low consistent reporting latency.
Majority (Voting)	Lane Assignment tab Voting algorithm



Name Term or Component	Alias or explanation
Non-Redundant Reader	A Reader having only the Secondary Reader, used for Vehicle Identification or Traffic Control Management applications
Plaza	Structure for toll collection, typically with barriers between lanes and canopy overhead. Vehicles slow for ETC.
Primary Side	Primary CTM (or the set of Primary Reader components)
Reader	Generic term for the JANUS redundant Reader in this manual
Redundant Reader	A toll collection Reader having both Primary and Secondary controller modules.
Redundant Side	Secondary CTM (or the set of Secondary Reader components)
Service Laptop Computer	Service tool used to configure, setup, troubleshoot, and monitor the Reader.
Skip-on-sync	Skip-on-sync indicates what protocol the reader should start reading next.
Superframe	A configuration used for MPR2 and earlier versions of Reader software. The total number of frames that can be scanned in a Reader.
Status File	OBU Account Status File supplied by the client and made available in the lane controller for download to the Reader.
Tag	Transponder or OBU
Transponder	Tag or OBU
Voting Time	Represents the time delay after the initial read of the tag, at which point the Reader determines the lane assignment for the OBU in the transaction report sent to the lane controller.
Wide lane	A standard-width lane is 10 to 12 feet wide. Wide lanes are 12 to 14 feet wide.

## Differences between MPR2.3 and the Badger and JANUS Readers

**ATTENTION 1:** A JANUS Multi-protocol Reader 2.3 (MPR2.3) that is non-redundant uses primary-side hardware components whereas the JANUS non-redundant reader uses secondary-side hardware components.

**ATTENTION 2:** The software of a JANUS Multi-protocol Reader 2.3 (MPR2.3) that is non-redundant is locked in Primary mode; the mode switch mechanical position is ignored. The software of a JANUS non-redundant reader is locked in Secondary mode; the mode switch mechanical position is ignored.

Users familiar with the Badger Reader application for ORT must note the following changes with respect to the use of the Kapsch TrafficCom JANUS ETC Subsystem:

**Note 1:** Connection of the JANUS Readers in an inter-Reader network allows adjacent Readers to vote on the lane assignment used for the transaction report.

**Note 2:** Shared antennas are no longer required between Readers.

**Note 3:** The 4-channel scan configuration is no longer needed.

**Note 4:** Reporting latency is 50 ms for the JANUS MPR2.3 reader in multi-protocol operation, 25 ms for JANUS MPR2.3 in TDM only operation, 5 ms for the JANUS Reader, and was 35 ms for the Badger Reader. Use the configuration parameter Report Latency by Tag Type 0 – 4 to slow down the transaction reports to the LC for those legacy sites where the LC is expecting Badger Reader timing.

**Note 5:** There is no theoretical upper limit to the number of ORT lanes that can be supported with multiple co-located Readers.

**Note 6:** The IAG-3 antenna is recommended for use in JANUS ORT applications. (The IAG-2 antenna currently used in toll plaza lanes is not recommended.)

The JANUS and Badger Reader features are compared in Table 7-1.

**Table 7-1: Important Differences between the Badger Reader and the JANUS Reader**

Feature	JANUS	Badger	Notes
<b>Performance Features</b>			
Synchronization	Y	Y	Compatible performance with Badger Reader 4 wire sync circuit. (Not compatible with IAG Reader 2 wire sync circuit). Only syncs on 8 or 10 channel scan.
Reader redundancy	Y	Y	Automatic switchover upon failure to the redundant Reader without data loss.
Variable channel scan configuration	Y	Y	Improve handshakes per channel for ORT
Cross Reader Algorithm (via tag)	Y	Y	Dependent on successful tag programming.
Cross Reader Voting (via Ethernet link)	Y		
Fixed Voting within Reader	Y	Y	Based on tag/Reader handshakes

Feature	JANUS	Badger	Notes
Dynamic Voting	Y		Per channel, Separate voting time for FME/LPT (tag type 2) Update voting time using a configurable time interval. Improve lane assignment
Channel weighting	Y	Y	Option to de-emphasize straddle antenna (ORT)
Interpolated voting	Y		interpolated voting includes adjacent Readers
Early read voting delay	Y		Handshaking is continued for a longer period of time to include both sides of any gap in reading individual tags
Low read voting delay	Y		
Adjacent channel programming	Y		
Look for tags on adjacent channels	Y		Improve read performance
Implied Channel Groups		Y	global voting time (BGR), TTO
Configurable channel groups	Y		separate voting time, TTO, etc per group
Interleaved programming mode	Y	Y	
Non-interleaved programming mode	Y		
Read/Write Operation	Y	Y	Compatible handshake performance.
Improvement of Write performance	Y		Continue write attempts after voting ends
No tag programming on a Guard channel	Y	Y	
Dual read per frame	Y		Performance improvement
Tx/Rx Attenuation Control	Y		Power on each antenna is configurable
<b>Lane Controller &amp; Reporting Features</b>			
Filter out Non-IAG tags	Y		Non-IAG tags are not reported – configurable feature
Lane Assignment	Y	Y	Compatible performance (capture rate, read/write operation)
Support 8 LC Serial ports	Y	Y	
Max Serial port speed (kbps)	115.2	57.6	BGR max is on 5 ports
Support LC Ethernet interface	Y		Configurable 10/100/1000 Mbps
Support Inter-Reader Ethernet interface	Y		Configurable 10/100 Mbps for ORT use

Feature	JANUS	Badger	Notes
Handshaking with Adjacent Readers	Y		Adjacent Readers are included in voting. Also, conflicts in configurations of adjacent Readers are identified.
Host Port support		Y	
Multiplex transactions to single COM	Y	Y	Compatible transaction report and format
Re-Report	Y		re-report a tag in zone
Initial Read Report	Y		
Post capture zone report	Y		
Transaction buffering	Y	Y	JANUS: 1 million non-volatile BGR: 80K IAG: 1K
Reset transaction number	Y		Accept a Lane Controller command to reset OBU transaction number to zero
Latency measurement & reporting	Y		
Write protect transponder scratchpad fields	Y		
Status File Download for Feedback OBUs	Y		up to 40 million OBUs in the file
Feedback OBU support	Y		Beeper and LED on OBU supported
Maintenance Features			
Web interface for local/remote Reader HTTPS access and control	Y		Viewing/modify Reader configuration, view status, download/run software, manage OBU Status file
Real time reporting of transactions on web interface	Y		
Advanced / Simple parameter presentation	Y		each web page has a functional group
Multiple users & permissions per user	Y		
Zero re-configuration upon processor module (CTM) replacement	Y		When a CTM is swapped, Reader configuration parameters are retained in the CFM (a non-volatile memory off board from the CTM).
Save Reader Configuration File to laptop (also IP addresses and permissions passwords)	Y		Transition process is made easier. During service process, reload the original instead of manual setting many parameters.
Remote reset (reboot)	Y		reset via a lane controller or the web interface
Software/Firmware download	Y		
Maintain multiple software/firmware images	Y		At least 6 versions, including factory image.

Feature	JANUS	Badger	Notes
Automatic switchover recovery	Y		Reader will return control to Primary without operator intervention.
USB stick transaction logging	Y		
<b>Diagnostics</b>			
Diagnostic Port	Y	Y	
Test Tag Support	Y	Y	
Load monitoring (CPU/Mem)	Y		Allows anomaly detection.
High Speed Margin Diagnostic	Y		Proof of concept for channels with MRFM-S.
Trouble Log	Y		Separate trouble items from transaction log
Transaction Log	Y		Temporary transaction log
Event log	Y	Y	JANUS: number of events limited only by CF partition size. BGR & IAG: 10 events
Lane Controller serial interface check	Y		Via a loop-back adapter
Self-Test issued by Lane Controller	Y		LC commands a Reader to initiate/report self-test.
Controller (CGC) serial number reported	Y		S/N of controller board is sent to Web IF and log
<b>Other</b>			
Network Time Protocol	Y		Allows NTP to sync date and time for all Readers in a network
Feedback OBU activation – Option 1	Y	Y	BGR205 firmware
Dual Reporting Mode (Redundancy Reporting)	Y		Improved processing redundancy handling (JANUS Reader Phase 2).
<b>HARDWARE</b>			
The JANUS non-redundant Reader uses the secondary side components. The JANUS non-redundant MPR 2.3 reader uses the primary side components.	Y		The Badger non-redundant Reader uses the primary side components
The JANUS non-redundant Reader software is locked in Secondary mode; the mode switch mechanical position is ignored. The JANUS non-redundant MPR 2.3 reader software is locked in Primary mode; the mode switch mechanical position is ignored.	Y		The Badger non-redundant Reader mode switch is mechanically locked in the “primary” position.



## Appendix B FCC Approved Channel Frequencies and Selection

The frequency plan used at a toll site is dependent on the antenna spacing rules, local RF interferers and the approved FCC (or other applicable regulatory body) frequencies.

RF Module FCC ID JQU 802295A and also RF Module with Amplifier FCC ID JQU 802295A-A are approved for 30W ERP radiated power by the FCC for the following protocols.

**JQU802295A and JQU 802295A-A – FCC Approved Frequencies**

FDM Protocols	902-904 MHz Sub-Band	909.75-921.75 MHz Sub-Band
ATA	902.5-903.5	910-921.5
6B	n/a	911-920.5
SeGo	n/a	911.5-919.5
6C	903	910.5-920.5
TDM/mixed Protocols		
TDM	n/a	915.75
Allegro	n/a	915.75

In addition the following rules apply for FDM protocols:

The same channel frequency should not be used on adjacent lanes, including straddle and shoulder lanes (recommended at least 24 ft separation between in-line antennas and 21 ft. separation between staggered arrangement antennas).

The frequency spacing used shall be at least 2.5 MHz between adjacent antennas (i.e. in-line or straddle antennas).

For 6C read in ORT an in-line configuration can be used. For all other FDM protocols in ORT and for 6C write in ORT a staggered configuration should be used.

For the in-line and staggered antenna configurations outlined in **Installing a Lane Kit**, page 175, this means that a 4 or more frequency plan (i.e. can repeat every 5<sup>th</sup> antenna) must be used for in-line configurations and a 3 or more frequency plan (i.e. can repeat every 4<sup>th</sup> antenna) must be used for staggered configurations.

For example within the FCC limits and a staggered ORT antenna configuration a suitable selection can be made that covers all protocols with the following ranges

F1	F2 (+2.5 MHz)	F3 (+5.0 MHz)
911.5 to 914.5	914 to 917	916.5 to 919.5

For example using this, a larger 7 channel frequency plan can be easily realized without re-use and respecting all the rules on a staggered site.

Antenna #	1	2	3	4	5	6	7
Position	Main	Straddle	Main	Straddle	Main	Straddle	Main
Frequency	911.5	914	916.5	919	913	915.5	918



## Appendix C Non-redundant reader

The non-redundant Reader consists of:

**Note:** Numbers in the list below refer to those associated with the illustration below. The DSM, and CFM are not shown.

- One rack and Distribution Module ❶
- MRFM-S modules (up to 4 modules can be installed) ❷
- One Power Supply Module (PSM) and AC Power Cord ❸
- One Lane Port Modules (LPM) ❹
- One Controller Module (CTM), ❺ equipped with one Main Controller (MC), one Channel Group Controller (CGC)
- One Configuration Module (CFM) that attach directly to the DSM (not shown)
- One Synchronization Port Module (SPM) ❻

The following illustration shows the non-redundant reader setup with the right hand configuration. A left hand configuration is also available.

