

JANUS® MULTI-PROTOCOL READER VER. 2

OPERATOR AND MAINTENANCE MANUAL

QMS EDITION - ISO9001:2008

DOCUMENT: UM 360463-202

REVISION:A12 (Draft)

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Kapsch TrafficCom

| | |
|-------------------------|------------------------------------|
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Confidential

UM 360463-202 Revision: A12 (Draft)

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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 **JQU802295** must appear on a label on the front of the RF Modules installed in these Readers.

The Power output of a module at ambient (Pout(amb)) shall be constrained using internal or external TX attenuation so that the following is satisfied:

$$Pout(amb): Gfund \leq 43.77 \text{ dBmd} - Gfund;$$

Where Gfund is the net gain from antenna connector on the RF module to the antenna radiated signal where the antenna gain is expressed in dBd.

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 equipment.

SOFTWARE/FIRMWARE NOTE

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

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IMPORTANT!**NOTICE OF PATENTS:**

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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

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| 2014-05-08 | A12 | E. Rolo | Update to Section 1.0 About this Manual to include a caution concerning safe distance to the antenna. |

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1. ABOUT THIS MANUAL

The JANUS® Multi-Protocol Reader Ver. 2 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.

Technical Background

Personnel must have an electrical/electronic technical background and some prior experience using either internet browser: Internet Explorer, Mozilla Firefox or Google Chrome.

Assumptions

A redundant JANUS® Multi-Protocol Reader Ver. 2 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.

**WARNING:**

WARNING DESCRIPTION HERE.

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, 500VAC IS INSTALLED.

Cautions

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



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

During 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 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 firmware may not be appropriate for the specific application. Save the current Reader configuration before resetting the Reader configuration to the factory default.

On one redundant reader of a synchronization network, the synchronization connection should be looped back and this reader will declare sync even if it is disconnected from the other readers

To avoid damaging the RF adaptor cables, ensure they do not protrude to where items on the back of the cabinet doors can damage or press on them. Use 90-degree SMA adaptors where required.

Keep at least 100 cm away from the radiating face of the antenna when the radio is connected and operating.

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.

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 to choose from.

Example:

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

How to use this manual

The JANUS[®] Multi-Protocol Reader Ver. 2 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.

OPERATING INSTRUCTIONS

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2. OVERVIEW

Introduction

The JANUS® Multi-Protocol Reader Ver. 2 (MPR2) is part of the Electronic Toll Collection (ETC) Subsystem. Toll collection is the primary use of the Reader.

How the JANUS MPR2 Electronic Toll Collection (ETC) Subsystem works

The MPR2 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 a RF signal from the antenna. The OBU then starts transmitting data, which is received by the antenna and passed on to the Reader via a 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 a RF signal. As a vehicle equipped with a passive OBU approaches a toll zone, the OBU receives a RF signal from the antenna. The OBU then starts transmitting data, which is received by the antenna and passed on to the Reader via a 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.

JANUS MPR2 is factory configured to enable the specific protocols requested at the time of order. While multiple protocols may be displayed on the Web interface, only those protocols factory configured at the time of order are active. To activate additional protocols after delivery, contact Kapsch Sales.

JANUS MPR 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(❶ in Figure 2-1: A Redundant Reader)
- Two feedline adapter cable
- One Circulator
- One Circulator adapter cable. (3'5" for 902-904MHz, 3'3" for all other frequencies)

The 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 one Main Controller (MC), one Channel Group Controller (CGC)
- Two Configuration Modules (CFMs) attach directly to the DSM
- One Synchronization Port Module (SPM) ❹
- Two Lane Port Modules (LPM) ❺
- One secondary Power Supply Module (PSM) and AC power cord ❻
- One primary Power Supply Module (PSM) and AC Power Cord ❼
- AC Power cords for the PSM's

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

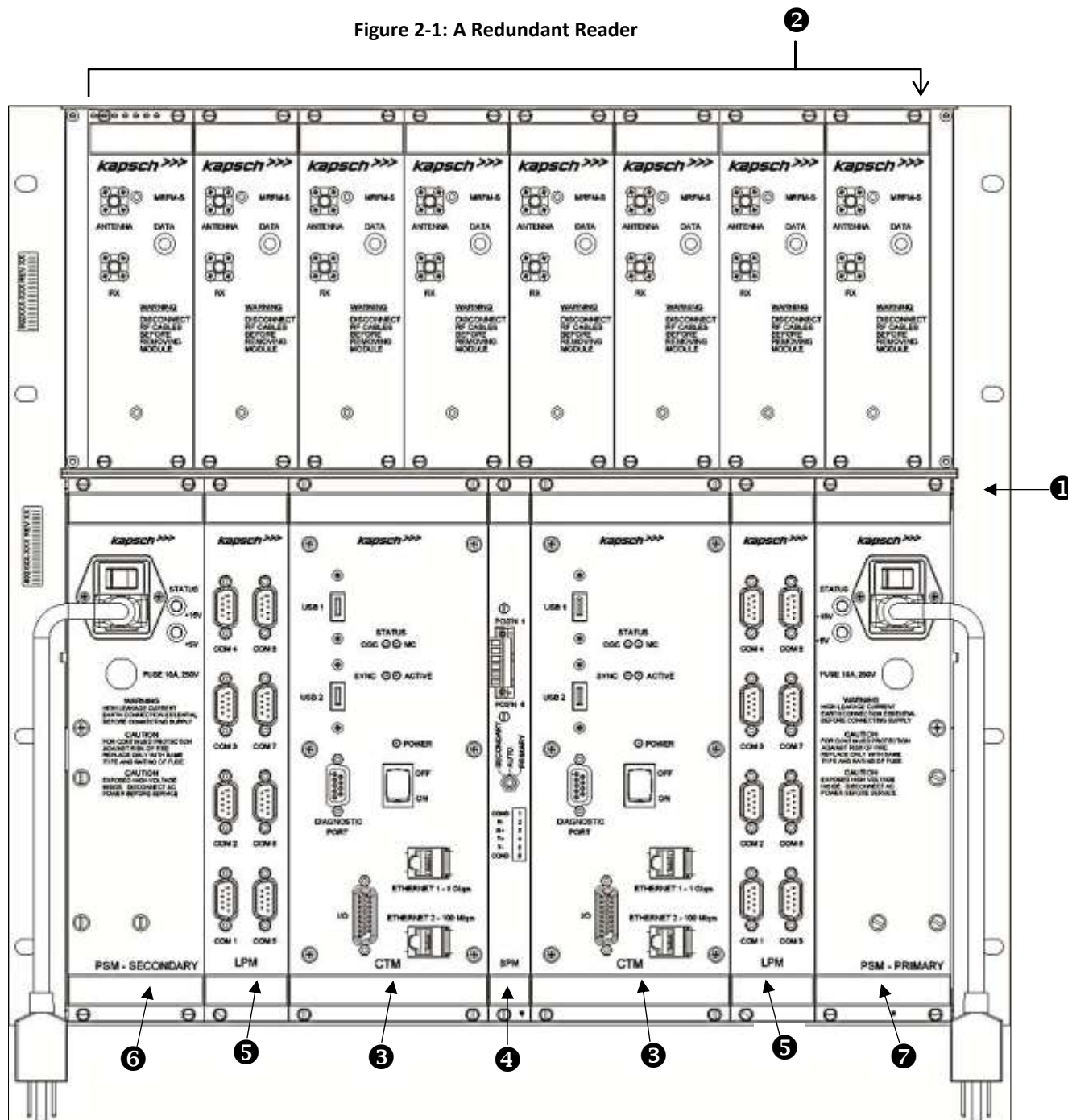
Additional installation components required are:

- Two RF cables from Reader to Circulator (type N male to type N female)
- Sealing tapes for RF and DC 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 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)

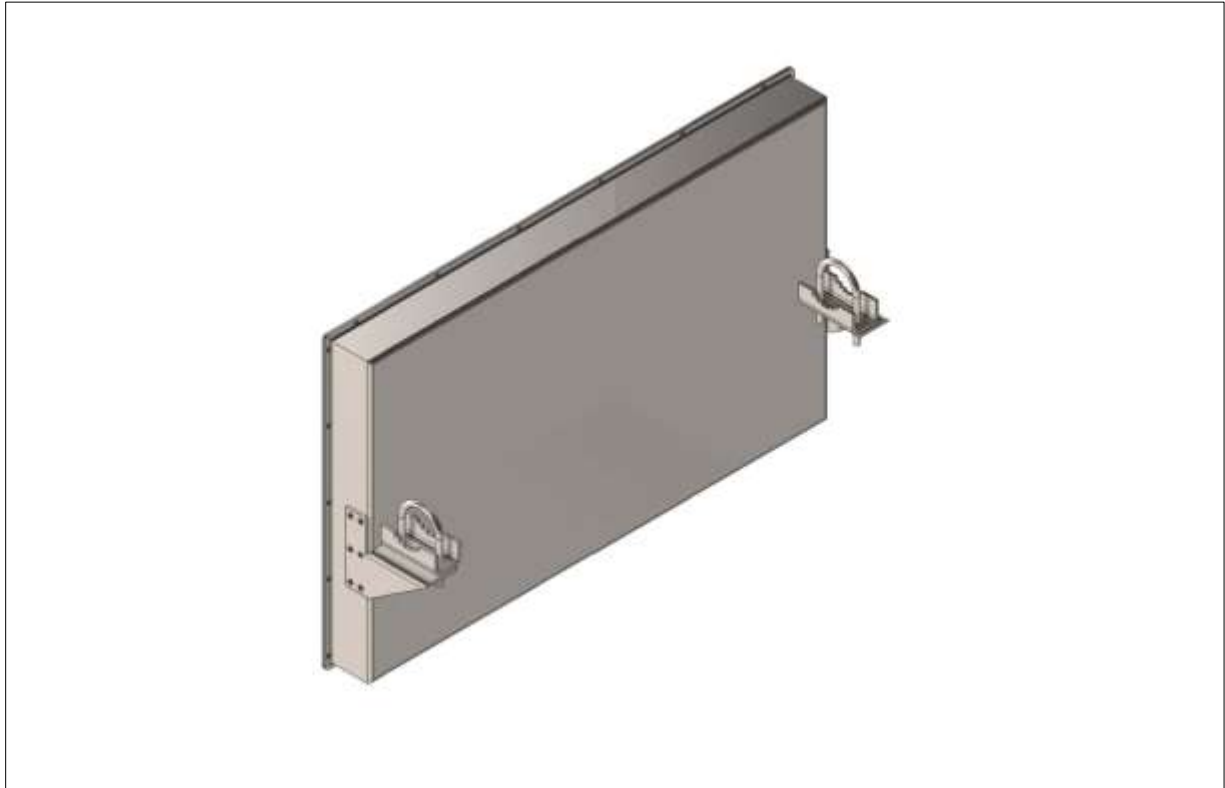
Figure 2-1: A Redundant Reader



Antenna

The antenna sends and receives RF signals to and from the vehicle On Board Units (OBUs). The IAG 3 and IAG 1 antennas are recommended for the MPR2 reader. See Antenna Specifications, page 270 for more details. Figure 2-2 shows an illustration of the IAG 3 antenna, one of the recommended antennas for the Multi-protocol Reader.

Figure 2-2: IAG 3 Antenna



IAG Antenna specifications

Table 2-1 IAG Antenna Specifications

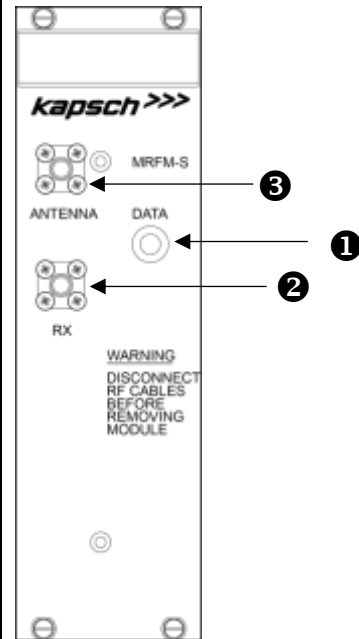
| P/N | Lane Kit # | Description | Width (in inches) | Length (in inches) | Depth (in inches) | Weight ¹ (in lbs) | Mounting |
|------------|------------|------------------|-------------------|--------------------|-------------------|------------------------------|------------|
| 800260-015 | 801692-019 | 3x4 dipole array | 34.5 | 21.25 | 3.13 | 19 | horizontal |
| 800260-011 | | 3x3 Patch | 34.5 | 31.75 | 2.3 | 28 | horizontal |

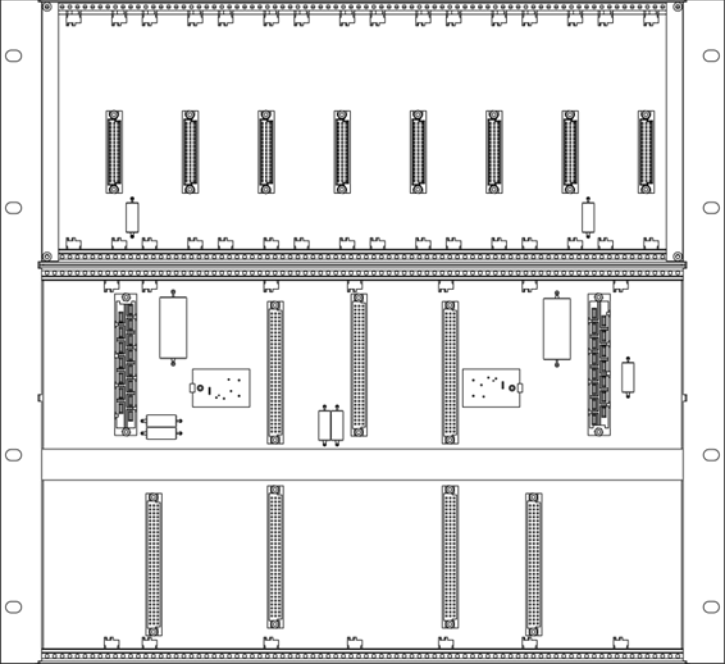
Note: Mounting information is provided as a guideline.

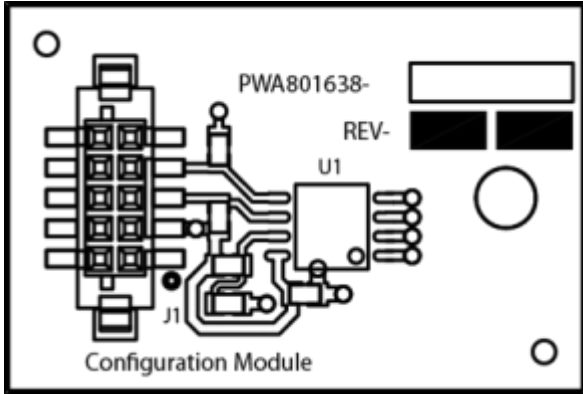
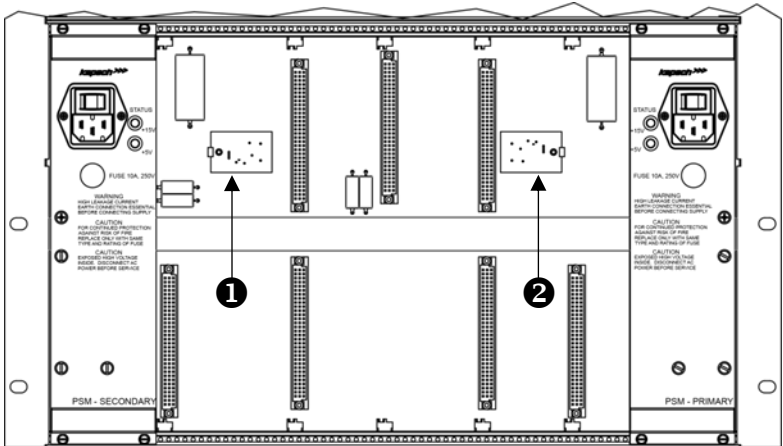
Weight specified is applicable to the antenna structure only, that is, it does not include mounting hardware.

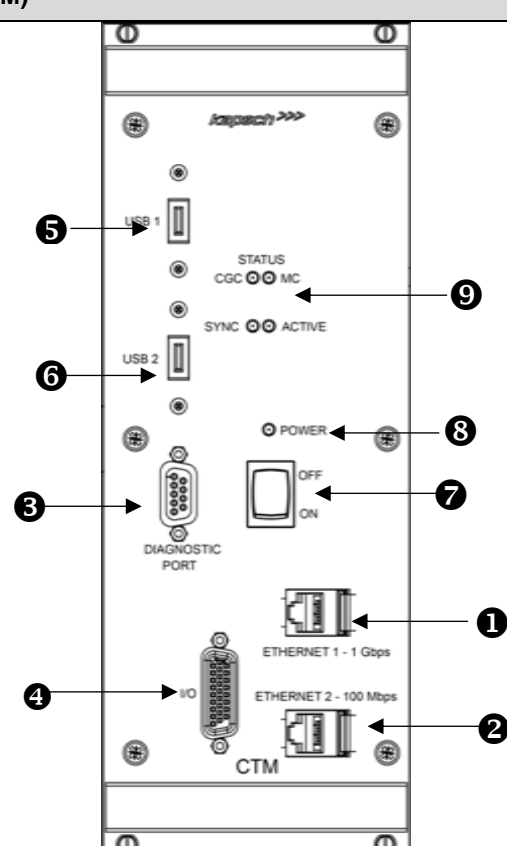
Module Descriptions

| Smart Multi-protocol RF Module (MRFM-S) | |
|---|--|
| Function | <p>Converts digital data from the Reader to an analog RF signal that is sent to the OBU via the antenna.</p> <p>Converts the analog RF signal collected from the OBU via the antenna into a digital signal that is sent to the CGC module via the DSM.</p> |
| Units per Redundant Reader | One MRFM-S for each antenna. A maximum of 8 MRFM-S per Reader. |
| Redundant | No |
| Normal State | The DATA LED 1 illuminates solid green when RF data is being transmitted. |
| Connections | <p>The MRFM-S module can support both bi-static and mono-static output configurations.</p> <p>In Mono-static operation only connection 3 is connected by an RF cable to the antenna.</p> <p>In Bi-static output configurations, both connections 2 3 are connected by an RF cable to the antenna.</p> |



| Distributions Module (DSM) and Rack | | |
|-------------------------------------|---|---|
| Function | The DSM is the back plane of the Reader rack. |  |
| Units per Redundant Reader | One DSM and one Rack | |
| Connections | <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) | | |
|-----------------------------------|--|---|
| Function | Stores the Reader configuration file so that the Reader configuration is retained when the CTMs fail or are removed. |  |
| Units per Redundant Reader | One CFM on the secondary side 1 , One CFM on the primary side 2 | |
| Connections | <p>The CFMs attach directly to the DSM in the secondary location 1 and the primary location 2.</p> <p>CFMs should not be swapped between readers or within the reader.</p> |  |

| Control Module (CTM) | | |
|-----------------------------------|--|---|
| Function | Contains the Reader processor (MC), the Channel Group Controller module (CGC). Allows the CTM to be reset with the CTM ON/OFF switch ⑦. Controls when the RF modules are interrogated. |  |
| Units per Redundant Reader | One CTM on primary side, One CTM on secondary side | |
| Normal State | The POWER LED ⑧ illuminates green when the CTM is on and is receiving power from the PSM. The STATUS LEDs ⑨ illuminate green to indicate SYNC is functional, CTM is active, CGC is functional and MC is functional. | |
| Connections | Port | Function |
| | ETHERNET 1 - 1 Gbps ① | One option for connecting a service laptop directly to the Reader, or, for creating a network to connect the Readers and LCs together. |
| | 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. |

| Control Module (CTM) | | |
|----------------------|---------|---|
| | | |
| | 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

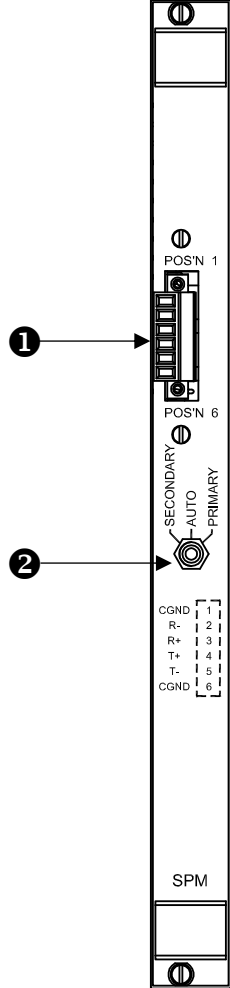
The MC is a single-board computer that runs the Reader firmware. The MC is mounted in the CTM.

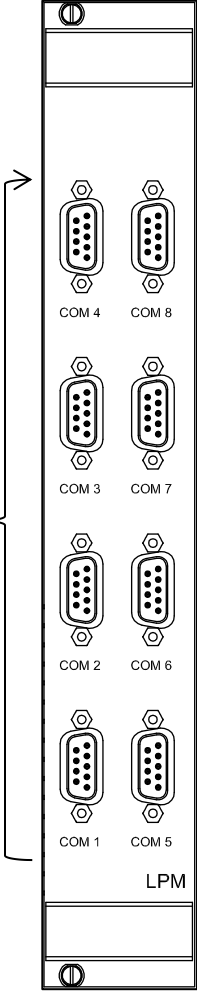
CTM CGC2

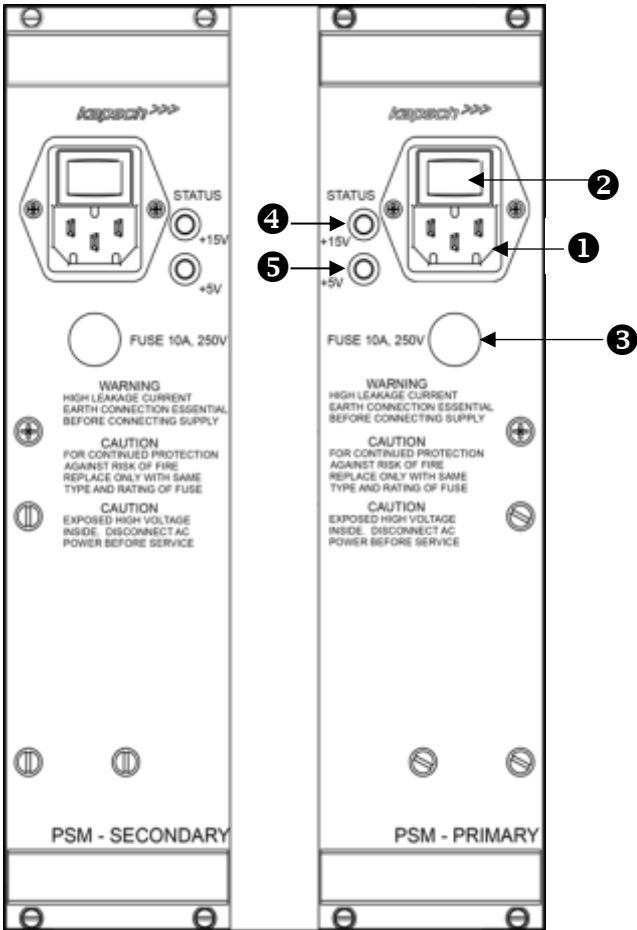
The CGC2 handles the communications between the MC and the RF modules. It also handles the serial communications between the reader and the Lane Controller via the serial connections on the LPM. The CGC2 is mounted in the CTM.

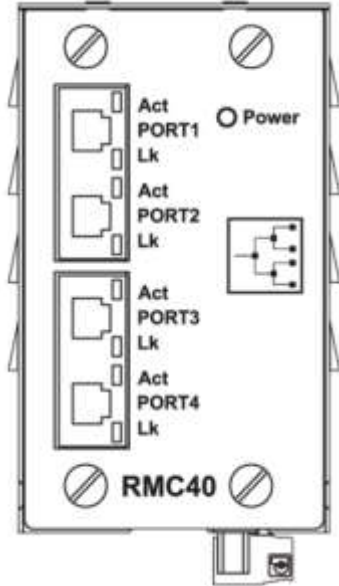
The CGC2 hardware supports the following functions.

- Controls the protocol frame timing for each protocol
- Controls the RF channel scanning as per configuration
- Handles the data communication exchange with the transponder via the RF link
- 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 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) | | |
|-----------------------------------|---|--|
| Function | <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> |  |
| Units per Redundant Reader | One | |
| Normal State | N/A (no status indicators on module) | |
| Connections | 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) | | |
|-----------------------------------|--|--|
| Function | Provides a serial interface between the LCs and CTM. All OBU Data processing is done by the CTM. |  |
| Units per Redundant Reader | One LPM on primary side, One LPM on secondary side | |
| Normal State | N/A (no status indicators on module) | |
| Connections | The Reader can send real-time OBU transactions to the LCs via the eight serial ports 1 on the LPM. The LC can also update the Reader configuration via these ports. | |

| Power Supply Module (PSM) | |
|---|---|
| Function Provides DC power to the modules in the Reader rack. Allows each side (primary or secondary) to be powered on and off via a power switch 2 . |  |
| Units per Redundant Reader One secondary PSM on the secondary side One primary PSM on the primary side 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. | |
| Normal State A +15V STATUS LED 4 illuminates green to indicate that 15V DC is being supplied to the Reader. A +5V STATUS LED 5 illuminates green to indicate that 5V DC is being supplied to the Reader. | |
| Connections A power cable plugs into a socket 1 to supply 120VAC to the PSMs. Each PSM is equipped with a replaceable 10A fuse 3 . | |
| | |

| Ethernet Switch Module (ESM) | |  |
|-----------------------------------|---|--|
| Function | <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> | |
| Units per Redundant Reader | Two per Ethernet network | |
| Normal State | See the manufacturer's documentation for details. | |
| Connections | See the manufacturer's documentation for details. | |

The CTM web interface

You can use a service laptop equipped with a web browser such as Internet Explorer, Firefox, or Chrome to access the CTM web interface, shown below. After entering your user name and password, you can monitor and configure the Reader depending on the permissions assigned to your user account.

Note: Depending on the permissions given a user by the Administrator, the panel on the left (indicated by the rectangle in the figure below) can have different options. For instance, the view below is for an Administrator. Among other privileges, an administrator can create, delete or modify users using the **Manage Users** option.



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, as required.

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 Kapsch's 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 192) perform the necessary troubleshooting procedure. See Troubleshooting Methodology on page 190 for more information.

Shutting down the Reader

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

Prerequisites: None.

1. Set both CTM ON/OFF switches to OFF.
2. Set both PSM power switches to the **off** (0) position.

Manually switching a Reader to the redundant side

The Reader is 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.

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: 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: 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 or the primary side recovers.

Connecting a service laptop to the Reader

You can use a service laptop to access the CTM web interface interface by connecting directly to one of the CTM USB ports or 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 225.225.225.0 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.
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 41).

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 interface monitors and configures the CTM.

Note: When you select an item through choosing a checkbox, or type into a field, pressing Enter or selecting another tab will accept your selection.

Prerequisites: A service laptop connected to one of the CTM USB ports or the **ETHERNET 1** port of the Reader.

1. Launch the web browser on the computer.

Note: You can use a recent versions of either Internet Explorer, Firefox or Chrome for a 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 (Ctrl F5) 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 maintained by the system integrator to determine the correct IP address by using the **hypertrm** command. See Using HyperTerminal to connect to the DIAGNOSTIC PORT on page 260.

Note: The default IP addresses of the primary and secondary CTM ETHERNET 2 port are 192.168.0.50 and 192.168.0.51 respectively. The IP addresses may change during installation.

3. Consult the record of system IP addresses to determine the correct IP address by using the **hypertrm** command. See Using HyperTerminal to connect to the DIAGNOSTIC PORT on page 260.
4. In the address bar of the web browser, type: **https://** followed by the IP address of the ETHERNET 1 Port or USB Adapter.
5. Use the following decision table to continue the procedure.

| IF ... | THEN ... |
|--|--|
| you click the Login button and a dialog box requesting a username and password appears, | go to step 6. |
| 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 https:// |
| a web browser message indicating there is a connection problem appears, | confirm that the IP address entered in step 2 is the correct record of system IP addresses. |
| a security certificate warning (Internet Explorer (IE)) or untrusted connection warning (Firefox) appears, | for IE, go to the website; for Firefox, add an exception. |

Note: Usernames and passwords are case-sensitive.

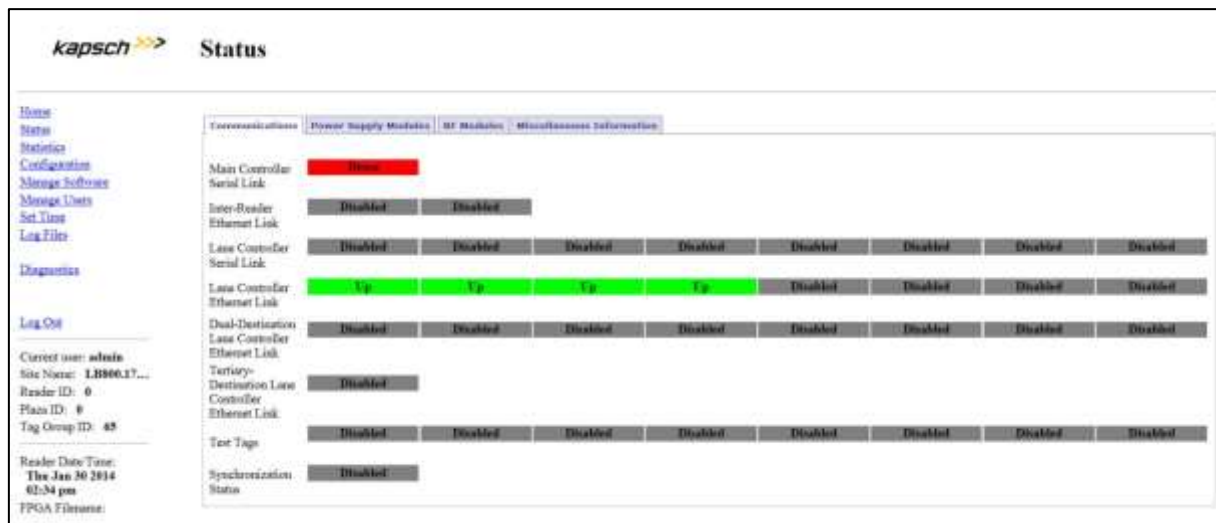
6. Enter your username and password.

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



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

Result: The following Status page appears.



8. Select the **Miscellaneous Information** tab.

Result: The following screen appears.



The screenshot shows the Kapsch Status page with the 'Miscellaneous Information' tab selected. The page includes a navigation menu on the left, a status summary on the right, and a detailed configuration table.

Navigation Menu:

- Home
- Status
- Statistics
- Configuration
- Manage Software
- Manage Users
- Set Time
- Log Files
- Diagnostics
- Log Out

Status Summary:

- Current user: admin
- Site Name: LB800.17...
- Reader ID: 0
- Plaza ID: 0
- Tag Group ID: 65
- Reader Date/Time: Thu Jan 30 2014 02:38 pm
- FPGA Filename:

Configuration Table:

| Communications | Power Supply Modules | RF Modules | Miscellaneous Information |
|-----------------------------|----------------------|------------|---------------------------|
| LC Serial Type | Undefined | | |
| CTM Position | Primary | | |
| Active State | Active | | |
| CGC Health Status | Operational | | |
| Board | LB800 | | |
| Other Side Config Compare | Communication Down | | |
| Front-panel Switch Position | Auto | | |
| CFM Status | present | | |
| Lane Tuning Mode | Disabled | | |
| Super Frame Time (us) | 11475 | | |
| System Identification | | | |

9. 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: 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 40.

1. 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 40.

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 User Admin permissions, | navigate to the Change Password tab on the User Management page. Go to step 3. |
| does NOT have User Admin permissions, | from ANY page, click Change Password in the navigation sidebar. Result: The User Management Change Password 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 User Admin permissions, | go to step 3 and continue to step 5. |
| does NOT have User Admin 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 44).
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 44).

Result: Your password resets.

Configuring the Reader to recover automatically to the primary side


The Reader can be 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 40.

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

1. Set the SPM redundancy mode switch to the **AUTO** position.
2. From the CTM web **Main Page**, select the **Configuration** link on the left panel of the screen.

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



3. Select the **Auto Recovery To Prime** check box.
4. Press **Enter** to accept the selection.

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 USB port.

Reader status

The **Status** page in the CTM web interface displays the state of the communication links, the power supply modules, and the CTM/CGC2, and is useful for troubleshooting the Reader.

Communications

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

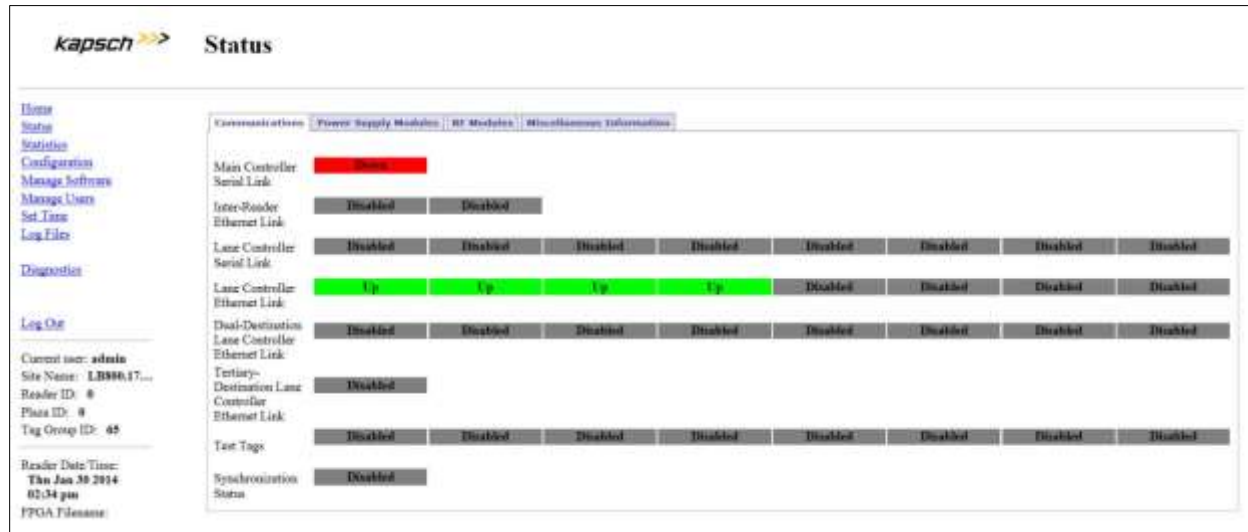


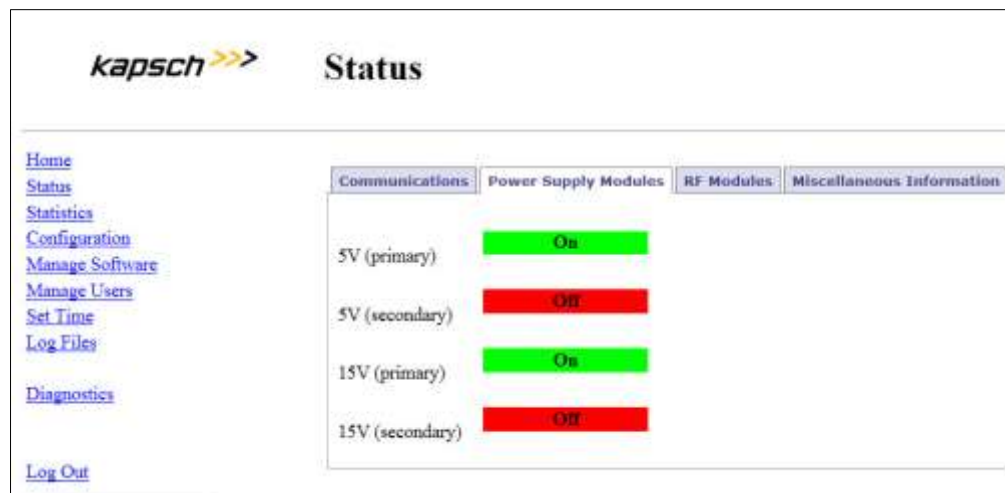
Table 3-1: Communications fields

| 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 | Enabled | successful link connection |
| | Down | link failure |
| | Disabled | link not enabled |
| Lane Controller Serial link | Enabled | successful link connection between CTM (via LPM) and LC |
| | Down | link failure |
| | Disabled | link not enabled |
| Lane Controller Ethernet link | Enabled | successful link connection |
| | Down | link failure |
| | Disabled | link not enabled |
| Test Tags | Enabled | the Reader is configured to periodically communicate with |

| Communications tab | | |
|--------------------|----------|---|
| Field | Status | Description |
| | | test tags to confirm RF Channel health |
| | Disabled | test tags are not used to confirm RF Channel health |
| Synchronization | 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.



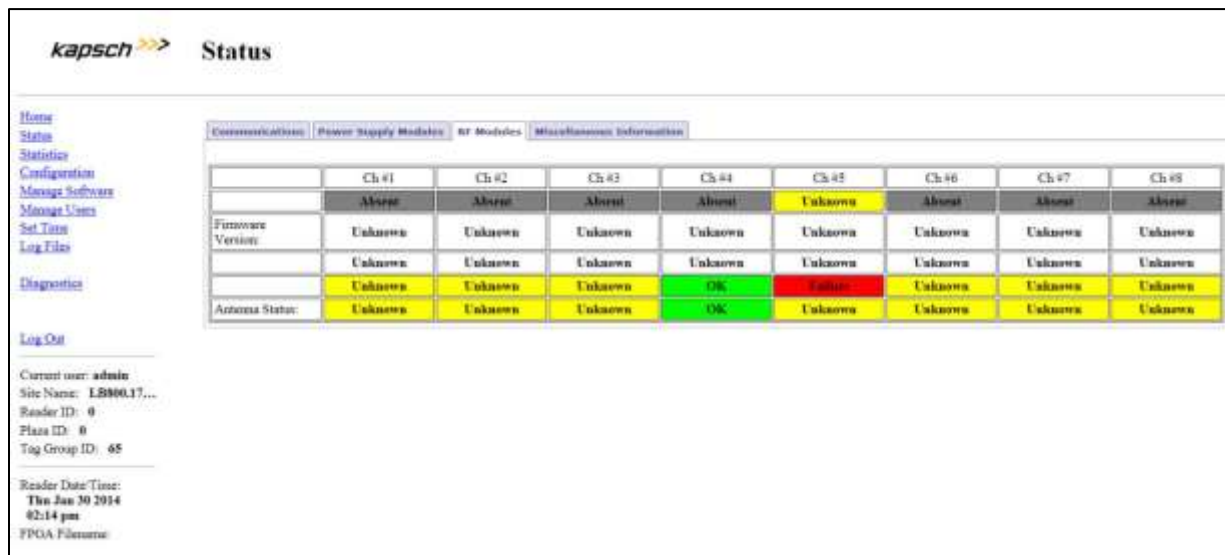
| | |
|---|----------------------|
| Home Status Statistics Configuration Manage Software Manage Users Set Time Log Files Diagnostics Log Out | |
| Communications | Power Supply Modules |
| 5V (primary) | On |
| 5V (secondary) | Off |
| 15V (primary) | On |
| 15V (secondary) | Off |

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 |
| 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 | | | | | | | | |
|---|---------|---------|---------|---------|---------|---------|---------|---------|
| Home Status Statistics Configuration Manage Software Manage Users Set Time Log Files Diagnostics Log Out | | | | | | | | |
| Communications Power Supply Modules RF Modules Miscellaneous Information | | | | | | | | |
| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
| | Absent | Absent | Absent | Absent | Unknown | Absent | Absent | Absent |
| Firmware Version: | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown |
| | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown |
| | Unknown | Unknown | Unknown | OK | Failure | Unknown | Unknown | Unknown |
| Antenna Status: | Unknown | Unknown | Unknown | OK | Unknown | Unknown | Unknown | Unknown |

Current user: admin
Site Name: LB000.17...
Reader ID: 0
Place ID: 0
Tag Group ID: 65

Reader Date/Time:
Thu Jan 30 2014
02:14 pm
FPGA Firmware:

Table 3-3 RF Modules fields

| RF Modules tab | | |
|------------------|---------|--|
| Field | Status | Description |
| Firmware Version | Absent | Not installed |
| | OK | Successfully installed and verified |
| | Failure | Unsuccessfully installed |
| | Unknown | Status not known |
| Antenna Status | Absent | Not installed |
| | 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.

Table 3-4: Miscellaneous Information fields

| Miscellaneous Information tab | | |
|-------------------------------|-------------------------------------|--|
| Field | Status | Description |
| LC Serial Type | Defined | LC Serial Type is known |
| | Undefined | LC Serial Type is unknown |
| 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 | CGC2 is operational |
| | Down | CGC2 Failure |
| Board | Example: LB800, LB735 | Provides information on the model of the single board computer (SBC) board installed Type of Board installed |
| 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 |
| Lane Tuning Mode | Disabled | 'Disabled' is normal status |
| Super Frame Time (µs) | Numerical read | Reader timing information In microseconds |

RF Channel Statistics

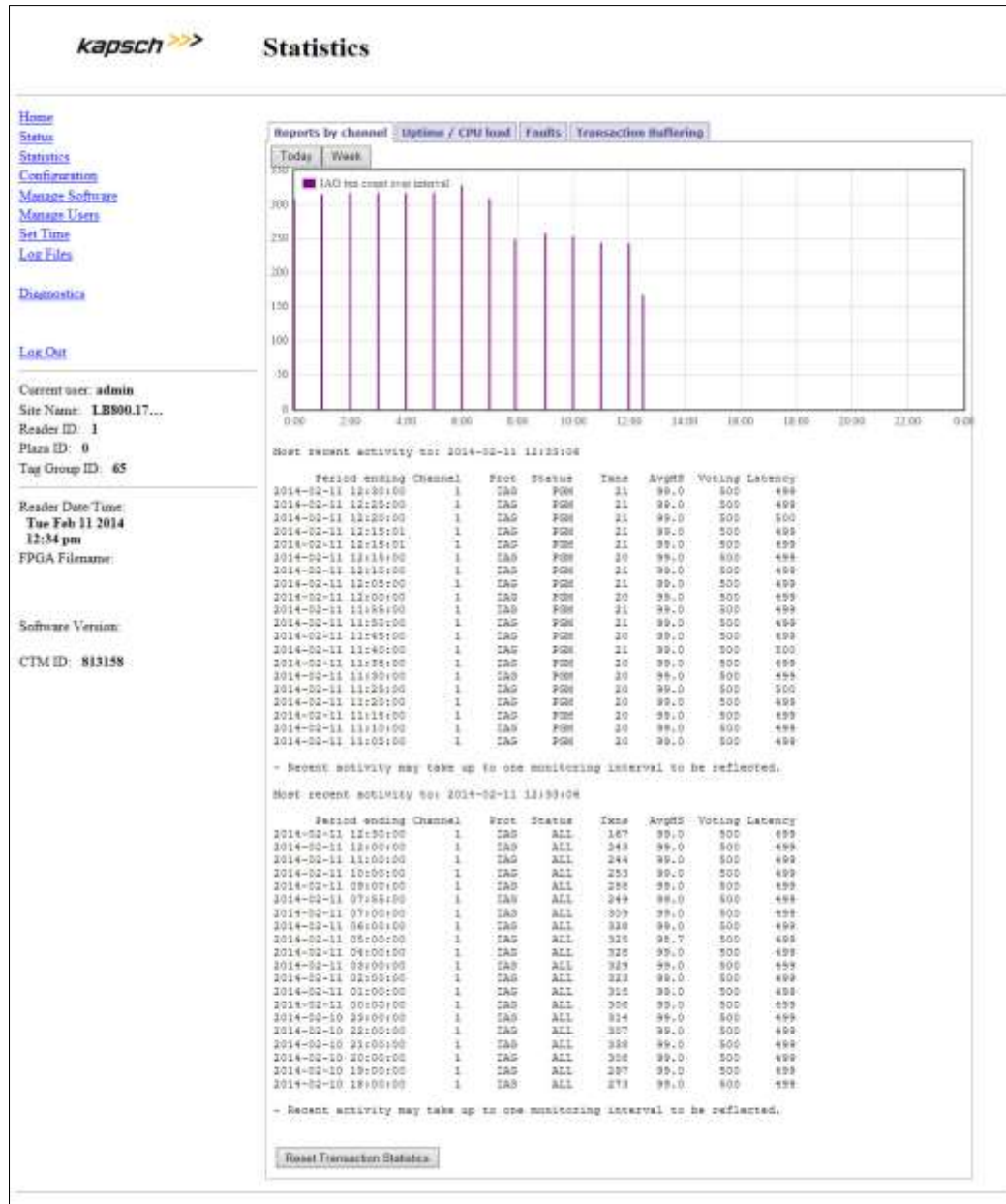
The **Statistics** page displays performance information for each MRFM-S channel. The statistics displayed do not update automatically as transactions occur. Update the statistics with the latest data by navigating away from, and then returning to the **Statistics** page, or by refreshing/reloading your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



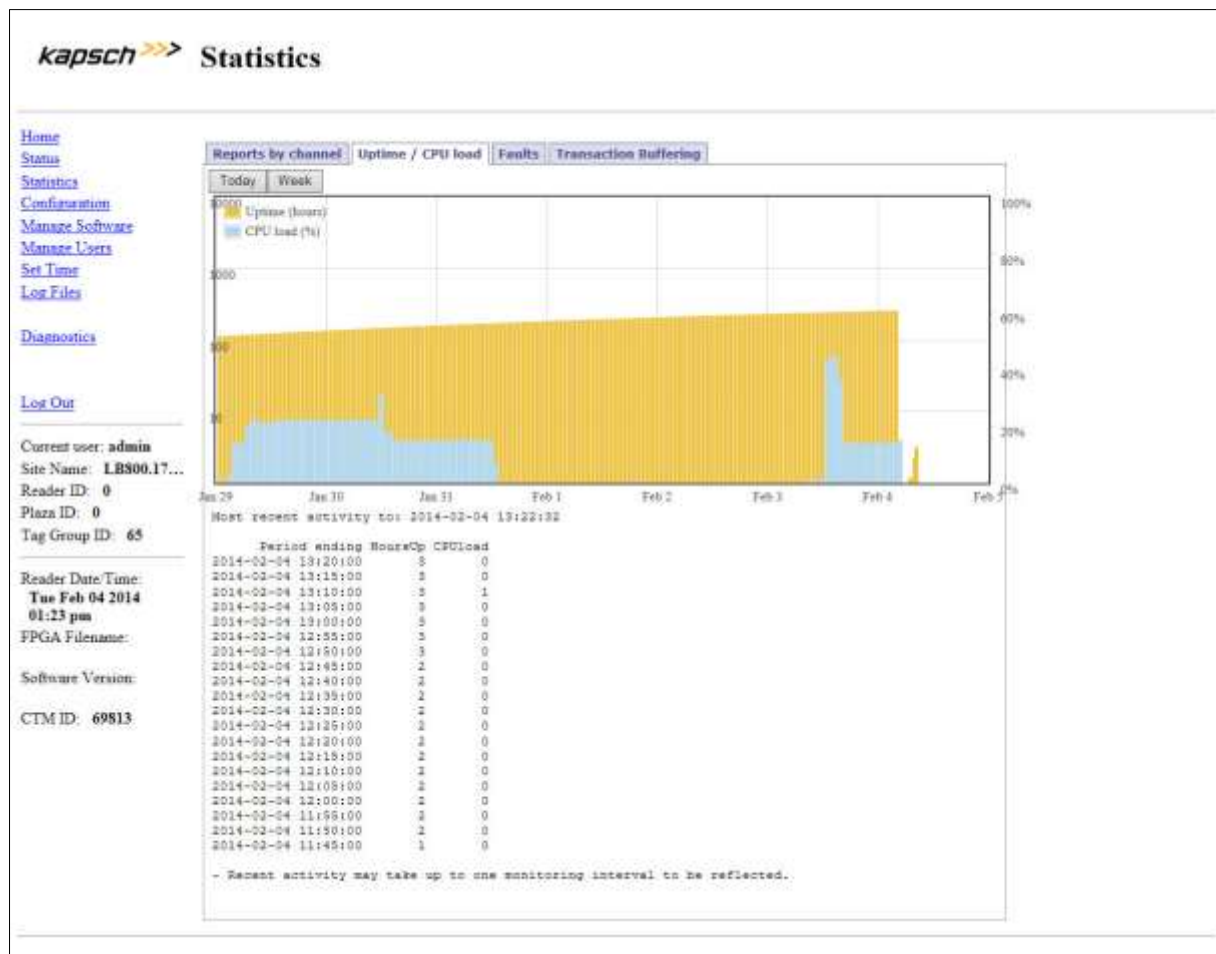
You can reset the values of the report by clicking the **Reset Transaction Statistics** button.

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 Statistics page, or refresh/reload your browser screen to update the statistics. |
| Channel | The RF Channel that the statistics in that row represent. |
| Prot | Protocol being used by the Reader |
| Status | TBD |
| 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 | TBD |
| Latency | The average latency time to report transactions |

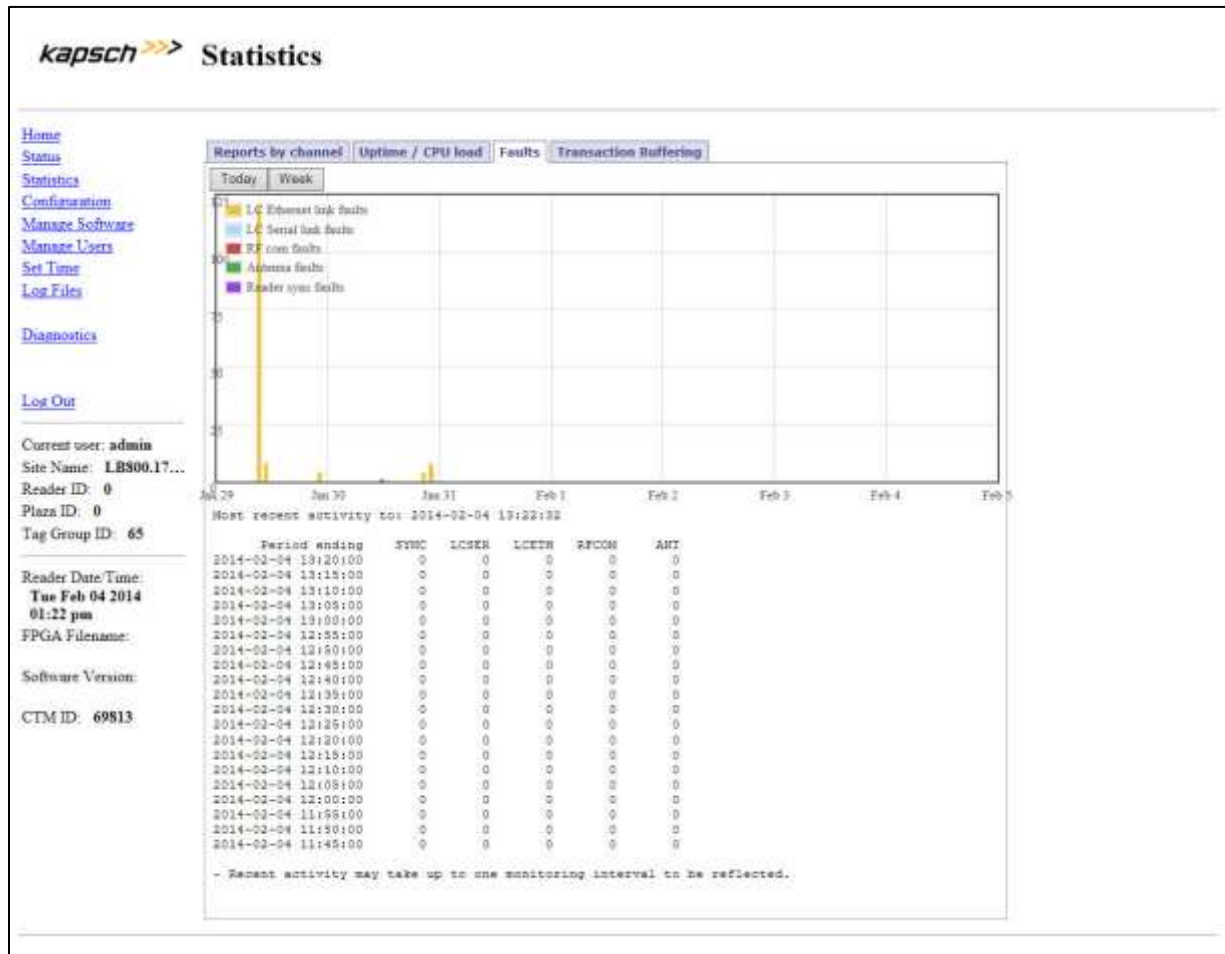
Uptime / CPU Load

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



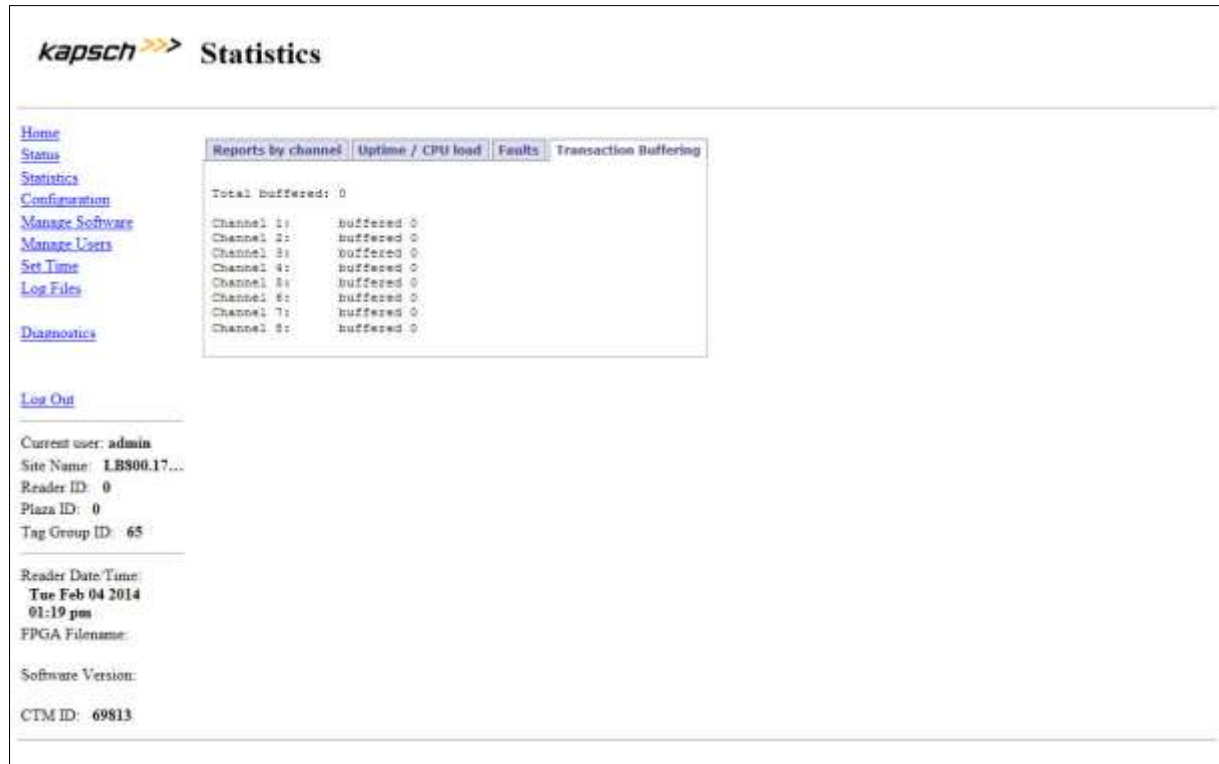
Faults

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



Transaction Buffering

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



kapsch Statistics

Home
Status
Statistics
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: LBS00.17...
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65

Reader Date/Time:
Tue Feb 04 2014
01:19 pm
FPGA Filename:
Software Version:
CTM ID: 69813

Reports by channel | Uptime / CPU load | Faults | Transaction Buffering

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.

Monitoring OBU transactions as they occur via the Diagnostics page

Monitoring OBU transactions from the **Diagnostics** page is a better alternative to viewing transactions from a transaction log on the **Log Files** page because the transactions on the **Diagnostics** page are updated automatically. However, transactions that occurred before the **Diagnostics** page was accessed can only be viewed from the transaction log.

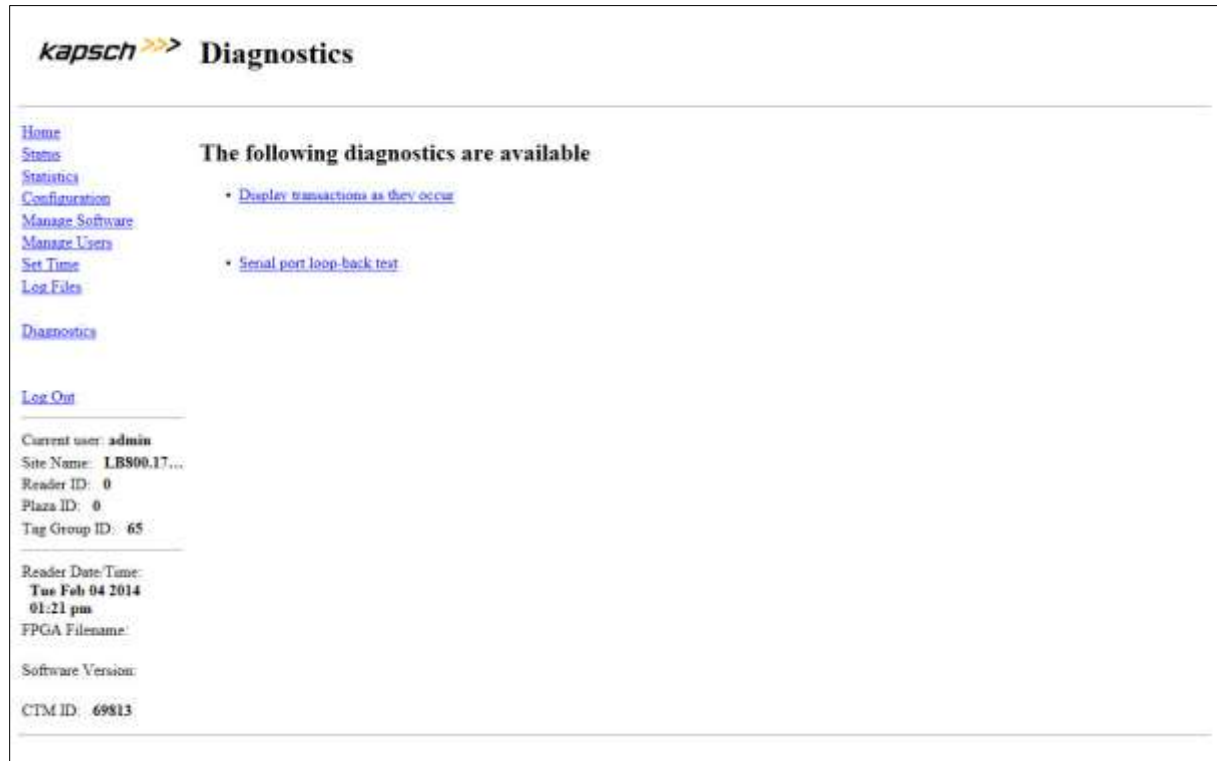
The **Display Transactions** option displays both active and passive transactions.

Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web Refer to Connecting a service laptop to the Reader, page 40. You must have **Advanced User** permissions.

Note: The computer must have Java version 6.0 installed (see www.java.com).

1. Select the **Diagnostics** link from the left side panel.

Result: The following **Diagnostics Page** appears.



2. An authentication window may appear on the **Diagnostics Page** when accessed the first time. If it appears, enter a valid user name and password.

Note: To avoid having to re-enter authentication information on the Diagnostics Page, click the Save this password in your password list button.

Result: After the Java program starts, the Tag Transaction window appears. All OBU transactions for the Reader display automatically. The display update stops if someone updates the Reader software or reboots the Reader.

Note: If a second computer or second browser window is used to access the Diagnostics Page, new transactions will no longer be displayed in the first browser window.

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 the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. 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.

kapsch >>> **Log Files**

[Home](#)
[Status](#)
[Statistics](#)
[Configuration](#)
[Manage Software](#)
[Manage Users](#)
[Set Time](#)
[Log Files](#)
[Diagnostics](#)
[Log Out](#)

Log Files | **USB Logging** | Ethernet Logging

[debug 2014-02-04](#)
[dev 2014-02-04](#)
[record 2014-02-04](#)

[event 2014-02-03](#)
[event 2014-02-04](#)
[ntp](#)
[trouble 2014-02-03](#)
[trouble 2014-02-04](#)

Delete Event Logs
Delete All Logs

Current user: **admin**
Site Name: **LB800.17...**
Reader ID: **0**
Plaza ID: **0**
Tag Group ID: **65**

Reader Date/Time:
Tue Feb 04 2014 01:33 pm
FPGA Filename:
Software Version:
CTM ID: **69813**

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

Result: The following screen appears.

kapsch >>> **Log Files**

[Home](#)
[Status](#)
[Statistics](#)
[Configuration](#)
[Manage Software](#)
[Manage Users](#)
[Set Time](#)
[Log Files](#)
[Diagnostics](#)

[Log Out](#)

Log Files | USB Logging | Ethernet Logging

Copy Log Files to USB device

Start Logging to USB device

USB Logging: Disabled

USB Device Status: Available

Current user: **admin**
Site Name: **LB800.17...**
Reader ID: **0**
Plaza ID: **0**
Tag Group ID: **65**

Reader Date/Time:
Tue Feb 04 2014
01:37 pm
FPGA Filename:

Software Version:

CTM ID: **69813**

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: 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 realtime when required.

Note: 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.

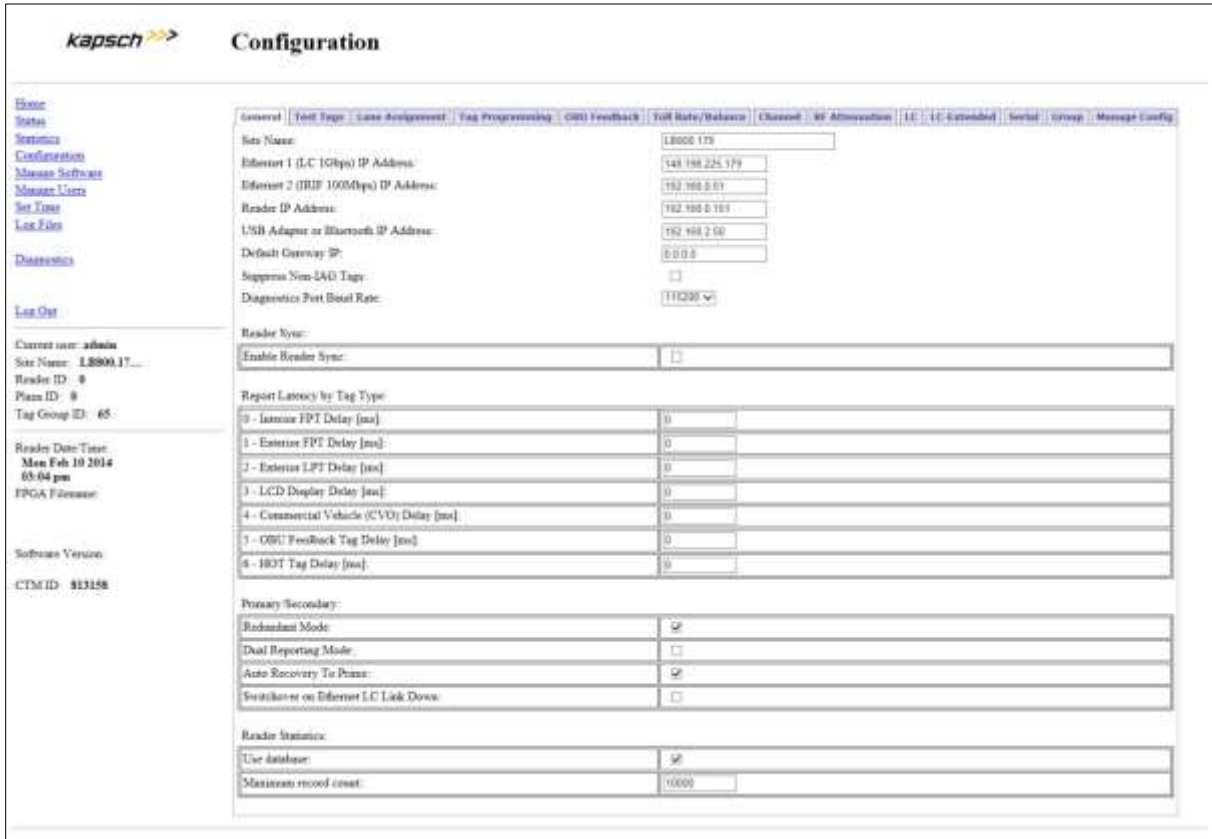
OBU Programming

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

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 40.

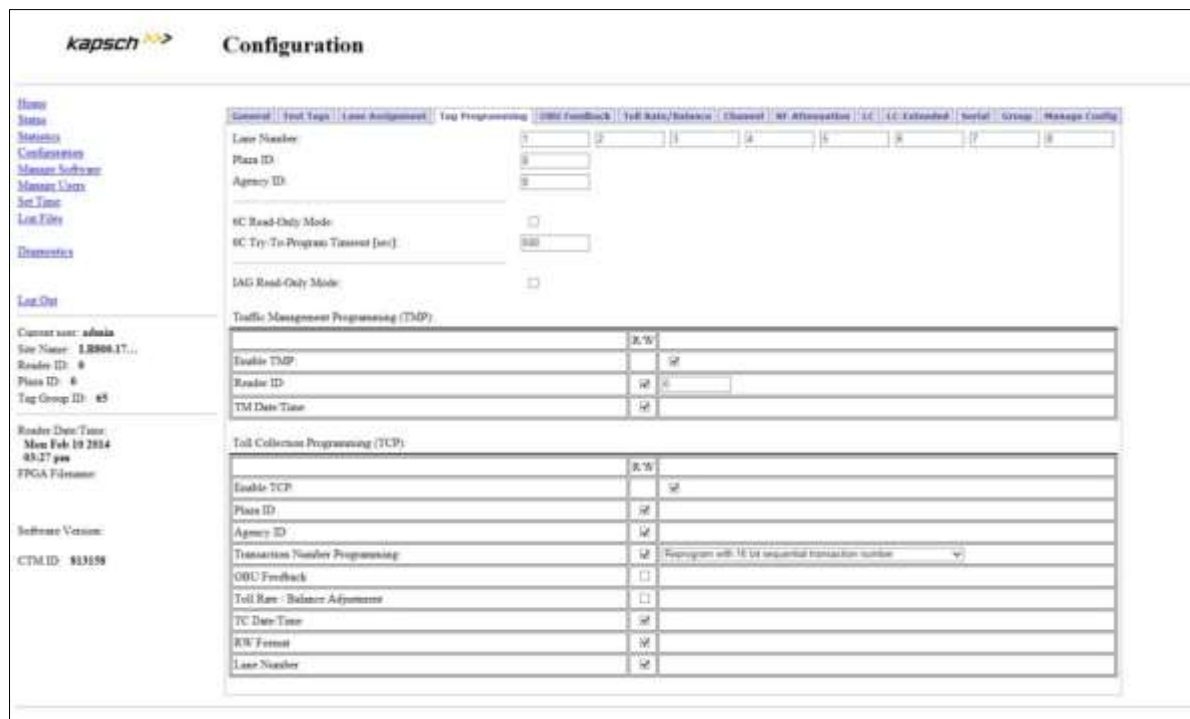
1. Select the **Configuration** link on the left side panel of the screen.

Result: The following screen appears.



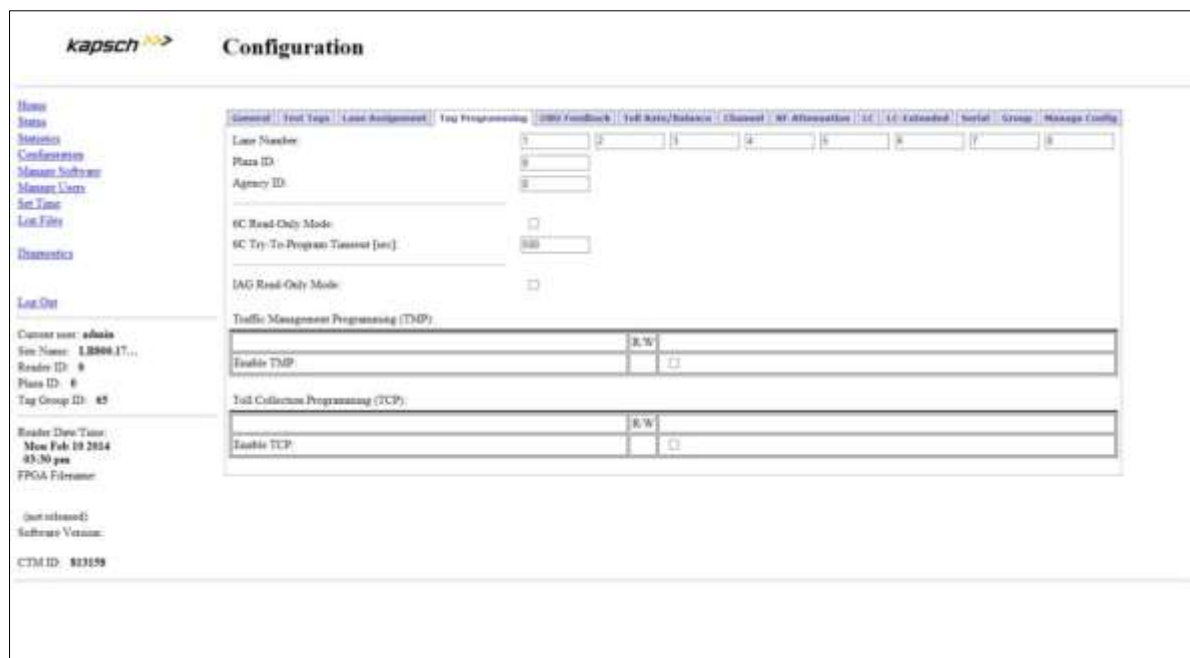
2. Click the **Tag Programming** tab.

Result: The following screen appears.



3. Clear the check boxes.

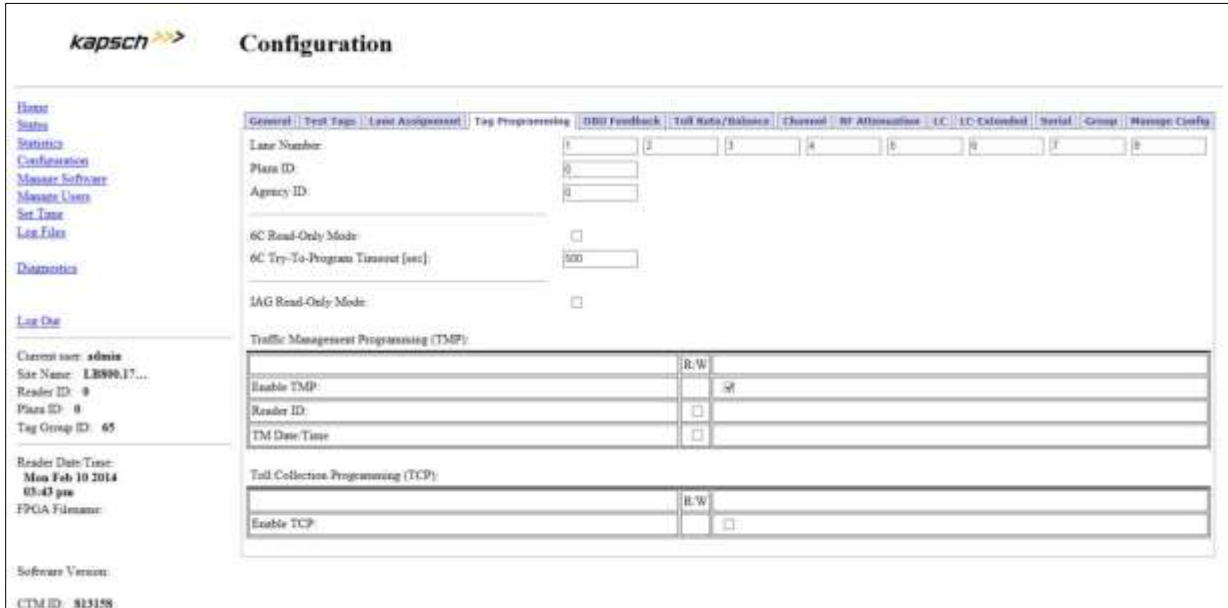
Result: The following screen appears.



Configuring OBU programming for Traffic Management Applications

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

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | **Tag Programming** | OBU Feedback | Toll Rate/Balances | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Home
Status
Statistics
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: LB8880.17...
Reader ID: 0
Pilot ID: 0
Tag Group ID: 65

Reader Data Time:
Mon Feb 10 2014
03:43 pm
FPGA Filename:
Software Version:
CTM ID: 813158

Lane Number: 1 2 3 4 5 6 7 8
Pilot ID: 0
Agency ID: 0
6C Read-Only Mode: ☐
6C Try-To-Program Timeout (sec): 100
IAG Read-Only Mode: ☐

Traffic Management Programming (TMP):

| | R | W |
|---------------|-------------------------------------|-------------------------------------|
| Enable TMP: | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Reader ID: | <input type="checkbox"/> | <input type="checkbox"/> |
| TM Date/Time: | <input type="checkbox"/> | <input type="checkbox"/> |

Toll Collection Programming (TCP):

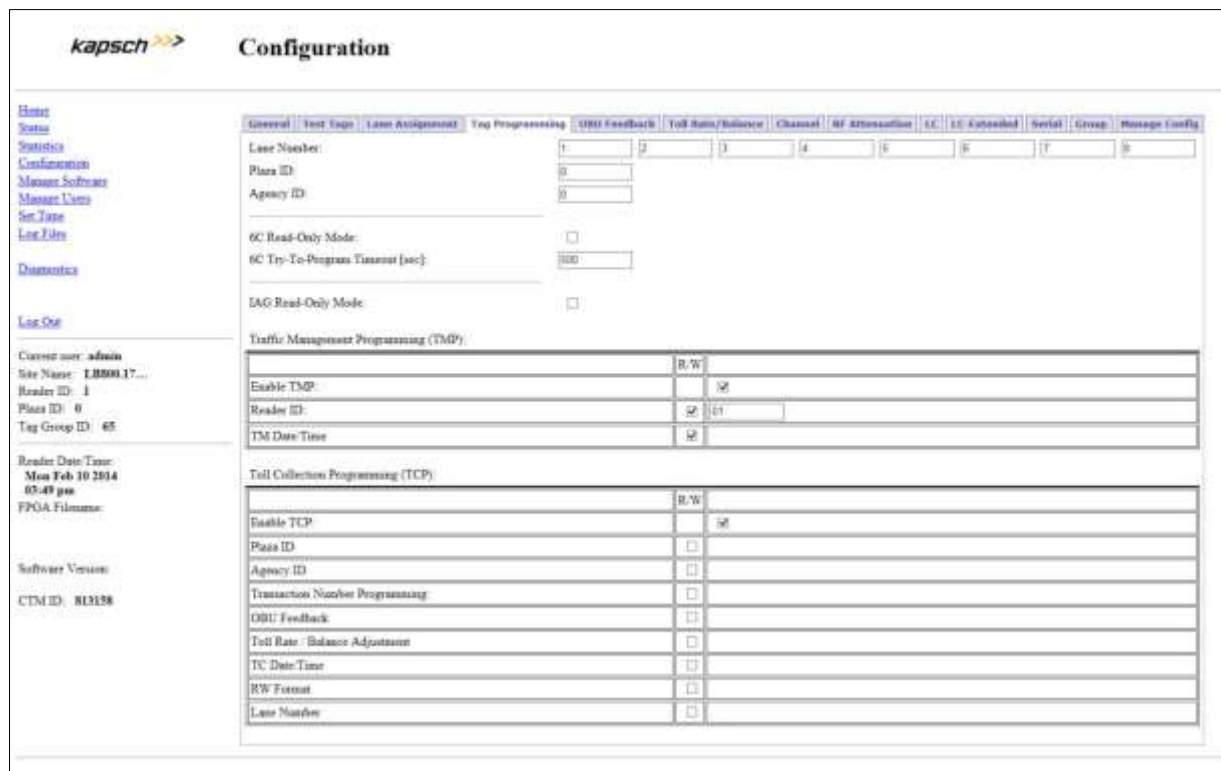
| | R | W |
|-------------|--------------------------|--------------------------|
| Enable TCP: | <input type="checkbox"/> | <input type="checkbox"/> |

4. Select the **Reader ID** check box to enable writing the Reader ID to OBUs.
5. Enter a unique Reader ID.
6. Select the **TM Date/Time** check box to write the Reader TM time to OBUs.
7. Press **Enter** to accept the selections.

Configuring OBU programming for Toll Collection applications

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

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manager Software | Manager Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: 1.0000.17...
Reader ID: 1
Plaza ID: 0
Tag Group ID: 65
Reader Date/Time: Mon Feb 10 2014 03:49 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Lane Number: 1 2 3 4 5 6 7 8
Plaza ID: 0
Agency ID: 0
OC Read-Only Mode: ☐
OC Try-To-Program Timeout (sec): 300
IAG Read-Only Mode: ☐
Traffic Management Programming (TMP):
Enable TMP: ☒
Reader ID: 01
TM Date/Time: 01
Toll Collection Programming (TCP):
Enable TCP: ☒
Plaza ID: ☐
Agency ID: ☐
Transaction Number Programming: ☐
OBU Feedback: ☐
Toll Rate/Balance Adjustment: ☐
TC Date/Time: ☐
RW Format: ☐
Lane Number: ☐

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.
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.



5. Select the desired transaction numbering calculation from the drop-down box.
6. Select the **TC Date/Time** check box to write the transaction time to the OBU.
7. Select the **RW Format** check box to determine how the scratchpad data is encoded when written to OBUs.
8. Select the **OBU Feedback** check box to enable OBU feedback, ensuring that you first enabled and configured the **Plaza ID** in step 7 on page 66.
9. Assign a Lane Number to each RF channel. 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.
10. Select the **OBU Feedback** tab.
11. Select either **Type 1** or **Type 2** feedback.
12. Select the desired audible feedback to control OBU beeping when a transaction occurs.
13. Select the desired visual feedback to control OBU LED flashing when a transaction occurs.
14. Press **Enter** to accept selections.

Configuring Toll charges

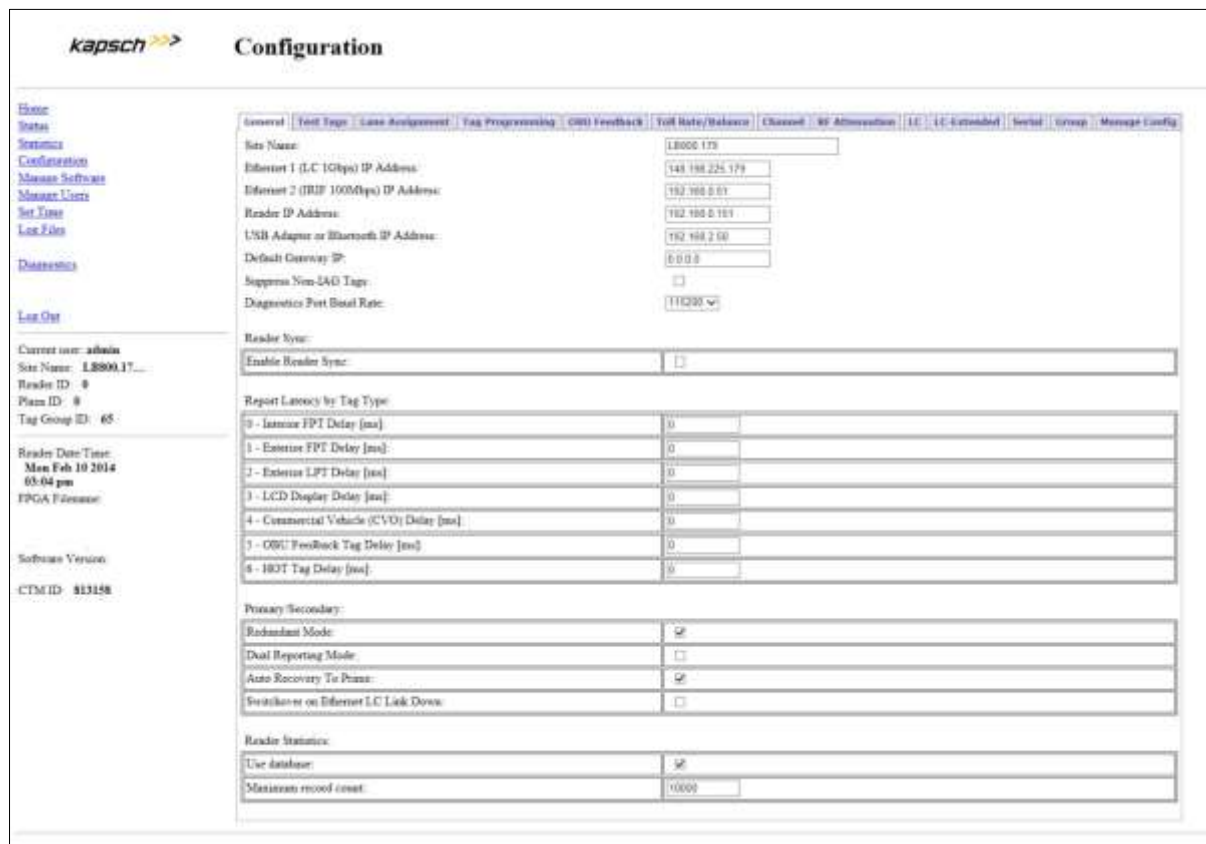
The Reader can deduct toll charges from a toll/balance OBU based on a number of parameters. BAT 1 tolling deducts charges based on the vehicle type and the lane the vehicle is in when it passes through the toll plaza. BAT 2 tolling deducts charges based on distance by determining the toll plazas the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

Result: The following screen appears.



2. Select the **Toll/Rate Balance** tab

Result: The following screen appears.



3. Select **BAT 1 - Fixed Toll** as the TRBA BAT Processing Type.

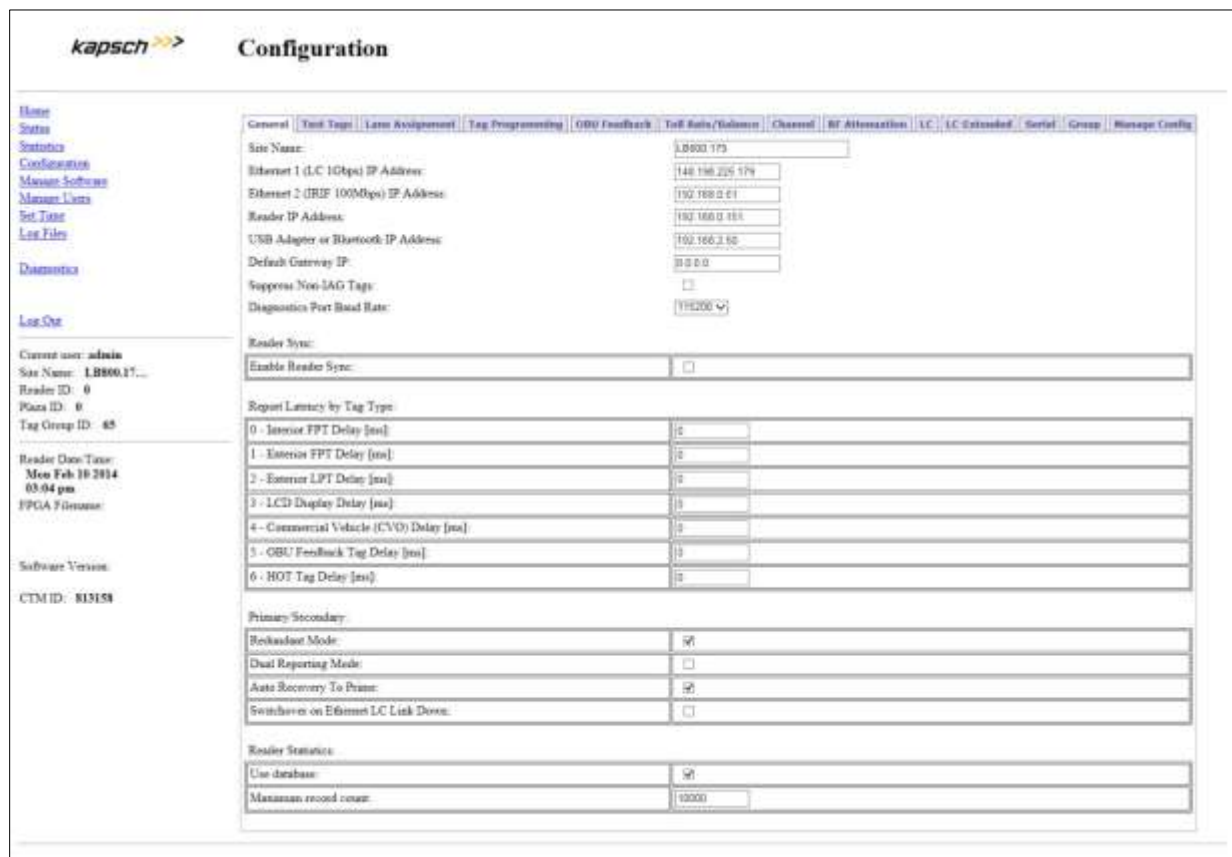
4. Select one of four Toll Rate Tables for each channel, which determines the charge for the lane associated with each channel.
5. Select the **Enforce Adjustment ID Checking** check box to limit how frequently the balance can be updated.
6. Press **Enter** to accept the values.

Result: The Reader now charges OBU's based on your choices.

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

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

Result: The following screen appears.



2. Select the **Toll Rate/Balance** tab
3. Select **BAT 2 - Variable Toll** as the TRBA BAT Processing Type.

Result: The following screen appears.

The screenshot shows the 'Configuration' page of the Kapsch TrafficCom interface. On the left is a navigation menu with links: Home, Status, Statistics, Configuration (highlighted), Manage Software, Manage Users, Set Time, Log Files, Diagnostics, and Log Out. The main content area has tabs: General, Test Tags, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Balance, Channel (selected), LC, LC-Extended, Serial, Group, and Manage Config. Under the 'Channel' tab, the 'TRBA BAT Processing Type' section has radio buttons for 'BAT 1-Fixed Toll' and 'BAT 2-Variable Toll'. Below this, the 'BAT 2 - Variable Toll Parameters' section contains a table with two rows: 'Entry / Exit Reader' and 'Enforce Adjustment ID Checking'. The 'Entry / Exit Reader' row has radio buttons for 'Entry Reader' and 'Exit Reader'. The 'Enforce Adjustment ID Checking' row has a 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** check box to limit how frequently the balance can be updated.
5. Press **Enter** to accept the values.

Result: The Reader now charges OBUs based on your choices.

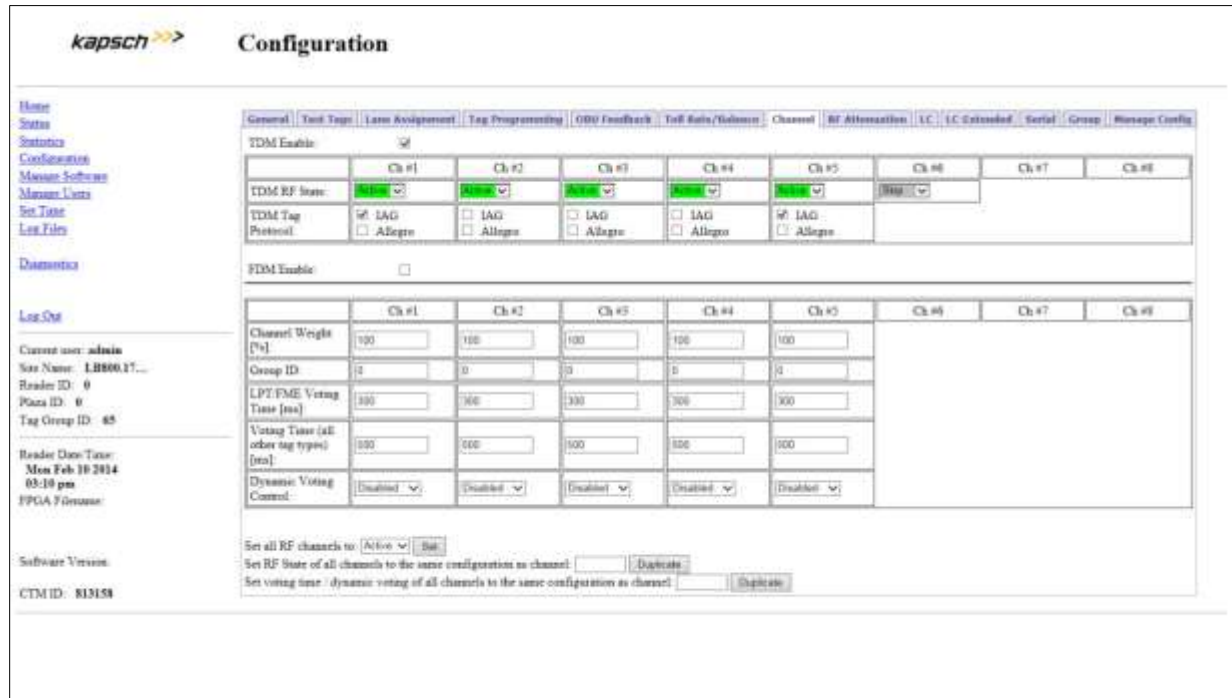
Configuring Protocols

Configure the Reader to interact with various protocol tags.

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

1. After selecting the **Configuration** link on the left side, select the **Channel** tab,

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balances | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|--|--|--|--|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Active | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Alltags | <input type="checkbox"/> IAG <input type="checkbox"/> Alltags | <input type="checkbox"/> IAG <input type="checkbox"/> Alltags | <input type="checkbox"/> IAG <input type="checkbox"/> Alltags | <input type="checkbox"/> IAG <input type="checkbox"/> Alltags | <input type="checkbox"/> IAG <input type="checkbox"/> Alltags | | |

FDM Enable: ☐

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT FME Voting Time [ms] | 100 | 100 | 100 | 100 | 100 | | | |
| Voting Time (all other tag types) [ms] | 100 | 100 | 100 | 100 | 100 | | | |
| Dynamic Voting Control: | 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:

Current user: admin
Site Name: 1.BB00.17...
Reader ID: 0
Paza ID: 0
Tag Group ID: 85
Reader Date/Time: Mon Feb 10 2014 03:10 pm
PPGA Firmware:
Software Version:
CTM ID: 813158

- When the reader leaves the factory, only those protocols selected by the customer are available for configuration. All other protocols will be de-selected.
- Select each channel and use the **TDM RF State** and **FDM RF State** to enable or disable a channel.
- Select the frequency for each channel by using the FDM Frequency (MHZ) selection.
Note: This should only be performed with Kapsch technical support.
- Select the specific combination of protocols desired.
Note: This should only be performed with Kapsch Technical Support.

Configuration

The following table lists and describes the commands and controls that can be deployed in the various Configuration screens that are available to a user.

Table 3-6 Commands and Controls

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------|--|-------------------------------|----------------|-------------------------|-------------------------|---|---|
| Home | In the navigation side bar: Click Home . | anyone | N/A | N/A | N/A | displays the Main Page 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 Status 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------|---|--|----------------|-------------------------|-------------------------|--|---|
| Statistics | In the navigation side bar: Click Statistics . | anyone | N/A | N/A | N/A | displays the Statistics page in the CTM web interface. | Used to view Reports by channel , Low/Early Reads, Transaction Buffering statistics. Note: 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 Configuration 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 Manage Software permissions | N/A | N/A | N/A | displays the Software Management 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. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------|---|--|----------------|-------------------------|-------------------------|---|--|
| Manage Users | In the navigation side bar: Click Manage Users . | user with User Admin permissions | N/A | N/A | N/A | displays the User Management 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 User Admin permissions | N/A | N/A | N/A | displays a User Management page limited to commands for changing passwords | to change the password of the user currently logged into the CTM web interface |
| Set Time | In the navigation side bar: Click Set Time . | anyone | N/A | N/A | N/A | displays the Time Management page in the CTM web interface | to Disable/Enable Network Time Protocol (NTP) access NTP servers IPv4 addresses and select a new time zone |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--------------------|---|--|----------------|-------------------------|-------------------------|--|---|
| Log Files | In the navigation side bar: Click Log Files . | user with View Log Files permission | N/A | N/A | N/A | displays the Log Files page in the CTM web interface. Also displays the USB Logging tab and the Ethernet Logging tab. | to view , manage or copy log files, depending on user permissions |
| 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"> • Static and Dynamic Margin Maps • Displaying transactions as they occur • Serial port loop-back test |
| Log Out | In the navigation side bar: Click Log Out . | 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|---|--|----------------|-------------------------|-------------------------|--|--|
| 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 |
| 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 |
| Site Name | From the General tab on the Configuration page: Type a Reader name in Site Name text, then, click outside the field, press Enter, or select a different tab. | anyone | SITENM | no default value | 32 | sets the site name used in the log file strings and is used in the name of the configuration files | Used to identify which Reader the log files and configuration files originated from |
| Ethernet 1 IP (LC 1Gbps) Address | From the General tab on the Configuration page: Type a ETHERNET 1 port IP address in Ethernet 1 (LC 1Gbps) IP Address field, then, , click outside the field, press Enter, or select a different tab. | anyone | LETHIF | 192.168.1.50 | N/A | sets the IP address for the ETHERNET 1 port on the CTM | Used to specify an appropriate ETHERNET 1 IP address when configuring an LC network |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|--|----------------|--|-------------------------|---|---|
| Ethernet 2 IP (IRIF 100Mbps) Address: | From the General tab on the Configuration page: Type an ETHERNET 2 port IP address in the Ethernet 2 (IRIF 100Mbps) IP Address field, then, , click outside the field, press Enter, or select a different tab. | anyone | PRIMIP | 192.168.0.50 Primary 192.168.0.51 Secondary | N/A | sets the IP address for the ETHERNET 2 port on the CTM | Used to specify an appropriate ETHERNET 2 IP address when configuring an IR network |
| IP Address | From the General tab on the Configuration page: Type an IP address in IP Address field in General tab of the Configuration page, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | SCNDIP | 192.168.0.51 | N/A | sets the 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. This address should be provided by the SI network planner. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|--|--|----------------|-------------------------|-------------------------|---|--|
| Reader IP address | From the General tab on the Configuration page: Type a Reader IP address in Reader IP Address field in General tab of the Configuration page, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 |
| USB Adapter IP or Bluetooth IP Address | From the General tab on the Configuration page: Type an IP address in the USB Adapter IP Address field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 | Used to specify a unique IP address for the USB-to-Ethernet adapter for connecting a service laptop computer to a CTM USB port |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------------|--|-------------------------------|----------------|-------------------------|-----------------------------|---|---|
| Default Gateway IP | From the General tab on the Configuration page: Type an IP address in the Default Gateway IP Address field, then, , click outside the field, press Enter, or select a different tab. | anyone | DFGWIP | 0.0.0.0.0 | 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-IAG Tags | From the General tab on the Configuration page: Select Suppress Non-IAG Tags check box, then, , click outside the field, press Enter, or select a different tab. | anyone | NONIAG | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: All transactions are reported Enabled: suppresses reporting of OBUs not matching the Group ID that the Reader is provisioned | Used to prevent incompatible report formats from being sent to the LC |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-----------------------------------|--|-------------------------------|----------------|-------------------------|---|---|---|
| Diagnostics Port Baud Rate | From the General tab on the Configuration page: Select a baud rate from the Diagnostics Port Baud Rate drop-down box, then, , click outside the field, press Enter, or select a different tab. | anyone | DIAGBD | 0 (9600) | 0 (9600) 1 (19200) 2 (38400) 3 (57600) 4 (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 Sync: | | | | | | | |
| Enable Reader Sync | From the General tab on the Configuration page: Select the Enable Reader Sync check box, then, , click outside the field, press Enter, or select a different tab. | anyone | RFSYNC | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader RF interrogation is not synchronized with other Readers Enabled: Reader RF interrogation is synchronized with other Readers in the sync network | Used to synchronize superframes between Readers connected together in a synchronization network |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|----------------------------------|--|--|----------------|--------------------------------------|--|---|---|
| Superframe Sync Skip | From the General tab on the Configuration page: Select either Sync to superframe or Sync to every other superframe , then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | RFSKSK | 0 (Sync to every superframe enabled) | 0 (Sync to every superframe) 1 (Sync to every other superframe) | specifies whether the Reader tries to sync every superframe or every other superframe | Used to allow Readers with different superframe sizes to sync after the same number of frames |
| Add 2 Dummy Frames | From the General tab on the Configuration page: Select either No or Yes , then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | RFADD2 | 0 (No) | 0 (No) 1 (Yes) | No : dummy frames are not added to superframe Yes : dummy frames are added to superframe. | Used to allow Readers with different superframe sizes to sync after the same number of frames |
| Type Of Reader Syncing To | From the General tab on the Configuration page: Select either JANUS or Badger from the drop-down box, then, click outside the field, press Enter, or select a different tab. | anyone | SYNCTO | 0 (JANUS) | 0 (JANUS) 1 (Badger) | JANUS : normal frame rate is used for synchronization Badger : Reader synchronization is adjusted to Badger frame rate | Used to cause JANUS® Readers to adjust to the same frame rate as BADGER Readers |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------------------|---|--|----------------|-------------------------|-------------------------|--|---|
| Report Latency by Tag Type: | | | | | | | |
| 0 - Interior FPT Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the 0- Interior FPT Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | LYCTL0 | 0 | 0-5000 | sets report delay time in milliseconds for Interior FTP 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 |
| 1 - Exterior FPT Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the Exterior FPT Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------------------|--|--|----------------|-------------------------|-------------------------|--|---|
| 2 - Exterior LPT Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the Exterior LPT Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 General tab on the Configuration page: Enter a time (in milliseconds) in the LCD Display Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|--|----------------|-------------------------|-------------------------|---|---|
| 4 - Commercial Vehicle (CVO) Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the Commercial Vehicle (CVO) Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User 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 |
| 5 - OBU Feedback Tag Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the OBU Feedback Tag Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | LYCTL5 | 0 | 0-5000 | sets report delay time in milliseconds for CVO 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------------|---|--|----------------|----------------------------|-----------------------------|---|---|
| 6 - HOT Tag Delay [ms] | From the General tab on the Configuration page: Enter a time (in milliseconds) in the HOT Tag Delay field, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | LYCTL6 | 0 | 0-5000 | sets report delay time in milliseconds for CVO 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 General tab on the Configuration page: Select the Redundant Mode check box, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | RDNDNT | 1 (Redundant Mode enabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader does not attempt to switch to redundant side when a failure occurs. Enabled: 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------------|--|--|----------------|------------------------------------|---|---|---|
| Dual Reporting Mode | From the General tab on the Configuration page: Select the Dual Reporting Mode check box, then, , click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | DUALRP | 0 (Dual Reporting Mode disabled) | 0 (Dual Reporting Mode disabled) 1 (Dual Reporting Mode enabled) | sets Reader to Dual Reporting mode | Used to gather reports from both the primary and secondary sides of the Reader |
| Auto Recovery To Prime | From the General tab on the Configuration page: Select the Auto Recovery To Prime check box, then, ., click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | A_RCVR | 1 (Auto Recovery to Prime Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader does not attempt to recover to Primary side when failure clears. Enabled: 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|--|----------------|-------------------------|-----------------------------|---|---|
| Switchover on Serial Link Down | From the General tab on the Configuration page: With Serial communications enabled, select the Switchover on Serial Link Down check box, then, click outside the field, press Enter, or select a different tab. | user with Advanced User permission | SOSERL | 0 | 0-1 | Disabled: switchover does not occur when the Serial link is down. Enabled: 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. | NOTE: If enabled, you MUST also disable all unused COM ports (see SERIAL tab) as well as unused LC destinations (see LC tab). |
| Switchover on Ethernet LC Link Down | From the General tab on the Configuration page: With Ethernet LC communications enabled, select the Switchover on Ethernet LC Link Down check box, then, click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | SO_ETH | 0 | 0 (Disabled) 1 (Enabled) | Disabled: switchover does not occur when the Ethernet LC link is down. Enabled: to enable the Reader to switchover from the primary side to the secondary side when an Ethernet link to the LC is down | N/A |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|--|----------------|-------------------------|-------------------------|--|--------------------------------------|
| Switchover on Ethernet IRIF Link Down | From the General tab on the Configuration page: With Ethernet LC communications enabled, select the Switchover on Ethernet IRIF Link Down check box, then, click outside the field, press Enter, or select a different tab. | user with Advanced User permissions | SOIRIF | 0 | 0-1 | Disabled: switchover does not occur when the Ethernet IRIF link is down. Enabled: Enable means switch-over if a connection to an adjacent reader over the Ethernet interface is down. | N/A |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|--|----------------|-------------------------|-------------------------|---|---|
| Test Tags tab | | | | | | | |
| Test Tag Single Fault Threshold | From the Test Tags tab on the Configuration page: Enter a number in the Test Tag Single Fault Threshold field, then, press Enter or select a different tab. | user with Advanced User permissions | SFT____ | 6 | 1-99 | sets the number of consecutive test tag faults before a channel is considered bad | to continuously monitor channel quality and set a failure threshold |
| Test Tag Multiple Fault Threshold | From the Test Tags tab on the Configuration page: Enter a number in the Test Tag Multiple Fault Threshold field, then, press Enter or select a different tab. | user with Advanced User permissions | MFT____ | 8 | 1-8 | sets the number of bad channels that trigger a switchover | to continuously monitor channel quality and set a failure threshold for triggering a switchover |
| Test Tag Period | From the Test Tags tab on the Configuration page: Enter a time, in seconds, in the Test Tag Period field, then, press Enter or select a different tab. | user with Advanced User permissions | TTP____ | 30 | 10-99 | sets the test tag period | to set the frequency of test tag checks |
| Test Tag State | From the Test Tags tab on the Configuration page: Enter a time, in seconds, in the Test Tag Period field, then, press Enter or select a different tab. | user with Advanced User permissions | RFTTST | 0 | 0-1 | Enable means start checking for test tags and switch-over if the Multiple Fault Threshold has been reached. | N/A |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|--|--|--|-------------------------|---|--|---|
| Lane Assignment tab | | | | | | | |
| IAG 6B 6C Allegro ATA SeGo | From the Lane Assignment tab on the Configuration page: Select First to Read/Program , Majority , or Interpolated from the Lane Assignment Algorithm box, then, press Enter or select a different tab. | user with Advanced User permissions | VTALGO VTAG6B VTAG6C VTAGAG VTAGAA VTAGSG | 1 | 0-First to read program 1-Majority 2-Interpolated | runs the selected tag assignment algorithm | to set which algorithm is used for determining OBU lane assignment between multiple Readers |
| Interpolated Handshake Equalization Ratio (%) | From the Lane Assignment tab on the Configuration page: Select Interpolated from the Lane Assignment Algorithm box. Enter a value in the field and, press Enter or select a different tab. | user with Advanced User permissions | HSEQR | 25 | 1-100 | Assigns a numerical value to the Handshake equalization ratio field used in interpolated voting | used in interpolated voting |
| Communication Method | From the Lane Assignment tab on the Configuration page: Select Disabled , Badger-style CRA , or Ethernet from Communication Method drop-down box, then, press Enter or select a different tab. | user with Advanced User permissions | MULTRD | 0 (Disabled) | 0 (Disabled) 1 (Badger-Style CRA) 2 (Ethernet) | Disabled: Reader is not set to communicate with other Readers. Badger-Style CRA: Voting between Readers relies on vote counts. Ethernet: Voting between Readers relies on algorithms. | sets how Readers communicate when determining lane assignments between multiple Readers |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|---|--|----------------|-------------------------|---|---|---|
| Cross-Reader Reporting | From the Lane Assignment tab on the Configuration page, with Badger-style CRA or Ethernet communication method enabled: Select Disabled , Report All , or Report Non-Zero from the Cross-Reader Reporting drop-down box, then, press Enter or select a different tab. | user with Advanced User permissions | CRARPT | 0 (Disabled) | 0 (Disabled) 1 (Report All) 2 (Report Non-Zero) | Disabled: Reader is not set to communicate with other Readers. Report All results in all transactions being sent to the LC Report Non-Zero informs the LC of suppressed transactions | to set which transactions are sent to LC in multi-reader configurations |
| IRIF Timeout [ms] (make sure the TTO values of all IRIF readers are the same) | From the Lane Assignment tab on the Configuration page, with Ethernet communication method enabled: Enter a time, in milliseconds, in the IRIF Timeout field, then, press Enter or select a different tab. | user with Advanced User permissions | IRIFTO | 50 | 30-5000 | sets IRIF timeout time | sets the threshold for determining an IR network problem and enable a switchover if enabled |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------|--|--|----------------|-------------------------|-----------------------------|---|--|
| Enable Left Reader | From the Lane Assignment tab on the Configuration page, with Ethernet communication method enabled: Select the Enable Left Reader check box, then, press Enter or select a different tab. | user with Advanced User permissions | LEFTRD | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader does not coordinate voting with Reader covering lanes to the left. Enabled: 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 (see Figure 5-13, page 175) |
| Left Reader IP | From the Lane Assignment tab on the Configuration page, with the Left Reader enabled, Enter the IP address of the left Reader in the Left Reader IP field, then, press Enter or select a different tab. | user with Advanced User 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 (see Figure 5-13, page 175) |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------|---|--|----------------|-------------------------|-----------------------------|---|---|
| Enable Right Reader | From the Lane Assignment tab on the Configuration page, with Ethernet communication method enabled: Select the Enable Right Reader check box, then, press Enter or select a different tab. | user with Advanced User permissions | RGHTRD | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader does not coordinate voting with Reader covering lanes to the right. Enabled: 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 (see Figure 5-13, page 175) |
| Right Reader IP | From the Lane Assignment tab on the Configuration page, with the Right Reader enabled, Enter the IP address of the right Reader in the Right Reader IP field, then, press Enter or select a different tab. | user with Advanced User 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 (see Figure 5-13, page 175) |
| Tag Programming tab | | | | | | | |
| Read-Only Mode (enabled) | From the Tag Programming tab on the Configuration page: Select the Read-Only Mode check box. | anyone | RDONLY | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader is able to write to OBUs. Enabled: Reader is not permitted to write to OBUs. | to disable the ability to write data to OBUs |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------|---|-------------------------------|----------------|-------------------------|-----------------------------|---|---|
| Enable TMP | From the Tag Programming tab on the Configuration page: With the Read-Only Mode check box disabled, select the Enable TMP check box. | anyone | TMP____ | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: Timestamp and Reader ID fields not updated. Enabled: Timestamp and Reader ID written to OBU. | to control if Reader ID or date/time data is written to the OBU |
| Reader ID (enable) | From the Tag Programming tab on the Configuration page: With TMP enabled, select the Reader ID check box. | anyone | N/A | N/A | N/A | enables Reader ID to be written to OBUs | to write Reader ID to OBUs and access Reader ID field |
| Reader ID | From the Tag Programming tab on the Configuration page: With Reader ID enabled, enter a numeric Reader ID, then, press Enter or select a different tab. | anyone | RID____ | 0 | 0-4095 | sets Reader ID | to keep a record in OBUs of the Reader ID |
| TM Date/Time | From the Tag Programming tab on the Configuration page: With TMP enabled, select TM Date/Time . | anyone | TMDTTM | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: the Reader date and time is not written to OBUs Enabled: the Reader date and time is written to OBUs | to keep a record in OBUs of the TM transaction time |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------|---|-------------------------------|----------------|-------------------------|-----------------------------|---|---|
| Enable TCP | From the Tag Programming tab on the Configuration page: With the Read-Only Mode check box cleared, select the Enable TCP check box. | anyone | TCP____ | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader is not permitted to update toll collection fields in OBUs Enabled: 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 |
| Plaza ID (enable) | From the Tag Programming tab on the Configuration page: With TCP enabled, select the Plaza ID check box. | anyone | N/A | N/A | N/A | enables Plaza ID to be written to OBUs | to write Plaza ID to OBUs and access the Plaza ID field |
| Plaza ID | From the Tag Programming tab on the Configuration page: With Plaza ID enabled, enter a numeric Plaza ID, then, press Enter or select a different tab. | anyone | PID____ | 0 | 0-127 | sets Plaza ID | to keep a record in OBUs of the Plaza ID |
| Agency ID (enable) | From the Tag Programming tab on the Configuration page: With TCP enabled, select the Agency ID check box. | anyone | N/A | N/A | N/A | enables Agency ID to be written to OBUs | to write the agency ID to OBUs and access the Agency ID field |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|---|-------------------------------|----------------|-------------------------|-------------------------|---|--|
| Agency ID | From the Tag Programming tab on the Configuration page: With Agency ID enabled, enter a numeric Agency ID, then, press Enter or select a different tab. | anyone | AID____ | 0 | 0 - 127 | sets the agency ID | to keep a record in OBUs of the agency ID |
| Transaction number programming (enable) | From the Tag Programming tab on the Configuration page: With TCP enabled, select the Transaction number programming check box. | anyone | N/A | N/A | N/A | 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------------|--|-------------------------------|----------------|---|---|---|---|
| Transaction number programming | From the Tag Programming tab on the Configuration page: With Transaction number programming enabled, select the appropriate calculation type from the Transaction number programming drop-down box, then, press Enter or select a different tab. | anyone | TFRM__ | 2 Reprogram with 16 bit sequential transaction number | 0 Don't reprogram transaction field 1 Reprogram with 16 bit random number 2 Reprogram with 16 bit sequential transaction number 3 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------------|--|-------------------------------|----------------|-------------------------|-----------------------------|---|---|
| OBU Feedback | <p>From the Tag Programming tab on the Configuration page:</p> <p>Select the OBU feedback check box.</p> <p>Note: If the checkbox is grayed out, it is because the Toll Rate/Balance Adjustment is checked. Uncheck this checkbox to activate the OBU feedback checkbox</p> | anyone | rw_OBU | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | <p>Disabled: programs feedback-type OBUs to not provide feedback</p> <p>Enabled: programs feedback-type OBUs to provide feedback</p> | to configure feedback-type OBUs to notify when an ETC transaction has occurred. |
| 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>Note: If the checkbox is grayedout, it is because the OBU feedback checkbox is checked. Uncheck this checkbox to activate the Toll Rate/Balance Adjustment checkbox.</p> | anyone | rw_TRB | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | <p>Disabled: blanks out the Toll Rate / Balance Adjustment tab.</p> <p>Enabled: Reader is responsible for adjusting Toll Rate and Balance in OBU.</p> | to allow the Toll/Rate Balance adjustment to be made by the Reader and access configuration settings. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--------------------------------|--|-------------------------------|----------------|-------------------------|-----------------------------|---|---|
| TC Date/Time | From the Tag Programming tab on the Configuration page: With TCP enabled, select TC Date/Time . | anyone | TCDTTM | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader Date/Time not written to OBU TC data fields. Enabled: 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 RW Format check box. | anyone | RW_FMT | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: RW Format not affected Enabled: 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 Lane Number R/W check box, then, press Enter or select a different tab. | anyone | | | | enables lane number programming | to enable ability to set a specific lane number for each RF channel |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|-------------------------------|----------------|--|-------------------------|---|--|
| Lane Number (channel assignment) | From the Tag Programming tab on the Configuration page: With Lane Number R/W enabled, enter a value from 0 to 31 in each channel number field, then, press Enter or select a different tab. | 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. ATTENTION: 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-----------------------------|---|-------------------------------|----------------|-------------------------|---|--|--|
| OBU Feedback tab | | | | | | | |
| OBU Feedback type | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, select Type 1 or Type 2 . | anyone | OBUTYP | 0 (Type 1) | 0 (Type 1) 1 (Type 2) | Specifies which type of OBU feedback to employ: TYPE1 : all tags provide the same feedback TYPE2 : determine what feedback to use based on a table lookup choose one of: 0 - Type 1 1 - Type 2 | to turn on and specify which type of feedback an OBU provides |
| OBU Feedback Type 1 | | | | | | | |
| OBU Audible Feedback | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled and Type 1 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | OBUAUD | 0 (Off) | 0 (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) | 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|----------------------------|--|-------------------------------|----------------|-------------------------|---|--|--|
| OBU Visual Feedback | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled and Type 1 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | OBUVIS | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (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 | | | | | | | |
| Valid Tag: Audible | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | O2VLDA | 0 (Off) | 0 (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 valid tag | to configure how long and how many times an OBU beeps to indicate a successful transaction |
| Valid Tag: Visual | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | O2VLDV | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s) | Specify 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------|--|-------------------------------|----------------|-------------------------|---|--|--|
| Invalid Tag: Audible | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | O2IVDA | 0 (Off) | 0 (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) | Specify 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 |
| Invalid Tag: Visual | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | O2IVDV | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s) | Specify 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 |
| Lost/Stolen Tag: Audible | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | O2LSTA | 0 (Off) | 0 (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) | Specify 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|-------------------------------|----------------|-------------------------|---|---|--|
| Lost/Stolen Tag: Visual | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | O2LSTV | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s) | Specify 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 |
| Low Balance Tag: Audible | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | O2LBLA | 0 (Off) | 0 (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) | Specify the audible feedback to provide for a low balance tag | to configure how long and how many times an OBU beeps to indicate a successful transaction |
| Low Balance Tag: Visual | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | O2LBLV | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s) | Specify 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 successful transaction |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|-------------------------------|----------------|-------------------------|---|--|--|
| Not Available / Internal Error: Audible | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Audible Feedback drop-down box. | anyone | O2NA_A | 0 (Off) | 0 (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) | Specify the audible feedback to provide for a not available / internal error | to configure how long and how many times an OBU beeps to indicate a successful transaction |
| Not Available / Internal Error: Visual | From the OBU Feedback tab on the Configuration page: With OBU feedback enabled, and Type 2 selected, select a feedback option from the OBU Visual Feedback drop-down box. | anyone | O2NA_V | 0 (Off) | 0 (Off) 1 (Green: 2s) 2 (Red: 2s) 3 (Yellow: 2s) | Specify the visual feedback to provide in the case of a not available / internal error | to configure how long and what color an OBU LED flashes to indicate a successful transaction |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|---|-------------------------------|----------------|-------------------------|---|--|--|
| Toll Rate / Balance adjustment tab | | | | | | | |
| 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 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: Reader does not adjust Toll Rate or Balance Enabled: 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 Toll Rate/Balance adjustment enabled, select BAT 1-Fixed Toll or BAT 2-Variable Toll, then, click the Update TRBA Configuration button | anyone | TRBTYP | 0 (BAT 1-Fixed Toll) | 0 (BAT 1-Fixed Toll) 1 (BAT 2-Variable Toll) | BAT 1-Fixed Toll: the Reader charges a toll based on the RF Channel(i.e. lane) and type of vehicle BAT 2 –VariablT Toll: 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------------|---|-------------------------------|----------------|-------------------------|--|--|--|
| Toll Rate Table Select | From the Toll Rate/Balance tab on the Configuration page: with BAT 1 enabled, select one of four toll rates from the Toll Rate Table Select drop-down box for each RF channel click the Update TRBA Configuration button | anyone | TRBATS | 0 (Table 1) | 0 (Table 1) 1 (Table 2) 2 (Table 3) 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 BAT 2 enabled, select Entry Reader or Exit Reader click the Update TRBA Configuration button | anyone | TRBAER | 0 (Entry Reader) | 0 (Entry Reader) 1 (Exit Reader) | Entry Reader: This Reader location is used as the highway entry point when calculating the toll Exit Reader: 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 |
| 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 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: no limits on how often Reader can update OBU balance Enabled: limits how often Reader can update OBU balance | to set limits on how frequently the balance stored in a toll/balance OBU can be updated. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------|--|-------------------------------|----------------|-------------------------|---|--|---|
| MPR RF Protocol | This command is unavailable to users and is set by Kapsch TrafficCom personnel | Kapsch TrafficCom personnel | MPR_RF | 0 (ISO-6B) | 0 (ISO-6B) 1 (ISO-6C) 2 (ATA) 3 (ISO-6B/ATA) | Sets the MPR RF protocol for each MRFM channel | to set the MRFM to ISO-6B, ISO-6C, ATA, or ISO-6B/ATA Note: the MRFM hardware must also be configured when selecting the 6C protocol. |
| MPR Frequency | This command is unavailable to users and is set by Kapsch TrafficCom personnel | Kapsch TrafficCom personnel | MPRFRQ | 0 (903.25) | 0 (903.25) 1 (912.25) 2 (915.25) 3 (918.25) | sets the MPR Frequency for each MRFM channel | to set the MPR frequency to 903.12, 912.25, 915.25, or 918.25 |
| Channel tab | | | | | | | |
| TDM Enable | From the Channel tab on the Configuration page: Select the TDM Enable checkbox. | anyone | TDMEBL | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: TDM selections not available to configure. Enabled: TDM selections available for configuration. | Enables TDM RF scanning. Note: At least one of 'TDM Enable' or 'FDM Enable' must be enabled at all times. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------|---|-------------------------------|----------------|-------------------------|--|---|--------------------------------------|
| TDM RF State | From the Channel tab on the Configuration page: Select one of the choices offered from the drop down menu for every appropriate channel. | anyone | RF_STS | 0 (Offline) | 0 (Offline) 1 Active 2 Guard 3 Skip | Offline means the MRFM-S module is off. Active means the MRFM-S module is on and reports transactions on this channel Guard means MRFM-S module is on, but transactions assigned to this channel are not reported. Skip controls the scanning rate and should be used only for channels 5 or higher. | Used for IAG, Allegro protocols, |
| TDM Tag Protocol | From the Channel tab on the Configuration page: Select one or both of the checkboxes for every appropriate channel. | anyone | TDMPRT | 0 | 0-3 | Specifies which TDM protocols are to be interrogated per channel. Select any or none of the following by adding selected values together: 0x00000001 - IAG 0x00000002 - Allegro | Used for IAG, Allegro protocols, |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------|---|-------------------------------|----------------|-------------------------|---|---|--------------------------------------|
| FDM Enable | From the Channel tab on the Configuration page: Select the FDM Enable checkbox. | anyone | FDMEBL | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: TDM selections not available to configure. Enabled: FDM selections available for configuration. | Used for ATA, 6B, 6C, Sego protocols |
| FDM RF State | From the Channel tab on the Configuration page: Select one of the choices offered from the drop down menu for every appropriate channel. | anyone | RFFSTS | 0 (Offline) | 0 (Offline) 1 Active 2 Guard 3 Off | Offline means the frame timing for this channel is preserved, but the MRFM-S module is off. Active means the MRFM-S module is on and reports transactions on this channel. Guard means the MRFM-S module is on, but transactions assigned to this channel are not reported. Off means the MRFM-S module is off and the framing is not preserved. | Used for ATA, 6B, 6C, Sego protocols |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|----------------------------|---|-------------------------------|----------------|-------------------------|-------------------------|---|--------------------------------------|
| FDM Frequency (MHz) | From the Channel tab on the Configuration page: Select one of the choices offered from the drop down menu for every appropriate channel. | anyone | FDMFRQ | 0 | 0-27 | FDM tag protocol frequency. 0 - 902.50 1 - 903.00 2 - 903.50 3 - 910.00 4 - 910.50 5 - 911.00 6 - 911.50 7 - 912.00 8 - 912.50 9 - 913.00 10 - 913.50 11 - 914.00 12 - 914.50 13 - 915.00 14 - 915.50 15 - 915.75 16 - 916.00 17 - 916.50 18 - 917.00 19 - 917.50 20 - 918.00 21 - 918.50 22 - 919.00 23 - 919.50 24 - 920.00 25 - 920.50 26 - 921.00 27 - 921.50 | Used for ATA, 6B, 6C, Sego protocols |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------|---|-------------------------------|----------------|-------------------------|-------------------------|---|--|
| FDM Tag Protocol | From the Channel tab on the Configuration page: Select one of the choices of protocol offered from the list. | anyone | FDMPRT | 0 | 0-5 | Specify which FDM protocol to use. choose one of: Off SeGo (UID) 6B (UID) 6C (EPC) ATA SeGo (UID)+ 6C (EPC) 6B (UID,eATA)+ 6C (TID,EPC) | N/A |
| 6C Skip Count | From the Channel tab on the Configuration page: When 6B+6C FDM Tag Protocol is selected. | Anyone | 6CSKIP | 3 | 1-10 | Defines how many times the reader will attempt to read 6B tags before attempting to read a 6C tag. | This allows the reader to weight 6B tag reads versus 6C tag reads. |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-----------------------------------|--|--|----------------|-------------------------|-------------------------|---|--------------------------------------|
| ATA Super-Frame Skip Count | From the Channel tab on the Configuration page: | anyone | ATASKP | 0 | 0-5 | This value defines the ON and OFF times for the ATA protocol FDM frames. I.e. how many super-frames should be generated without doing ATA before a super-frame with ATA should be created. 0 means 'do ATA on every super-frame' 1 means 'do ATA every other super-frame', etc... | Used for 6B, 6C, Sego protocols |
| Channel Weight [%] | From the Channel tab on the Configuration page: Type the Channel Weight as a percent in the appropriate fields. | user with Advanced User 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. | Used by all protocols |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--------------------------|--|-------------------------------------|----------------|-------------------------|-------------------------|--|--------------------------------------|
| Group ID | From the Channel tab on the Configuration page: Type the Group ID in the appropriate fields. | user with Advanced User 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 group IDs, multiple independent coverage zones can be created. This is useful for certain applications. | Used by all protocols |
| LPT/FME Voting time [ms] | From the Channel tab on the Configuration page: Type the voting time in the appropriate fields. | user with Advanced User permissions | LPTVTO | 300 | 0-9999 | Specify the time after the initial entry of the transponder into the capture zone after which a 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 only. | Used by all protocols |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|---|-------------------------------------|----------------|-------------------------|--|--|--------------------------------------|
| Voting Time (all other tag types) [ms] | From the Channel tab on the Configuration page: Type the Voting Time for all other tag types in the appropriate fields. | user with Advanced User permissions | VOTETO | 100 | 0-9999 | Specify the time after the initial entry of the transponder into the capture zone, subject to the Programming Timeout parameter. | Used by all protocols |
| Dynamic Voting Control | From the Channel 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), then, press Enter or select a different tab. | user with Advanced User permissions | DVCTRL | 0 (Disabled) | 0 (Disabled) 1 (Reader) 2 (LC Speed) 3 (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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------------------|--|--|----------------|-------------------------|-------------------------|---|---|
| Dynamic Voting Sample Size | From the Channel tab on the Configuration page: With Dynamic Voting Control set to Reader, enter the desired number of samples, then, press Enter or select a different tab. | user with Advanced User 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 |
| Dynamic Voting Threshold [%] | From the Channel tab on the Configuration page: With Dynamic Voting Control set to Reader, enter the voting threshold percentage in the Dynamic Voting Threshold field, then, press Enter or select a different tab. | user with Advanced User 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|--|----------------|-------------------------|-----------------------------|--|--|
| Dynamic Voting Capture Zone Span Multiplier | From the Channel tab on the Configuration page: With Dynamic Voting Control set to Reader, enter a voting time multiplier in the Dynamic Voting Capture Zone Span Multiplier field, then, press Enter or select a different tab. | user with Advanced User permissions | DVCZTM | 2 | 1-5 | sets the Capture Zone Span Time multiplier | to determine how long an OBU has to be out of a capture zone before re-entry is considered a new transaction. This number is a multiple of the Average Voting time |
| LC tab | | | | | | | |
| Allow Remote LC Configuration | From the LC tab on the Configuration page: Select the Allow Remote LC Configuration check box, then, press Enter or select a different tab.. | user with Advanced User permissions | RMOTLC | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: LC is not permitted to Configure Reader Enabled: allows the LC to configure the Reader remotely | allows changes to the Reader configuration from the LC |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|--|--|----------------|-------------------------|-----------------------------|--|---|
| Use RFP-Compliant Message Format | From the LC tab on the Configuration page: Select the Use RFP-Compliant Message Format check box, then, press Enter or select a different tab.. | user with Advanced User permissions | RfpMsg | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | enables the RFP-compliant message format | allows the Reader to report transactions to the LC in the new E-ZPass-specified format |
| LC Ethernet TCP-Socket Timeout | From the LC tab on the Configuration page: With at least one RF Channel configured to send data to the LC via Ethernet, type a time, in milliseconds, in the LC Ethernet TCP-Socket Timeout check box, then, press Enter or select a different tab.. | user with Advanced User 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 LC tab on the Configuration page: Select the Send Heartbeat Messages check box, then, press Enter or select a different tab.. | anyone | LCHTBT | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: No heartbeat messages are sent to LC. Enabled: 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------|--|-------------------------------|----------------|-------------------------|--|---|--|
| Heartbeat Interval | From the LC tab on the Configuration page: With heartbeat messages enabled, enter a time, in seconds, in the Heartbeat Interval check box, then, press Enter or select a different tab. | anyone | LCHBTM | 2 | 1-30 | sets the heartbeat message interval | to configure how often heartbeat messages are sent from the Reader to the LC |
| Destination | From the LC tab on the Configuration page: Select the Serial and/or Ethernet check box for each RF channel and then press Enter or select a different tab.. | anyone | LCDEST | 0 (Serial) | 0 (Serial) 1 (Ethernet) | Serial: sets channel to communicate with the LC by a serial connection Ethernet: sets channel to communicate with the LC by an Ethernet connection | sets how individual RF channels communicate with the LC |
| Serial Port | From the LC tab on the Configuration page: With serial communications enabled, select the appropriate LPM COM Port from the Serial Port drop-down box and then press Enter or select a different tab.. | anyone | LCSERL | 0 (COM 1) | 0 (COM 1) 1 (COM 2) 2 (COM 3) 3 (COM 4) 4 (COM 5) 5 (COM 6) 6 (COM 7) 7 (COM 8) | assigns an LPM COM Port to each MRFM-S channel | to configure which LPM COM Port sends data for a specific MRFM-S channel |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--------------------------|--|--|----------------|-------------------------|---|---|---|
| LC Retry Timeout | From the Serial tab on the Configuration page: Enter a time, in milliseconds, in the LC Retry Timeout field, then, press Enter or select a different tab. | user with Advanced User 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 Port State | From the Serial tab on the Configuration page: Select the Serial Port State check box for the required LPM COM port, then, press Enter or select a different tab. | anyone | COM_ST | 1 (Enabled) | 0 (Disabled) 1 (Enabled) | Disabled: LCM COM port disabled Enabled: LCM COM port enabled to communicate with LC | to enable or disable communications on each LPM COM port |
| Baud Rate | From the Serial tab on the Configuration page: With the Serial Port State enabled, select the desired Baud Rate from the drop-down box, then, press Enter or select a different tab. | anyone | COM_BR | 1 (19200) | 0 (9600) 1 (19200) 2 (38400) 3 (57600) 4 (115200) | sets the LPM baud rate for individual COM ports | to configure the LPM baud rate on a port by port basis |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------|--|-------------------------------|----------------|-------------------------|----------------------------------|---|--|
| Data Bits | From the Serial tab on the Configuration page: With the Serial Port State enabled, select the desired Data Bits from the drop-down box, then, press Enter or select a different tab. | anyone | COMBTZ | 3 (8) | 0 (5) 1 (6) 2 (7) 3 (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 Serial tab on the Configuration page: With the Serial Port State enabled, select the desired Parity from the drop-down box, then, press Enter or select a different tab. | anyone | COMPTY | 0 (None) | 0 (None) 1 (Even) 2 (Odd) | sets the LPM parity for individual COM ports | to configure the LPM parity on a port by port basis |
| Stop Bits | From the Serial tab on the Configuration page: With the Serial Port State enabled, select the desired Stop Bits from the drop-down box, then, press Enter or select a different tab. | 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 |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|-------------------------------|----------------|-------------------------|-------------------------|---|---|
| Transponder Timeout | From the Group tab on the Configuration page: Enter a time, in seconds, in the Transponder Timeout field, then, press Enter or select a different tab. | 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 |
| Save Config | From the Manage Config tab on the Configuration page: Click the Save Config button. | anyone | N/A | N/A | N/A | in IE, displays configuration file in Firefox, opens a file management box | to allow Reader configuration file to be saved. The file can then be reloaded later or used to configure other Readers |
| Browse (select configuration file to upload) | From the Manage Config tab on the Configuration page: Click the Browse button. | anyone | N/A | N/A | N/A | opens the File Upload window | to select a saved configuration file to upload |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---|---|-------------------------------|----------------|-------------------------|-------------------------|--|--|
| Upload Config (without changing IP addresses) | From the Manage Config tab on the Configuration page: With the correct configuration file displayed in the Filename field above, click the upper Upload Config 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 |
| Upload Config (including the IP addresses) | From the Manage Config tab on the Configuration page: With the correct configuration file displayed in the Filename field above, click the bottom Upload Config 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 |
| Browse (select Reader Firmware to upload) | From the Manage Config tab on the Configuration page: Click the Browse button. | anyone | N/A | N/A | N/A | opens the File Upload window | to select a saved configuration file to upload |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--------------------|---|--|----------------|-------------------------|-------------------------|---|---|
| Upload File | From the Software Management page: Click the Upload File button. | user with Software Management permissions | N/A | N/A | N/A | uploads a firmware version | to upload a firmware version to the Reader so it can be activated |
| Reboot | From the Software Management page: Click the Reboot button. | user with Software Management permissions | N/A | N/A | N/A | reboots the Reader | to remotely reboot a Reader |
| Activate | From the Software Management page: Click the Activate button. | user with Software Management permissions | N/A | N/A | N/A | activates the selected firmware version | to deactivate the firmware version currently running and activate a new version once the new firmware version has been uploaded to the Reader |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-----------------------------|--|--|----------------|-------------------------|-------------------------|---------------------------------------|---|
| Delete (firmware) | From the Software Management page: Click the Delete button. | user with Software Management permissions | N/A | N/A | N/A | deletes the selected firmware version | to delete an inactive, non-factory firmware version that is no longer required to free up space for newer firmware versions |
| Change Permissions | From the User Management tab on the User Management page: Click the Change Permissions button. | user with User Admin permissions | N/A | N/A | N/A | enables any permission changes | to add or remove permissions for a given user |
| Clear Password | From the User Management tab on the User Management page: Click the Clear Password button. | user with User Admin 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 User Management tab on the User Management page: Click the Delete button. | user with User Admin 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|---------------------------------|--|--|----------------|-------------------------|-------------------------|---|--|
| Create New User | From the User Management tab on the User Management page: Click the Create New User button. | user with User Admin permissions | N/A | N/A | N/A | creates a new user | to create a user account |
| Submit (new password) | From the Change Password tab on the User Management page: Click the Submit button. | user with User Admin permissions | N/A | N/A | N/A | submits a new password | to change the password of the user currently logged into the CTM web interface |
| Network Time Protocol | From the Time Management page: select Disable or Enable, then, Click the Update NTP Settings button. | user with Advanced User permissions | NTP____ | 0 Disabled | 0 Disabled 1 Enabled | enables or disables setting the Reader time via an NTP server | to ensure readers are time synced to a time server |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|------------------------------|---|--|----------------------------|-------------------------|--|---|--|
| NTP Server 1, 2 and 3 | From the Time Management page: enter three different valid NTP server IP address in the NTP Server fields, then, Click the Update NTP Settings button. | user with Advanced User permissions | NTP__1 NTP__2 NTP__3 | N/A | N/A | sets the NTP server IP addresses | to provide the Reader with three NTP servers it can access to accurately maintain time with other Readers in an IR network |
| Time Zone | From the Time Management page: select the appropriate time zone from the Time Zone drop down box, then, click the Set Time button. | anyone | TMZONE | 2 (NewYork) | 0 (UTC) 1 (Toronto) 2 (New York) 3 (Halifax) 4 (Chicago) | Adjust the time sent from the NTP server to the local time zone | to ensure that the time provided by the NTP server is displayed as the local time |
| Set Time | From the Time Management page: enter the date and time in the format MMDDYY<sp>HHMMSS, then, Click the Set Time button. | anyone | N/A | N/A | N/A | manually sets the Reader time | to manually set the time on a Reader not in an IR network |

| Command | How is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-----------------------------------|--|---|----------------|-------------------------|-------------------------|--|---|
| Delete Event Logs | From the Log Files tab on the Log Files page: Click the Delete Event Logs button. | user with View Log Files and Manage Log Files permissions | N/A | N/A | N/A | deletes all event logs | to free up memory for more logs |
| Delete All Logs | From the Log Files tab on the Log Files page: Click the Delete All Logs button. | user with View Log Files and Manage Log Files permissions | N/A | N/A | N/A | deletes all logs | to free up memory for more logs |
| Copy Log Files to USB disk | From the USB Logging tab on the Log Files 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 | to save a copy of the Reader log files for analysis or for backup |
| Start Logging to USB disk | From the USB Logging tab on the Log Files 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|-------------------------------------|---|---|----------------|-------------------------|-----------------------------|--|---|
| Ethernet Logging (enable) | From the Ethernet Logging tab on the Log Files page: Select the Ethernet check box, then, click the Update Ethernet Logging Configuration button. | user with View Log Files and Manage Log Files permissions | ETHLOG | 0 (Disabled) | 0 (Disabled) 1 (Enabled) | Disabled: No Ethernet logging Enabled: 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 Ethernet Logging tab on the Log Files page: Enter the IP address and port number of the computer to receive log files, then, click the Update Ethernet Logging Configuration button. | user with View Log Files and Manage Log Files permissions | ELDTIP | 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 Ethernet Logging tab on the Log Files page: Select either TCP or UDP, then, click the Update Ethernet Logging Configuration button. | user with View Log Files and Manage Log Files permissions | ELPROT | 0 (TCP) | 0 (TCP) 1 (UDP) | TCP: use TCP protocol for sending log files via Ethernet UDP: 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 is this command executed? | Who can execute this command? | Parameter Name | Default Parameter Value | Parameter Range/Options | What does this command do? | What is the purpose of this command? |
|--|--|---|----------------|-------------------------|---|--|---|
| Select Logs | From the Ethernet Logging tab on the Log Files page: Select the check boxes of the log files to be sent, then, click the Update Ethernet Logging Configuration button. | user with View Log Files and Manage Log Files permissions | ELLOGS | 0 (trouble) | 0 (trouble) 1 (tag) 2 (event) 3 (developer) 4 (debug) 5 (fifo) | sets which log files are sent via Ethernet | to select only the log files you want to receive |
| Perform Tests (serial comms) | From the Diagnostics Page : Select the LPM COM port to be tested from the Test Enable/Disable drop-down box, then, click the Perform Test(s) button. | user with Advanced User 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 |

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 create a RF coverage zone on the roadway. The antennas are situated to create overlapping coverage zones between channels. For high speed lanes, one reader can support 5 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.

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 lane configuration.

Note: Installation on these type of lanes is assessed by Kapsch Personnel prior to deployment in order to validate customer expectations and performance.

Superframes

The available RF Air time is divided into frames. A series of frames is assembled into a superframe which can be used to sync multiple readers together. In some configurations, a series of superframes is assembled into a megafame which is used to sync multiple readers together. A frame can be either a TDM or FDM period. A superframe can be a collection of TDM and/or FDM frames.

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 IAG. The MRFM-S hardware must be configured by Kapsch TrafficCom to handle 6C OBUs.

In a scanning operation, multiple MRFM-S channels can fire simultaneously, depending on the application (straddle channels do not fire when lane channels fire). The Reader bitstream determines the pattern of MRFM-S channel firing. Time slots are issued within time division control signals sent from the CTM CGC2 via the DSM to each MRFM-S. Each MRFM-S channel is configured by Kapsch TrafficCom with a unique frequency to prevent interference between channels.

The MRFM-S design includes a software command for adjusting the transmitter peak output power. Due to regulatory requirements, software controls for setting the Tx power level and Rx sensitivity are limited to users authorized by Kapsch TrafficCom. Contact Kapsch TrafficCom if these levels need to be adjusted.

When installing or replacing an MRFM-S, the lane must be retuned.

The MRFM-S transmits a message to the CGC. After the message is processed by the CTM, a message is sent to the LC.

The signals between the MRFM-S and the DSM are shown in Table 4-1.

Table 4-1: MRFM-S signals to and from DSM

| Signal | Description |
|----------------------|---|
| data input from DSM | Tx DA \pm signals, RS422 bi-polar AM envelope modulation signals |
| data output to DSM | Rx DA \pm signals, RS422 bi-polar AM envelope demodulation signals |
| RF control | Rx EN \pm and Tx EN \pm , RS422 bi-polar transceiver enable signals |
| RF control | A0 \pm and A1 \pm , RS422 bi-polar data address enable signals |
| power input from DSM | +5VDC (Vcc), +15VDC |

The serial communication settings for the LC COM port are configurable through the web interface.

Power Supply Module (PSM)

The PSM AC mains power requirement is 95-135VAC (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.

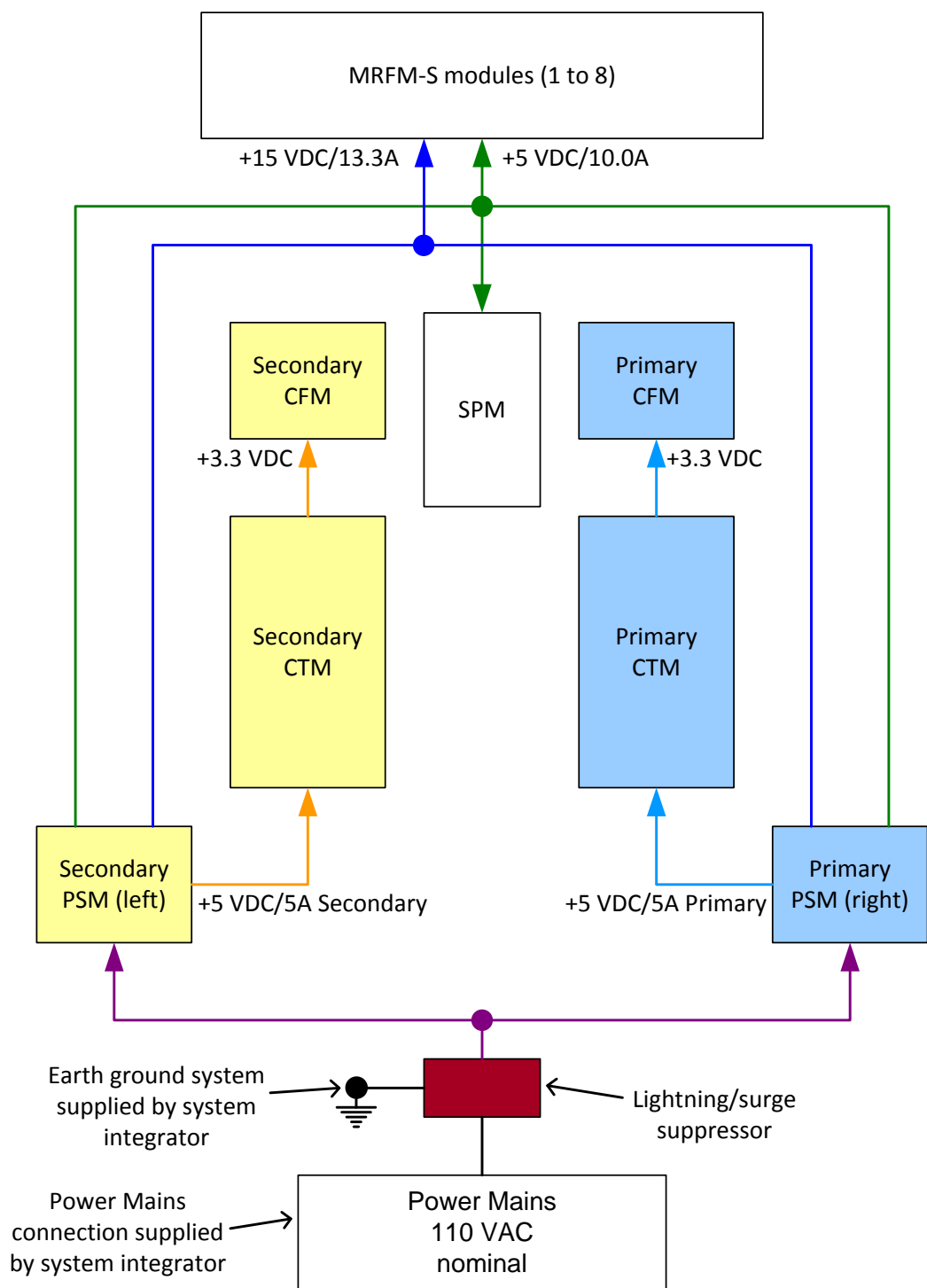
In the event of failure of one PSM, an automatic switchover will occur and the redundant PSM provides all the power for the RF module load.

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 @ 500 V, UL rated.

The power supply distribution is shown in Figure 4-1, page 136.

Figure 4-1: Reader Power distribution



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 lighting protection. The LPM is field replaceable.

The JANUS® Multi-Protocol Reader Ver. 2 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 360450-111.

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 digital signal processing for 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 OBU information from its associated CGC2 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 360450-112.

Channel Group Controller Module (CGC2)

The CGC2 is used as a scheduler and a controller. It schedules when the MRFM-S operates and routes the data from the MRFM-S to the MC.

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

The DSM is responsible for the following.

- 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

Synchronization



CAUTION:

On one redundant reader of a synchronization network, the synchronization connection should be looped back and this reader will declare sync even if it is disconnected from the other readers.

Readers must be synchronized if they have overlapping capture zones, are connected in an IR network, or if Reader-to-Reader RF interference is present.

If unsynchronized Readers are located within a 200 meter (660 feet) radius, tests for in-band RF interference should be carried out to ensure that no Reader-to-Reader interference occurs. This test should be carried out under live traffic conditions to ensure that RF signal reflections off moving vehicles do not exceed the in-band limits. If Reader-to-Reader RF interference exceeds the in-band limits then the Readers must be synchronized.

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 Sync** is set ON for all Readers in the sync network does synchronization occur.

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 4-2: 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 µSec.

The Sync Recovery Process

When a Reader detects it is out of synchronization, it attempts to re-establish synchronization at the beginning of every superframe. During this time, the CTM SYNC LED flashes green/orange (the orange is a mix of green and red due to the short amount of time in red).

Note: Connection of other equipment or external synchronization devices is not supported and may cause Reader errors.

Log files


The log files for OBU transactions are saved on the CFM. 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 4-3: List of Available Log Files

| Log File Type | Description |
|---------------------|---|
| tagtxns_YYYY-MM-DD | Daily tag Transaction log. |
| eventlog_YYYY-MM-DD | Daily event log files. Event log contain a periodic report of system health and transaction count totals. |
| 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 generates a two-line report containing the fields described in the table below.

Table 4-4: 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) |

| Field | Description |
|------------|---|
| 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) |
| 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. |
| Ag | Agency ID of transponder in capture zone. |
| Sn | Serial number of transponder in capture zone. |
| Ahs | Number of handshakes up to voting time. |
| THs | Total Handshakes for previous transaction assigned to this channel. |
| GUARD | Shown for a transaction assigned to a RF channel set to Guard. These transactions will 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. |
| Lx-HS | HS tag handshakes seen up to voting/post time on the MasterSet left Reader. |
| Rx-HS | HS tag handshakes seen up to voting/post time on the MasterSet right Reader. |

Transaction Buffering

Transactions from OBUs, are processed by the CTM. When a Reader CTM loses communications with an Lane Controller (LC), the Reader buffers OBU transactions and error messages (up to a combined total of 400,000) 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.

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 [lab3_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, separate from the Reader, each consist of an antenna, an MRFM-S, and a feedline cable adapter. After the equipment is installed, the Reader must be configured via the browser interface. After configuration is complete, the Reader configuration should be saved (see Saving the Reader configuration, page 243) 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 the grounding and power conforms to local regulatory and safety requirements. The recommendations herein are those to ensure 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.

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.

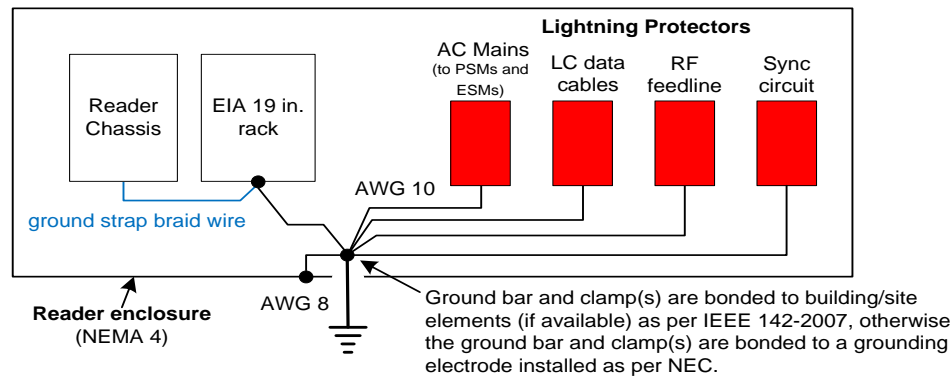


Figure 5-1: Earth Ground System (with recommended lightning protectors shown)

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 145 |
| PSM power | Figure 5-2 AC Mains, page 147 |
| LC Data inputs | Figure 5-3: LC Data Cable Installation, page 148 |
| ESM power | Figure 5-10: Schematic of a three-Reader IR network, page 165 |
| Synchronization circuit | Figure 5-9: Synchronization circuit schematic for three Readers, page 159 |

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 144).

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.

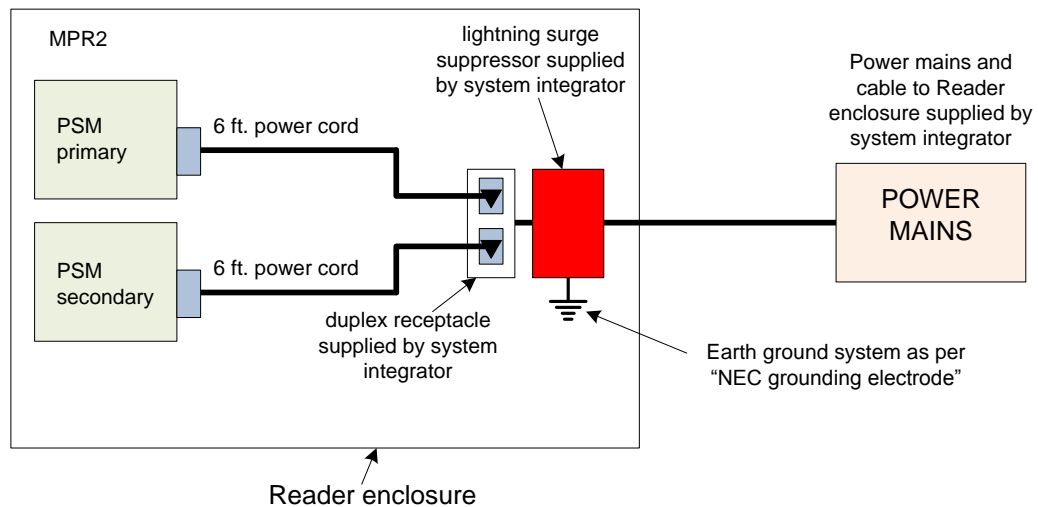


CAUTION:

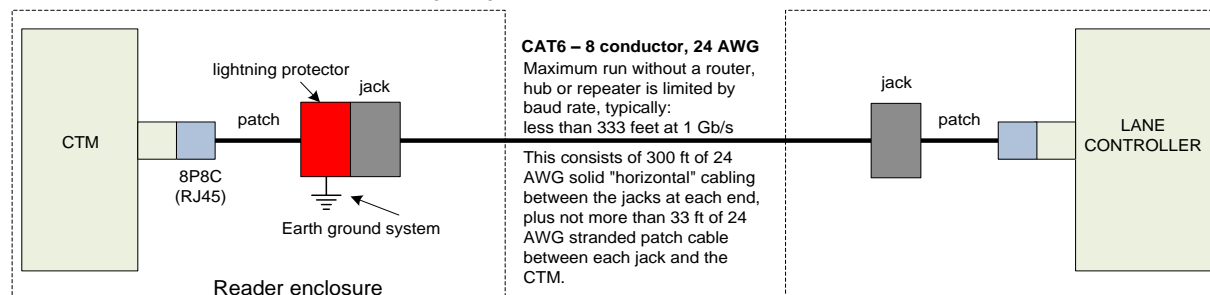
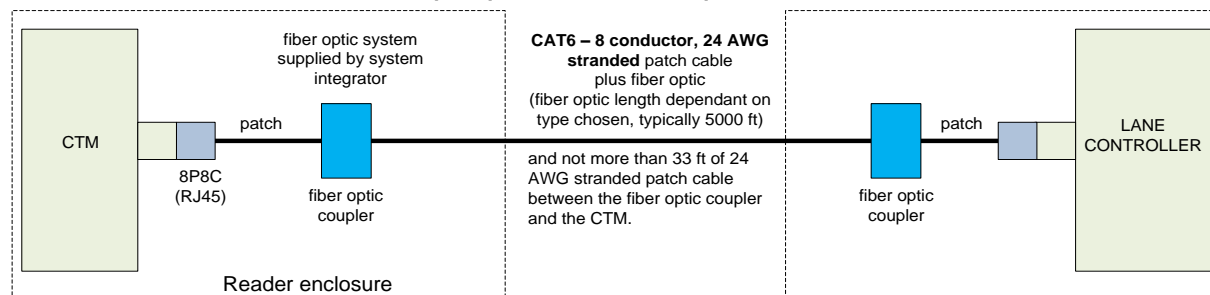
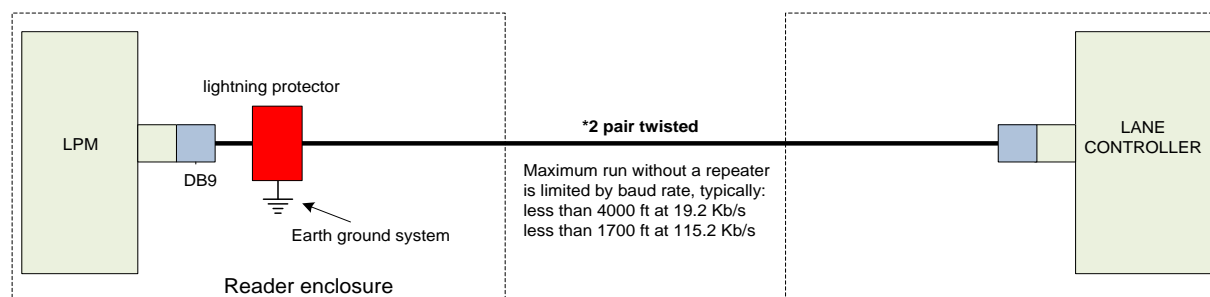
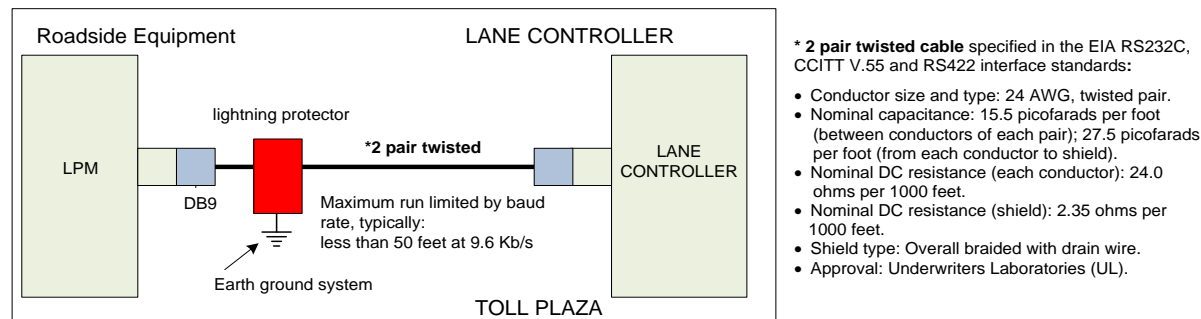
To avoid damaging the modules, ensure that alignment of both the connector on the module and the connector on the DSM (back plane) is correct before securely plugging the module into the DSM.

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 149.
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 147).

Figure 5-2 AC Mains



Connect the appropriate cables from the Reader to the LC as shown in Figure 5-3 on page 148.

LC data cable installation – ETHERNET 1 port, patch cable to solid conductor**LC data cable installation – ETHERNET 1 port, patch cable to fiber optic****LC data cable installation from LPM – RS422****LC data cable installation from LPM – RS232****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. Position the center antenna at lane center of the defined lane. For wide ORT applications, the straddle antenna must be at the midpoint between the left and right antennas. Orient the weep holes down, such that the radome is facing oncoming traffic.
2. Using a tilt meter, measure the road pitch and cross lane slope directly under each IAG antenna. Record the results.
3. 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 2 (e.g., If the road pitch is 2 degrees. and the antenna tilt must be 15 degrees, mount the antenna at 17 degrees.)
4. Ensure that the height of the antenna's lower edge as tilted falls within the height range given Table 5-2. Please contact Kapsch Service when considering mounting the antennas outside the specified heights.
5. Adjust the roll angle of the antenna equal to 0 degrees with respect to the cross lane slope obtained in step 2.
6. For TDM only protocol, the antenna installation may be all antennas (IAG 1 or IAG 2 or IAG 3) inline across the roadway as shown in Figure 5-3
7. For TDM protocol, and/or ISO18000-6C protocol (read only) only, the antenna installation may be all antennas IAG 3 only) inline across the roadway as shown in Figure 5-3.
8. For all passive protocols (other than ISO18000-6C read only) the antenna installation must be all antennas (IAG 3 only) staggered across the roadway as shown in Figure 5-3.

Table 5-2 Antenna mounting for the IAG 3 antenna and lane configuration

| Antenna | Application | Lane Width | Height | Tilt (off horizontal) |
|---------|--------------|------------|---------------|-----------------------|
| IAG-3 | ORT or Plaza | 12 ft. | 17 ft. ±1 ft. | 10 deg. |
| IAG-1 | ORT or Plaza | 12 ft. | 16 ft. ±1 ft. | 10 deg. |

Figure 5-4 Inline Antenna Installation

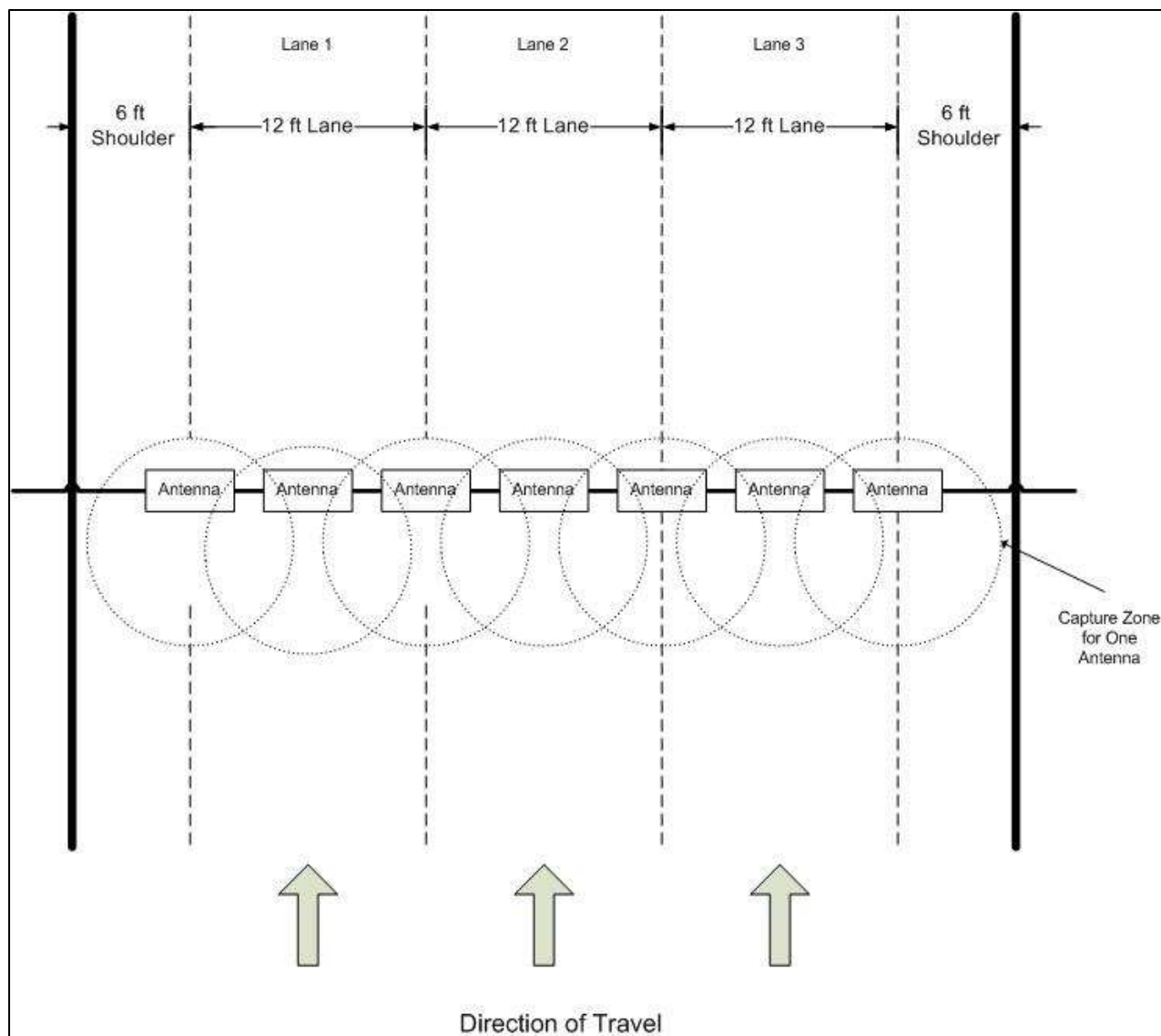
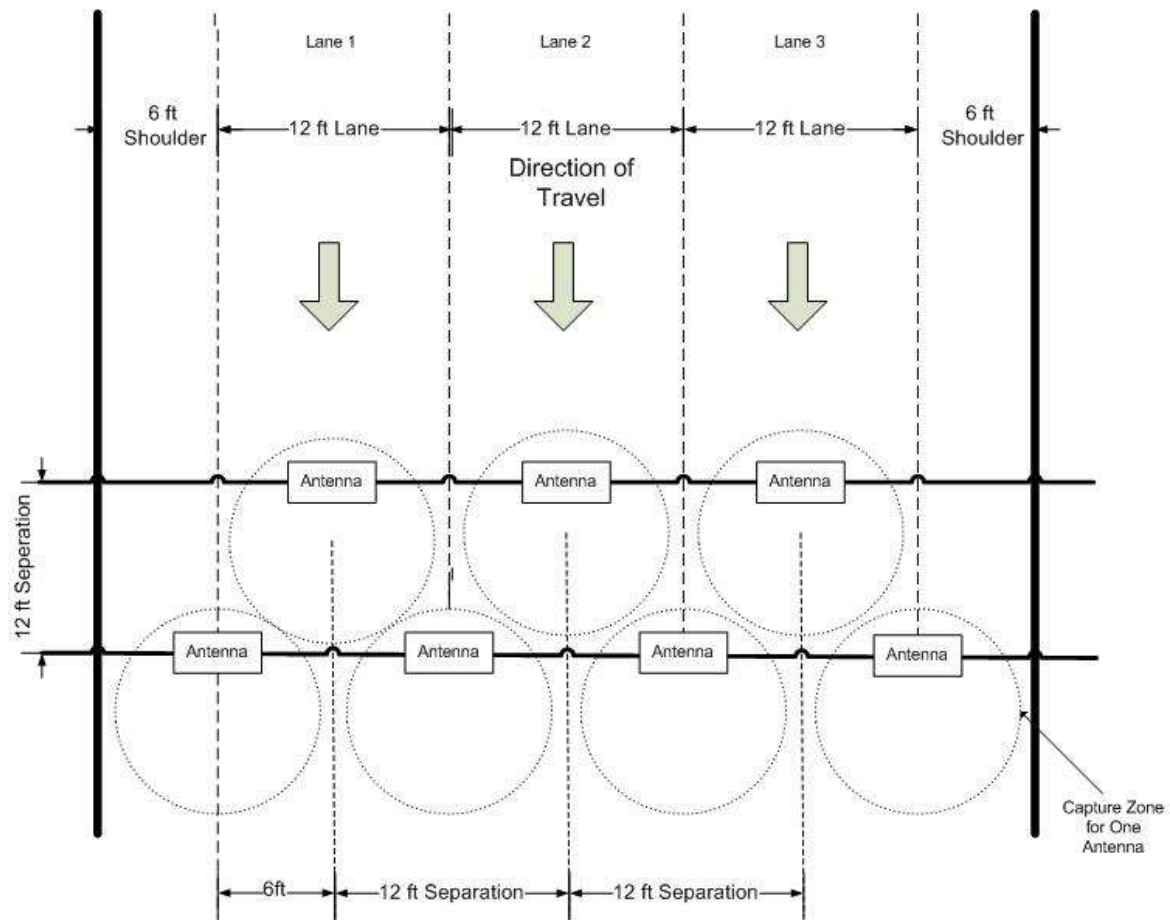


Figure 5-5 Staggered Antenna Installation



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 boresite should be on the lane centerline and lane markings.
- Physical lane widths below 12 ft 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, the lane should be treated as a multi-lane free flow configuration and multiple lane kits used per lane.

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

- The readers must be synchronized and running the same configuration.
- The same FDM channel frequency should not be used on adjacent lanes (including straddle and shoulder).
- The same active channel from two (2) synchronized readers should not be used on adjacent lanes (including straddle and shoulder).

Installing the MRFM-S Modules

**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.

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 Helix) to ensure the RF feedline cable does not produce a signal loss greater than permitted, see section 8 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 feet 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 Mono-Static Operation only

(Not Currently Supported). See Figure 5-3

1. Using a 10in-lb torque wrench, connect the RF feedline cable to the antenna. Using self-amalgamating tape, wrap the connection to ensure water cannot enter.
2. Attach the N-Type female connector to the Reader end of the feedline cable. Firmly crimp the female connector.
3. Using a 10in-lb torque wrench, connect the RF feedline from the antenna to the RF adapter cable (800125-001).

Note: A lightning protector should be installed between the RF adapter cable and the feedline cable.

For Bi-Static Operation Only.

See Figure 5-3

1. Using a 10in-lb torque wrench, connect the first RF feedline cable to the Circulator (Port 1). Using self-amalgamating tape, wrap the connection to ensure water cannot enter.
2. Using a 10in-lb torque wrench, connect the second RF feedline cable to the Circulator (Port 3). Using self-amalgamating tape, wrap the connection to ensure water cannot enter.
3. Using a 10in-lb torque wrench, connect a third (3.0 foot long) RF feedline cable to the Circulator (Port 2). Using self-amalgamating tape, wrap the connection to ensure water cannot enter.
4. Attach the N-Type male connector (322389-032) to the antenna end of the third (3.0 foot long) RF feedline cable. Firmly crimp the male connector.
5. Using a 10in-lb torque wrench, connect the other end of the third (3.0 foot 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 MRFMS.
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 MRFMS.

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, using marker tie wraps from the label set (800498-001).
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 only protocol configuration (i.e., no 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); see Figure 5-3.

Figure 5-6 RF Cable Installation Schematic Mono-Static Operation

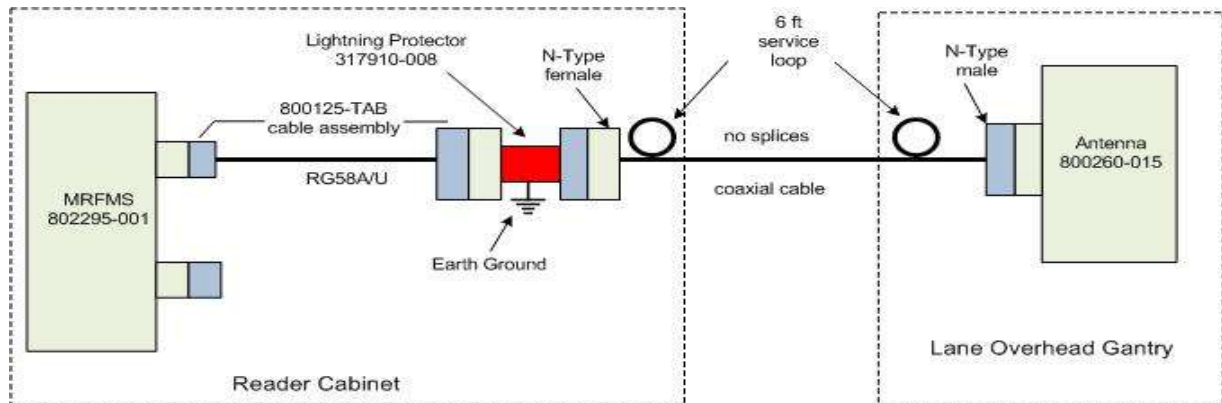


Figure 5-7 RF Cable Installation Schematic Bi-Static Operation

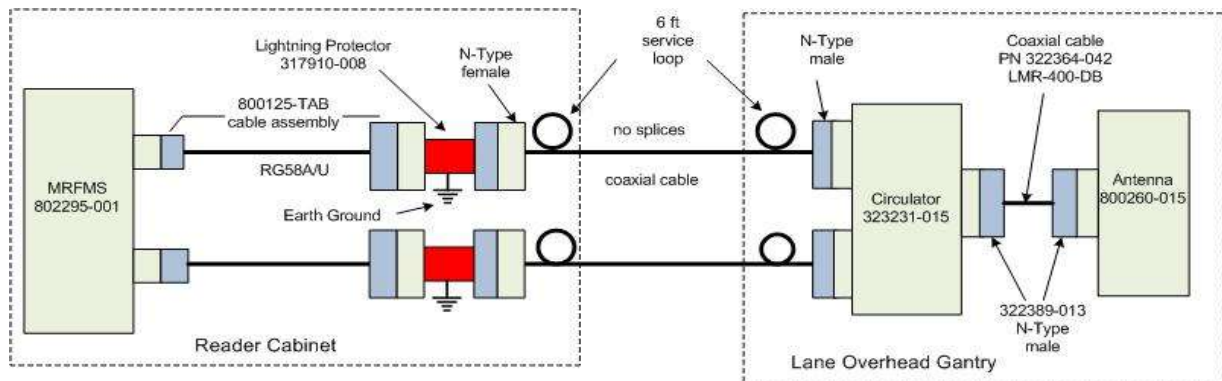
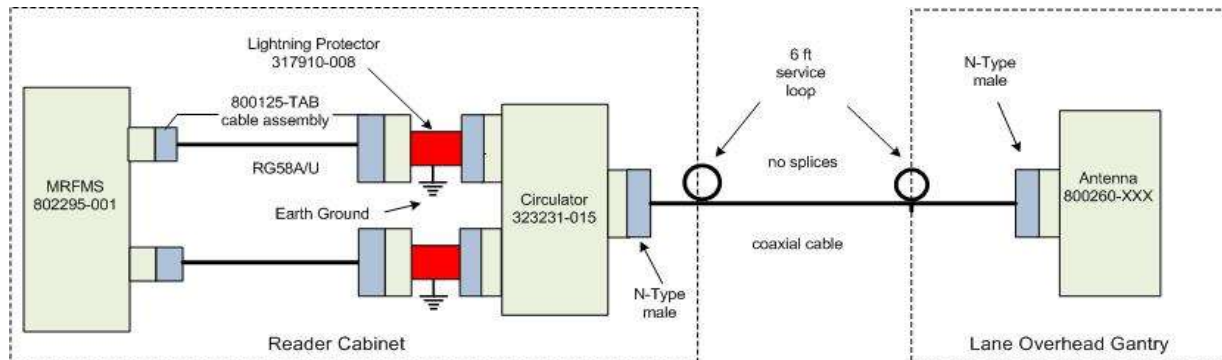


Figure 5-8 RF Cable Installation Schematic Bi-Static TDM Only Operation



Performing Lane Tuning

Lane Tuning consist 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 Operations Group 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 (incl straddle and shoulder).
- The same TDM channel from 2 synchronized readers should not be used on adjacent lanes (incl straddle and shoulder).
- The TX attenuation should be adjusted to obtain capture zones nominally 8-12 ft 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 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:

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

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

The Synchronization circuit

Reader synchronization ensures antennas from different Readers do not attempt to communicate simultaneously with the same on-board unit (OBU). 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. 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 feet from the sync hub terminal block
- Readers arranged so that the total synchronization network cable length is no greater than 2000 feet
- No more than six (6) Readers in the synchronization circuit

Note: 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 5-9 on page 159.

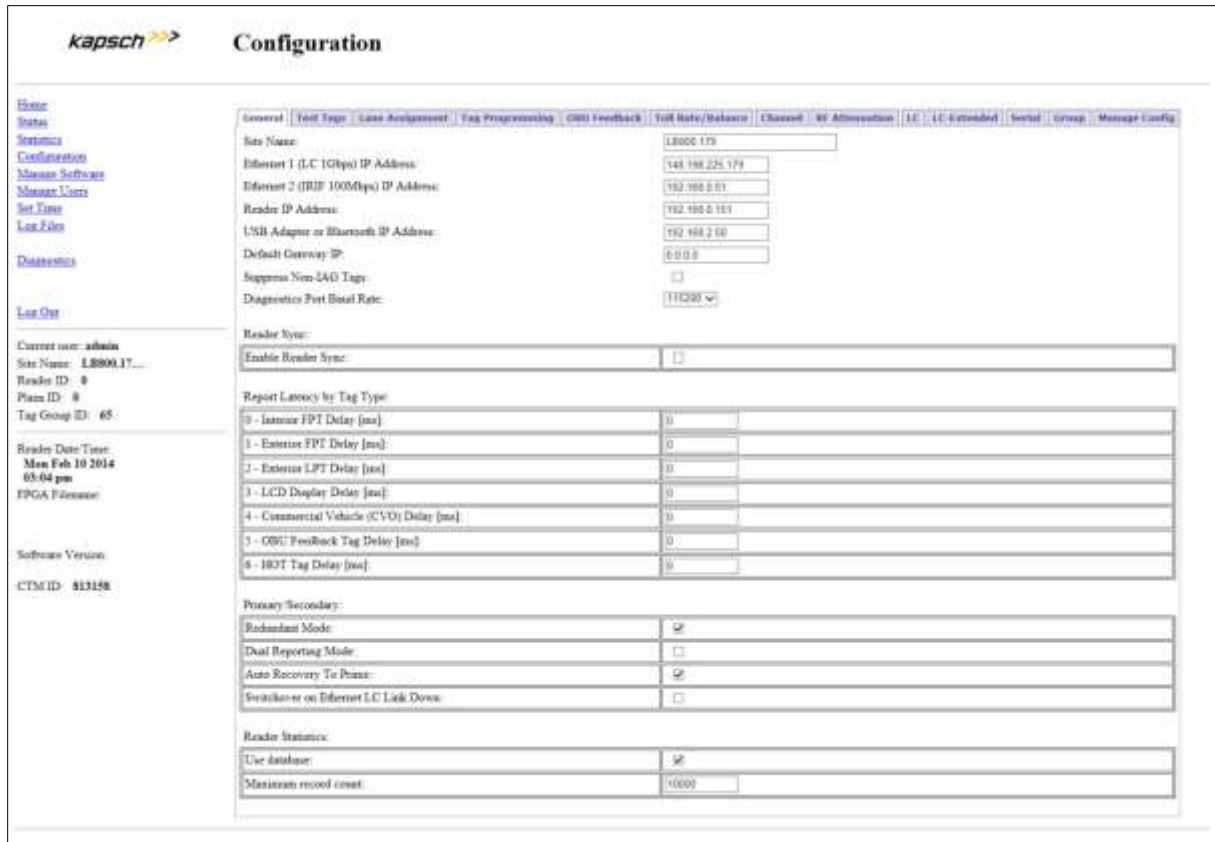
Attention: Ensure that cables do not connect from the GND terminal on the SPM to the Sync hub terminal block, as this can create a ground loop and affect synchronization performance.

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 40
- Changing the service laptop IP address on page 40
- Testing the connection to the reader on page 40
- Accessing the CTM web interface on page 41

2. Select the **Configuration** link on the left side panel.

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: LB000178

Ethernet 1 (LC 1Gbps) IP Address: 143.198.225.179

Ethernet 2 (TRIP 100Mbps) IP Address: 192.168.0.61

Reader IP Address: 192.168.0.181

USB Adapter or Bluetooth IP Address: 192.168.2.60

Default Gateway IP: 0.0.0.0

Suppress Non-SAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync: ☐

Report Latency by Tag Type:

| | |
|---|---|
| 0 - Instance FPI Delay [ms] | 0 |
| 1 - Entire Instance FPI Delay [ms] | 0 |
| 2 - Entire Instance 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: ☒

Dual Reporting Mode: ☐

Auto Recovery To Primary: ☒

Switchback on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count: 10000

Current user: admin

Site Name: LB000178

Reader ID: 0

Plant ID: 0

Tag Group ID: 65

Reader Date/Time: Mon Feb 19 2014 05:04 pm

FPGA Firmware:

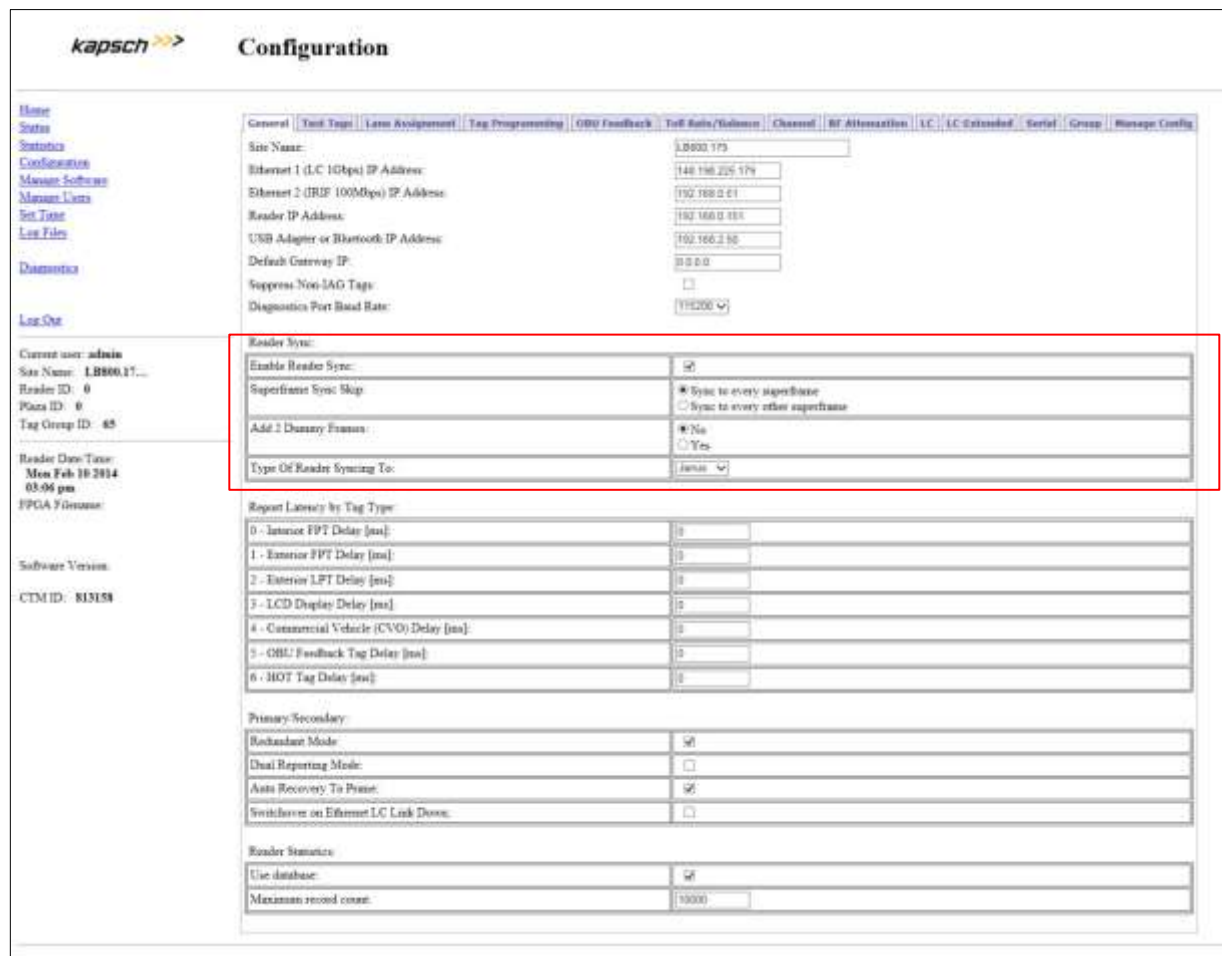
Software Version:

CTM ID: 813158

3. Select the **Enable Reader Sync** check box, if necessary.

Result: The following screen appears.

Note: Expanded **Enable Reader Sync** outlined in overlaid red box below.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Test Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB000.17...
Reader ID: 0
Pace ID: 0
Tag Group ID: 45
Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

Reader Sync

Enable Reader Sync: ☒ **Yes**

Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Channel Frames: ☒ No
☐ Yes

Type Of Reader Syncing To: **Janus**

Report Latency by Tag Type

| | |
|--|---|
| 0 - Interior FPT Delay [ms] | 0 |
| 1 - Exterior FPT Delay [ms] | 0 |
| 2 - Interior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CV) Delay [ms] | 0 |
| 5 - OBU/ Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary

Redundant Mode: ☒ **Yes**

Dual Reporting Mode: ☐ **No**

Auto Recovery To Prime: ☒ **Yes**

Switchover on Ethernet LC Link Down: ☐ **No**

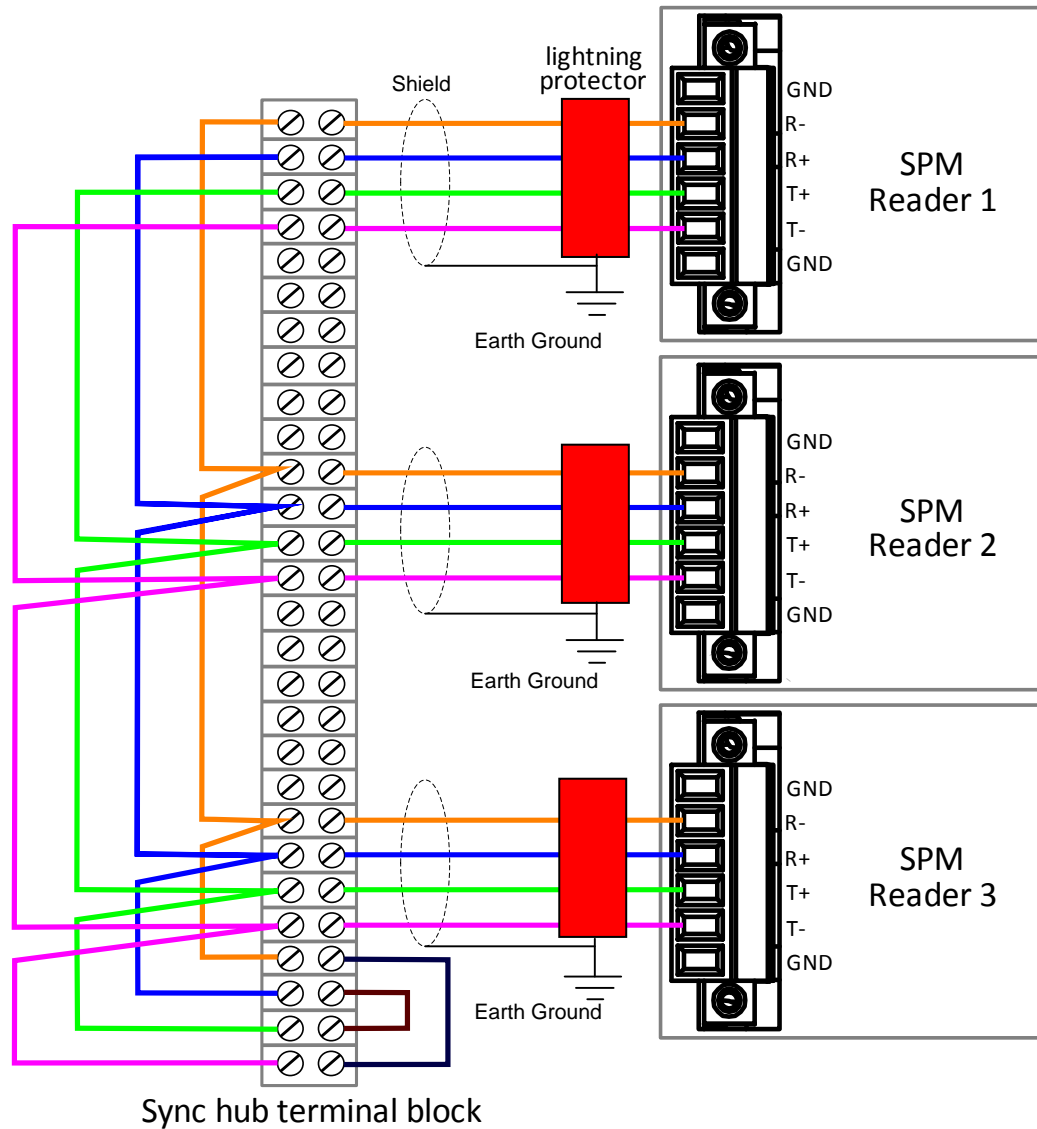
Reader Statistics

Use database: ☒ **Yes**

Maximum record count: 10000

4. Press **Enter** to accept selection.

Figure 5-9: Synchronization circuit schematic for three Readers



Synchronization between MPR2 Readers

All Readers in a synchronization circuit must be configured correctly for Synchronization to work. Also, the number of frames per superframe must be equal between MPR2 Readers in the synchronization circuit.

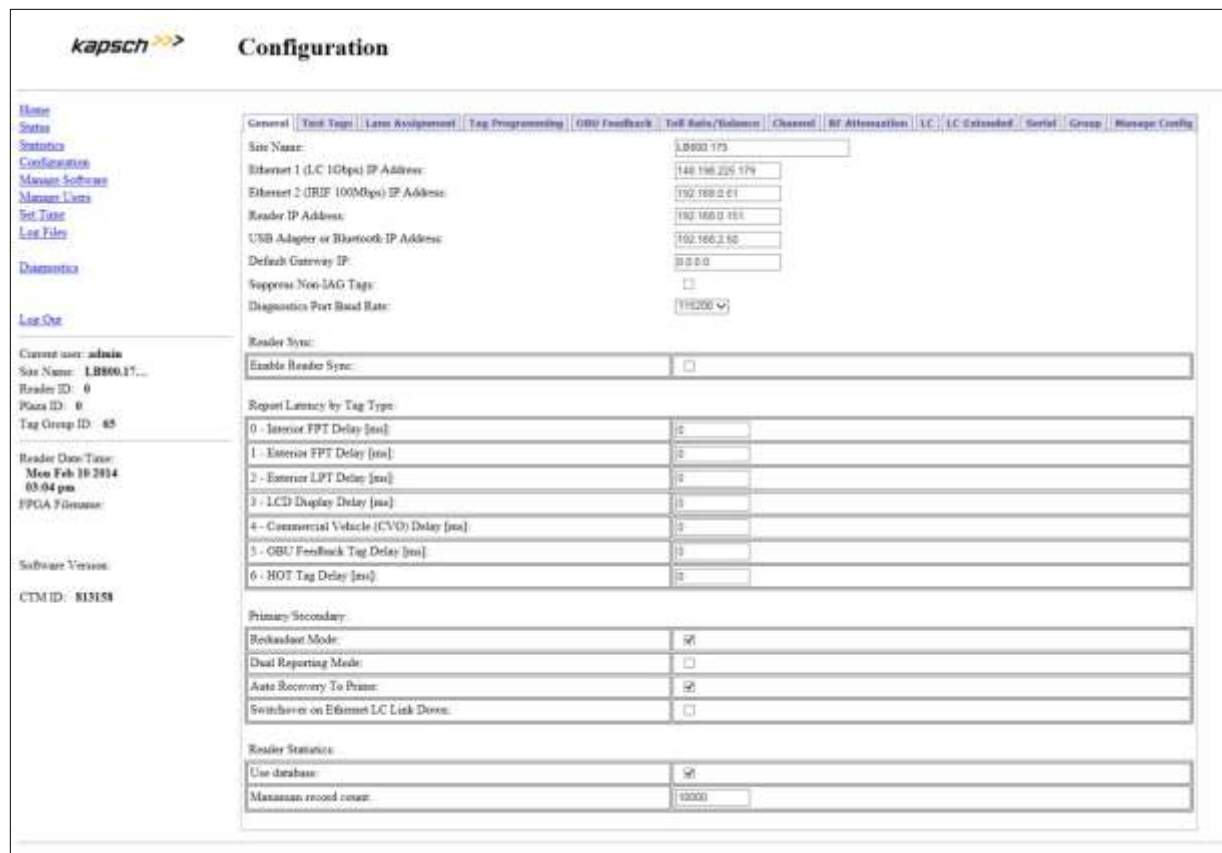
Configuring synchronization

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 40.

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

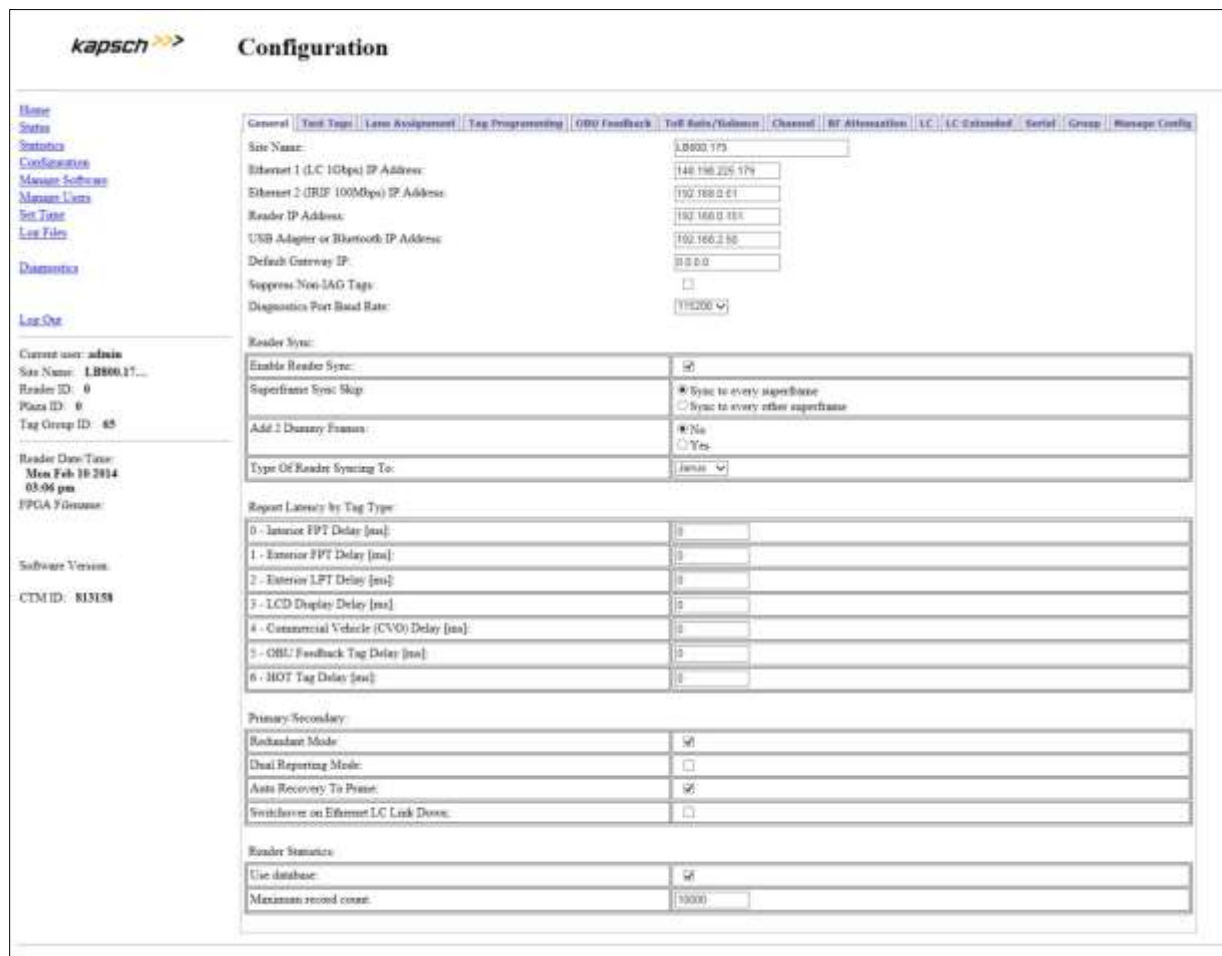
1. Select the **Configuration** link on the left side panel.

Result: The following screen appears.



2. Select the **Enable Reader Sync** check box, if necessary.

Result: The synchronization settings appear.



Configuration

Home | Status | Statistics | **Configuration** | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: 18800.17...
Reader ID: 0
Paza ID: 0
Tag Group ID: 85
Reader Date/Time: Mon Feb 10 2014 03:06 pm
PPGA Firmware:
Software Version:
CTM ID: 813158

General | **Test Tags** | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18800.175
Ethernet 1 (LC 10Gbps) IP Address: 148.196.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.50
Default Gateway IP: 0.0.0.0
Suppress Non-LAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

| | |
|--|---|
| 0 - Interior EPT Delay [ms] | 0 |
| 1 - Exterior EPT Delay [ms] | 0 |
| 2 - Exterior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CV) Delay [ms] | 0 |
| 5 - GBU/ Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:

Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒
Maximum record count: 10000

3. Select **Sync to Every Superframe** in the **Superframe Sync Skip** row.
4. Select **No** in the **Add 2 Dummy Frames** row.
5. Select **JANUS** from the drop-down box in the **Type of Reader Syncing To** row.
6. Repeat these steps for all Readers in the Synchronization circuit.
7. When you are finished, press **Enter** to accept the selections.

Synchronization between JANUS® Readers and BADGER Readers

JANUS® and BADGER Readers in the same synchronization network can be configured as in step 1 in the procedure Synchronization between MPR2 Readers. However, JANUS® and BADGER Readers can also have the superframe configurations shown in Table 5-3 on page 164.

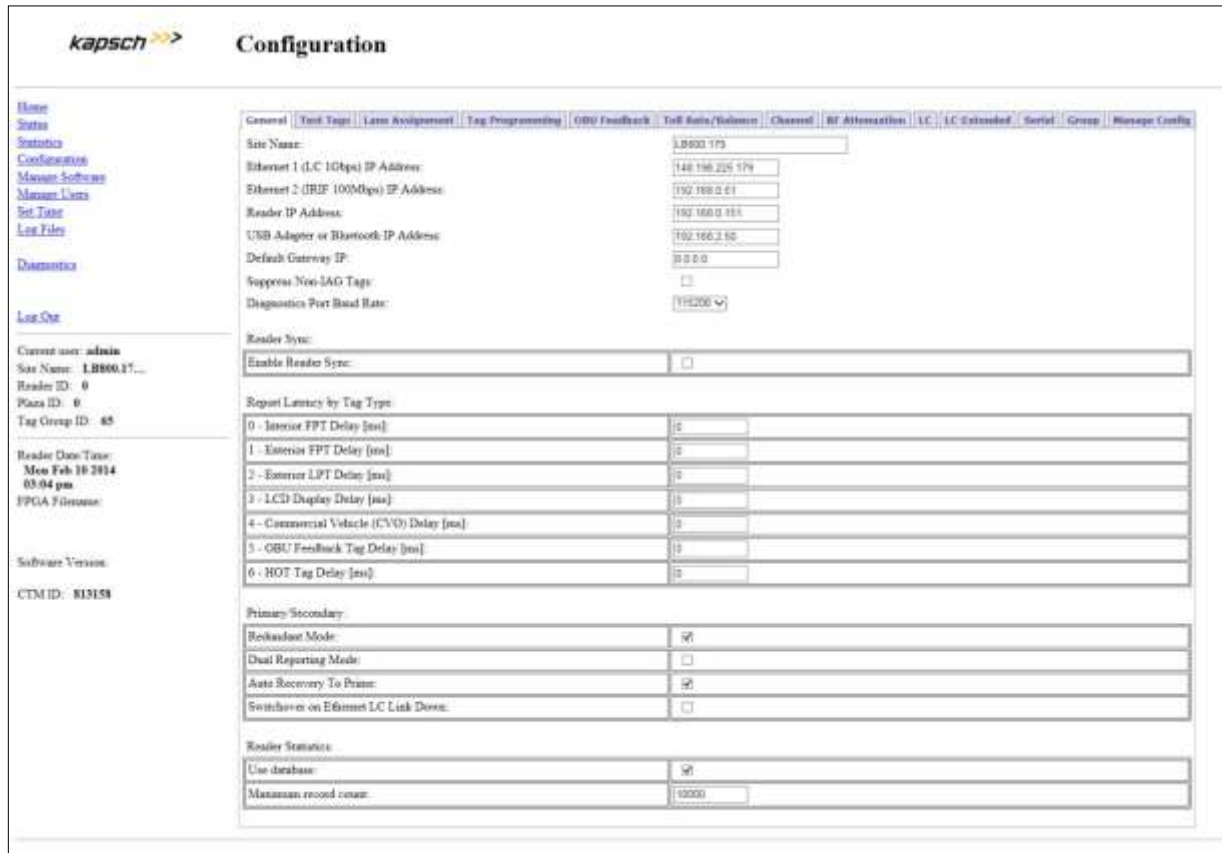
Configuring Synchronization

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 40.

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

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

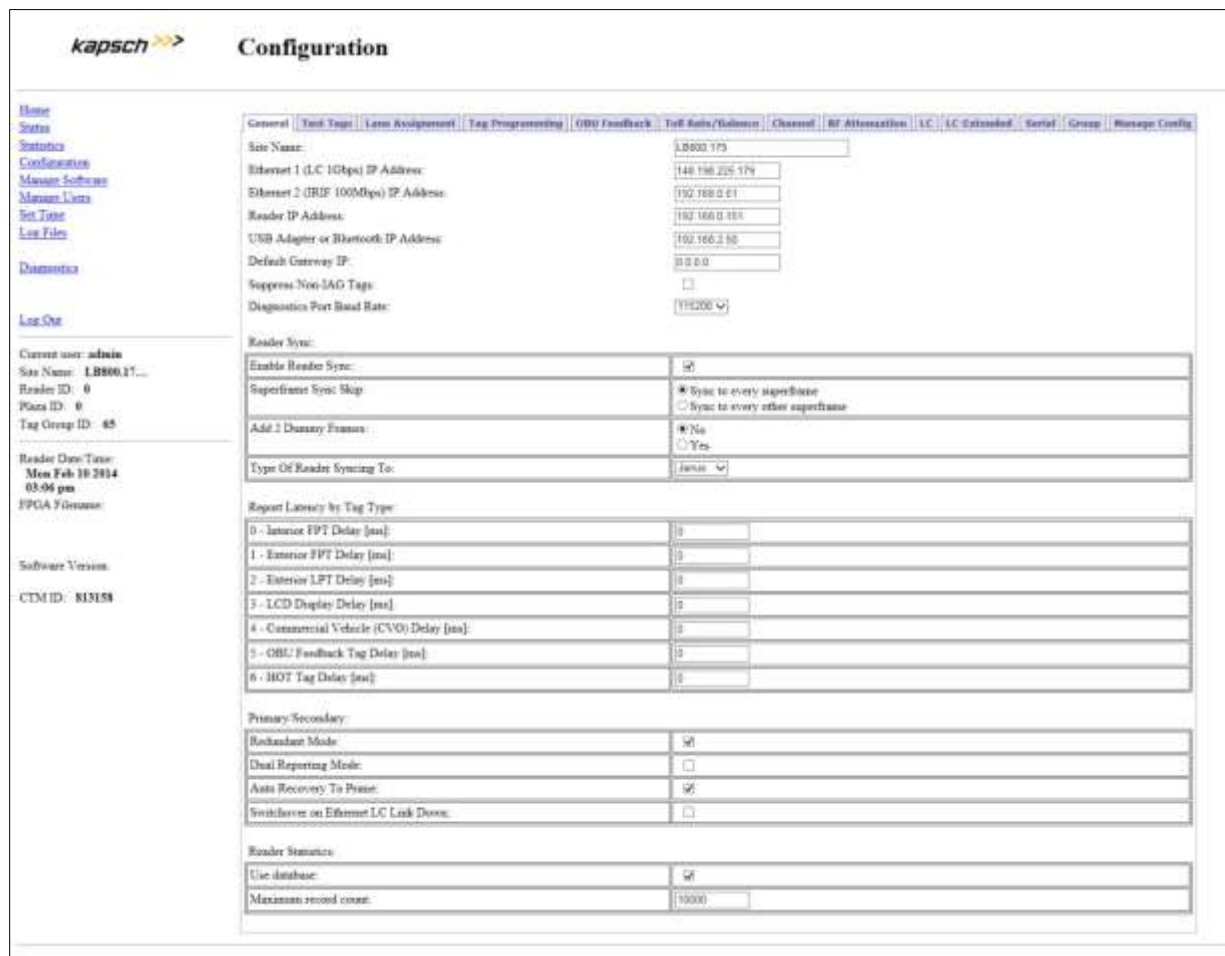
Result: The following screen appears.



The screenshot shows the Kapsch Configuration web interface. The left sidebar contains links: Home, Status, Statistics, Configuration (selected), Manage Software, Manage Users, Test Tools, Log Files, Diagnostics, and Log Out. The main content area has a top navigation bar with tabs: General, Test Tools, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Balance, Channel, RF Attenuation, LC, LC Extended, Serial, Group, and Message Config. The General tab is active, showing fields for Site Name, Ethernet 1 (LC 1Gbps) IP Address, Ethernet 2 (IRIF 100Mbps) IP Address, Reader IP Address, USB Adapter or Bluetooth IP Address, Default Gateway IP, Suppress Non-IAG Tags, and Diagnostic Port Baud Rate. Below these are sections for Reader Sync (with an Enable Reader Sync checkbox), Report Latency by Tag Type (a table with 7 rows for various delays), Primary/Secondary settings (with checkboxes for Redundant Mode, Dual Reporting Mode, Auto Recovery To Prime, and Switchover on Ethernet LC Link Down), and Reader Statistics (with checkboxes for Use database and Maximum record count).

2. Select the **Enable Reader Sync** check box, if necessary.

Result: The synchronization settings appear.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: 1.BB00.17...
Reader ID: 0
PDA ID: 0
Tag Group ID: 45
Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 1.BB00.175
Ethernet 1 (LC 10Gbps) IP Address: 148.196.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.50
Default Gateway IP: 0.0.0.0
Suppress Non-LAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

| | |
|--|---|
| 0 - Interior EPT Delay [ms] | 0 |
| 1 - Exterior EPT Delay [ms] | 0 |
| 2 - Exterior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CV) Delay [ms] | 0 |
| 5 - OBU/Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:

Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒
Maximum record count: 10000

- If the configuration is not already set, then set Superframe **Sync Skip** to **Select Sync** to **Every Superframe**, set **Add 2 Dummy Frames** to **No**, set **Type of Reader Syncing to** to **JANUS** or **BADGER**, as applicable.
- Press **Enter** to accept the selections.
- If the superframes for all Readers will be equal (4, 5, or 8 frames) go to Synchronization between MPR2 Readers and perform step 1.
- If the superframes will be configured as shown in Table 5-3, configure the **Superframe Sync Skip** and **Add 2 Dummy Frames** parameters in the **General** tab on the **Configuration** page as outlined in Table 5-3 on page 164.

Table 5-3: Synchronization Compatibility Matrix – JANUS® and BADGER

| JANUS® Reader superframe size | Superframe Sync Skip | Add two dummy frames | BADGER Reader superframe size | Superframe Sync Skip | Add two dummy frames |
|-------------------------------|--------------------------------|--|-------------------------------|--------------------------------|--|
| 4 frames | sync to every other superframe | No | 8 frames | sync to every superframe | No |
| 8 frames | sync to every superframe | No | 4 frames | sync to every other superframe | No |
| 5 frames | sync to every other superframe | No | 10 frames | sync to every superframe | Yes (with 8 active or offline RF channels) |
| 10 frames | sync to every superframe | Yes (with 8 active or offline RF channels) | 5 frames | sync to every other superframe | No |

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.

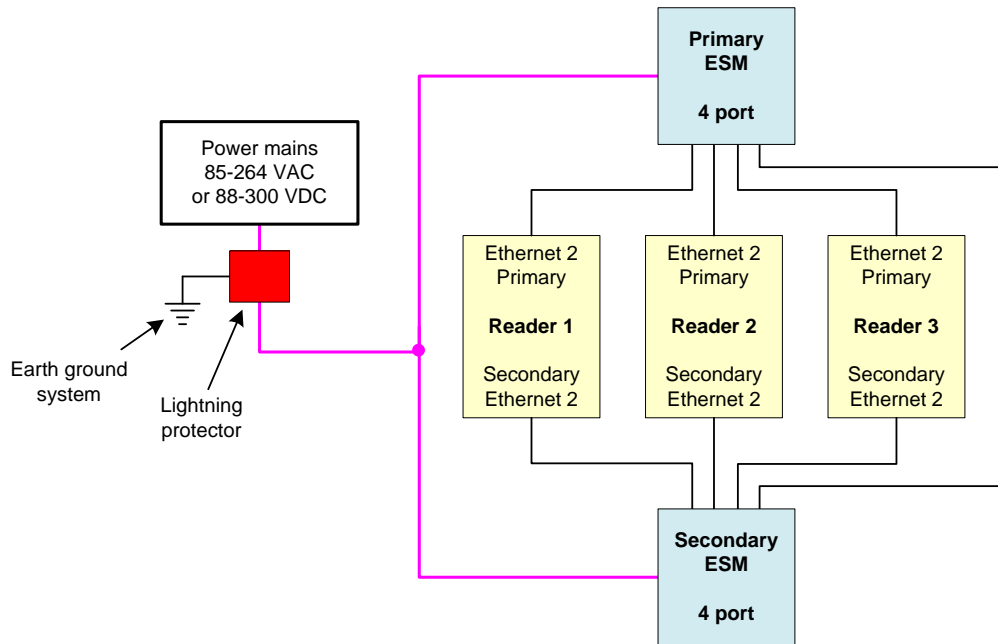


Figure 5-10: Schematic of a three-Reader IR network

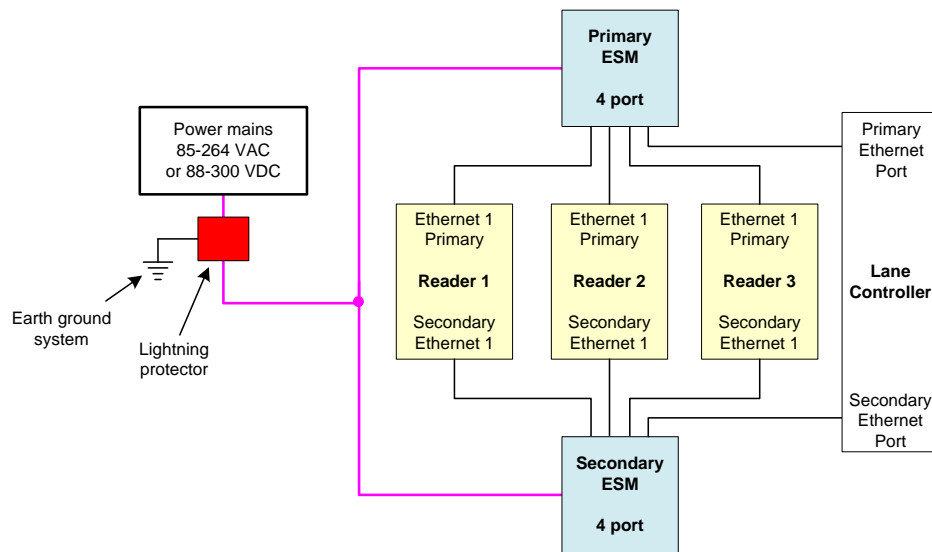


Figure 5-11: Schematic of a three-Reader LC network

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.

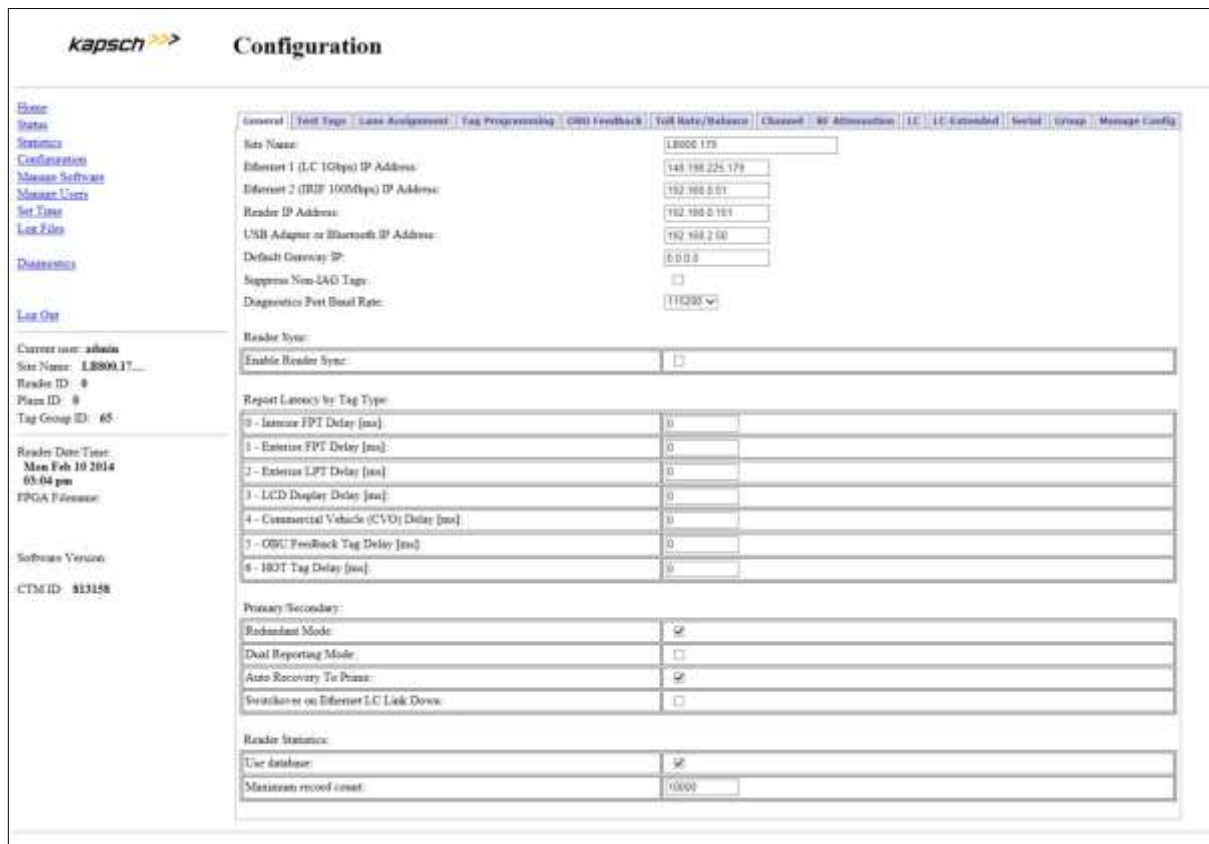
Configuring reader connections

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 40. 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.

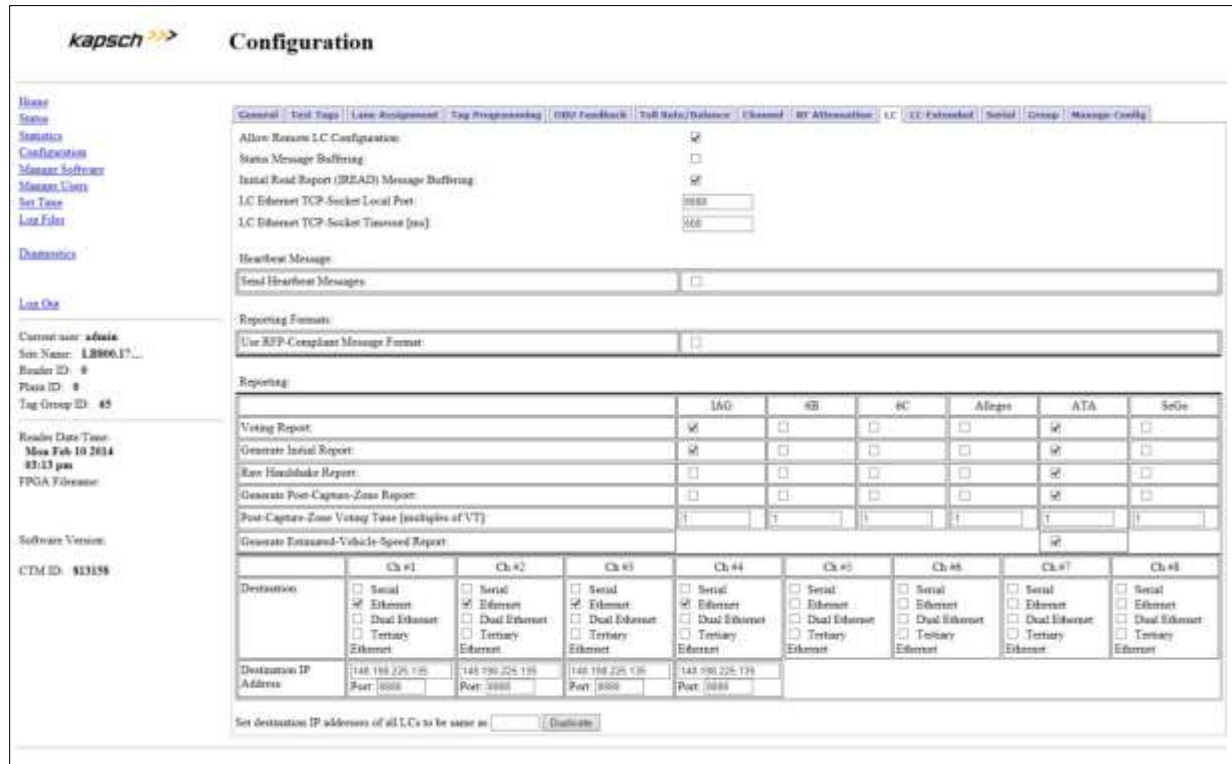
Result: The following screen appears.



The screenshot shows the Kapsch Configuration web interface. The left sidebar contains navigation links: Home, Status, Settings, Configuration (selected), Manage Software, Manage Users, Set Time, Log Files, Diagnostics, and Log Out. The main content area is titled 'Configuration' and has a tabbed interface with tabs for General, Test Page, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Release, Channel, RF Assignment, LC, LC Extended, Serial, Group, and Manage Config. The 'General' tab is active, showing fields for Site Name (LB000 173), Ethernet 1 (LC 1Gbps) IP Address (148.198.225.179), Ethernet 2 (TRIP 100Mbps) IP Address (192.168.0.81), Reader IP Address (192.168.0.181), USB Adapter or Bluetooth IP Address (192.168.2.08), Default Gateway IP (0.0.0.0), Suppress Non-SAG Tags (checked), and Diagnostic Port Baud Rate (115200). Below these are sections for Reader Type (Enable Reader Sync), Report Latency by Tag Type (a table with 8 rows for various delay types, all set to 0), Primary/Secondary (Redundant Mode checked, Dual Reporting Mode unchecked, Auto Recovery To Prime checked, Switchover on Ethernet LC Link Down unchecked), and Reader Statistics (Use database checked, Maximum record count 10000).

3. Click the **LC** tab.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Message Software | Message Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: L8806.17...
Reader ID: 0
Pilot ID: 0
Tag Group ID: 05

Reader Data Time:
Mon Feb 10 2014
03:13 pm
FPGA Firmware:

Software Version:
CTM ID: 83158

General | Test Tags | Lane Assignment | Tag Programming | IDU Feedback | Toll Rate/Balance | Channel | RT Authentication | LC | LC Extended | Serial | Group | Message Config

Allow Remote LC Configuration: ☒
 Status Message Buffering: ☐
 Initial Read Report (IRAD) Message Buffering: ☒
 LC Ethernet TCP Socket Local Port: 8080
 LC Ethernet TCP Socket Timeout (ms): 200

Heartbeat Message:
Send Heartbeat Messages: ☐

Reporting Format:
Use RFP-Compliant Message Format: ☐

Reporting:


| | LAG | #B | #C | AirTag | ATA | SeGS |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|
| Vehicle Report: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Initial Report: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Raw Handshake Report: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Post-Capture-Zone Report: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Post-Capture-Zone Vehicle Data (multiple of VT) | 1 | 1 | 1 | 1 | 1 | 1 |
| Generate Estimated-Vehicle-Speed Report: | <input checked="" 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: | 148.198.225.136 Port: 8080 | 148.198.225.136 Port: 8080 | 148.198.225.136 Port: 8080 | 148.198.225.136 Port: 8080 | | | | |

Set destination IP addresses of all LCs to be same as: 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.



Configuration

General | Test Tools | Lane Assignment | Tag Programming | RF Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | **Serial** | Group | Message Config

Allow Remote LC Configuration: ☒

Status Message Buffering: ☐

Serial Read Region (READ) Message Buffering: ☒

LC Ethernet TCP Socket Local Port: 8080

LC Ethernet TCP Socket Timeout (sec): 300

Heartbeat Message:

Send Heartbeat Message: ☐

Reporting Format:

Use RFP-Compliant Message Format: ☐

Reporting:

| | LAO | EB | EC | Allegro | ATA | SeGeo |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|
| Vehicle Report | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Initial Report | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Rate Hash/Date Report | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Post-Capture-Zone Report | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Post-Capture-Zone Voting Time (multiples of VT) | 1 | 1 | 1 | 1 | 1 | 1 |
| Generate Estimated-Vehicle Speed Report | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------------|--|--|--|--|--|--|--|--|
| Destination: | <input checked="" type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input checked="" type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input checked="" type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input checked="" type="checkbox"/> Serial <input checked="" type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet | <input type="checkbox"/> Serial <input type="checkbox"/> Ethernet <input type="checkbox"/> Dual Ethernet <input type="checkbox"/> Tertiary Ethernet |
| Serial Port: | COM1 | COM2 | COM3 | COM4 | | | | |
| Destination IP Address: | 140.198.225.135 | 140.198.225.135 | 140.198.225.135 | 140.198.225.135 | | | | |
| Port: | 8080 | 8080 | 8080 | 8080 | | | | |

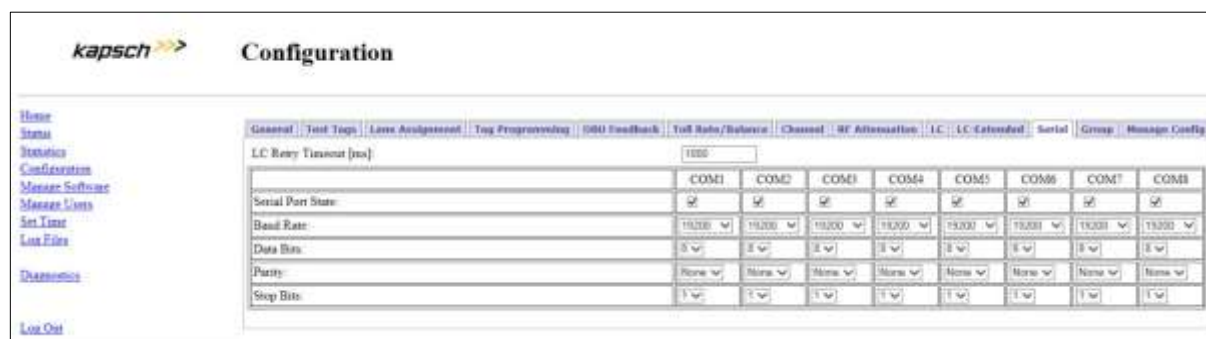
Set destination IP addresses of all LCs to be same as:

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

Note: 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.



Configuration

General | Test Tools | Lane Assignment | Tag Programming | RF Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | **Serial** | Group | Message Config

LC Baud Rate (baud): 115200

Serial Port State:

| | 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 | 115200 | 115200 | 115200 | 115200 | 115200 | 115200 | 115200 | 115200 |
| 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 |

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.
9. Press **Enter** to accept the configuration.

Refer to the Configuring the Reader to switch automatically over when an LC link is down procedure on page 232 to configure the Reader to switch over when the connection from the LPM to the LC is down.

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 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**

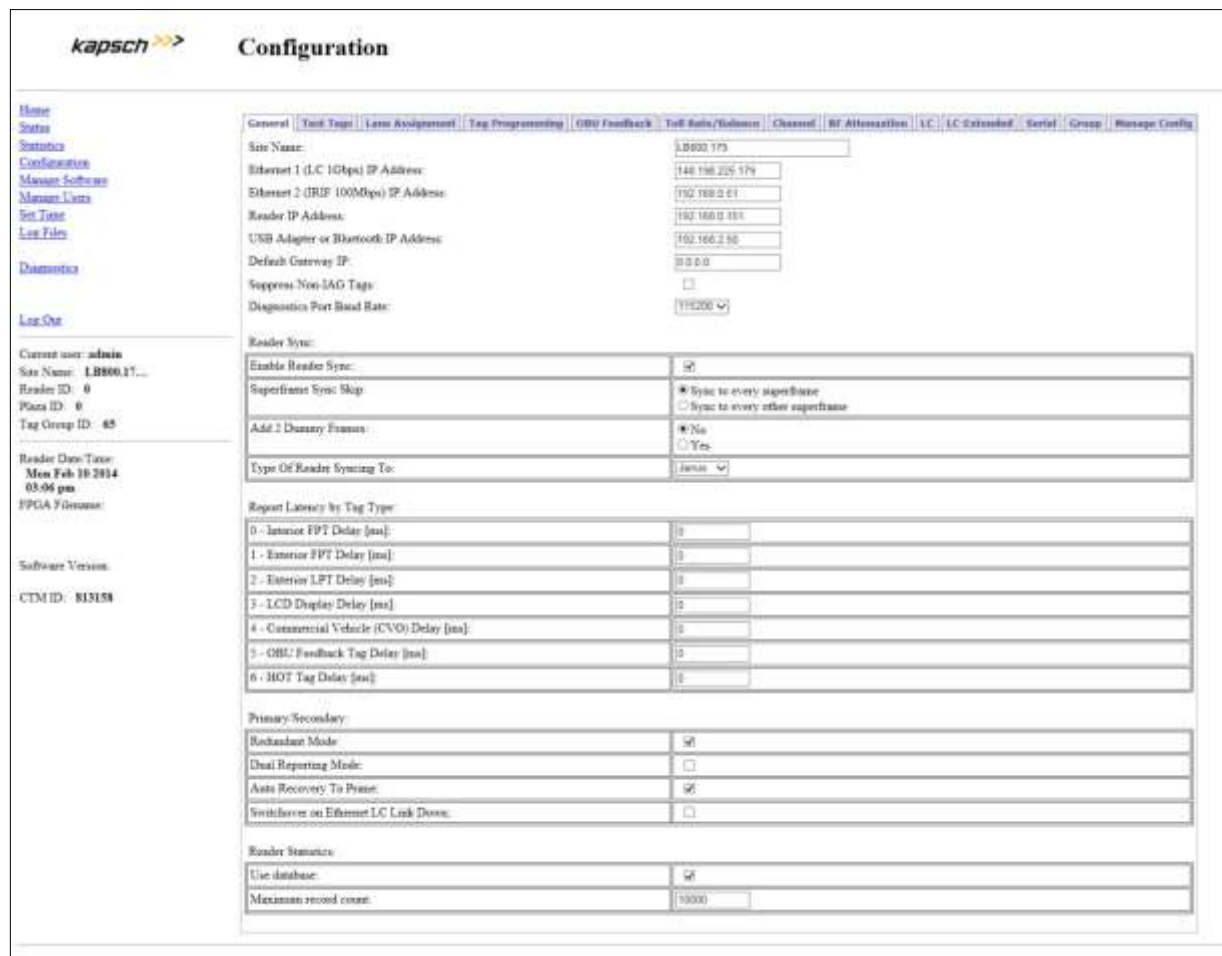
Setting the IP addresses

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 40.

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.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Test Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB000.17...
Reader ID: 0
Place ID: 0
Tag Group ID: 45
Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Time | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: LB000.175
Ethernet 1 (LC 1Gbps) IP Address: 148.196.225.175
Ethernet 2 (IRIF 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.001
USB Adapter or Bluetooth IP Address: 192.168.2.50
Default Gateway IP: 0.0.0.0
Suppress Non-IAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Channel Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Auto

Report Latency by Tag Type:
0 - Interior FPT Delay [ms]: 0
1 - Exterior FPT Delay [ms]: 0
2 - Exterior LFT Delay [ms]: 0
3 - LCD Display Delay [ms]: 0
4 - Commercial Vehicle (CVV) Delay [ms]: 0
5 - OBU Feedback Tag Delay [ms]: 0
6 - HOT Tag Delay [ms]: 0

Primary/Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:
Use database: ☒
Maximum record count: 10000

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 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. Press **Enter** to accept all addresses.
8. Repeat steps 1 through 7 for the secondary CTM.

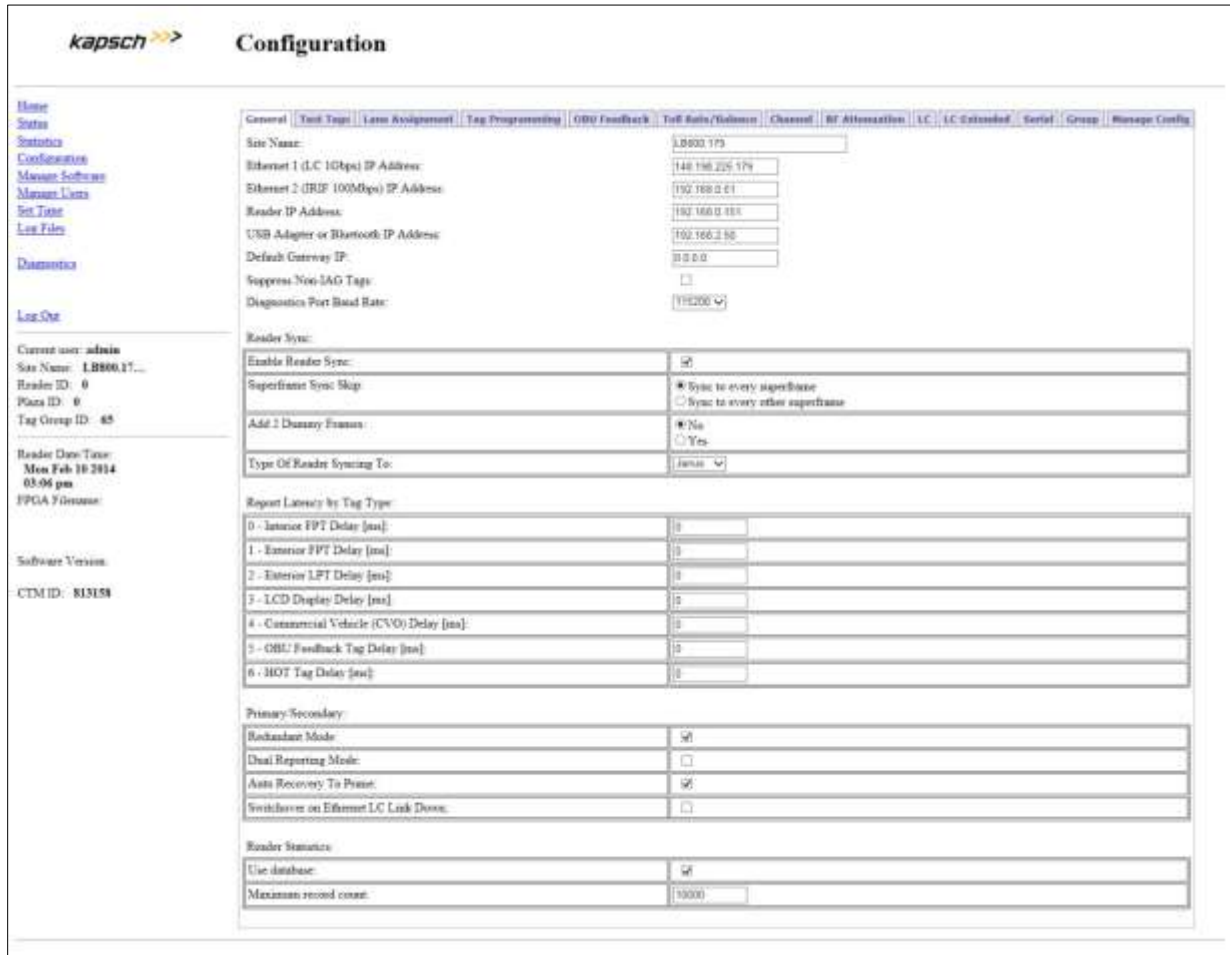
Configuring an LC Ethernet network

The Reader data can also be sent to the LC via an Ethernet network.

Prerequisites: The service laptop connects to the port and the CTM web accessed. . Refer to Connecting a service laptop to the Reader, page 40. You must have **Advanced User** permissions.

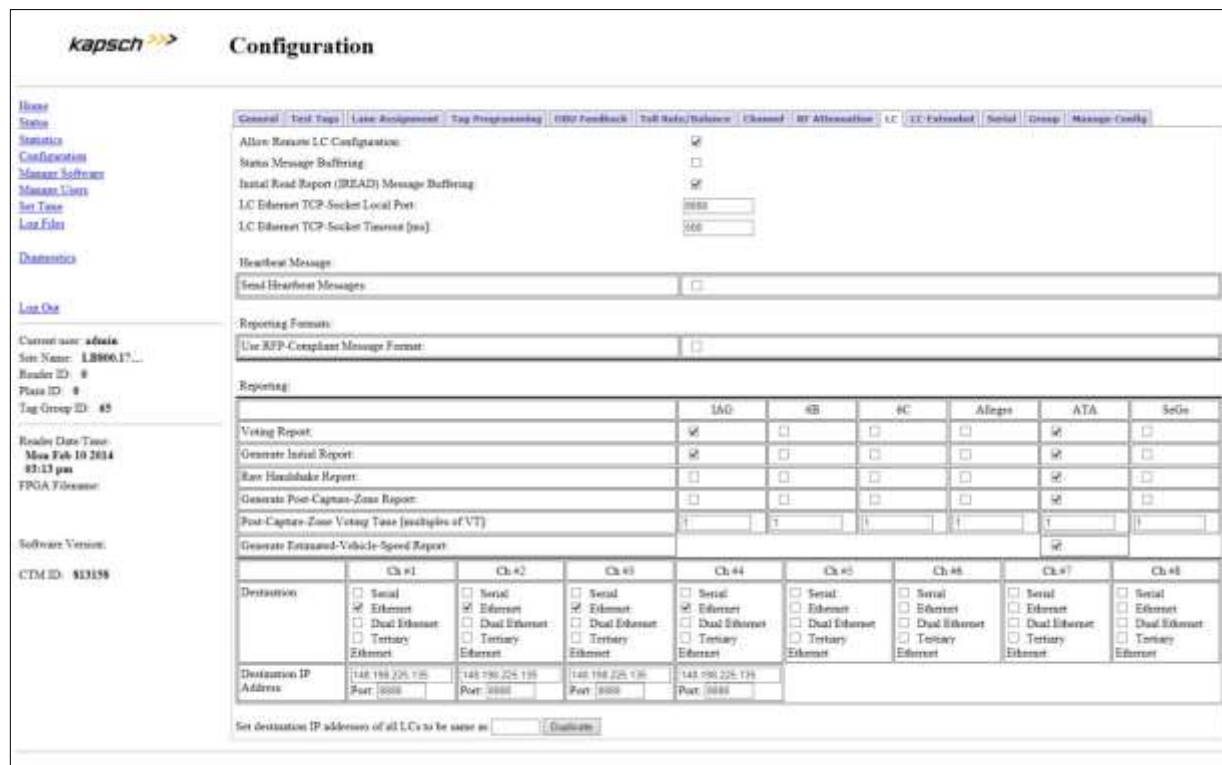
1. Select the **Configuration** link on the left side panel.

Result: The following screen appears.



2. Click the **LC** tab.

Result: The following screen appears.



- In the **Destination** row, select the **Ethernet** check box for each RF channel that will communicate with the LC via Ethernet.
- Enter the LC IP address and Port number for each RF channel.
- 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, in the **LC Ethernet TCP-Socket Timeout** field.
- Press **Enter** to accept your selections and inputs.

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

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 voting for ORT applications

ORT lanes allow OBUs to cross multiple capture zones. The Readers must assign an OBU to one RF channel to prevent duplicate transactions.

Selecting the correct communication method

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 5-12, where, to assign the OBU to a lane, Reader 1 and Reader 2 need to share handshaking information.

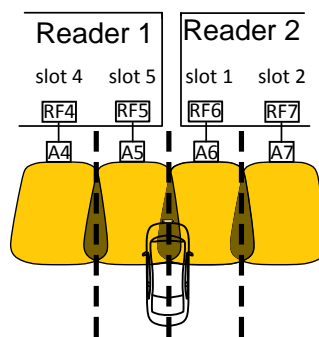


Figure 5-12: Two Readers communicating with one OBU

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.

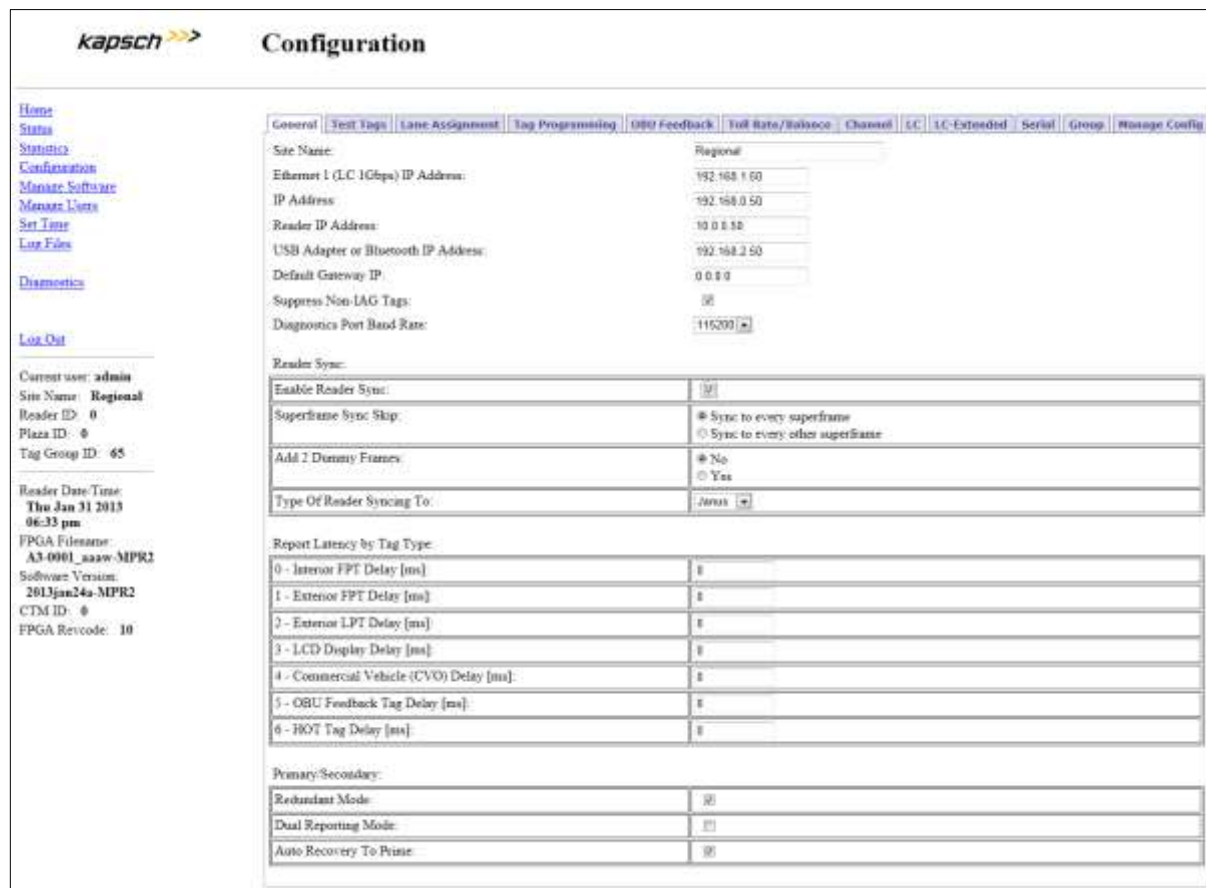
Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. You must have **Advanced User** permissions.

Note: 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 will see that it was recently programmed and ignore the OBU.

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.

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

Result: The following screen appears.



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: Regional
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65

Reader Date/Time:
Thu Jan 31 2013
06:33 pm
FPGA Filename:
A3-0001_aaaa-MPR2
Software Version:
2013jan24a-MPR2
CTM ID: 0
FPGA Revcode: 10

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | LC | LC-Extended | Serial | Group | Manage Config

Site Name: Regional

Ethernet 1 (LC 1Gbps) IP Address: 192.168.1.60

IP Address: 192.168.0.50

Reader IP Address: 10.0.1.10

USB Adapter or Bluetooth IP Address: 192.168.2.50

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☒

Diagnostics Port Band Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Dummy Frames: ☒ No
☐ Yes

Type Of Reader Syncing To: Janus

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:

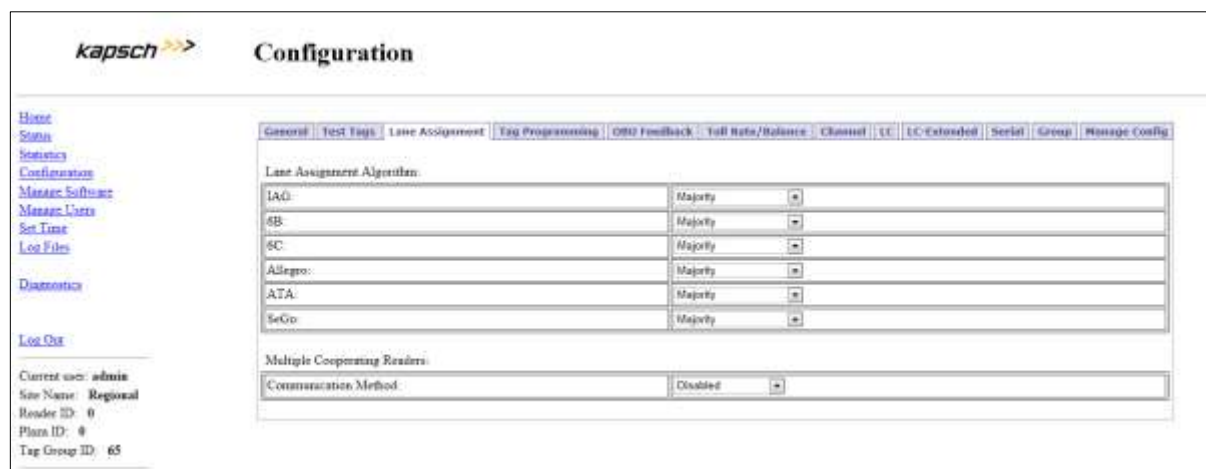
Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

2. Click the **Lane Assignment** tab.

Result: The following screen appears.



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: Regional
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | LC | LC-Extended | Serial | Group | Manage Config

Lane Assignment Algorithm:

LAQ: Majority

6B: Majority

6C: Majority

Allegro: Majority

ATA: Majority

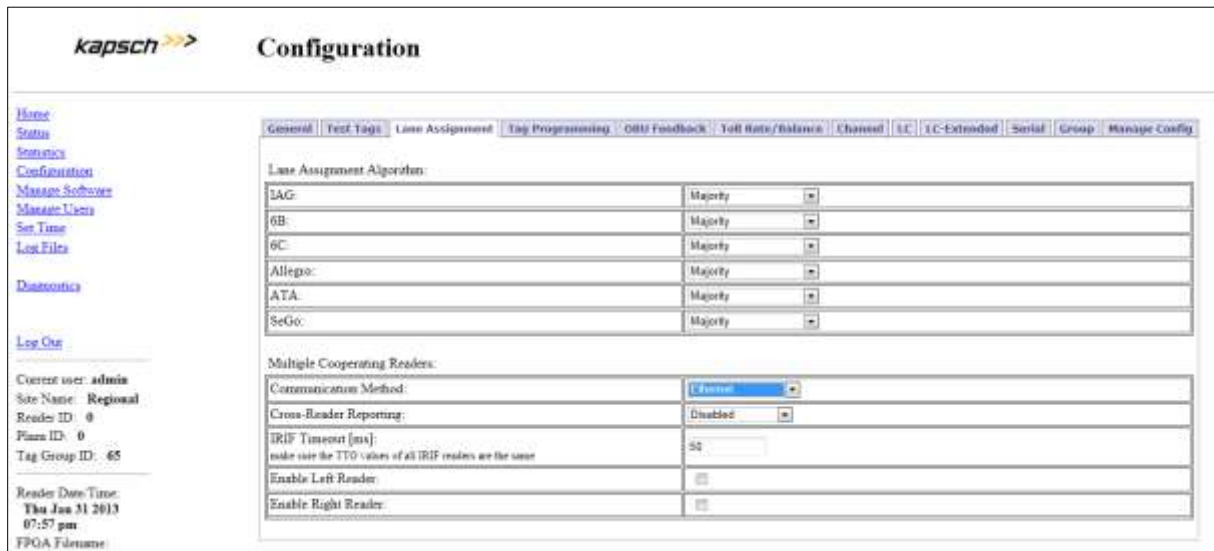
SeGo: Majority

Multiple Cooperating Readers:

Communication Method: Disabled

3. Select **Ethernet** from the **Communication Method** drop-down box.

Result: The following screen appears.



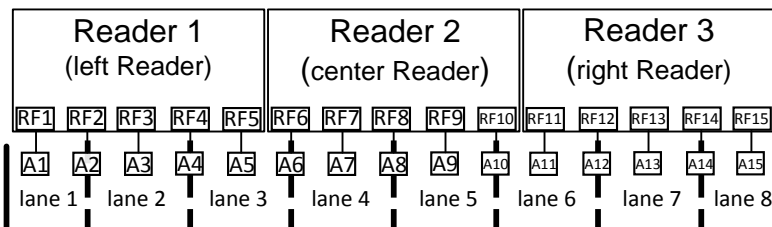
Configure how multiple transactions are reported to the LC:

- 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 all transaction reports 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.

1. Configure the IR network by determining where the Reader sits in the IR network.

Example: Reader 1 in Figure 5-13 has a Reader on its right (Reader 2) but no Reader on the left. Reader 2 in Figure 5-13 has a Reader on its right (Reader 3) and a Reader on its left (Reader 1). Reader 3 in Figure 5-13 does not have a Reader on its right but has one on its left (Reader 2).

Figure 5-13: Three readers covering one direction of wide lane ORT traffic



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.

2. If there is a Reader on the left, select the **Enable Left Reader** check box.
3. Enter the Reader IP address of the left Reader.

4. Press Enter or select a different tab.
5. If there is a Reader on the right, select the **Enable Right Reader** check box.
6. Enter the Reader IP address of the right Reader.
7. Press Enter or select a different tab.
8. TTO values for the grouped IDs must be the same across all readers.
9. A reader restart is required when the IR network configuration is complete
10. To set the Reader to switchover when an IR link is down, see the Configuring events that cause a switchover procedure, page 231.
11. Configure **Tag Programming** (see OBU Programming on page 61) 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
12. Configure the Reader clocks in the IR network to have the same time (see Using an NTP Server to synchronize the clocks of Readers in an IR network, page 254).

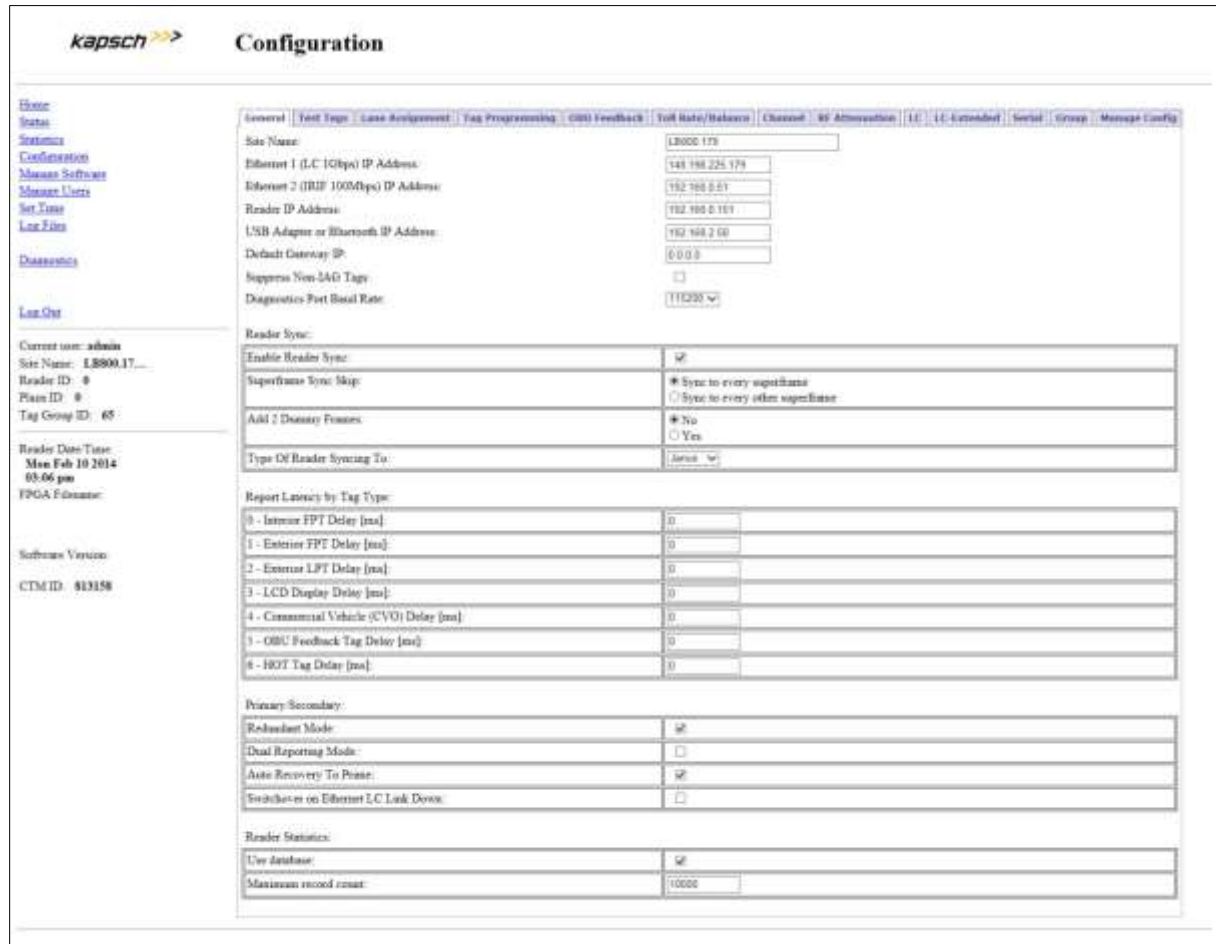
Note: Multiple group IDs are not supported across multiple readers.
13. From the **Channel** tab on the **Configuration** page, ensure all channels covering one direction of traffic have the same Group ID.

Configuring Badger-style Cross Reader Algorithm (CRA) communication

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 40.

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

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: L8900.17...
Reader ID: 0
Plan ID: 0
Tag Group ID: 65
Reader Date Time: Mon Feb 10 2014 05:06 pm
FPGA Firmware:
Software Version:
CTM ID: 013158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Site Name: L8900.17
Ethernet 1 (LC 10Gbps) IP Address: 145.198.225.179
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.61
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.60
Default Gateway IP: 0.0.0.0
Suppress Non-SAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Serial

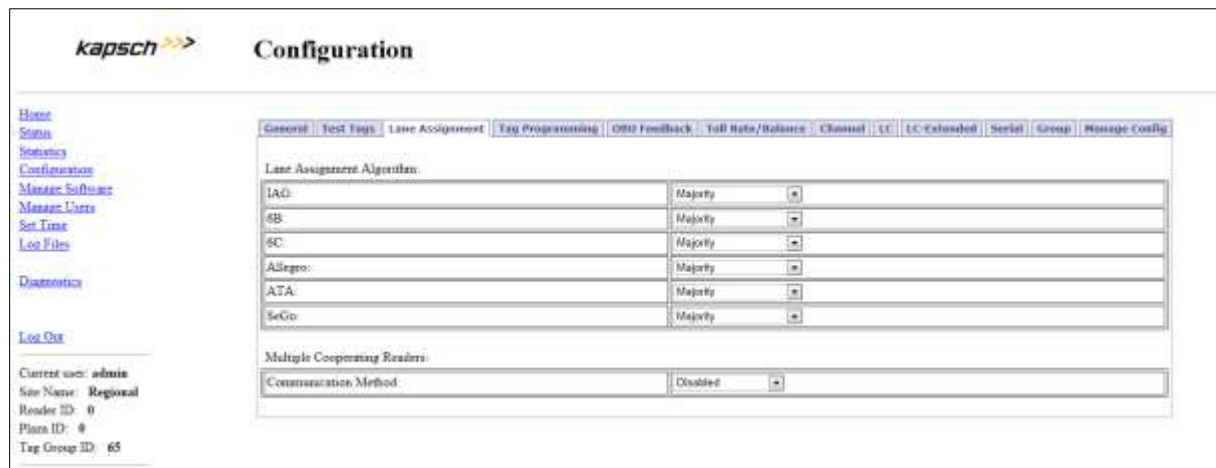
Report Latency by Tag Type:
0 - Interior FRT Delay [ms]: 0
1 - Exterior FRT Delay [ms]: 0
2 - Exterior LPT Delay [ms]: 0
3 - LCD Display Delay [ms]: 0
4 - Commercial Vehicle (CVU) Delay [ms]: 0
5 - OBU Feedback Tag Delay [ms]: 0
6 - HOT Tag Delay [ms]: 0

Primary Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switches on Ethernet LC Link Down: ☐

Reader Statistics:
Use Database: ☒
Maximum record count: 10000

2. Click the **Lane Assignment** tab.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: Regional
Reader ID: 0
Plan ID: 0
Tag Group ID: 65

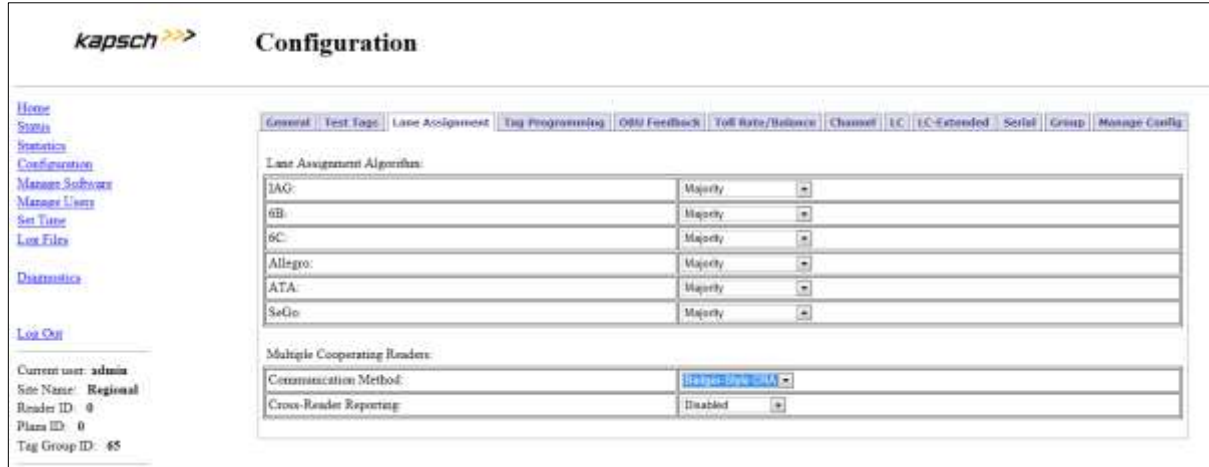
General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | LC | LC Extended | Serial | Group | Manage Config

Lane Assignment Algorithm:
IAG: Majority
SB: Majority
SC: Majority
Allgro: 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.



The screenshot shows the Kapsch Configuration web interface. On the left is a navigation menu with links: Home, Status, Statistics, Configuration, Manage Software, Manage Users, Set Time, Log Files, Diagnostics, and Log Out. Below the menu, it displays: Current user: admin, Site Name: Regional, Reader ID: 0, Plaza ID: 0, Tag Group ID: 65. The main content area has tabs: General, Test Tags, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Balance, Channel, LC, LC-Extended, Serial, Group, and Manage Config. The 'Lane Assignment' tab is active, showing 'Lane Assignment Algorithms' with a table of settings for IAG, nB, 6C, Allegro, ATA, and SeGo, all set to 'Majority'. Below this is the 'Multiple Cooperating Readers' section with 'Communication Method' set to 'Badger-Style CRA' and 'Cross-Reader Reporting' set to '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 on 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.
5. Configure **Tag Programming** (see OBU Programming on page 61) 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: Multiple group IDs are not supported across multiple Readers.
6. From the **Channel** tab on the **Configuration** page, ensure all channels covering one direction of traffic have the same Group ID.

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.
7. Manually set the Reader clocks to within 2 seconds of the same time (refer to the Manually setting the Reader time and date procedure on page 255).

Selecting the Voting Algorithm

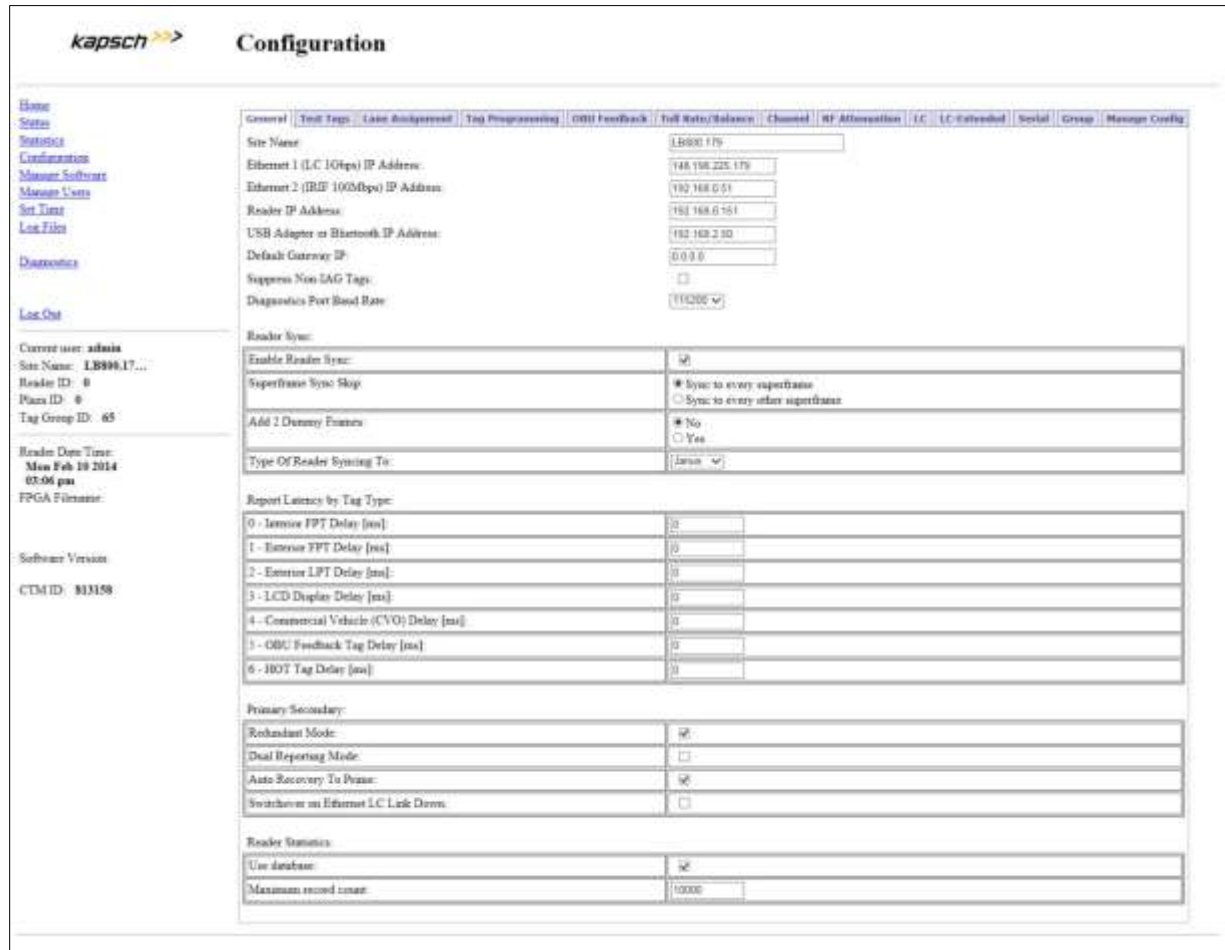
Prerequisites: Connect the service laptop to the Reader configuration port to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40.

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.

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

Result: The following screen appears.



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB999.17...
Reader ID: 0
Pilot ID: 0
Tag Group ID: 65
Reader Date Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC-Extended | Serial | Group | Manage Config

Site Name: LB999.179
Ethernet 1 (LC 10Gbps) IP Address: 192.168.225.179
Ethernet 2 (RF 100Mbps) IP Address: 192.168.0.51
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.30
Default Gateway IP: 0.0.0.0
Suppress Non-LAG Tags: ☐
Diagnostics Port Band Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:
0 - Intensive FPT Delay [ms]: 10
1 - Intensive FPT Delay [ms]: 10
2 - Extensive LPT Delay [ms]: 10
3 - LCD Display Delay [ms]: 10
4 - Commercial Vehicle (CVO) Delay [ms]: 10
5 - OBU Feedback Tag Delay [ms]: 10
6 - HOT Tag Delay [ms]: 10

Primary/Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Primary: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:
Use database: ☒
Maximum record count: 10000

1. Click the **Lane Assignment** tab.

Result: The following screen appears.



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: MPR2.19...
Reader ID: 449
Pilot ID: 0
Tag Group ID: 65

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | LC | LC-Extended | Serial | Group | Manage Config

Lane Assignment Algorithm:
LAG: Majority
6B: Majority
6C: Majority
Allrpo: Majority
ATA: Majority
SeGo: Majority

Multiple Cooperating Readers:
Communication Method: Disabled

2. 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.

3. If **Interpolated** was selected in step 1, enter a percentage in the **Handshake Equalization Ratio** field.
4. Press **Enter** to accept the selections.

Configuring Voting Time

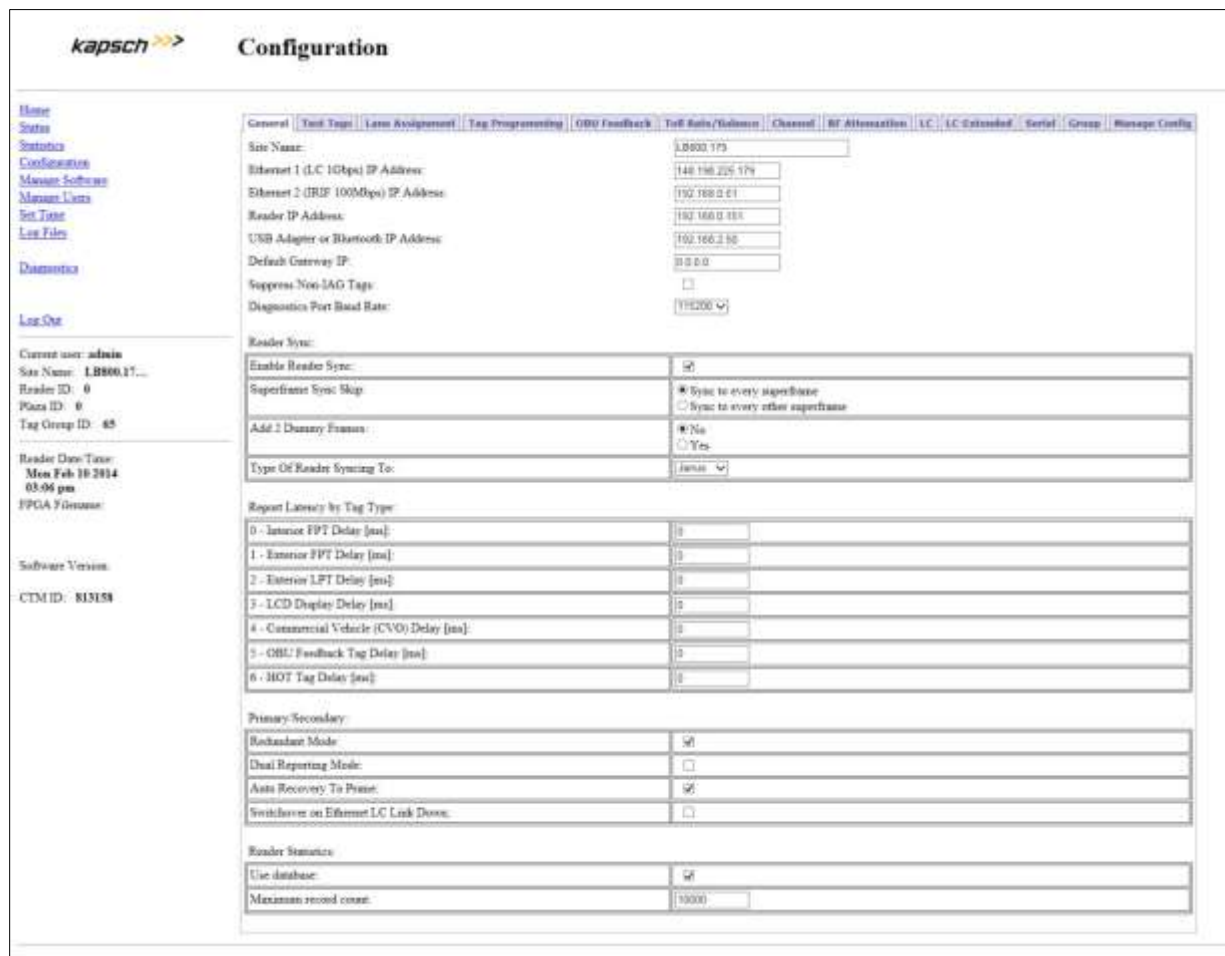
Manually setting a voting time gives a fixed voting time to each channel. Dynamic voting time allows the Reader to calculate and base the voting time on the average capture zone span time (the time it takes for an OBU to pass through a capture zone).

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 40.

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

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | **Channel** | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18900.179

Ethernet 1 (LC 10Gbps) IP Address: 148.198.225.179

Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01

Reader IP Address: 192.168.0.101

USB Adapter or Bluetooth IP Address: 192.168.2.50

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Mode: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Channel Frames: ☒ No
☐ Yes

Type Of Reader Syncing To:

Report Latency by Tag Type:

| | |
|--|---|
| 0 - Interior EPT Delay [ms] | 0 |
| 1 - Exterior EPT Delay [ms] | 0 |
| 2 - Exterior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CV) Delay [ms] | 0 |
| 5 - GBU Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count: 10000

Left Sidebar:

- Home
- Status
- Statistics
- Configuration
- Manage Software
- Manage Users
- Set Time
- Log Files
- Diagnostics
- Log Out

Current user: admin

Site Name: 18900.17...

Reader ID: 0

Plaza ID: 0

Tag Group ID: 05

Reader Date/Time: Mon Feb 10 2014 03:06 pm

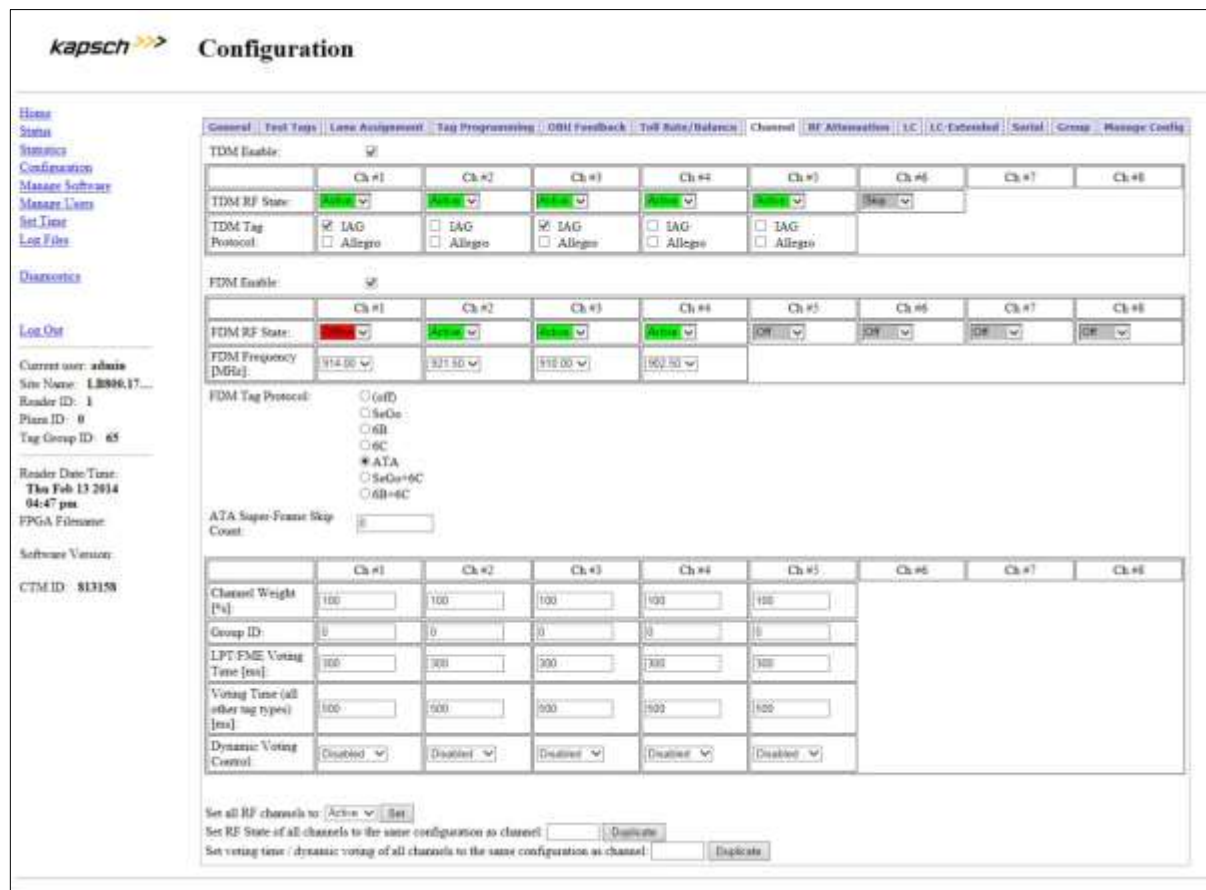
FPGA Firmware:

Software Version:

CTM ID: 813158

- Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home | Status | Instances | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: L8886.17...
Reader ID: 1
Plane ID: 0
Tag Group ID: 65
Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

Tabs: General | Test Tags | Lane Assignment | Tag Programming | DBM Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Cross | Message Config

Channel Configuration

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|---|--|---|--|--|-------|-------|-------|
| TDM Enable: | <input checked="" type="checkbox"/> | | | | | | | |
| TDM RF State: | Active | Active | Active | Active | Active | Skip | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |
| FDM Enable: | <input checked="" type="checkbox"/> | | | | | | | |
| FDM RF State: | Red | Active | Active | Active | Off | Off | Off | Off |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 912.00 | 907.50 | | | | |
| FDM Tag Protocol: | <input type="radio"/> (off) <input type="radio"/> SeGo <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGo+6C <input type="radio"/> 6B+6C | | | | | | | |
| ATA Super-Framer Skip Count: | 0 | | | | | | | |
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT/FME Voting Time [ms] | 100 | 300 | 300 | 300 | 300 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 500 | 500 | | | |
| Dynamic Voting Control: | Disabled | Disabled | Disabled | Disabled | Disabled | | | |

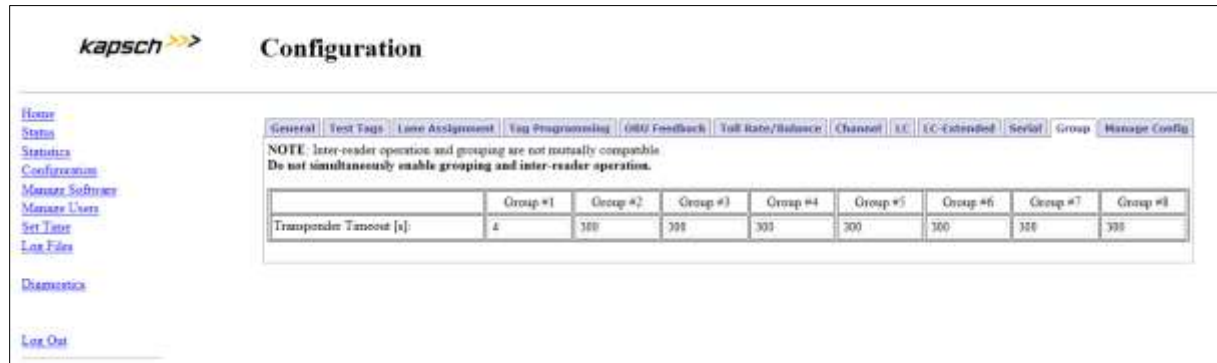
Set all RF channels to: Active | Set

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

3. Select **Disabled** from the drop-down menu in the **Dynamic Voting Control** row .
4. Enter a voting time, in milliseconds, in the **LPT/FME Voting Time** field to set the voting time for LPT and FME OBU's.
5. Enter a voting time, in milliseconds, in the **Voting Time (all other tags)** field to set the voting time for all OBU's that are not LPT or FME.
6. If a voting time of 0 was entered in step 4 and step 5 and **Dynamic Voting Control** is disabled (effectively disabling voting), click on the **Group** tab.

Result: The following screen appears.



| | Group #1 | Group #2 | Group #3 | Group #4 | Group #5 | Group #6 | Group #7 | Group #8 |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Transponder Timeout [s]: | 4 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

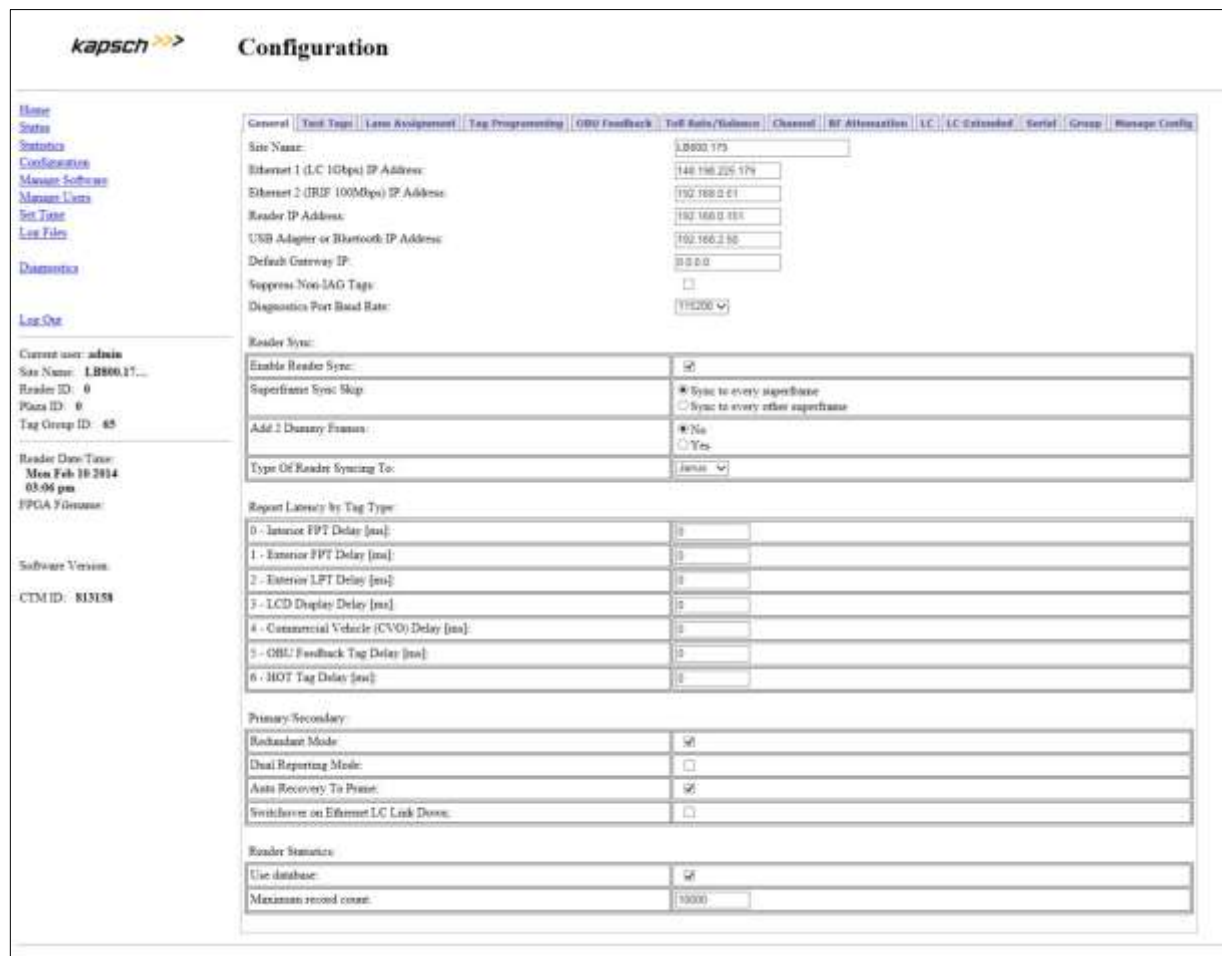
7. Enter a time, in ms, in the **Transponder Timeout** field to set the maximum time that a Reader attempts to program an OBU.
8. Repeat steps 4 through 7 to individually configure the other channels, or enter the number of a configured channel in the field beside the **Duplicate** button on the Channel screen.
9. 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 40.

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

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Test Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB000.17...
Reader ID: 0
Pace ID: 0
Tag Group ID: 45

Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:

Software Version:
CTM ID: 813158

General | Test Time | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balances | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: LB000.175
Ethernet 1 (LC 10Gbps) IP Address: 148.196.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.001
USB Adapter or Bluetooth IP Address: 192.168.2.00
Default Gateway IP: 0.0.0.0
Suppress Non-IAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Lane

Report Latency by Tag Type:

| | |
|---|---|
| 0 - Interior FPT Delay [ms] | 0 |
| 1 - Exterior FPT Delay [ms] | 0 |
| 2 - Interior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CVV) Delay [ms] | 0 |
| 5 - OBU Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:

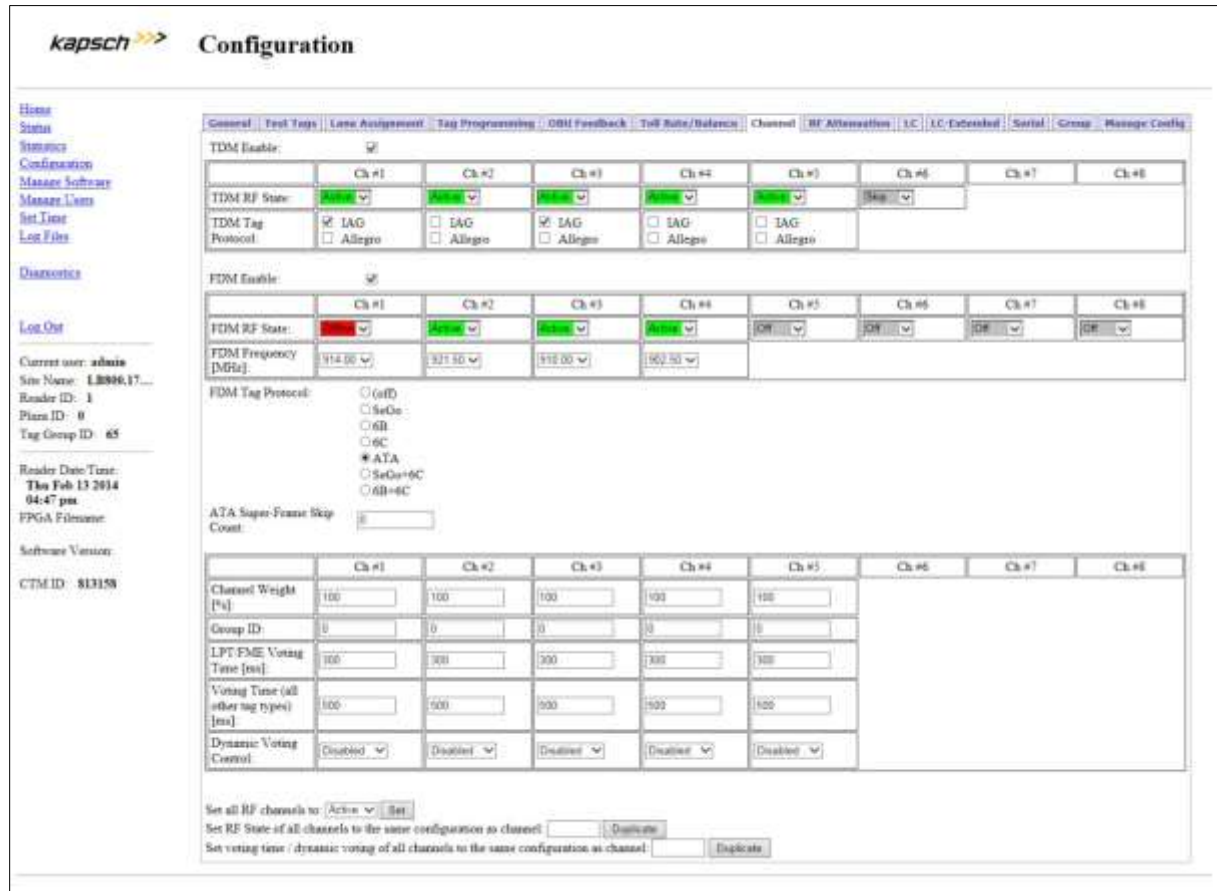
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒
Maximum record count: 10000

2. Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: L8886.17...
Reader ID: 1
Pilot ID: 0
Tag Group ID: 65
Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

TDDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--------------------|---|--|---|--|--|---------|-------|-------|
| TDDM RF State: | Active | Active | Active | Active | Active | Standby | | |
| TDDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-----------------------------|---|--------|--------|--------|---------|---------|---------|---------|
| FDDM RF State: | Active | Active | Active | Active | Standby | Standby | Standby | Standby |
| FDDM Frequency [MHz]: | 914.00 | 921.50 | 918.00 | 902.50 | | | | |
| FDDM Tag Protocol: | <input type="radio"/> aFD <input type="radio"/> SeGs <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGs+6C <input type="radio"/> 6B+6C | | | | | | | |
| ATA Super-Frame Skip Count: | 0 | | | | | | | |

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID: | 0 | 0 | 0 | 0 | 0 | | | |
| LPT-FME Voting Time [ms] | 100 | 300 | 300 | 300 | 300 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 500 | 500 | | | |
| Dynamic Voting Control: | Disabled | Disabled | Disabled | Disabled | Disabled | | | |

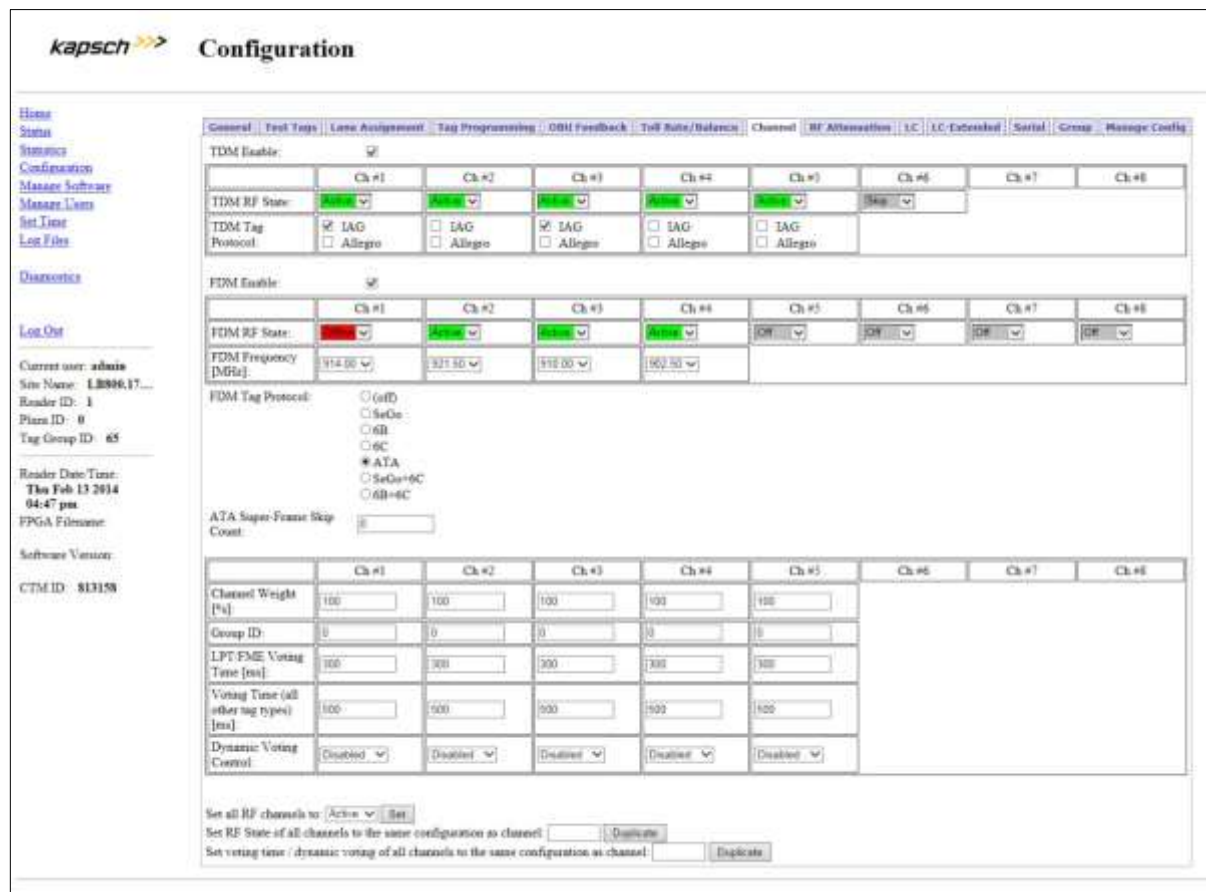
Set all RF channels to: Active

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:

- 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.
 - Press **Enter**.
 - Enter a sample size in the **Dynamic Voting Sample Size** field. This is the number of previous transactions the Reader includes when calculating the average capture zone span time.
- Note:** 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.
 - Press **Enter** or click outside the fields.

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | DBI Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|-------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Stop | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-----------------------------|---|--------|--------|--------|-------|-------|-------|-------|
| FDM RF State: | Active | Active | Active | Active | Stop | Stop | Stop | Stop |
| FDM Frequency [MHz]: | 914.00 | 914.00 | 914.00 | 902.50 | | | | |
| FDM Tag Protocol: | <input type="radio"/> (off) <input type="radio"/> SeGo <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGo+6C <input type="radio"/> 6B+6C | | | | | | | |
| ATA Super-Frame Skip Count: | 0 | | | | | | | |

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT-FME Voting Time [ms] | 100 | 300 | 300 | 300 | 300 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 500 | 500 | | | |
| Dynamic Voting Control: | 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:

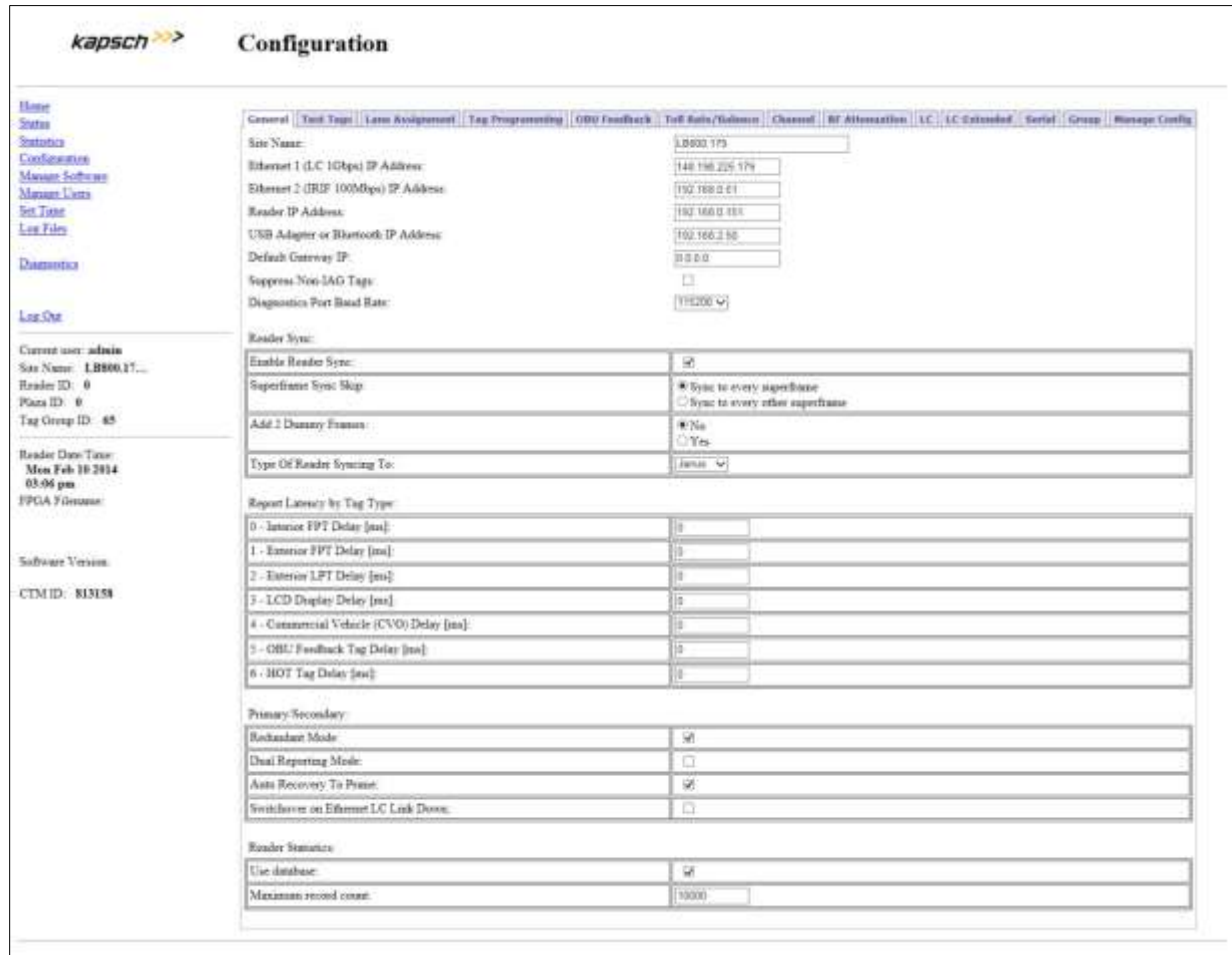
Configuring Channel Weight for straddle antennas

The handshake count of straddle channels (channels 2 and 4 in Figure 5-14) typically have less weight assigned to them than non-straddle channels (channels 1, 3, and 5 in Figure 5-14).

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 40.

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

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18800.179

Ethernet 1 (LC 10Gbps) IP Address: 148.198.225.179

Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01

Reader IP Address: 192.168.0.101

USB Adapter or Bluetooth IP Address: 192.168.2.50

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Mode: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Channel Frames: ☒ No
☐ Yes

Type Of Reader Syncing To:

Report Latency by Tag Type:

0 - Interior EPT Delay [ms]:

1 - Exterior EPT Delay [ms]:

2 - Exterior LPT Delay [ms]:

3 - LCD Display Delay [ms]:

4 - Commercial Vehicle (CVO) Delay [ms]:

5 - GBU/ Feedback Tag Delay [ms]:

6 - HOT Tag Delay [ms]:

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count:

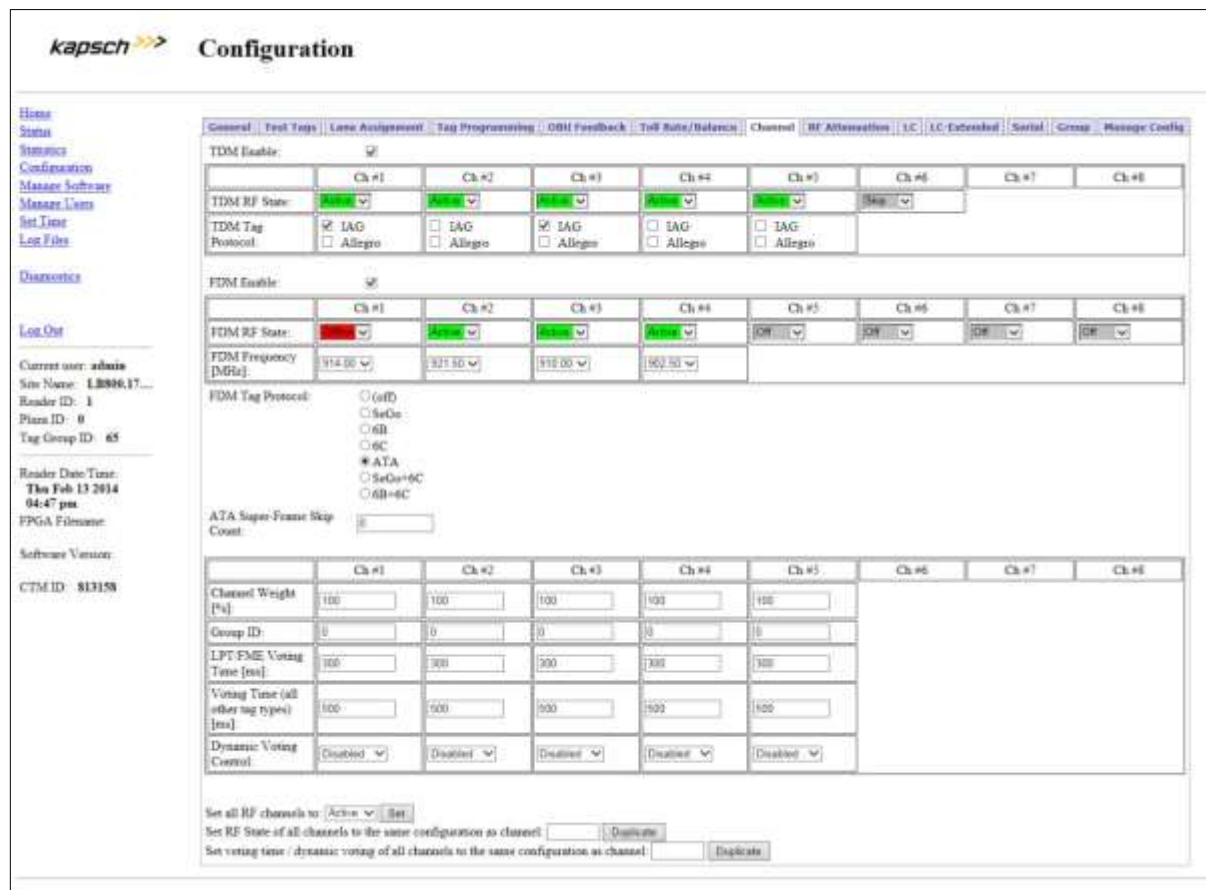
Current user: admin
Site Name: 18800.17...
Reader ID: 0
Pilot ID: 0
Tag Group ID: 05

Reader Date/Time:
Mon Feb 10 2014
03:06 pm
FPGA Firmware:

Software Version:
CTM ID: 813158

- Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home | Status | Instances | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: L8886.17...
Reader ID: 1
Plane ID: 0
Tag Group ID: 65
Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | DBI Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Cross | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|-------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Skip | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--|--------|--------|--------|-------|-------|-------|-------|
| FDM RF State: | Red | Active | Active | Active | Skip | Skip | Skip | Skip |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 912.00 | 907.50 | | | | |
| FDM Tag Protocol: | <input type="radio"/> offD <input type="radio"/> SeGo <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGo+6C <input type="radio"/> 6B+6C | | | | | | | |

ATA Super-Framer Skip Count:

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT-FME Voting Time [ms] | 100 | 300 | 300 | 300 | 300 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 500 | 500 | | | |
| Dynamic Voting Control: | Disabled | Disabled | Disabled | Disabled | Disabled | | | |

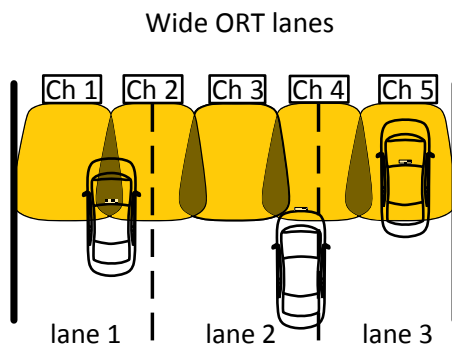
Set all RF channels to: Active

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

Example: 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.

Figure 5-14: 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 46).
 - Examine the RF channel statistics (page 53).
 - Examine the trouble log files for any reported issues with the Reader (page 141).
 - Observe the status LEDs on the Reader front panel (see LED Status, page 192).

Replace a suspected faulty component.

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

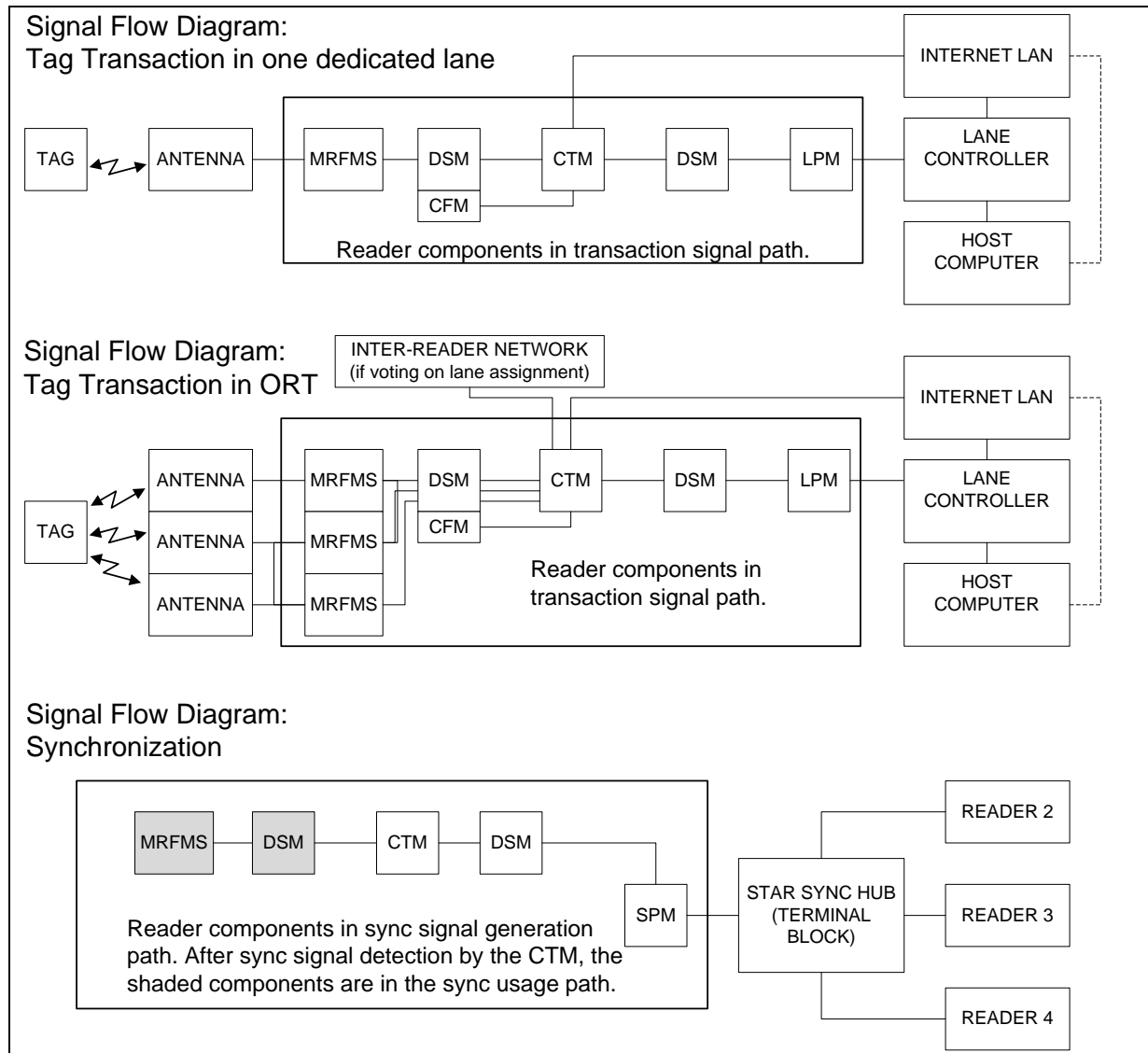


Figure 6-1: Signal Flow Diagrams

LED Statuses

The following table gives an overview of all the LEDs on the Reader. See the Troubleshooting Trees beginning on page 194 to resolve any issues.

Table 6-1: CTM LED states explained

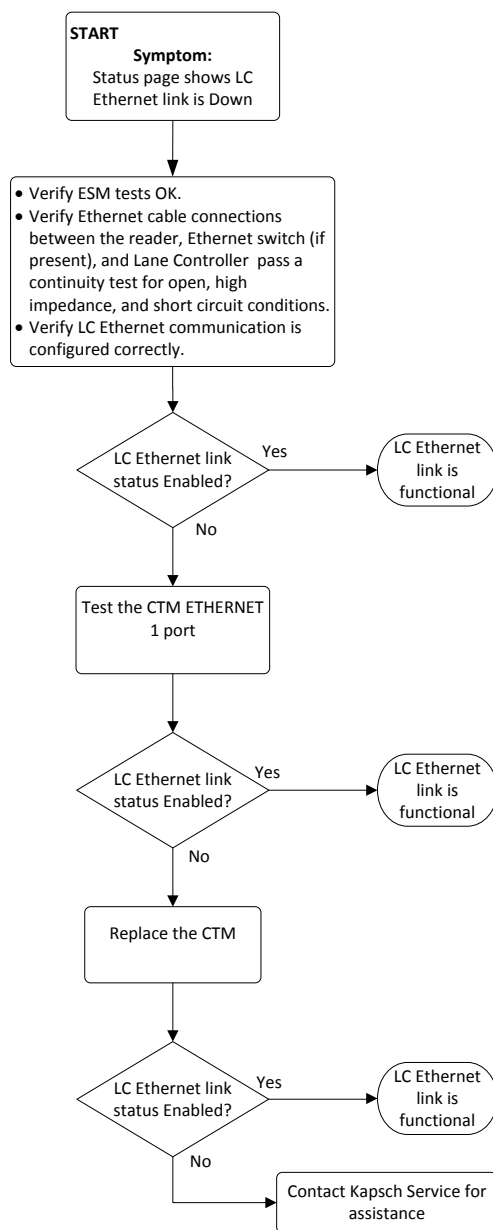
| CTM LEDs | | |
|-----------------------|-----------------------|--|
| LED | State | Meaning |
| CGC | solid green | CGC is functional |
| | solid red | CGC has failed |
| MC | solid green | MC is functional |
| | solid red | MC has failed |
| SYNC | solid green | Reader is synchronized |
| | flashing red | Reader out of sync, or, |
| | | No activity on the Rx port on the terminal block of the SPM (R+ and R- on the connector). |
| | | another Reader in sync network is stuck in the busy state |
| | flashing green/orange | Reader is out of sync and attempting recovery |
| ACTIVE | off | Synchronization is disabled |
| | | |
| POWER | 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 |
| ACTIVITY (Ethernet 1) | solid green | CTM is receiving power from PSM |
| | off | CTM is not receiving power from PSM, or, CTM reset switch is OFF |
| ACTIVITY (Ethernet 2) | 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 |

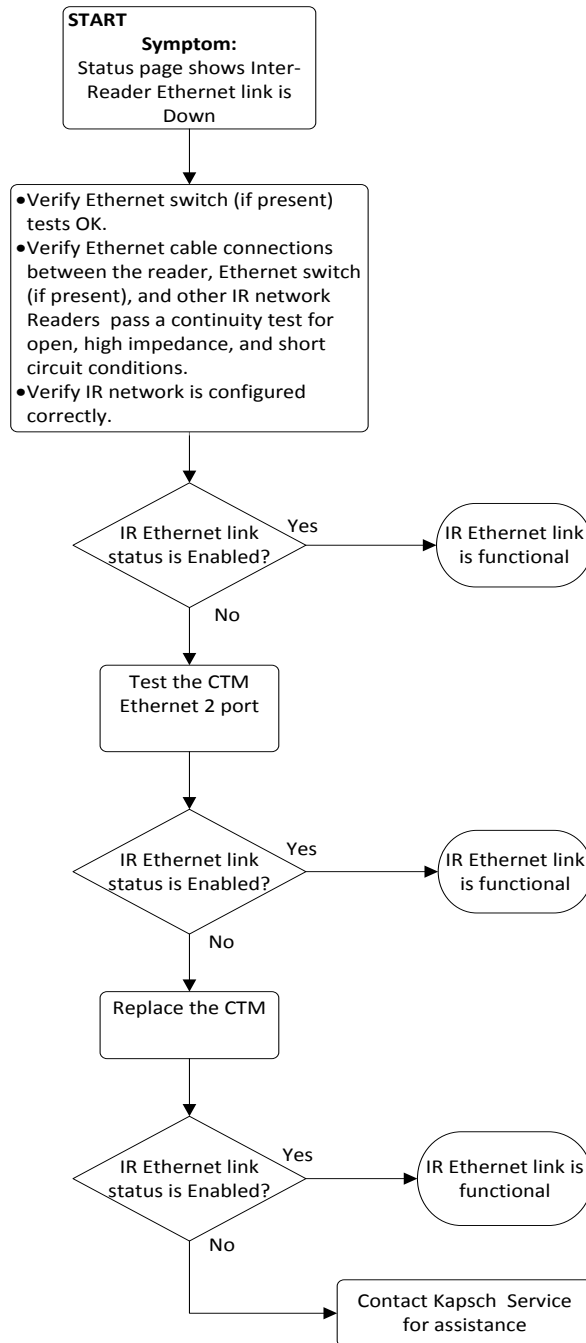
Table 6-2: PSM LED states explained

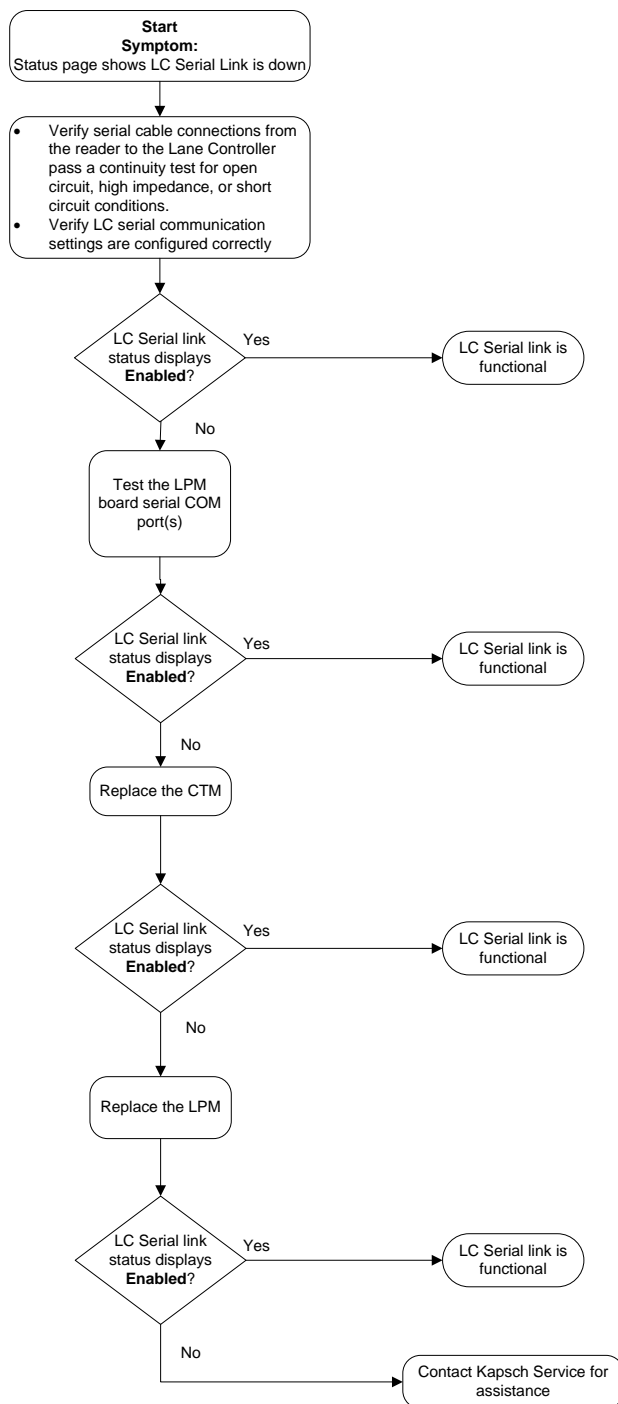
| PSM LED | | |
|------------|-------------|---------------------------------|
| LED | State | Meaning |
| +15 STATUS | solid green | PSM is supplying +15VDC via DSM |
| | off | PSM is not supplying +15VDC |
| +5 STATUS | solid green | PSM is supplying +5VDC via DSM |
| | off | PSM is not supplying +5VDC |

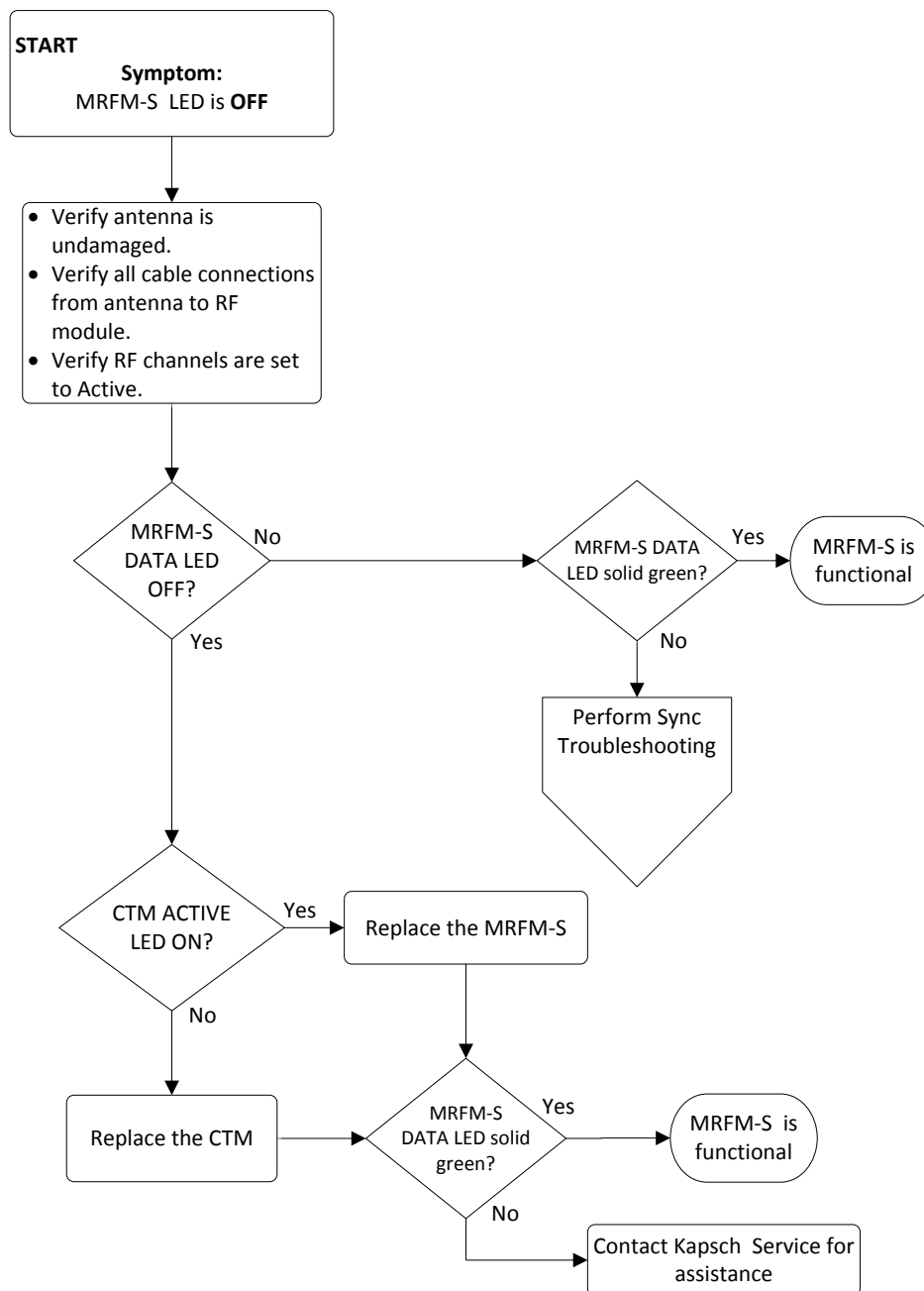
Table 6-3: MRFM-S LED states explained

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

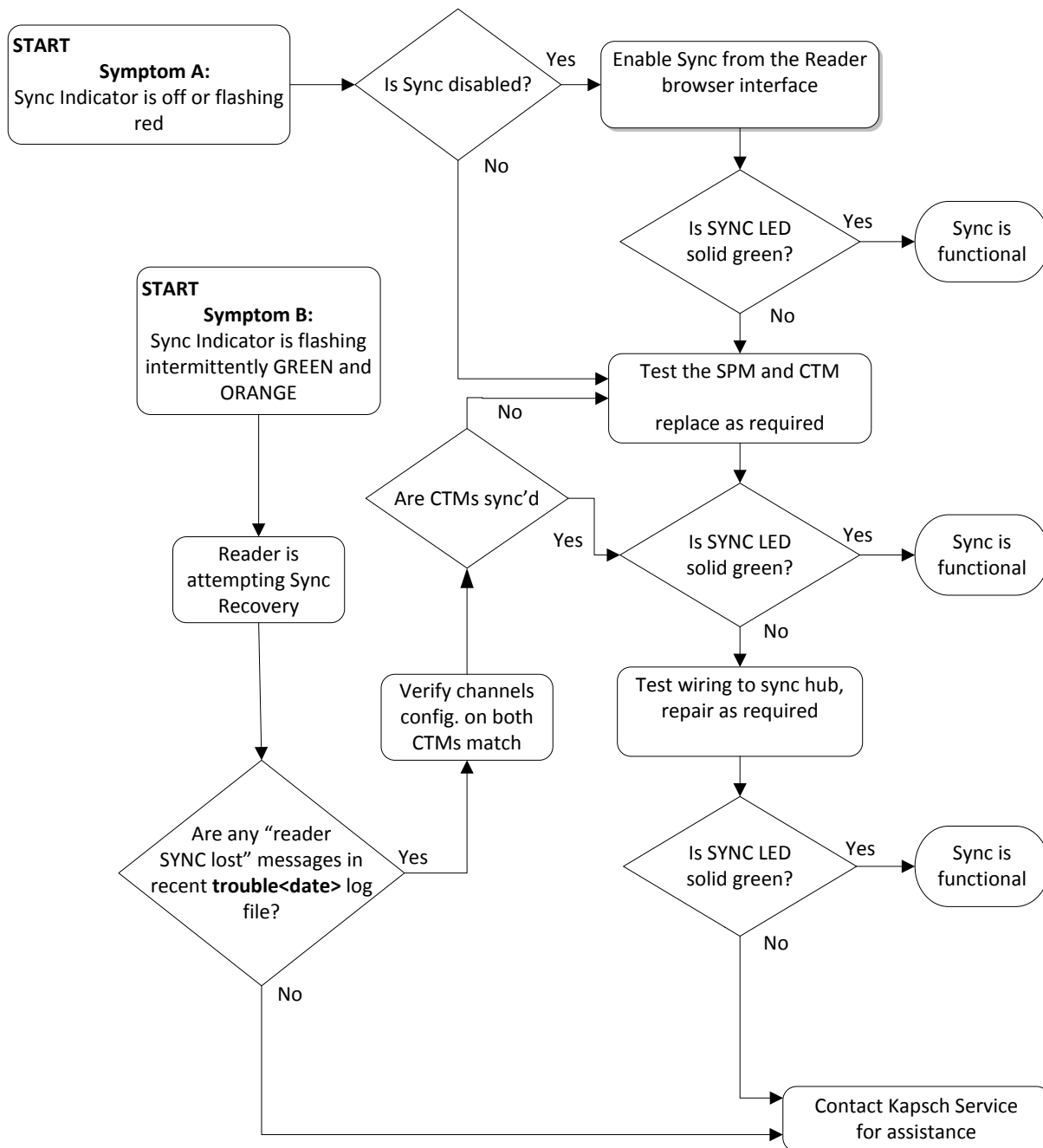
Troubleshooting tree: LC Ethernet 1 Port communications not working

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



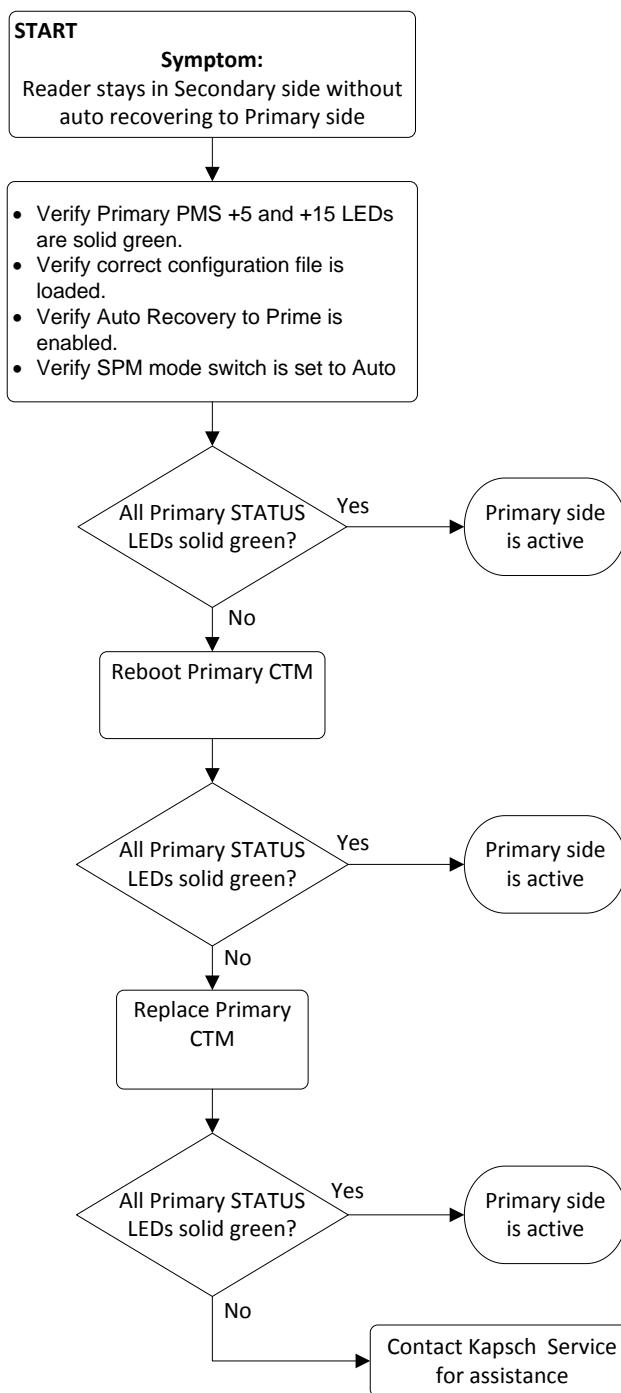
Constant busy state on sync bus

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.

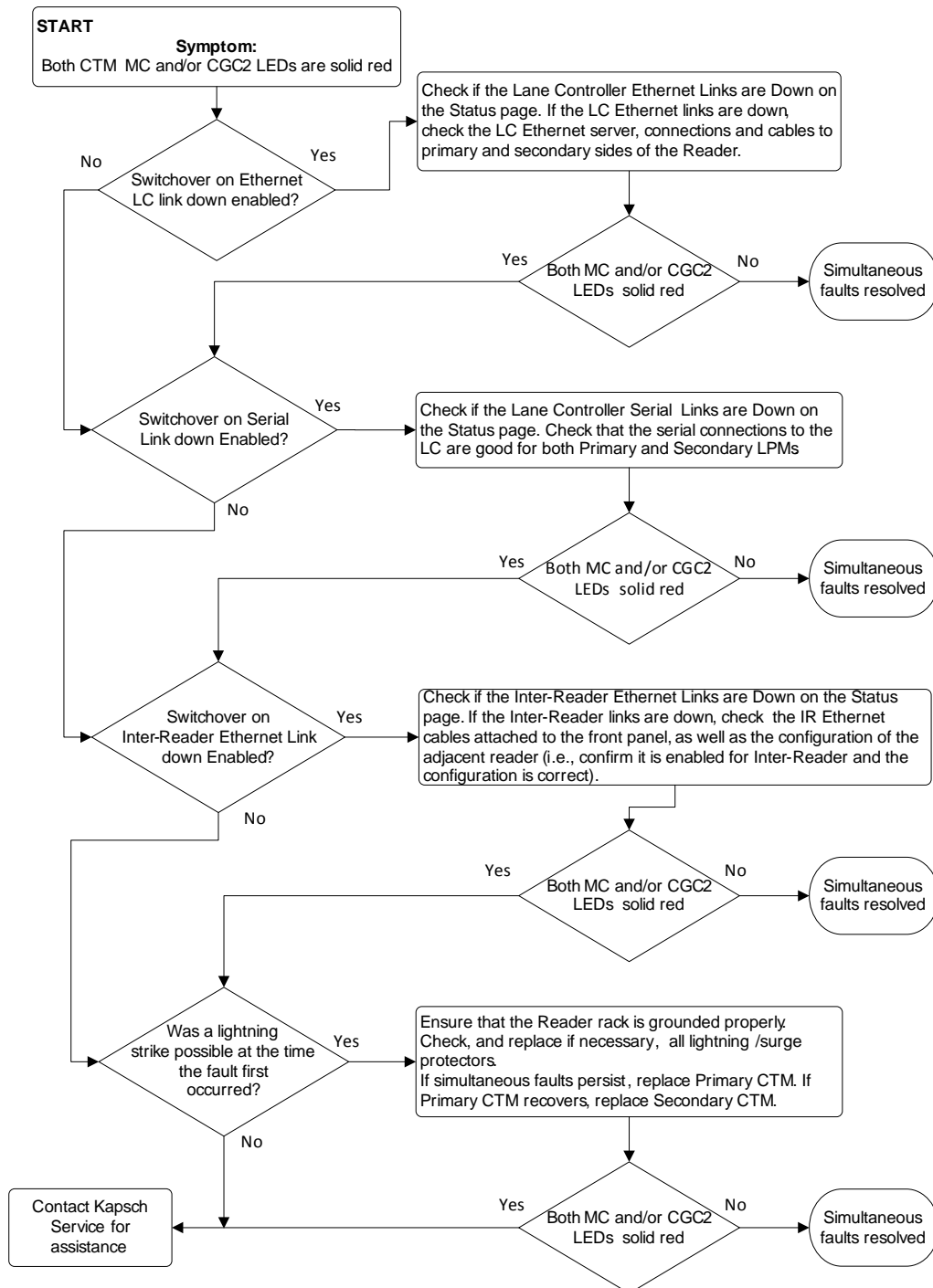
Sync board Failure Indicator for incomplete cable connections

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 |
| 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 General tab on Configuration page</p> <p>Must set LC Retry Timeout from Serial tab on Configuration page</p> <p>Set Heartbeat messages from LC tab on Configuration page</p> |

| Event | Cause | Enabling |
|--------------------------------------|---|--|
| Failed Ethernet Lane Controller Link | The Reader forces a switchover when an enabled Ethernet link has failed. Usually a downed link is due to external conditions. A downed link is detected regardless of whether OBU transactions are being generated or not. | Must enable Switchover on Ethernet LC Link Down from General tab on Configuration page User must set LC Ethernet TCP-socket Timeout from LC tab on the Configuration page |
| 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 Lane Assignment tab on Configuration 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 |
| 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 Configuration from LC tab on Configuration 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 |

| Event | Cause | Enabling |
|------------------|--|---|
| 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 Test Tag tab on the Configuration 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 |

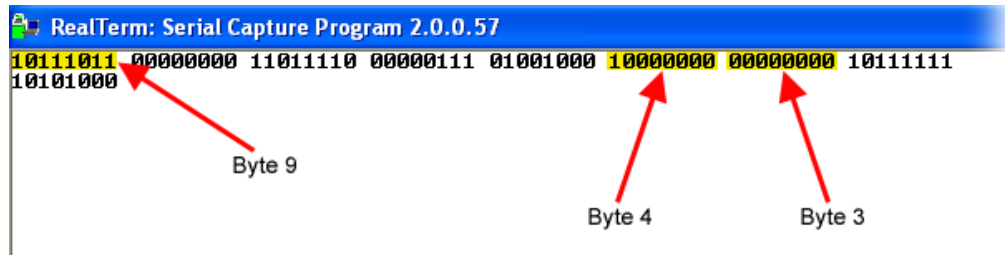
Viewing MRFM fault codes

The MRFM-S sends binary fault codes from its LC COM port as part of a heartbeat message every 5 seconds. These fault codes are Byte 4 and 3 of the heartbeat message and can be viewed on a computer connected to the reader LC COM port.

Prerequisites: A computer equipped with RealTerm (or equivalent).

1. Connect the computer to the MRFM LC COM port using RealTerm (see Using RealTerm to connect to the MRFM, page 261). Data from the MRFM will be visible in the RealTerm window.
2. If several messages appear in the RealTerm program, identify the heartbeat message by identifying Byte 9. The value of Byte 9 is always 10111011.
3. Note the values of Byte 4 and Byte 3. Check Table 6-6 to determine if there is an MRFM fault.

Figure 6-2: Typical MRFM Heartbeat message



| Byte number | Value | Meaning |
|-------------|----------|--|
| Byte 4 | 10000000 | normal lane operation |
| Byte 4 | 10000001 | lane hardware fault |
| Byte 3 | 00000000 | normal lane operation |
| Byte 3 | 00000001 | no activity on backplane control lines |

Table 6-6: MRFM fault codes

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 40).

Ensure that you can access the CTM web interface with the service laptop (see Accessing the CTM web interface, page 41). 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 40. You must have Advanced User permissions.

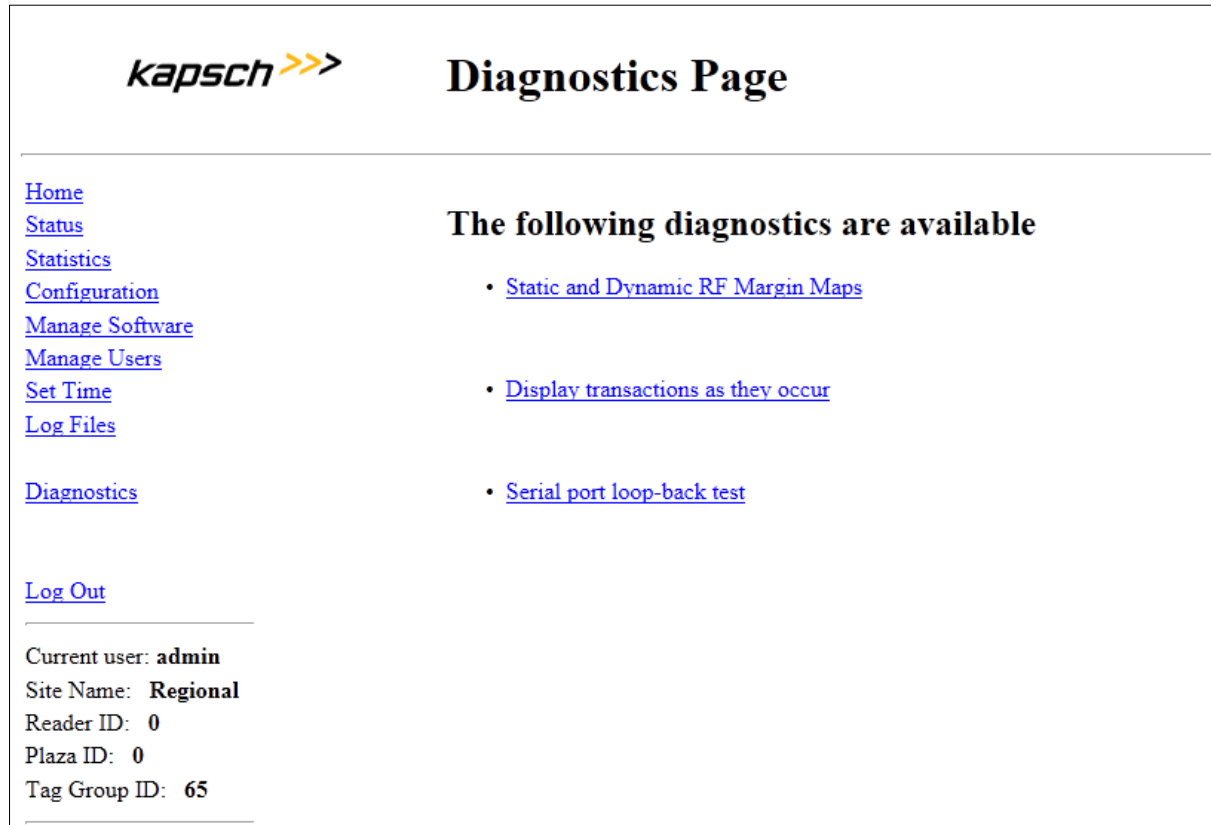
Note: All OBU transactions on this port are buffered while the LC is disconnected from the LPM ports to perform the test.


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 268; the LPM RS-422 pin outs are shown on page 269.
3. Select the **Diagnostics** link on the left side panel of the CTM web interface.

Result: The following screen appears.



Kapsch  **Diagnostics Page**

[Home](#)
[Status](#)
[Statistics](#)
[Configuration](#)
[Manage Software](#)
[Manage Users](#)
[Set Time](#)
[Log Files](#)
[Diagnostics](#)
[Log Out](#)

The following diagnostics are available

- [Static and Dynamic RF Margin Maps](#)
- [Display transactions as they occur](#)
- [Serial port loop-back test](#)

Current user: **admin**
Site Name: **Regional**
Reader ID: **0**
Plaza ID: **0**
Tag Group ID: **65**

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, replace the LPM.

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 are configured the same
- 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 267).
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.

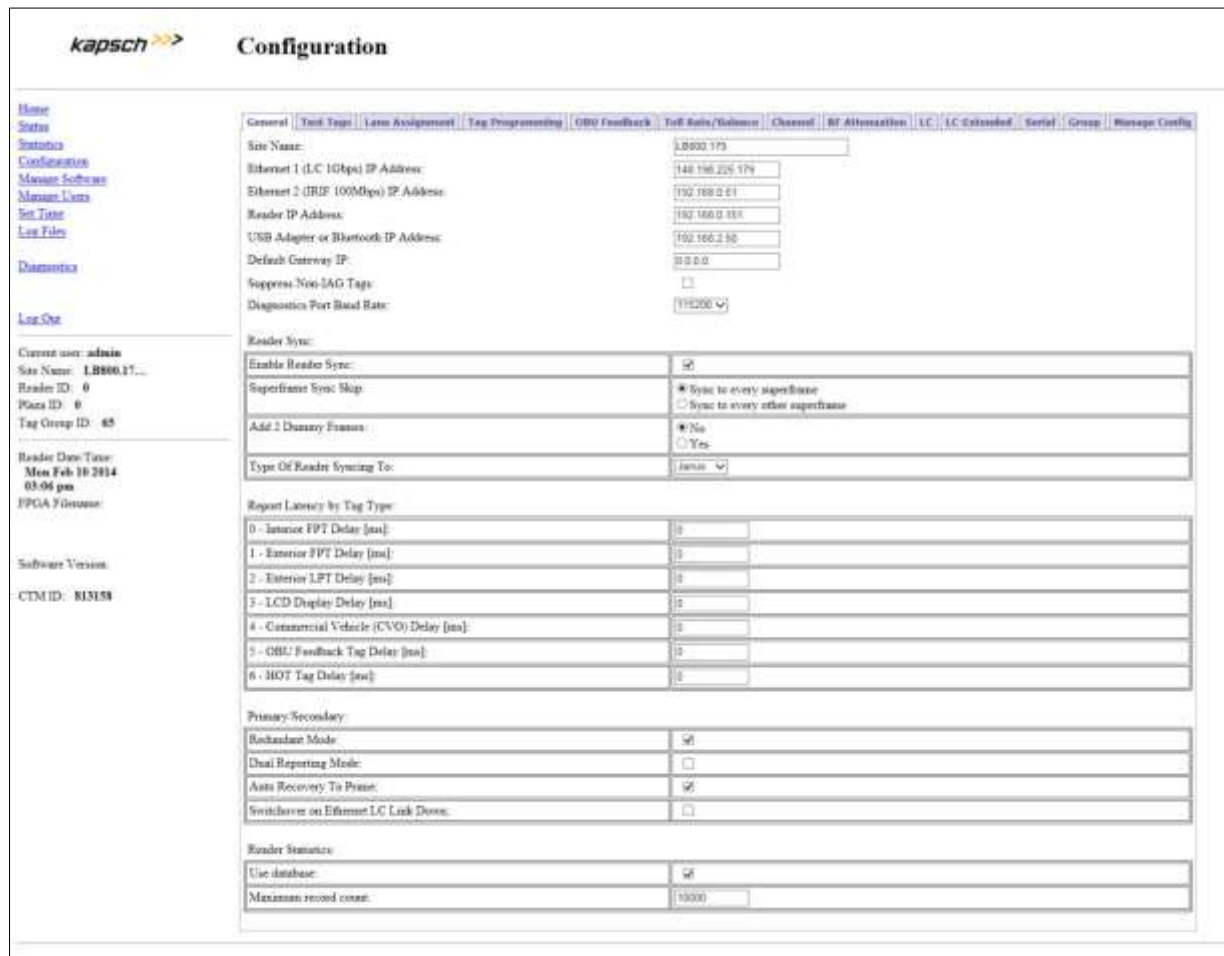
Testing the MRFM-S slots

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 to access the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. One functional MRFM-S is installed in the RF slot 1 of the Reader rack.

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

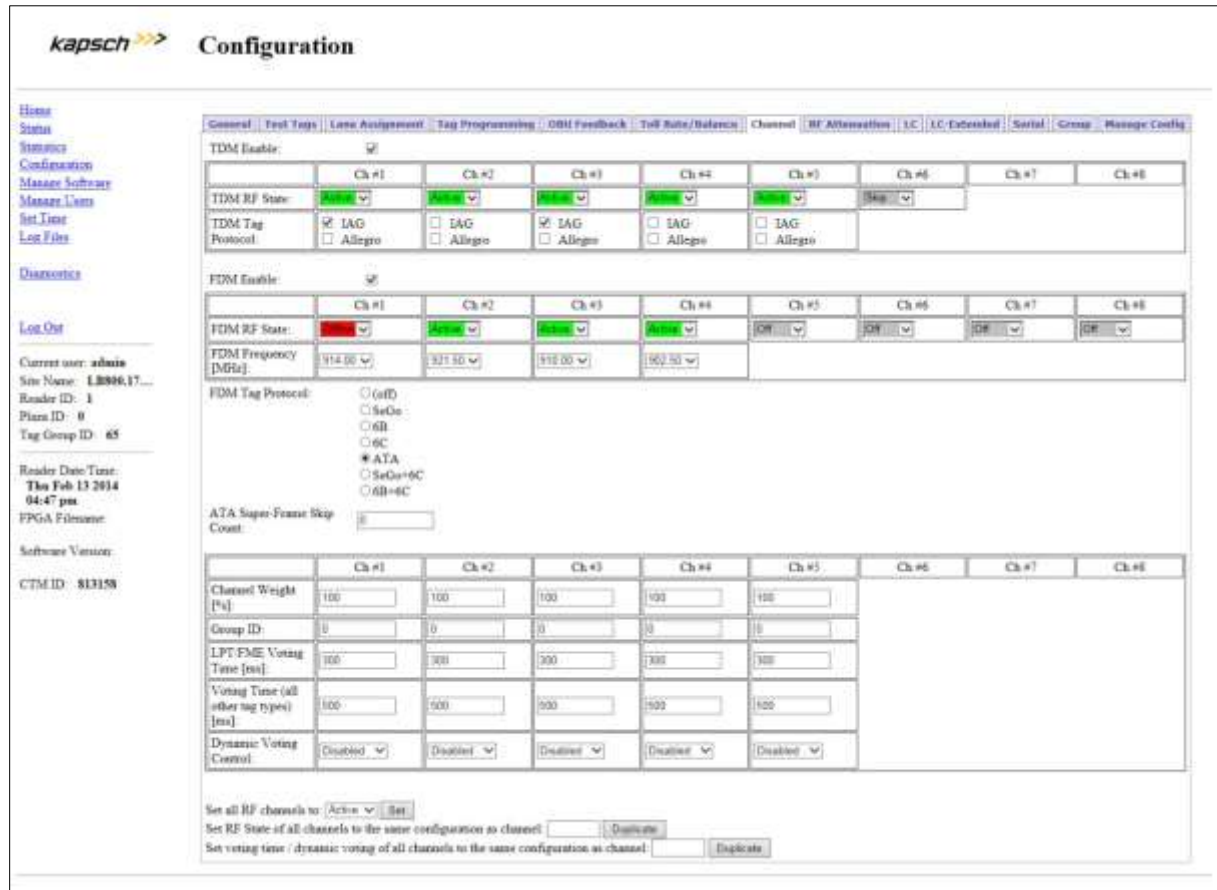
Result: The following screen appears.



The screenshot shows the Kapsch Configuration web interface. The left sidebar contains navigation links: Home, Status, Statistics, Configuration (selected), Message Software, Message Data, Test Time, Log File, Diagnostics, and Log Out. The main content area is titled 'Configuration' and has tabs for General, Test Time, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Balances, Channel, RF Attenuation, L.C., L.C. Extended, Serial, Group, and Message Config. The General tab is active, showing various settings for the reader. On the left, it displays 'Current user: admin', 'Site Name: LB000.17...', 'Reader ID: 0', 'Pana ID: 0', 'Tag Group ID: 45', 'Reader Date/Time: Mon Feb 10 2014 03:06 pm', 'FPGA Firmware', 'Software Version', and 'CTM ID: 83158'. The main settings include: Site Name (LB000.173), Ethernet 1 (GigE 10Gbps) IP Address (148.196.225.179), Ethernet 2 (RJ45 100Mbps) IP Address (192.168.0.61), Reader IP Address (192.168.0.101), USB Adapter or Bluetooth IP Address (192.168.2.50), Default Gateway IP (0.0.0.0), Suppress Non-SAG Tags (unchecked), Diagnostic Port Band Rate (115200), Reader Sync (checked), Enable Reader Sync (checked), Superframe Sync Skip (radio buttons for 'Sync to every superframe' and 'Sync to every other superframe'), Add 2 Dummy Frames (radio buttons for 'No' and 'Yes'), Type Of Reader Syncing To (radio buttons for 'Lane' and 'Tag'), Report Latency by Tag Type (a table with 7 rows for different tag types and their delays), Primary/Secondary (a table with 4 rows for various modes), Reader Statistics (a table with 2 rows for database and maximum record count).

- Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home
Status
Statistics
Configuration
Manage Users
Test Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: 13086.17...
Reader ID: 1
Plan ID: 0
Tag Group ID: 65
Reader Date Time: Thu Feb 13 2014 04:47 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tools | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | **Channel** | RF Attenuation | I.C. | I.C. Extended | Serial | Group | Manage Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|---------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Standby | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--------|--------|--------|--------|---------|---------|---------|---------|
| FDM RF State: | Active | Active | Active | Active | Standby | Standby | Standby | Standby |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 918.00 | 902.50 | | | | |

FDM Tag Protocol:

☐ (off)
☐ SeGo
☐ 6B
☐ 6C
☒ ATA
☐ SeGo+6C
☐ 6B+6C

ATA Super Frame Skip Count:

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID: | 0 | 0 | 0 | 0 | 0 | | | |
| LPT FME Voting Time [ms] | 100 | 300 | 300 | 300 | 300 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 500 | 500 | | | |
| Dynamic Voting Control: | 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:

- Set Ch# (where the RF module is installed) to active and press Enter.
- 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.
- Press **Enter**.
- Ensure that the DATA LED on the RF module is off.
- Move the RF module to the next slot and repeat steps 1 and 6.

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 40).
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 190).

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 4.5 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 40.



WARNING:

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



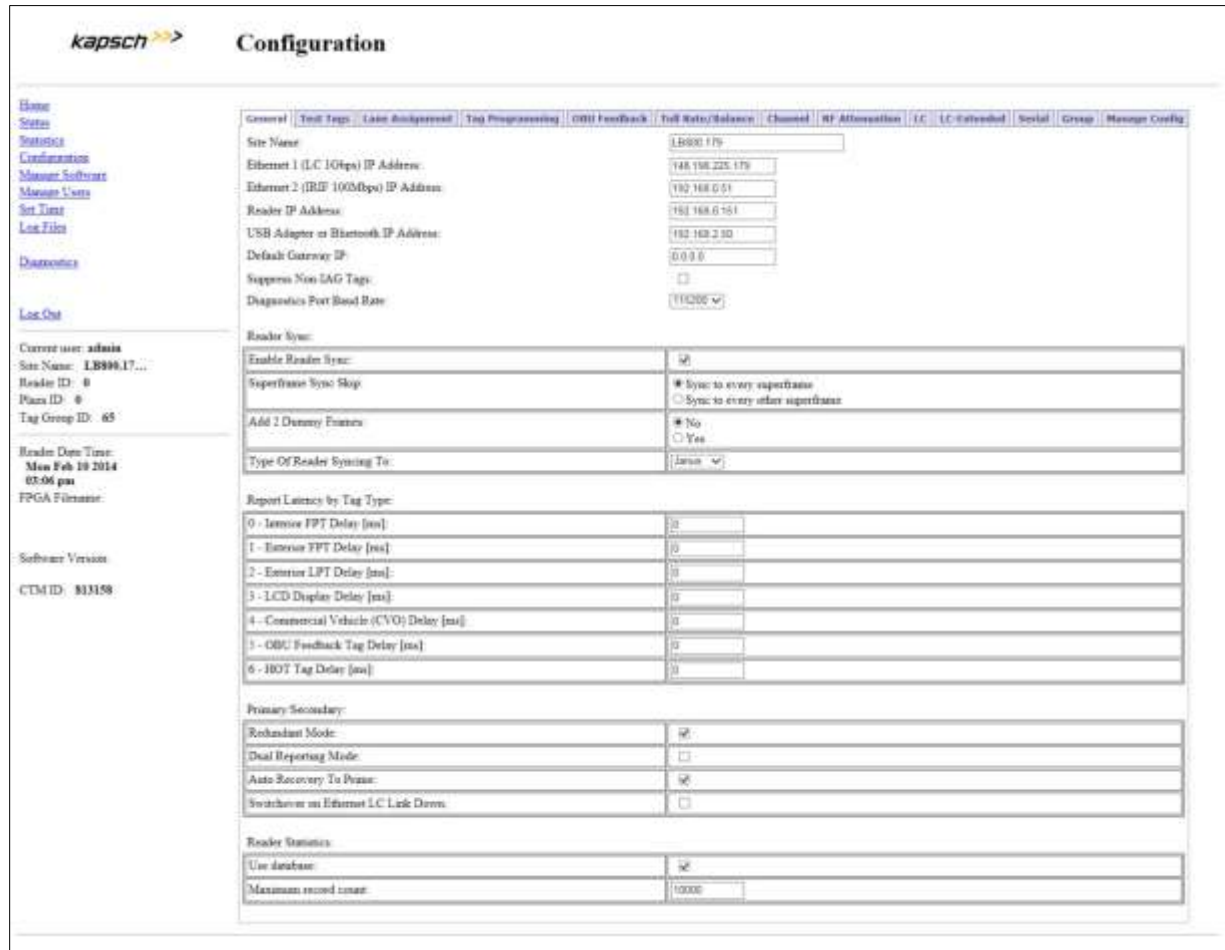
WARNING:

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.

Result: The following screen appears.



Configuration

General | **Test Tags** | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | **Channel** | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Site Name: LB000179

Ethernet 1 (LAN 10Gbps) IP Address: 148.198.225.179

Ethernet 2 (RF 100Mbps) IP Address: 192.168.0.51

Reader IP Address: 192.168.0.51

USB Adapter or Bluetooth IP Address: 192.168.2.30

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☐

Diagnostics Port Band Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Dummy Entries: ☒ No
☐ Yes

Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

| | |
|---|----|
| 0 - Janus FPT Delay [ms] | 10 |
| 1 - Janus FPT Delay [ms] | 10 |
| 2 - Janus LPT Delay [ms] | 10 |
| 3 - LCD Display Delay [ms] | 10 |
| 4 - Commercial Vehicle (CVO) Delay [ms] | 10 |
| 5 - OBU Feedback Tag Delay [ms] | 10 |
| 6 - HOT Tag Delay [ms] | 10 |

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

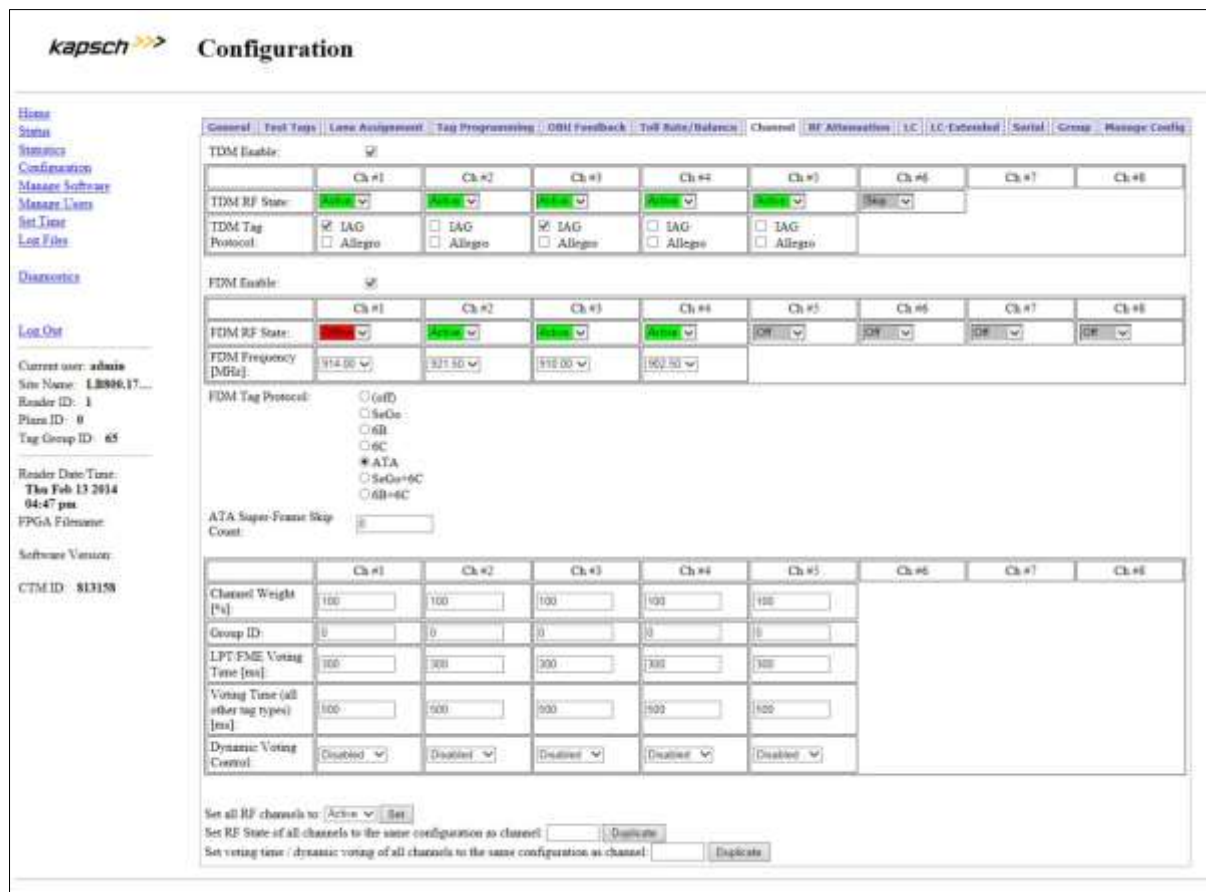
Use database: ☒

Maximum record count: 10000

Current user: admin
Site Name: LB000179...
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65
Reader Date Time: Mon Feb 10 2014 03:06 pm
FPGA Filename:
Software Version:
CTM ID: 813158

- Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home | Status | Instances | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB886.17...
Reader ID: 1
Plane ID: 0
Tag Group ID: 65

Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | DBI Feedback | Toll Rate/Balance | **Channel** | RF Attenuation | I.C. | I.C. Extended | Serial | Cross | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|-------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Stop | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--------|--------|--------|--------|-------|-------|-------|-------|
| FDM RF State: | Active | Active | Active | Active | Stop | Stop | Stop | Stop |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 912.00 | 902.50 | | | | |

FDM Tag Protocol:

☐ (off)
☐ SeGo
☐ 6B
☐ 6C
☒ ATA
☐ SeGo+6C
☐ 6B+6C

ATA Super-Frame Skip Count:

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT FME Voting Time [ms] | 100 | 100 | 100 | 100 | 100 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 100 | 100 | | | |
| Dynamic Voting Control: | 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**.
- Press **Enter** or select a different tab.
- 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

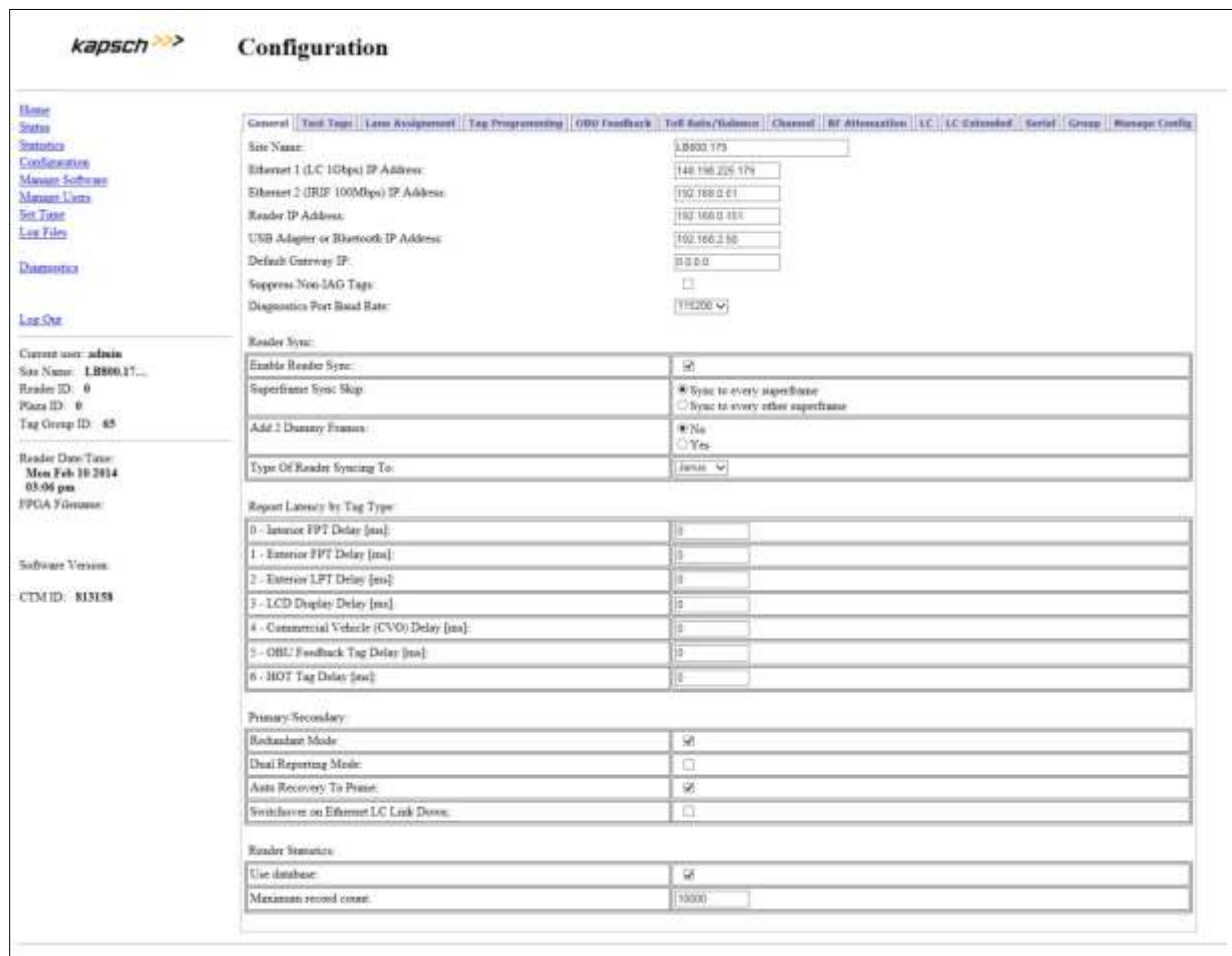


CAUTION:

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.

1. Insert the MRFM-S module into the Reader. Tighten the screws to secure the MRFM-S to the Reader rack.
2. Connect the RF cable(s) to the MRFM-S appropriate port and tighten with a proper torque wrench.
3. Select the **Configuration** link on the left side panel of the CTM web interface.

Result: The following screen appears.



The screenshot shows the 'Configuration' page of the Kapsch TrafficCom web interface. The left sidebar contains links for Home, Status, Statistics, Configuration (selected), Manage Software, Manage Users, Set Time, Log Files, Diagnostics, and Log Out. The main content area has tabs for General, Test Tags, Lane Assignment, Tag Programming, OBU Feedback, Toll Data/Volume, Channel, RF Attenuation, LC, LC Extended, Serial, Group, and Manage Config. The 'General' tab is active, showing fields for Site Name, Ethernet 1 and 2 IP addresses, Reader IP Address, USB Adapter or Bluetooth IP Address, Default Gateway IP, Suppress Non-IAG Tags, and Diagnostic Port Baud Rate. Below these are sections for Reader Sync, Report Latency by Tag Type, Primary/Secondary settings, and Reader Statistics.

4. Click the **Channel** tab.

Result: The following screen appears.

kapsch **Configuration**

Home
Status
Statistics
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: Regional
Reader ID: 0
Pilot ID: 0
Tag Group ID: 65

Reader Data Time:
Thu Jan 31 2013
09:29 pm
FPGA Filename:
A3-0001_saww-MPR2
Software Version:
2013Jan24a-MPR2
CTM ID: 0
FPGA Revcode: 10

General Test Tags Lane Assignment Tag Programming OBU Feedback Toll Rate/Balance Channel LC LC-Extended Serial Group Manage Config

TDM Enable: ☐

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|--|--|---------|-------|-------|-------|-------|-------|
| TDM RF State: | Active | Active | Standby | | | | | |
| TDM Tag Protocol: | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | | | | |

FDM Enable: ☐

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--------|--------|---------|---------|---------|---------|---------|---------|
| FDM RF State: | Active | Active | Standby | Standby | Standby | Standby | Standby | Standby |
| FDM Frequency [MHz]: | 912.56 | 912.56 | 912.56 | 912.56 | 912.56 | 912.56 | 912.56 | 912.56 |

FDM Tag Protocol: ☐ (off)
☐ SeGo
☐ 6B
☐ 6C
☒ ATA
☐ SeGo+6C

ATA Super Frame Skip Count: 0

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|--------|--------|----------|----------|----------|----------|----------|----------|
| 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 | Disabled | Disabled | Disabled | Disabled | Disabled | Disabled |
| Dynamic Voting Sample Size: | 20 | 20 | | | | | | |
| Dynamic Voting Threshold [%] | 20 | 20 | | | | | | |
| Dynamic Voting Capture Zone Span Multiplier: | 2 | 2 | | | | | | |

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:

5. Set the **RF State** of the **Offline** MRFM-S channels back to **Active**.

6. Press **Enter** or select a different tab.

7. 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 197.

8. Verify module output power and power at antenna using a commercial off-the shelf spectrum analyzer

9. Ensure the RF channel is capturing OBU data (see Troubleshooting tree: MRFM-S not working page 197).

Antenna replacement

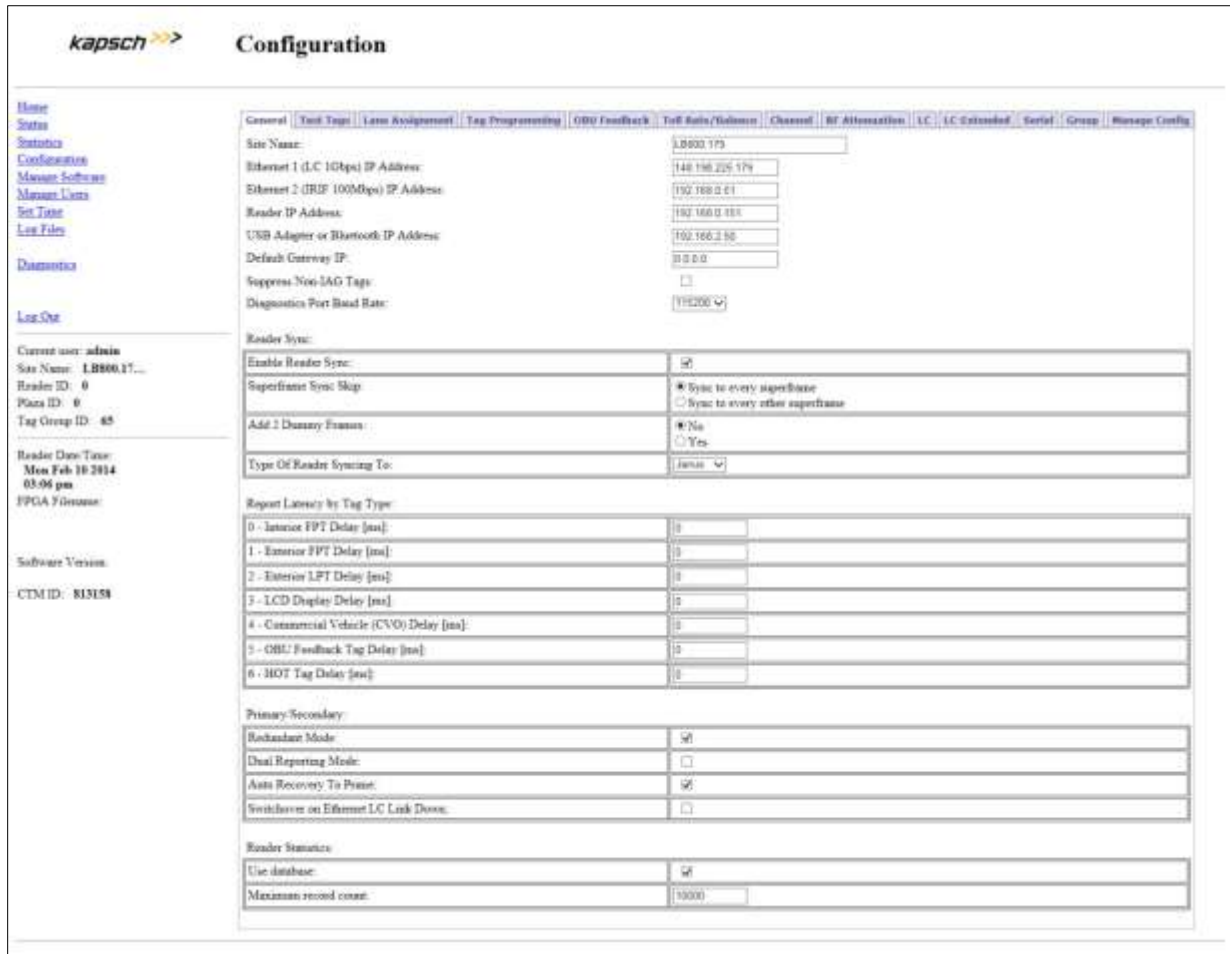
Note: The Reader does not need shutting down to replace an antenna.

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 40.

Removing an antenna

1. Select the **Configuration** link on the left side panel of the CTM web interface.

Result: The following screen appears.



Configuration

Home | Status | Statistics | **Configuration** | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: 18900.175
Reader ID: 0
Place ID: 0
Tag Group ID: 45
Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Data/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18900.175
Ethernet 1 (LC 10Gbps) IP Address: 148.196.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.104
USB Adapter or Bluetooth IP Address: 192.168.2.80
Default Gateway IP: 0.0.0.0
Suppress Non-LAG Tags: ☐
Diagnostic Port Baud Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Stop: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

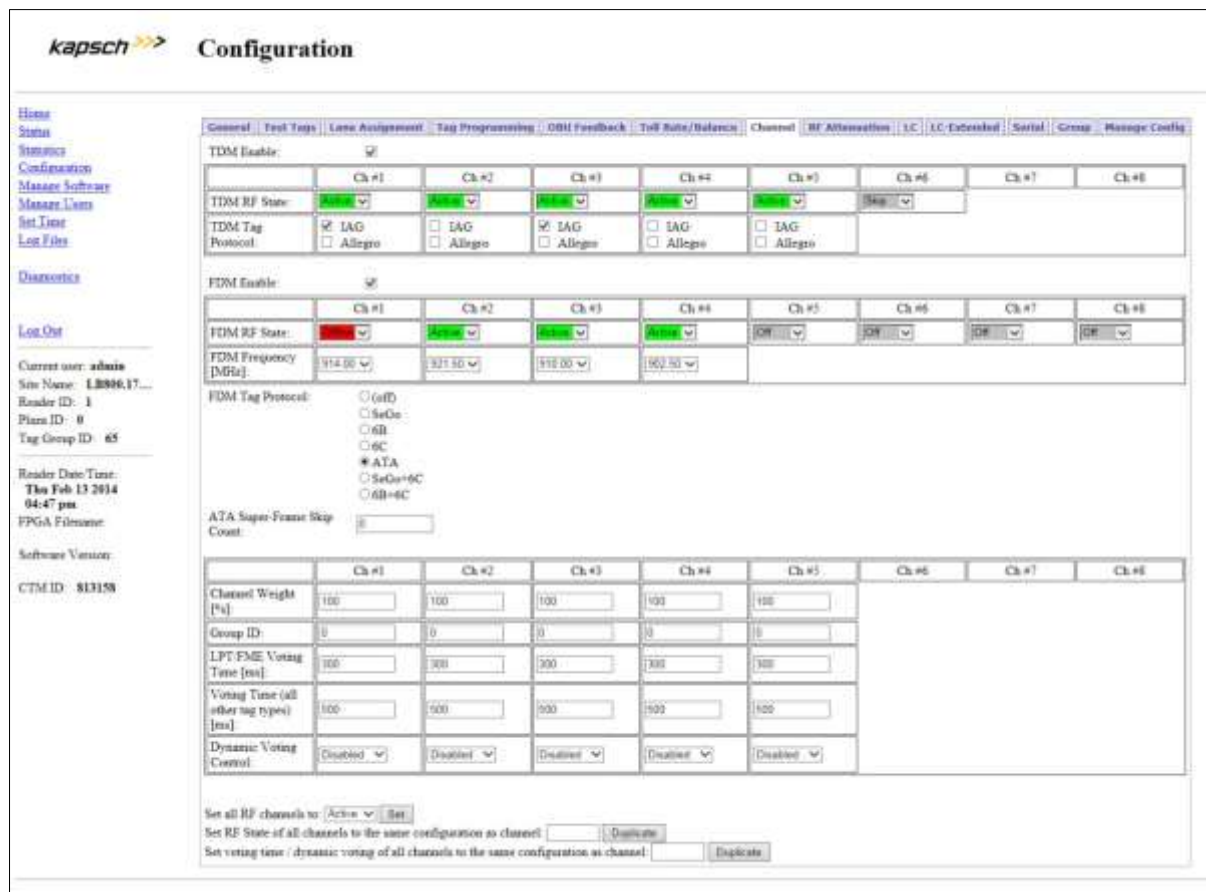
Report Latency by Tag Type:
0 - Interior FPT Delay [ms]: 0
1 - Exterior FPT Delay [ms]: 0
2 - Exterior LPT Delay [ms]: 0
3 - LCD Display Delay [ms]: 0
4 - Commercial Vehicle (CV0) Delay [ms]: 0
5 - GBU Feedback Tag Delay [ms]: 0
6 - HOT Tag Delay [ms]: 0

Primary/Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:
Use database: ☒
Maximum record count: 10000

2. Click the **Channel** tab.

Result: The following screen appears.

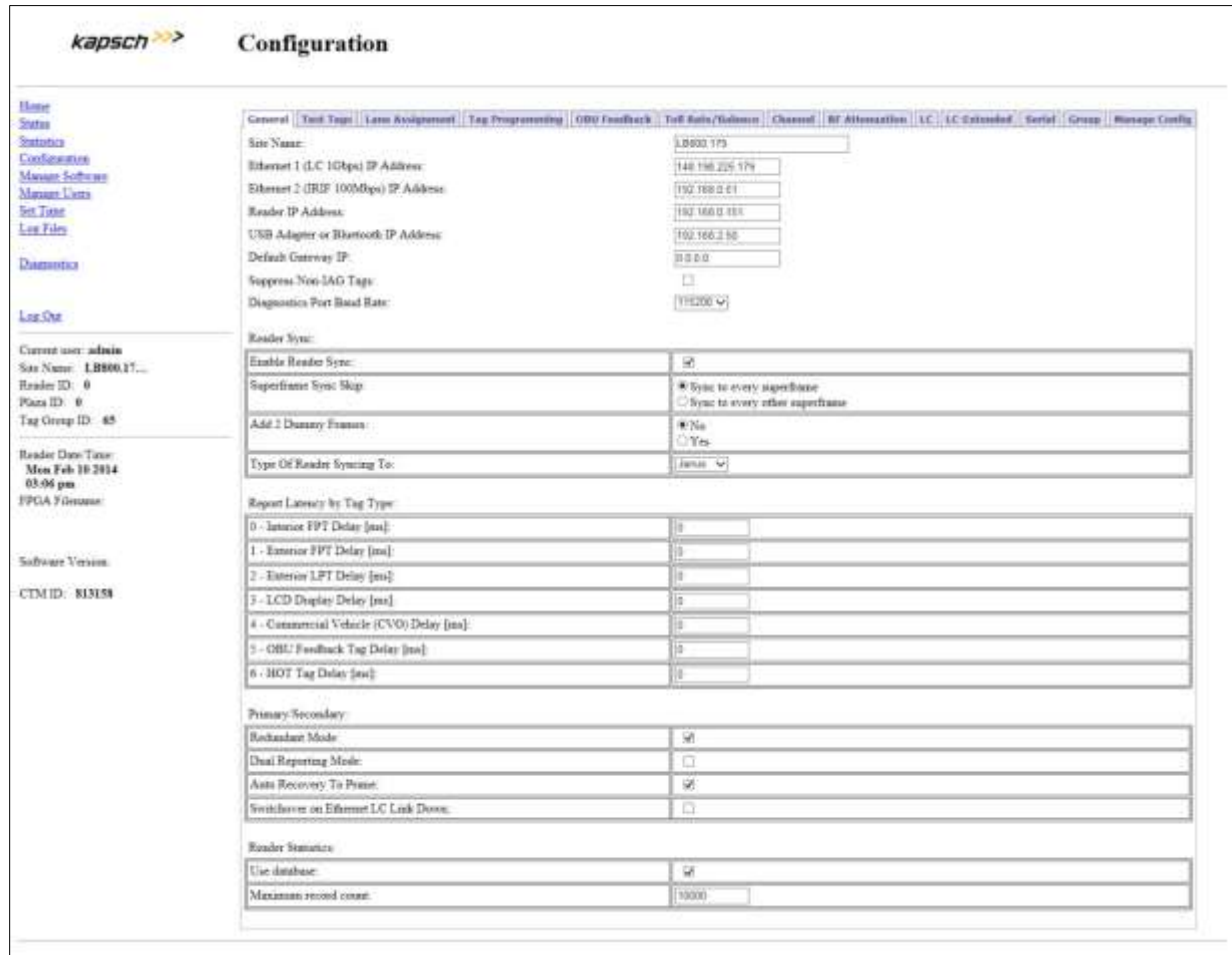


3. Set the **RF State** of the MRFM-S connected to the antenna to **Offline**.
4. Press **Enter** or select a different tab.
5. Remove the antenna.

Installing an antenna

1. Install the antenna (see Installing an Antenna, page 149).
2. Select the **Configuration** link on the left side panel of the CTM web interface.

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18900.179

Ethernet 1 (LC 10Gbps) IP Address: 148.198.225.179

Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01

Reader IP Address: 192.168.0.101

USB Adapter or Bluetooth IP Address: 192.168.0.80

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Mode: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Channel Frames: ☒ No
☐ Yes

Type Of Reader Syncing To:

Report Latency by Tag Type:

0 - Interior EPT Delay [ms]:

1 - Exterior EPT Delay [ms]:

2 - Exterior LPT Delay [ms]:

3 - LCD Display Delay [ms]:

4 - Commercial Vehicle (CVO) Delay [ms]:

5 - GBU/ Feedback Tag Delay [ms]:

6 - HOT Tag Delay [ms]:

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count:

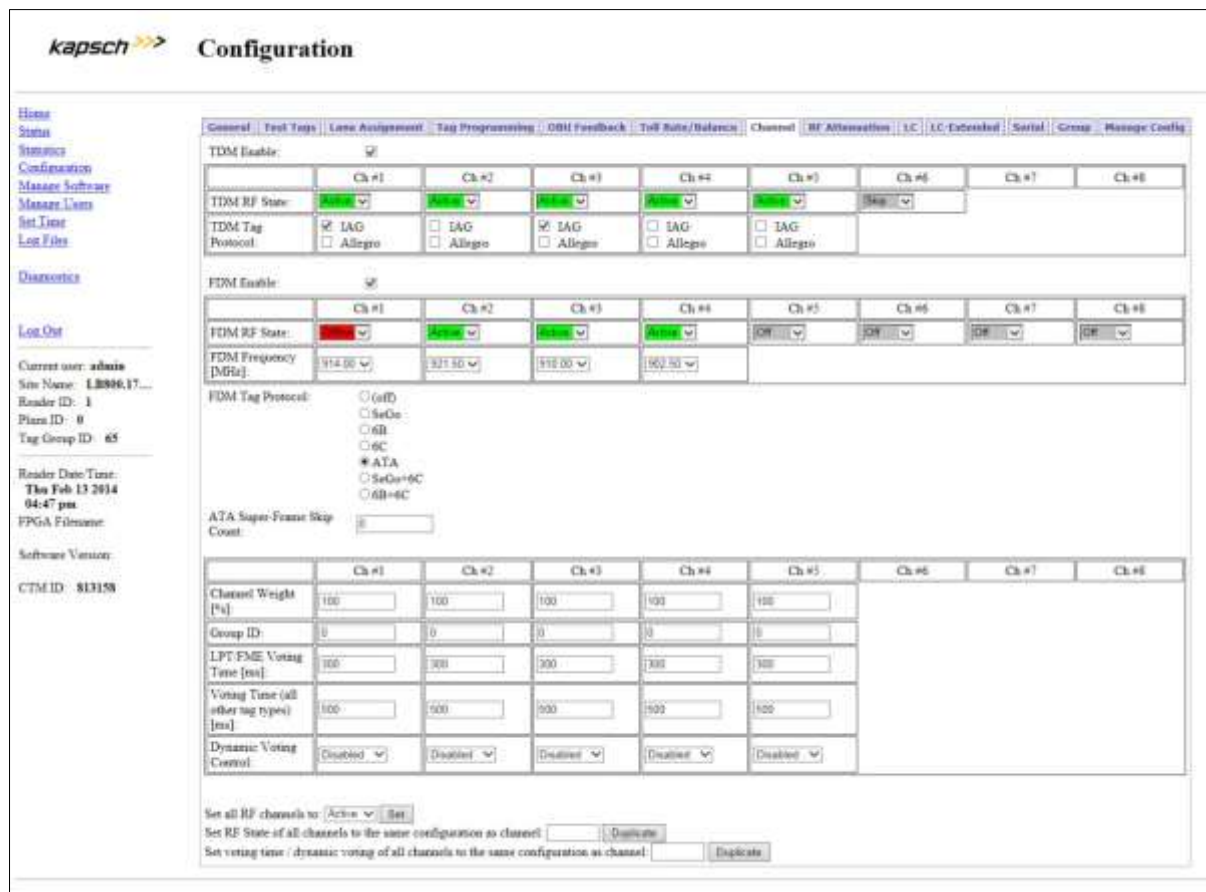
Current user: admin
Site Name: 18900.17...
Reader ID: 0
Plaza ID: 0
Tag Group ID: 85

Reader Date/Time:
Mon Feb 10 2014
03:06 pm
PPGA Firmware:

Software Version:
CTM ID: 813158

- Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home
Status
Instances
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: LB886.17...
Reader ID: 1
Plane ID: 0
Tag Group ID: 65
Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | L.C. | L.C. Extended | Serial | Cross | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|-------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Off | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--|--------|--------|--------|-------|-------|-------|-------|
| FDM RF State: | Offline | Active | Active | Active | Off | Off | Off | Off |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 912.00 | 902.50 | | | | |
| FDM Tag Protocol: | <input type="radio"/> offD <input type="radio"/> SeGo <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGo+6C <input type="radio"/> 6B+6C | | | | | | | |

ATA Super-Frame Skip Count:

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT FME Voting Time [ms] | 100 | 100 | 100 | 100 | 100 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 100 | 100 | | | |
| Dynamic Voting Control: | 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:

- Set the **Offline MRFM-S RF State** back to **Active**.
- Press **Enter**.
- Verify 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 (see Monitoring OBU transactions as they occur via the Diagnostics page, page 58).

RF cable or connector replacement

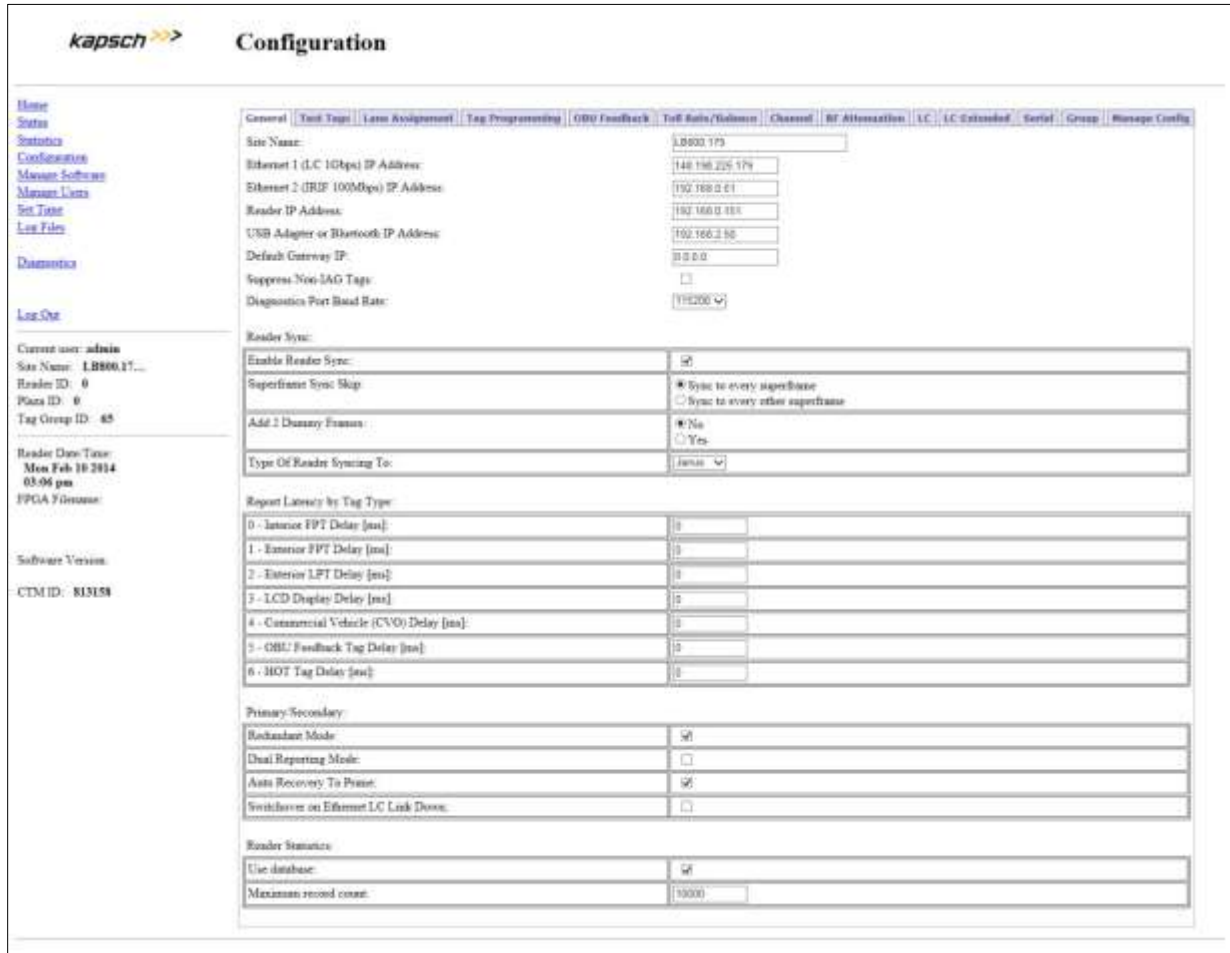
Note: The Reader does not need shutting down to replace an RF cable or connector.

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.

Result: The following screen appears.



Configuration

Home | Status | Statistics | **Configuration** | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB800.17...
Reader ID: 0
Polar ID: 0
Tag Group ID: 85
Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Version:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Data/Balances | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Site Name: LB800.175
Ethernet 1 (LC 10Gbps) IP Address: 148.198.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.61
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: ☐
Diagnostic Port Baud Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Map: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

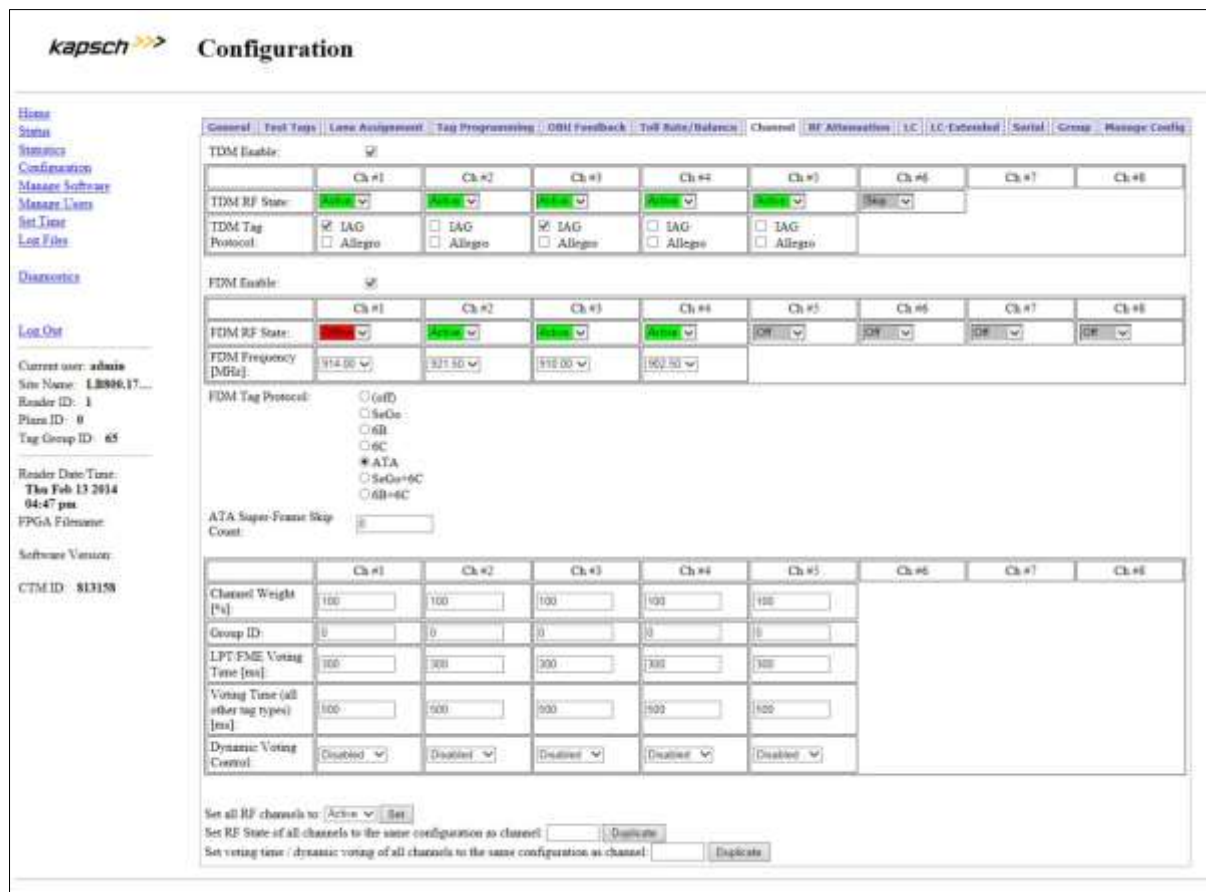
| | |
|---|---|
| 0 - Interior EPT Delay [ms] | 0 |
| 1 - Exterior EPT Delay [ms] | 0 |
| 2 - Exterior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CVO) Delay [ms] | 0 |
| 5 - OBU Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:
Use database: ☒
Maximum record count: 10000

2. Click the **Channel** tab.

Result: The following screen appears.



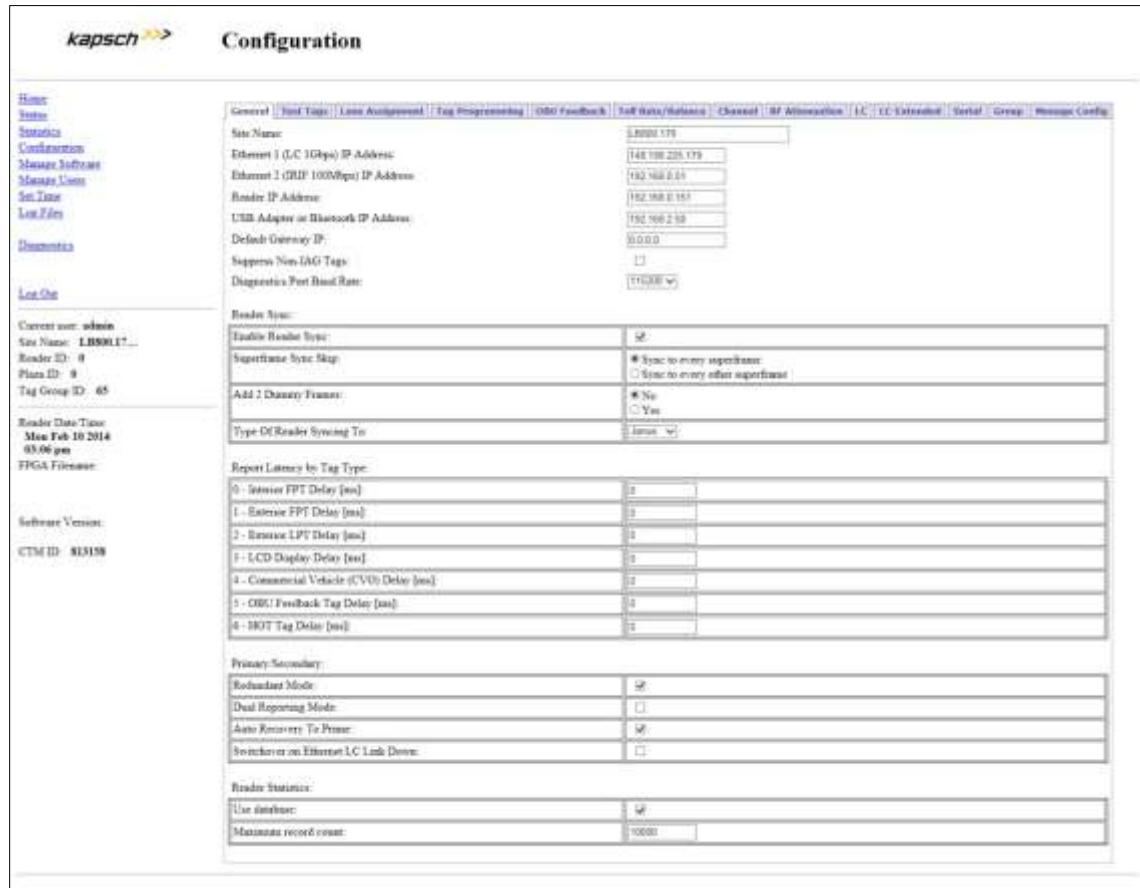
3. Set the **RF State** of the MRFM-S whose cable or connector is being replaced to **Offline**.
4. Press **Enter**.
5. Remove the RF cables or connectors.

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 40.

1. Install the RF cables or connectors.
2. Apply new self-amalgamating tape to the connections.
3. Select the **Configuration** link on the left side panel of the CTM web interface.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Message Software | Message User | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LRS0017
Reader ID: 0
Plant ID: 0
Tag Group ID: 65
Reader Data Time: Mon Feb 10 2014 03:06 pm
RTGA Filename:
Software Version:
CTM ID: 813198

General | Host Tags | Lane Assignment | Tag Programming | OBU Feedback | Self Data/Status | Channel | RF Attenuation | LC | LC Extension | Serial | Group | Message Config

Site Name: LRS0017
Ethernet 1 (LC 1Gbps) IP Address: 148.198.225.179
Ethernet 2 (RDP 100Mbps) IP Address: 192.168.2.15
Reader IP Address: 192.168.2.155
USB Adapter (as Bluetooth IP Address): 192.168.2.18
Default Gateway IP: 0.0.0.0
Suppress Non-DAG Tags: ☐
Diagnostics Port Band Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Supersync Sync Skip: ☒ Sync to every supersync ☐ Sync to every other supersync
Add 2 Channel Frames: ☒ No ☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

| | |
|---|---|
| 0 - Station FRT Delay (ms) | 0 |
| 1 - Entrance FRT Delay (ms) | 0 |
| 2 - Entrance LPT Delay (ms) | 0 |
| 3 - LCD Display Delay (ms) | 0 |
| 4 - Commercial Vehicle (CVU) Delay (ms) | 0 |
| 5 - OBU Feedback Tag Delay (ms) | 0 |
| 6 - HOT Tag Delay (ms) | 0 |

Primary/Secondary:

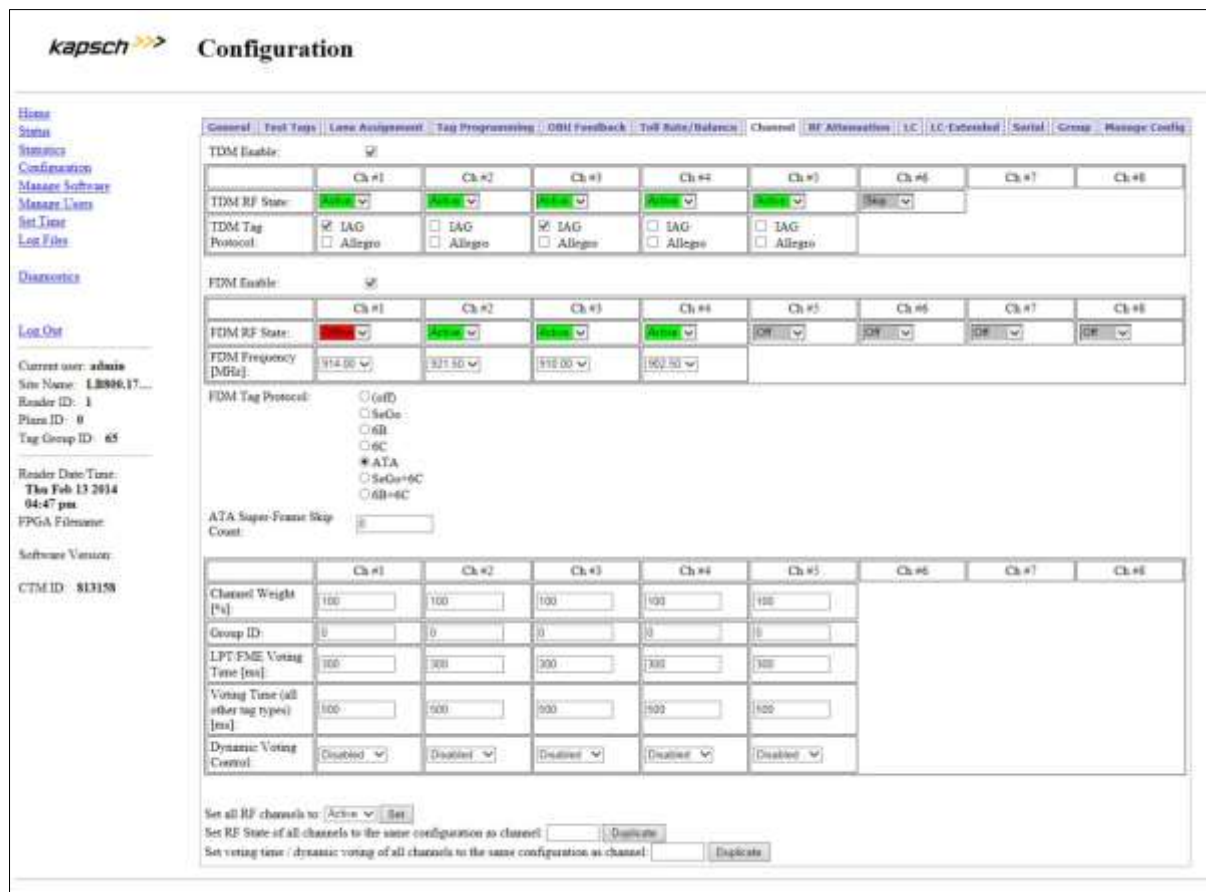
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Primer: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use Simulac: ☒
Maximum record count: 10000

4. Click the **Channel** tab.

Result: The following screen appears.



Configuration

Home | Status | Instances | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB886.17...
Reader ID: 1
Plane ID: 0
Tag Group ID: 65
Reader Date/Time: Thu Feb 13 2014 04:47 pm
FPGA Filename:
Software Version:
CTM ID: 813158

General | Test Tools | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Cross | Message Config

TDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------|---|--|---|--|--|-------|-------|-------|
| TDM RF State: | Active | Active | Active | Active | Active | Stop | | |
| TDM Tag Protocol: | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input checked="" type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | <input type="checkbox"/> IAG <input type="checkbox"/> Allegro | | | |

FDM Enable: ☒

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|----------------------|--|--------|--------|--------|-------|-------|-------|-------|
| FDM RF State: | Active | Active | Active | Active | Stop | Stop | Stop | Stop |
| FDM Frequency [MHz]: | 914.00 | 921.50 | 912.00 | 902.50 | | | | |
| FDM Tag Protocol: | <input type="radio"/> offD <input type="radio"/> SeGo <input type="radio"/> 6B <input type="radio"/> 6C <input checked="" type="radio"/> ATA <input type="radio"/> SeGo+6C <input type="radio"/> 6B+6C | | | | | | | |

ATA Super-Frame Skip Count:

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|--|----------|----------|----------|----------|----------|-------|-------|-------|
| Channel Weight [%] | 100 | 100 | 100 | 100 | 100 | | | |
| Group ID | 0 | 0 | 0 | 0 | 0 | | | |
| LPT FME Voting Time [ms] | 100 | 100 | 100 | 100 | 100 | | | |
| Voting Time (all other tag types) [ms] | 100 | 500 | 500 | 100 | 100 | | | |
| Dynamic Voting Control: | 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 **Offline MRFM-S RF State** back to **Active**.
- Press **Enter**.
- 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 (see Monitoring OBU transactions as they occur via the Diagnostics page, page 58).

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 40).
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 40).
5. If the CTM is in an IR network, reboot the CTM (see Rebooting the CTM, page 230).

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 207).

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 40).
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 40).
3. Test all the LPM COM ports (see Testing an LPM COM port, page 207).

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 40).
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 (see Manually switching a Reader to the redundant side, page 39).

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 243).
2. Remove the CTM on the side of the faulty CFM (see CTM, page 224).
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 224).
3. Load the configuration file saved in step 1 to the new CFM (see Uploading a saved configuration, page 246), 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.

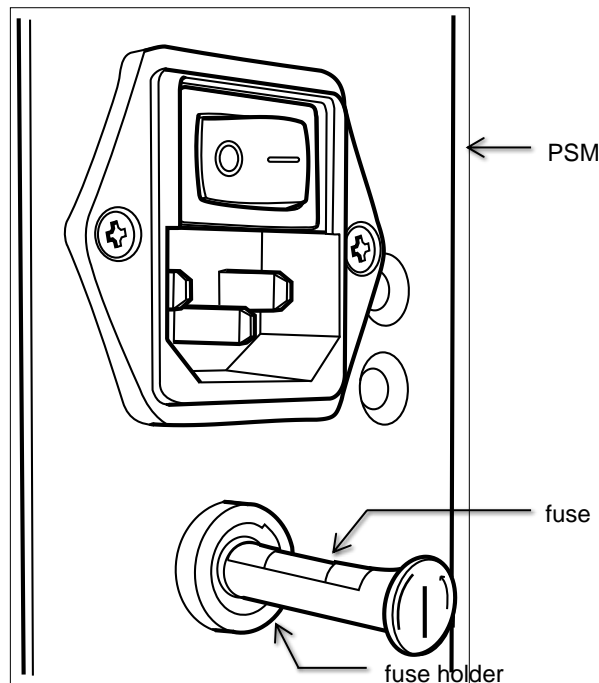


Figure 7-1: PSM fuse and fuse holder

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 **Software Management** 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 192).

Rebooting from the browser interface

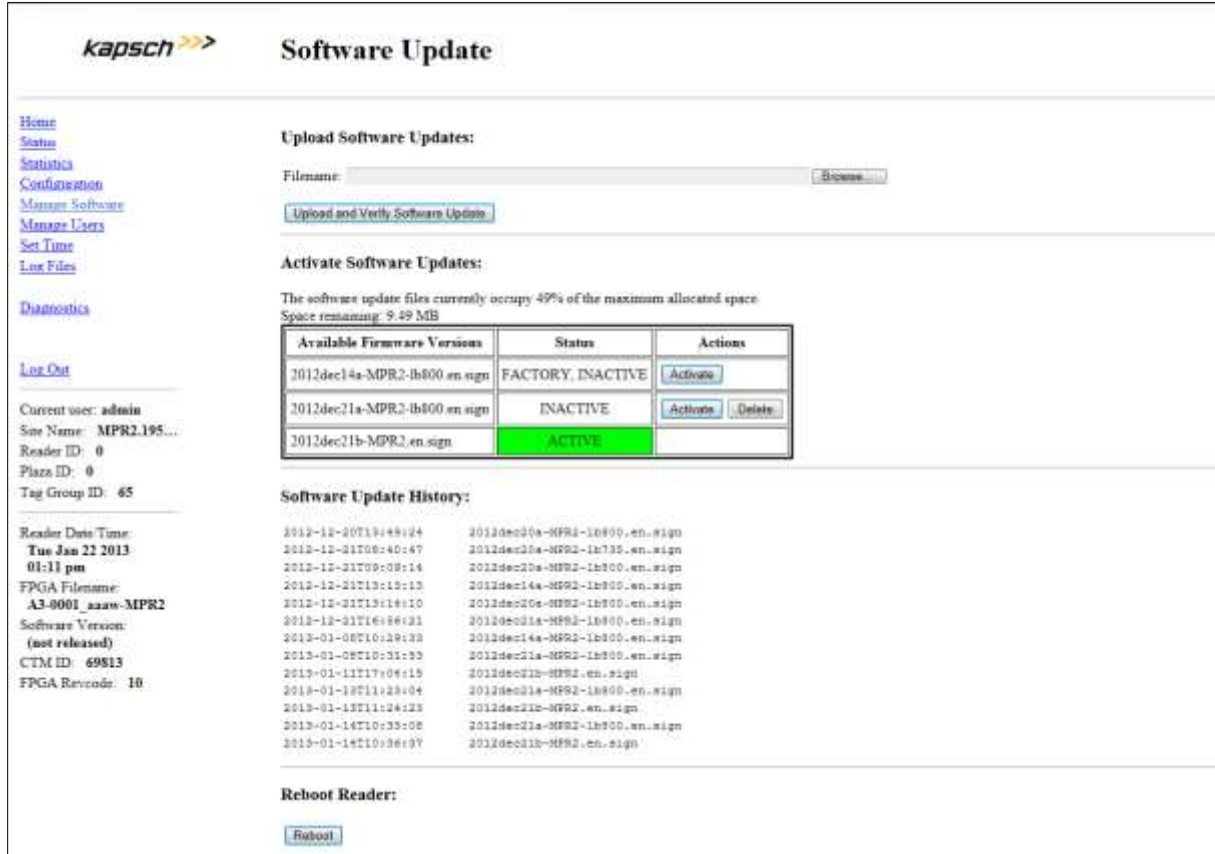
1. Login to the CTM web Interface.

Result: The following **Main Page** appears.



2. Select the **Manage Software** link on the left side panel of the CTM web interface.

Result: The following screen appears.



Software Update

Home
Status
Statistics
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: admin
Site Name: MPR2.195...
Reader ID: 0
Place ID: 0
Tag Group ID: 65

Reader Data Time:
Tue Jan 22 2013
01:11 pm
FPGA Filename:
A3-0001_aaa-MPR2
Software Version:
(not released)
CTM ID: 69813
FPGA Revcode: 10

Upload Software Updates:

Filename:

Activate Software Updates:

The software update files currently occupy 49% of the maximum allocated space.
Space remaining: 9.49 MB

| Available Firmware Versions | Status | Actions |
|-------------------------------|-------------------|---|
| 2012dec14a-MPR2-1b000.en.sign | FACTORY, INACTIVE | <input type="button" value="Activate"/> |
| 2012dec21a-MPR2-1b000.en.sign | INACTIVE | <input type="button" value="Activate"/> <input type="button" value="Delete"/> |
| 2012dec21b-MPR2.en.sign | ACTIVE | |

Software Update History:

| | |
|---------------------|-------------------------------|
| 2012-12-20T19:48:24 | 2012dec20a-MPR2-1b000.en.sign |
| 2012-12-21T08:40:47 | 2012dec20a-MPR2-1b735.en.sign |
| 2012-12-21T09:08:14 | 2012dec20a-MPR2-1b700.en.sign |
| 2012-12-21T13:13:13 | 2012dec14a-MPR2-1b000.en.sign |
| 2012-12-21T13:18:10 | 2012dec20a-MPR2-1b000.en.sign |
| 2012-12-21T16:56:21 | 2012dec21a-MPR2-1b000.en.sign |
| 2012-01-08T10:29:33 | 2012dec14a-MPR2-1b000.en.sign |
| 2012-01-08T10:31:03 | 2012dec21a-MPR2-1b000.en.sign |
| 2012-01-11T17:06:15 | 2012dec21b-MPR2.en.sign |
| 2012-01-13T11:23:04 | 2012dec21a-MPR2-1b000.en.sign |
| 2012-01-13T11:24:23 | 2012dec21b-MPR2.en.sign |
| 2012-01-14T10:35:08 | 2012dec21a-MPR2-1b000.en.sign |
| 2012-01-14T10:36:09 | 2012dec21b-MPR2.en.sign |

Reboot Reader:

3. 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 automatically over when an LC link is down

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

Result: The following screen appears.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Release | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Site Name: LB000 178

Ethernet 1 (LC 10Mbps) IP Address: 145.198.225.179

Ethernet 2 (IRIF 100Mbps) IP Address: 192.168.0.01

Reader IP Address: 192.168.0.101

USB Adapter or Bluetooth IP Address: 192.168.2.00

Default Gateway IP: 0.0.0.0

Suppress Non-SAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Dummy Frames: ☒ No
☐ Yes

Type Of Reader Syncing To: Serial

Report Latency by Tag Type:

0 - Interior FPF Delay (ms): 0

1 - Exterior FPF Delay (ms): 0

2 - Exterior LPT Delay (ms): 0

3 - LCD Display Delay (ms): 0

4 - Commercial Vehicle (CVU) Delay (ms): 0

5 - OBU Feedback Tag Delay (ms): 0

6 - HOT Tag Delay (ms): 0

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switches on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count: 10000

Current user: admin

Site Name: LB000.17...

Reader ID: 0

Plant ID: 0

Tag Group ID: 65

Reader Date/Time: Mon Feb 10 2014 05:06 pm

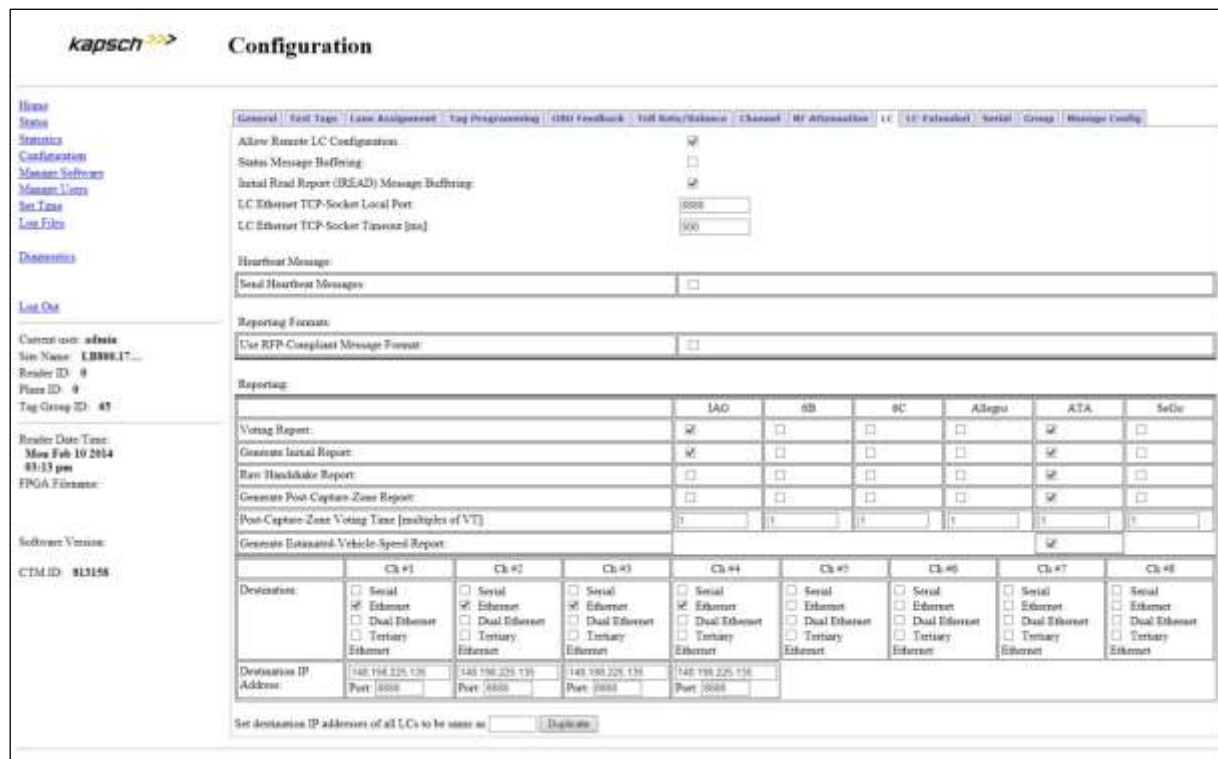
FPGA Firmware:

Software Version:

CTMID: 013158

- Click the **LC** tab.

Result: The following screen appears.



Configuration

Home | Status | Statistics | Configuration | Message Software | Message Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
 Site Name: LB000.17...
 Reader ID: 0
 Plant ID: 0
 Tag Group ID: 05

Reader Date/Time:
 Mon Feb 10 2014
 03:13 pm
 FPGA Firmware:

Software Version:
 CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | ORF Feedback | Toll Rate Balance | Channel | RF Attenuation | LC | 12-Extender | Serial | Group | Message Config

Allow Remote LC Configuration: ☒
 Status Message Buffering: ☐
 Initial Read Report (IRREAD) Message Buffering: ☒
 LC Ethernet TCP-Socket Local Port: 8088
 LC Ethernet TCP-Socket Timeout [ms]: 500

Heartbeat Message:
 Send Heartbeat Messages: ☐

Reporting Format:
 Use RFP-Compliant Message Format: ☐

Reporting:

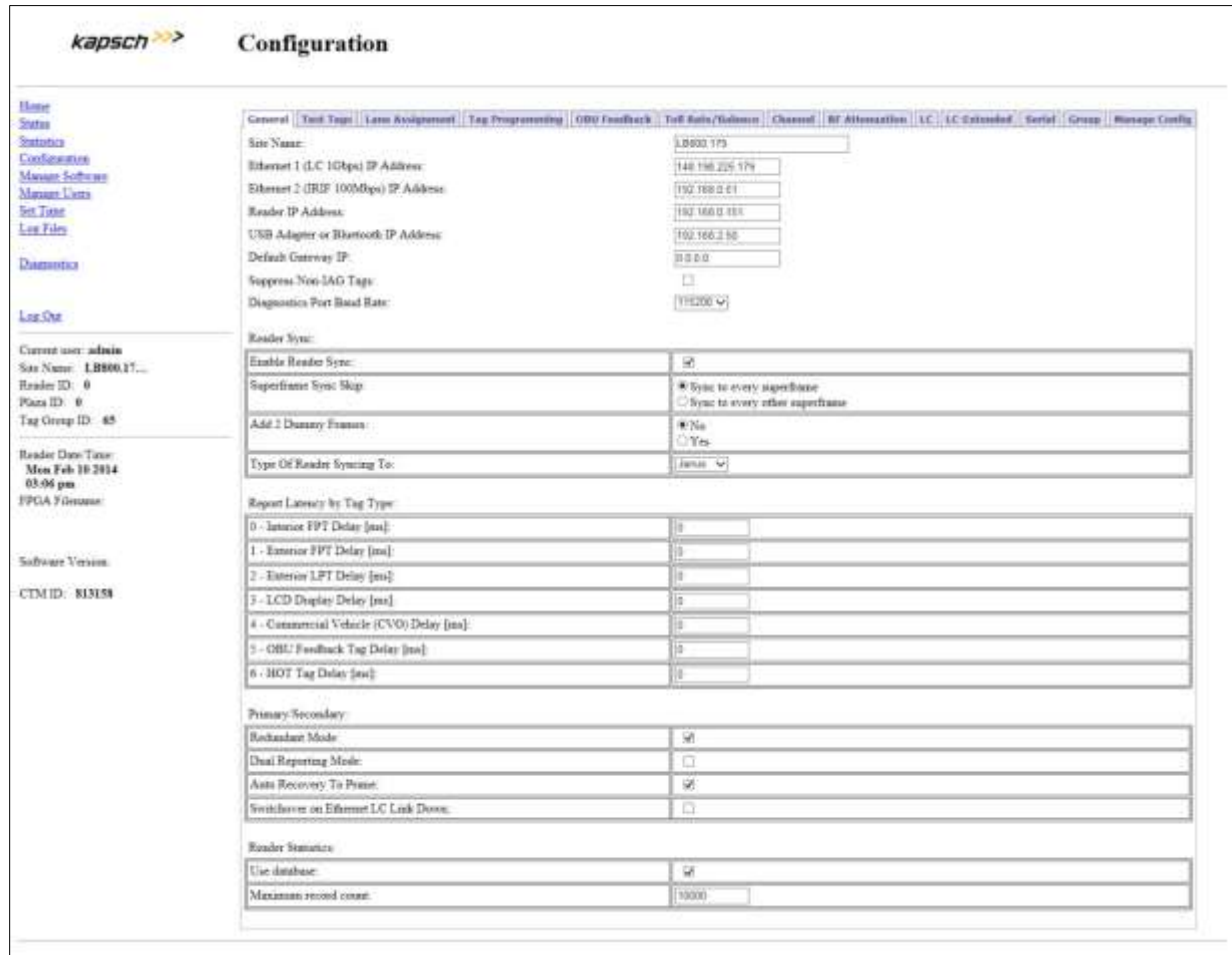
| | LAG | GB | BC | Allegro | ATA | SeGo |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|
| Voting Report: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Initial Report: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Raw Blackbox Report: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Generate Post-Capture-Zone Report: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Post-Capture-Zone Voting Time [multiples of VT]: | 1 | 1 | 1 | 1 | 1 | 1 |
| Generate Estimated-Vehicle Speed Report: | <input checked="" type="checkbox"/> | | | | | |

| | Ch #1 | Ch #2 | Ch #3 | Ch #4 | Ch #5 | Ch #6 | Ch #7 | Ch #8 |
|-------------------------|---|---|---|---|---|---|---|---|
| Destinations: | <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: | 140.194.225.136 Port: 8088 | 140.194.225.136 Port: 8088 | 140.194.225.136 Port: 8088 | 140.194.225.136 Port: 8088 | | | | |

Set destination IP addresses of all LCs to be same as: 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.



Configuration

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18800.179

Ethernet 1 (LC 10Gbps) IP Address: 148.196.225.179

Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01

Reader IP Address: 192.168.0.101

USB Adapter or Bluetooth IP Address: 192.168.2.50

Default Gateway IP: 0.0.0.0

Suppress Non-LAG Tags: ☐

Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒

Superframe Sync Mode: ☒ Sync to every superframe
☐ Sync to every other superframe

Add 2 Channel Frames: ☒ No
☐ Yes

Type Of Reader Syncing To: Auto

Report Latency by Tag Type:

0 - Interior EPT Delay [ms]: 0

1 - Exterior EPT Delay [ms]: 0

2 - Exterior LPT Delay [ms]: 0

3 - LCD Display Delay [ms]: 0

4 - Commercial Vehicle (CV) Delay [ms]: 0

5 - OBU/Feedback Tag Delay [ms]: 0

6 - HOT Tag Delay [ms]: 0

Primary/Secondary:

Redundant Mode: ☒

Dual Reporting Mode: ☐

Auto Recovery To Prime: ☒

Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒

Maximum record count: 10000

Current user: admin
Site Name: 18800.17...
Reader ID: 0
Place ID: 0
Tag Group ID: 05
Reader Date/Time: Mon Feb 10 2014 03:06 pm
PPGA Firmware:
Software Version:
CTM ID: 813158

7. Select the Switchover on Serial Link Down and/or Switchover on Ethernet LC Link Down check box, as required.
8. Press **Enter** or select a different tab to accept the selections.

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.

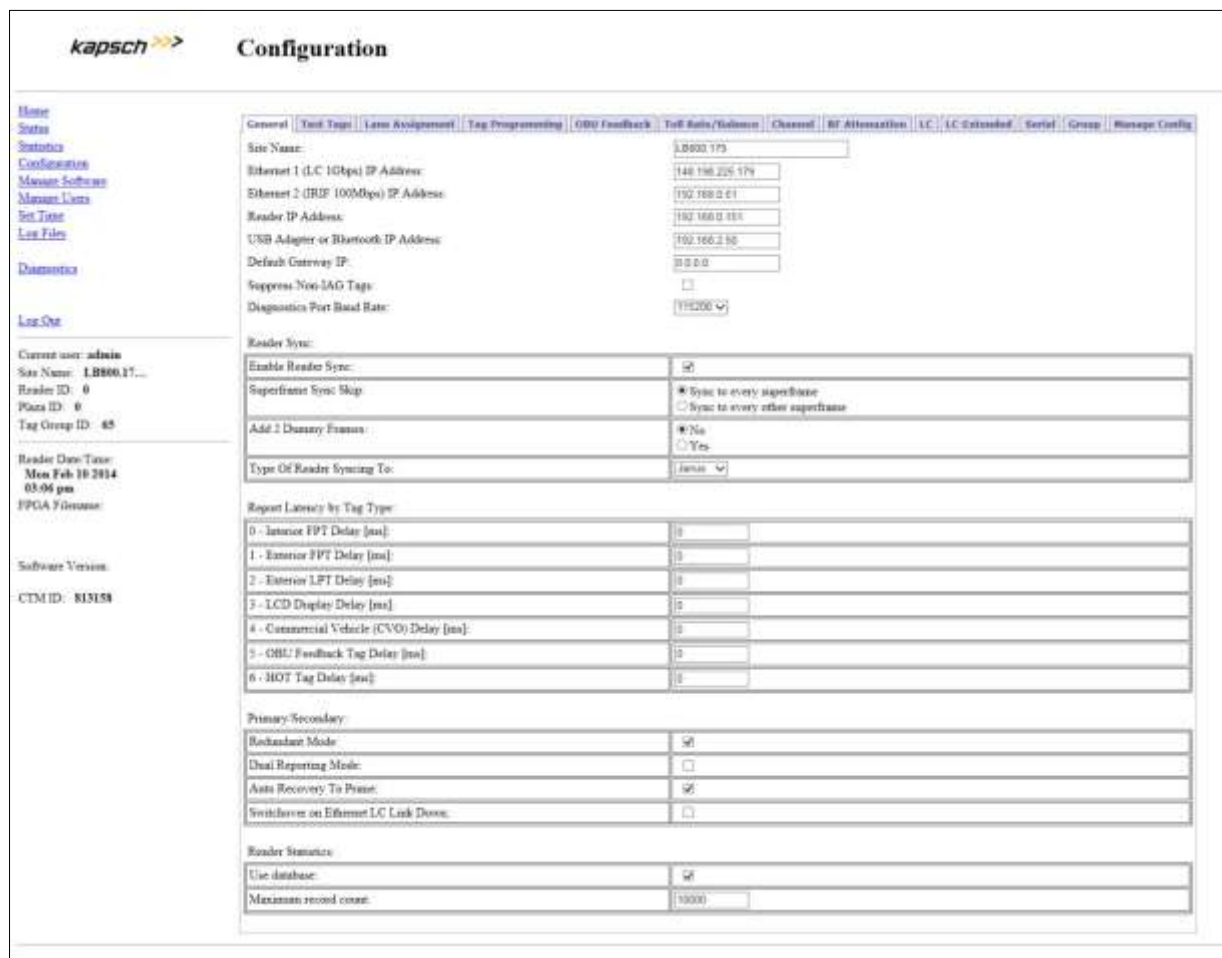
9. If **Switchover on Serial Link Down** is enabled, from the **Serial** tab on the **Configuration** page, enter a time, in milliseconds, in the **LC Retry Timeout** field. If an LC does not respond within this time, the Reader will consider serial communications to the LC to be down and will trigger a switchover if the SPM redundancy mode switch is in **AUTO**.
10. 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**.

To configure 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.

Result: The following screen appears.



The screenshot shows the Kapsch Configuration page with the General tab selected. The left sidebar contains links for Home, Status, Statistics, Configuration (selected), Manage Software, Manage Users, Test Tools, Log Files, Diagnostics, and Log Out. The main content area displays various configuration settings:

- General Settings:** Site Name (LB000.173), Ethernet 1 (J.C 10Gbps) IP Address (148.186.225.179), Ethernet 2 (IRIF 100Mbps) IP Address (192.168.0.61), Reader IP Address (192.168.0.181), USB Adapter or Bluetooth IP Address (192.168.2.56), Default Gateway IP (0.0.0.0), Suppress Non-SAG Tags (checked), Diagnostic Port Baud Rate (115200).
- Reader Sync:** Enable Reader Sync (checked), Superframe Sync Skip (Sync to every superframe), Add 2 Dummy Frames (No), Type Of Reader Syncing To (Lane).
- Report Latency by Tag Type:** A table with 7 rows for different tag types (0-6) and their respective delay times in milliseconds.
- Primary/Secondary:** Redundant Mode (checked), Dual Reporting Mode (unchecked), Auto Recovery To Prime (checked), Switchover on Ethernet LC Link Down (unchecked).
- Reader Statistics:** Use database (checked), Maximum record count (10000).

1. Select the Switchover on Ethernet IRIF Link Down check box.
2. From the **Lane assignment** tab on the **Configuration** page, enter an **IRIF timeout**, in milliseconds, in the **IRIF** text box.

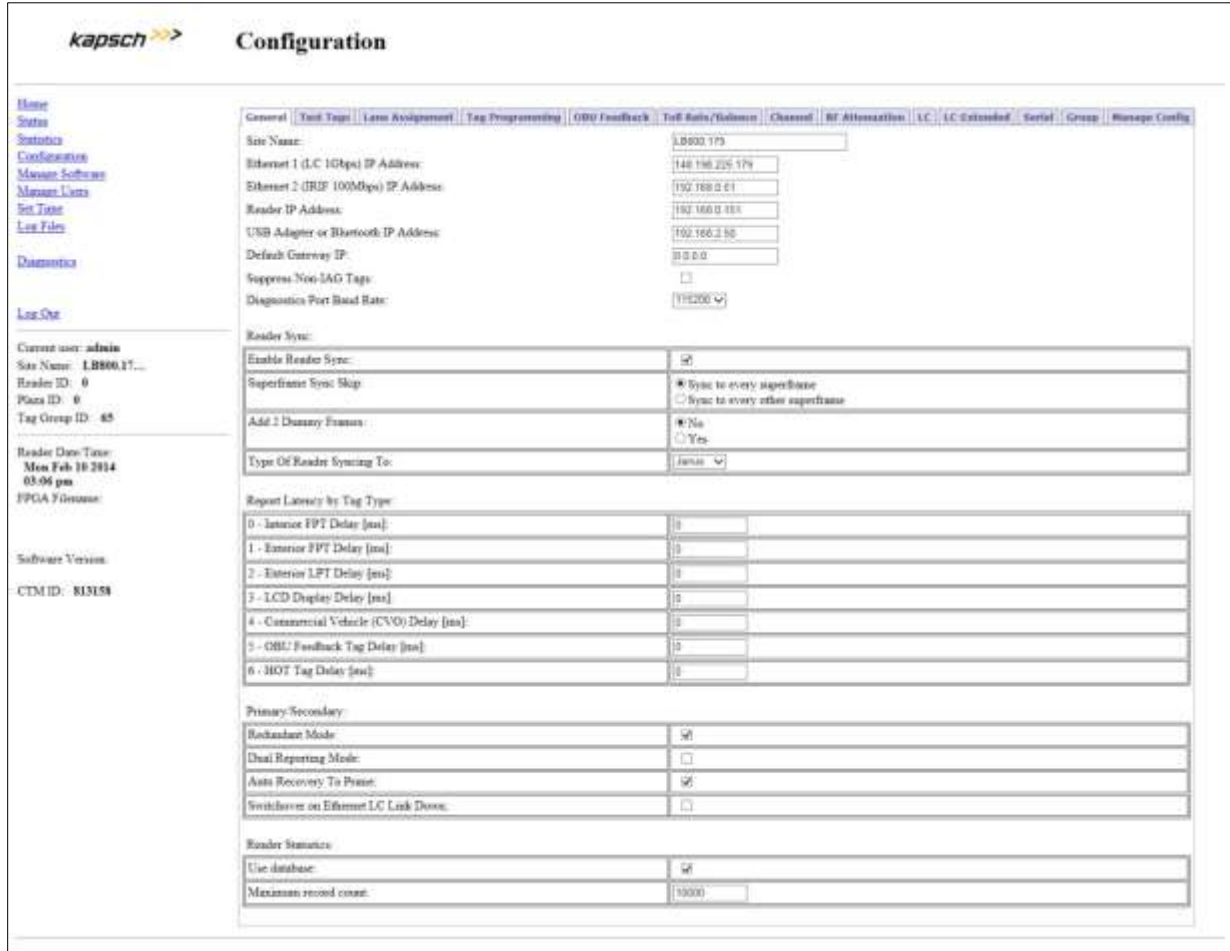
Result: The Reader now continuously checks the IRIF link and switches over whenever a downed Ethernet IRIF link is detected.

To configure the Reader to switchover based on Test tag feedback (if present)

Note: Test tags are used to continuously check and confirm the operation of the antennas.

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

Result: The following screen appears.



The screenshot shows the Kapsch Configuration web interface. On the left is a navigation menu with links: Home, Status, Statistics, Configuration (selected), Manage Software, Manage Users, Set Time, Log Files, Diagnostics, and Log Out. Below the menu, system information is displayed: Current user: admin, Site Name: LB800.17..., Reader ID: 0, Plaza ID: 0, Tag Group ID: 85, Reader Date Time: Mon Feb 10 2014 03:06 pm, FPGA Firmware, Software Version, and CTM ID: 813158.

The main configuration area has tabs: General, Test Tags, Lane Assignment, Tag Programming, OBU Feedback, Toll Rate/Balances, Channel, RF Attenuation, LC, LC Extended, Serial, Group, and Manage Config. The General tab is active, showing fields for Site Name (LB800.175), Ethernet 1 (LC 1Gbps) IP Address (140.196.225.179), Ethernet 2 (GRF 100Mbps) IP Address (192.168.0.61), Reader IP Address (192.168.0.101), USB Adapter or Bluetooth IP Address (192.168.2.50), Default Gateway IP (0.0.0.0), Suppress Non-LAG Tags (unchecked), and Diagnostic Port Baud Rate (115200).

Below these are sections for Reader Sync, Report Latency by Tag Type, Primary/Secondary, and Reader Statistics.

Reader Sync:

| | |
|----------------------------|---|
| Enable Reader Sync: | <input checked="" type="checkbox"/> |
| Superframe Sync: Skip | <input checked="" type="radio"/> Sync to every superframe <input type="radio"/> Sync to every other superframe |
| Add 2 Dummy Frames: | <input checked="" type="radio"/> No <input type="radio"/> Yes |
| Type Of Reader Syncing To: | Janus |

Report Latency by Tag Type:

| | |
|--|---|
| 0 - Interior FRT Delay [ms]: | 0 |
| 1 - Exterior FRT Delay [ms]: | 0 |
| 2 - Exterior LFT 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"/> |
| Maximum record count: | 10000 |

2. Click the **Test Tags** tab.

Result: The following screen appears.



Configuration

General | **Test Tags** | Lane Assignment | Tag Programming | Odds Feedback | Toll Rate/Balance | Channel | LC | LC-Extended | Serial | Group | Manage Config

Test Tag Single Fault Threshold: 6

Test Tag Multiple Fault Threshold: 8

Test Tag Period: 30

Current user: admin
Site Name: MPR2.195...
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65

3. Select the **Test Tag State** check box to enable tag testing for the appropriate RF channel(s).
4. Enter the number of consecutive test tag faults that cause a channel to be considered bad in the **Test Tag Single Fault Threshold** text box.
Note: This should be set to 5 or higher.
5. Enter the number of bad channels that will trigger an automatic switchover, if the SPM redundancy switch is in AUTO, in the **Test Tag Multiple Fault Threshold** text box.
Note: This value must be less than or equal to the number of RF channels equipped with test tags.
6. Enter the period of time between test tag checks, in seconds, in the **Test Tag Period** check box.
Note: This should be set between 30 and 90 seconds.
7. Press Enter or select a different tab to accept .

New firmware

Periodically, Kapsch Service will release a new version of the Reader firmware. The firmware name indicates the year, month, day, and revision number of the release.

This procedure outlines how to upload the new firmware to the Reader so it can then be activated.

Uploading new firmware

Prerequisites: A service laptop containing a copy of the latest firmware is connected to either the Ethernet 1 or a USB port and then logged into the CTM web interface.

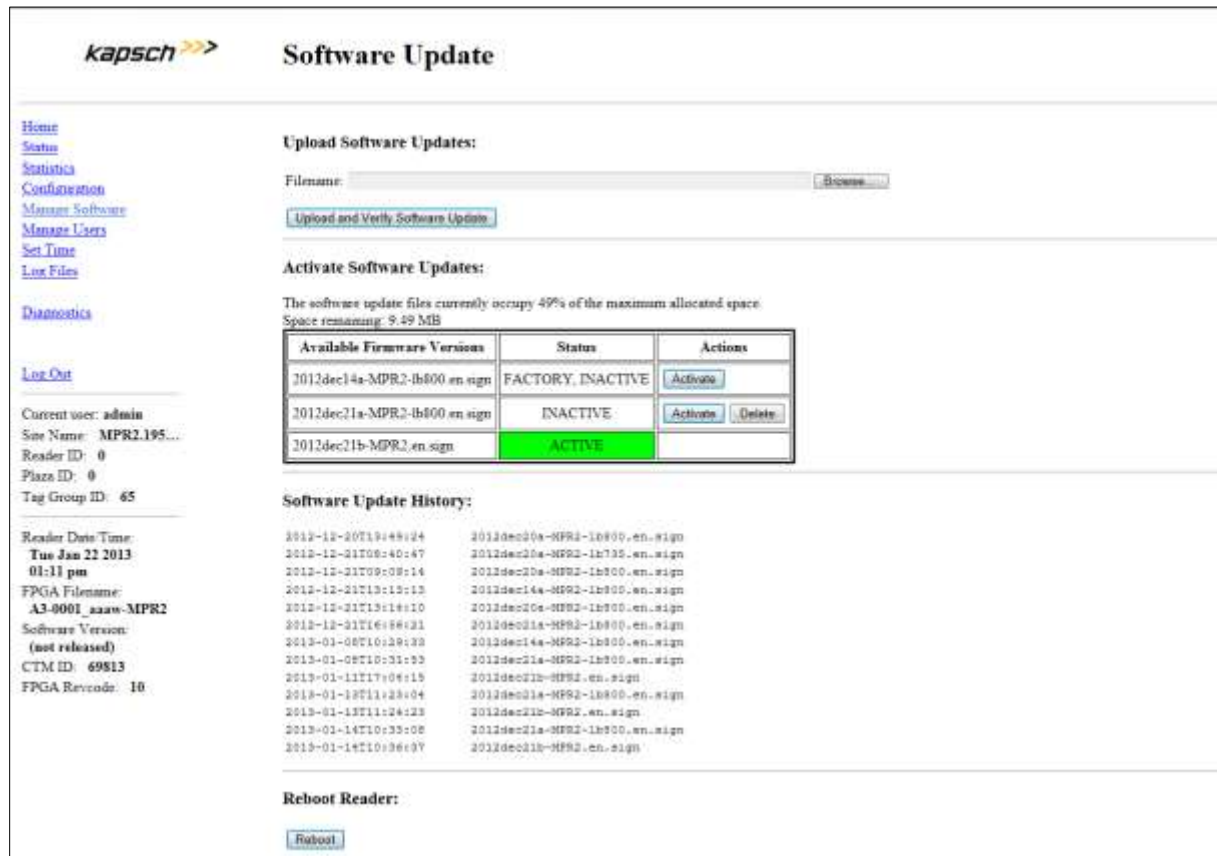
You must have **Software Management** permissions.

**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.



Software Update

Upload Software Updates:

Filename:

Activate Software Updates:

The software update files currently occupy 49% of the maximum allocated space.
Space remaining: 9.49 MB

| Available Firmware Versions | Status | Actions |
|-------------------------------|-------------------|---|
| 2012dec14a-MPR2-1b000.en.sign | FACTORY, INACTIVE | <input type="button" value="Activate"/> |
| 2012dec21a-MPR2-1b000.en.sign | INACTIVE | <input type="button" value="Activate"/> <input type="button" value="Delete"/> |
| 2012dec21b-MPR2.en.sign | ACTIVE | |

Software Update History:

| | |
|---------------------|-------------------------------|
| 2012-12-20T19:48:24 | 2012dec20a-MPR2-1b000.en.sign |
| 2012-12-21T08:40:47 | 2012dec20a-MPR2-1b735.en.sign |
| 2012-12-21T09:08:14 | 2012dec20a-MPR2-1b900.en.sign |
| 2012-12-21T13:15:13 | 2012dec14a-MPR2-1b900.en.sign |
| 2012-12-21T13:18:10 | 2012dec20a-MPR2-1b900.en.sign |
| 2012-12-21T16:08:21 | 2012dec21a-MPR2-1b000.en.sign |
| 2013-01-08T10:29:33 | 2012dec14a-MPR2-1b000.en.sign |
| 2013-01-08T10:31:33 | 2012dec21a-MPR2-1b000.en.sign |
| 2013-01-11T17:04:15 | 2012dec21b-MPR2.en.sign |
| 2013-01-13T11:28:04 | 2012dec21a-MPR2-1b000.en.sign |
| 2013-01-13T11:24:13 | 2012dec21b-MPR2.en.sign |
| 2013-01-14T10:35:08 | 2012dec21a-MPR2-1b900.en.sign |
| 2013-01-14T10:36:09 | 2012dec21b-MPR2.en.sign |

Reboot Reader:

Left Panel:

- Home
- Status
- Statistics
- Configuration
- Manage Software
- Manage Users
- Set Time
- Link Files
- Diagnostics
- Log Out

Current user: admin
Site Name: MPR2.195...
Reader ID: 0
Plate ID: 0
Tag Group ID: 65

Reader Data Time:
Tue Jan 22 2013
01:11 pm
FPGA Filename:
A3-0001_aaaa-MPR2
Software Version:
(not released)
CTM ID: 69813
FPGA Revcode: 10

Note: Ensure that the new firmware version is more recent than the active firmware version

2. Check the **Space remaining** to ensure there is enough Reader memory to load the new firmware.
3. If there is not enough Reader memory, delete an older, inactive version of the firmware (see Deleting firmware, page 242).
4. Click the **Browse** button to select the new firmware file saved on the computer.
5. Click the **Upload and Verify Software Update** button, then click **Yes** to confirm.

Result: The firmware will upload from the computer to the Reader. After the firmware has finished uploading to the Reader, the firmware appears in the table of available firmware versions as INACTIVE.

To begin using the new firmware, activate the firmware (see Activating new firmware).

Activating new firmware

The currently active firmware version becomes inactive once another firmware version is activated. All numbered callouts in parenthesis refer to Figure 7-2.

The following procedures outline the steps for activating an inactive firmware version stored on the Reader.

Prerequisites: You must have **Software Management** permissions.

The primary and secondary sides of the Reader are running normally.

The required firmware is uploaded to the Reader (see New firmware , page 238).

**CAUTION:**

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

**CAUTION: Redundant Reader**

During 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 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 243).
2. From the **Software Management** page, identify the inactive firmware version to be activated in the firmware version table (❶).
3. Click the corresponding **Activate** button (❷) to activate the firmware. Click to acknowledge there will be a delay before the firmware becomes active.
4. If necessary, restore the configuration file saved in step 1 (see Uploading a saved configuration, page 246).

Figure 7-2: Activating Firmware

| Available Firmware Versions | Status | Actions |
|---|-------------------|----------------------------|
| 2010sep22a.en.sign <small>md5sum: 158b1803d4f5da60c12bd51c3d3856eb</small> | FACTORY, INACTIVE | Activate |
| 2010oct05a.en.sign <small>md5sum: fac1bc20c73670e94c1223dda4e1153f</small> | INACTIVE | Activate Delete |
| 2010nov11b.en.sign <small>md5sum: 89249bc77361dd34dd1ac36b773b3d</small> | INACTIVE | Activate Delete |
| 2010nov24a.en.sign <small>md5sum: d7263eb1d29dccc3230989546700</small> | ACTIVE | |

On the Secondary side:

1. Repeat steps 1 through 4 for the secondary side, ensuring the same firmware version is active for the primary and secondary side.

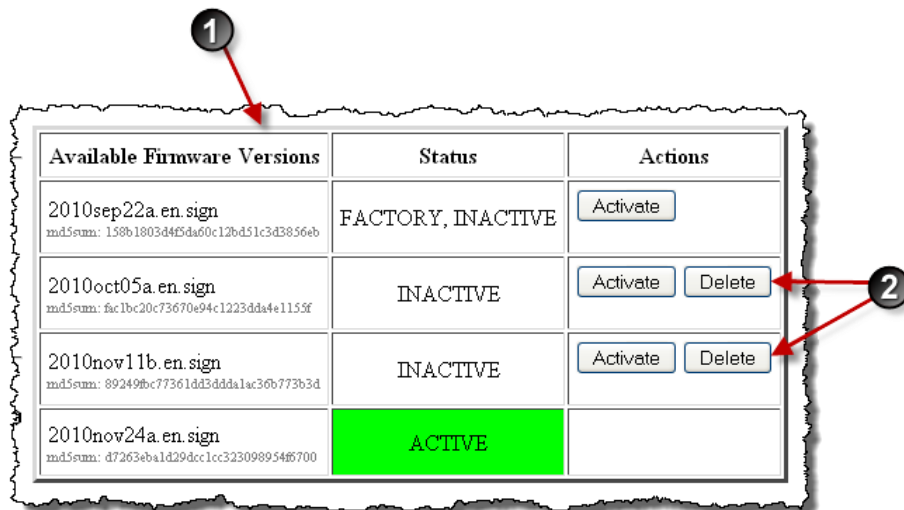
Deleting firmware

The Factory firmware and active firmware cannot be deleted. All callouts refer to Figure 7-3. This procedure outlines the steps for deleting an inactive firmware version stored on the Reader.

Prerequisites: You must have Software Management permissions.

1. From the **Software Management** page, identify the inactive firmware version to be deleted in the firmware version table (1).
2. Click the corresponding **Delete** button (2). Click **Yes** to confirm. The firmware will be deleted and will no longer appear in the firmware version table (1).

Figure 7-3: Deleting firmware



| Available Firmware Versions | Status | Actions |
|--|-------------------|-----------------|
| 2010sep22a.en.sign md5sum: 158b1803d4f2da60c12bd51c3d3856eb | FACTORY, INACTIVE | Activate |
| 2010oct05a.en.sign md5sum: fac1bc20c73670e94c1223dda4e1155f | INACTIVE | Activate Delete |
| 2010nov11b.en.sign md5sum: 89249bfc77361dd3ddda1ac36b773b3d | INACTIVE | Activate Delete |
| 2010nov24a.en.sign md5sum: d7263eb1d29dccc32309895465700 | ACTIVE | |

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.

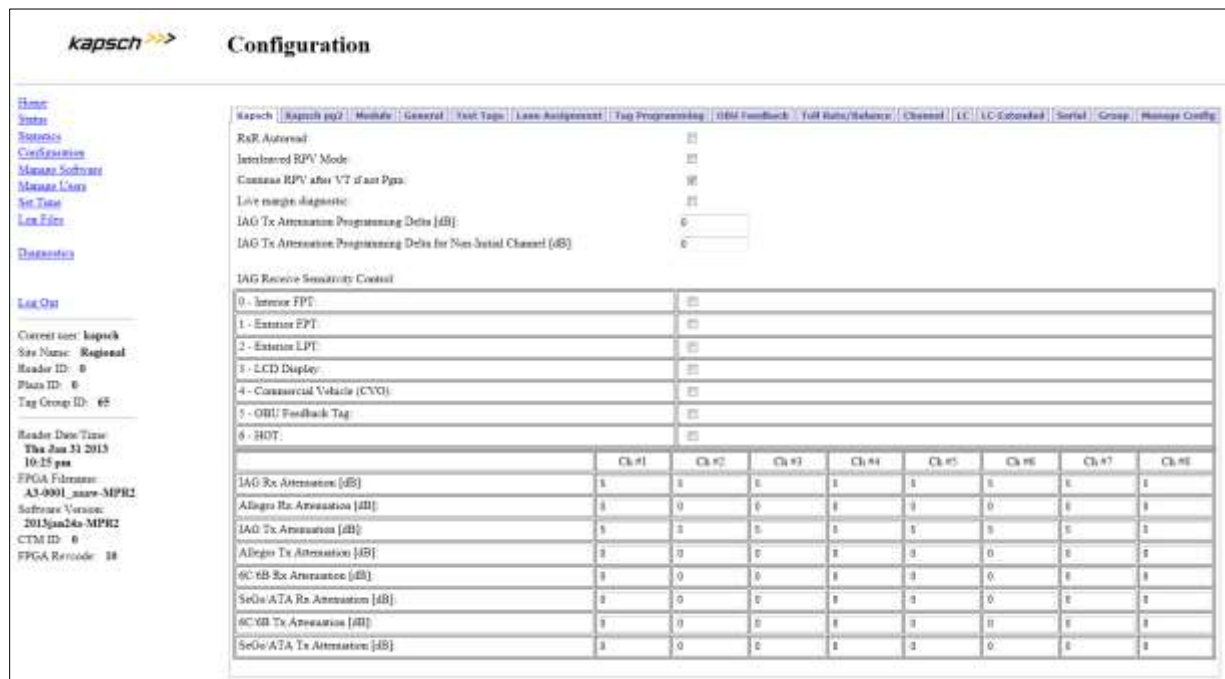
- Quickly configure another Reader requiring the same or similar configuration.
- Restore the Reader to a known configuration.
- Troubleshoot problems by comparing the current configuration to past configurations.

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 **Ethernet 1** or a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40.

1. Click the **Configuration** link on the left side panel.

Result: The following screen appears.



1. Click the **Manage Config** tab on the **Configuration** page.

Result: The following screen appears.

Configuration

Home | Status | Statistics | **Configuration** | Manage Software | Manage Users | Set Time | Log Files | Downloads

Current user: kapsch
Site Name: Regional
Reader ID: 0
Plan ID: 0
Tag Group ID: 85

Kapsch / Kapsch pg2 / Module / General / Test Tags / Lane Assignment / Tag Programming / OBU Feedback / Toll Rate/Balances / Channel / LC / LC Extended / Serial / Group / Manage Config

Save config to file: ☐ as HTTPC

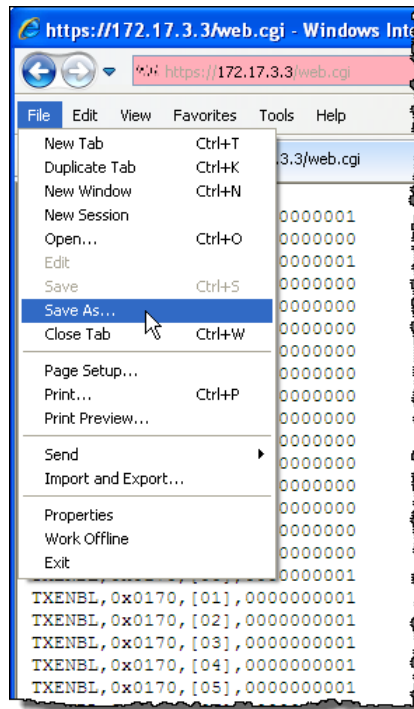
Upload config file:
Update the reader configuration: HTTPROCT modifying the networking IP information:
Update the entire reader configuration:

Reset config to default:

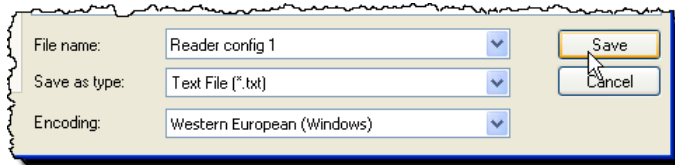
2. Click the **Save config** button to save the new configuration.

If using Internet Explorer:

1. From the **Internet Explorer File** menu, select **Save As**. Select **Yes** to confirm, if prompted.



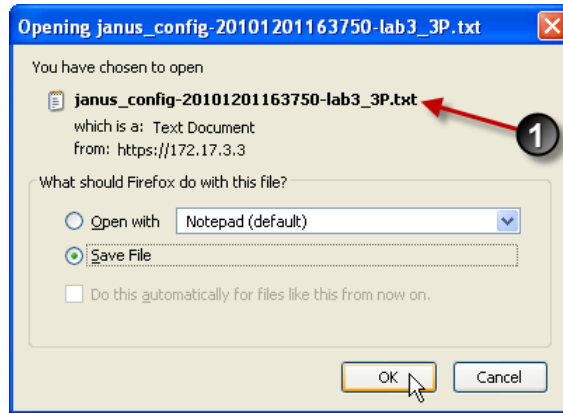
2. Select or create the destination folder, enter a unique file name, and select **Text File** as the file type.
3. Click **Save**.



If using Firefox:


1. Select **Save File**. Note the configuration filename (❶) that is automatically generated.
2. Click **OK**.

Result: The configuration file will be saved as a text file in the default Firefox download location.

**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. All callouts refer to Figure 7-4.

Prerequisites: A service laptop connected to Ethernet 1 or a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. A version of the configuration file to be loaded is saved on a service laptop connected to the Reader.

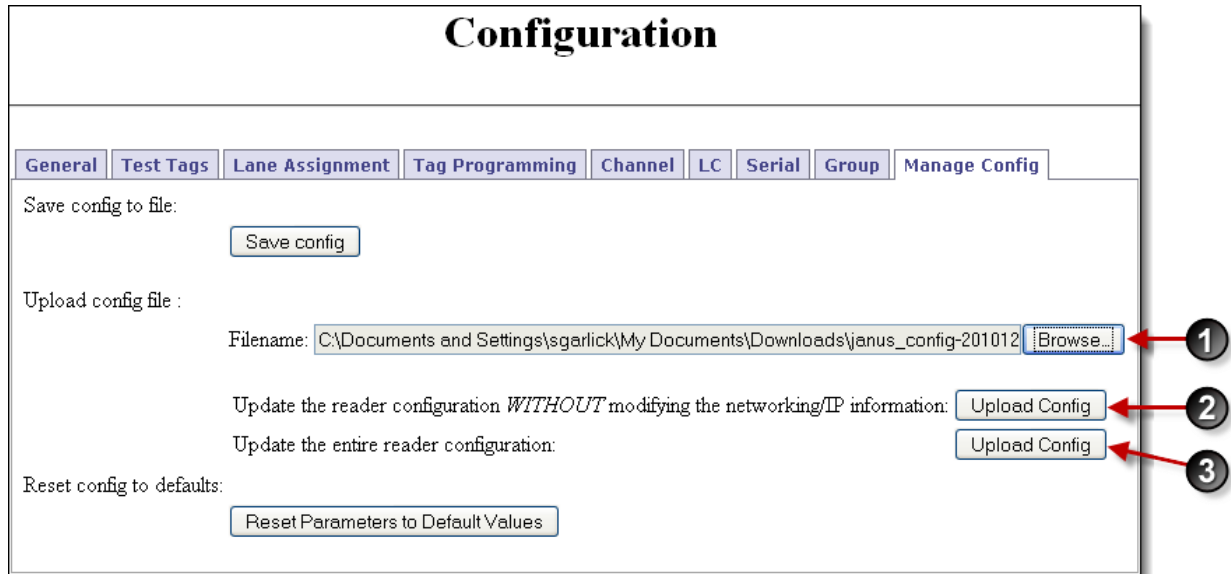


CAUTION:

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 (❶) 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 (❷).
3. If uploading all configuration settings to the Reader, including the IP addresses, click the second **Upload Config** button (❸).


Figure 7-4: The Manage Config tab on the Configuration page


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 a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. Save the current Reader configuration (Saving the Reader configuration, page 243).

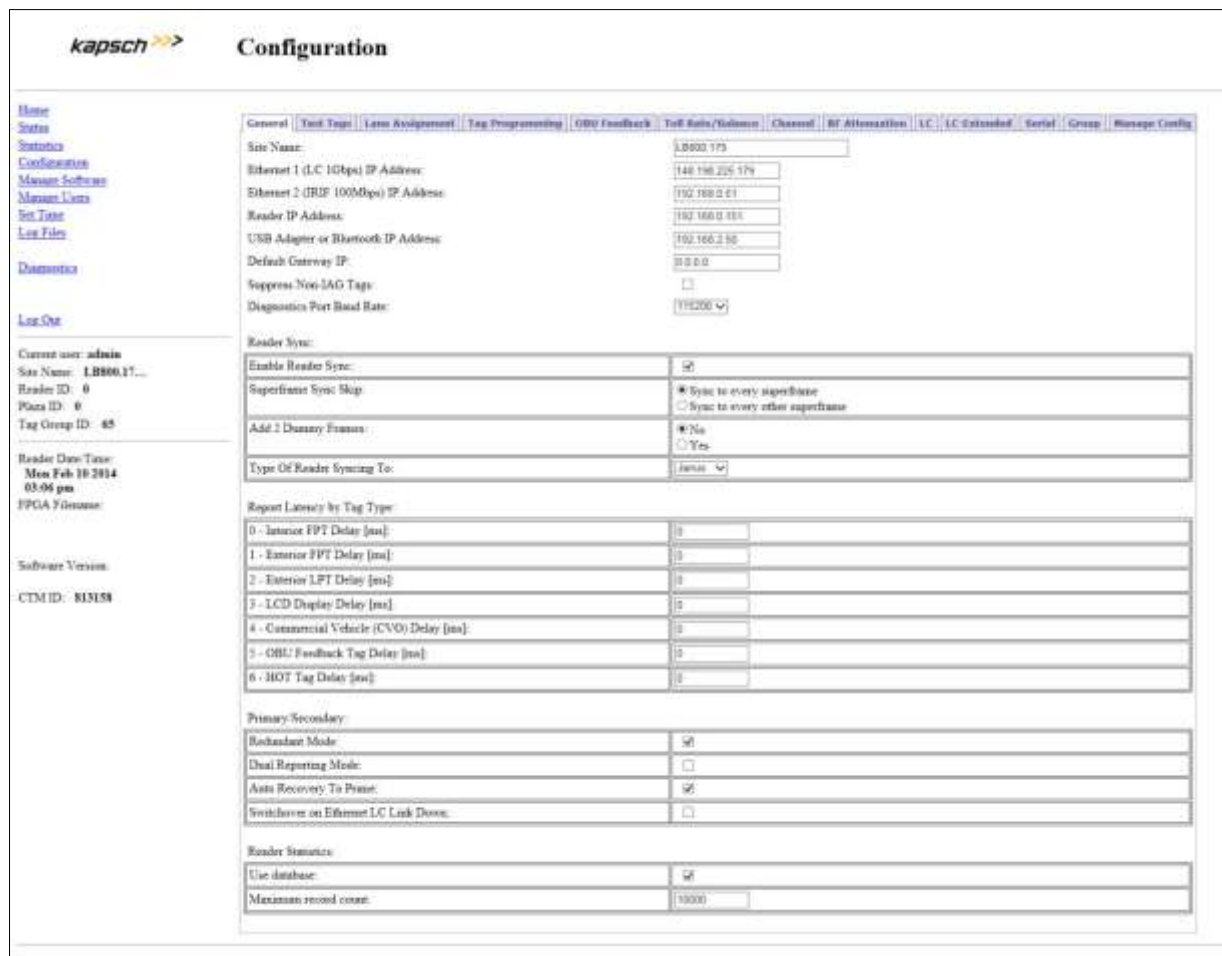
CAUTION:



The factory default configuration should not be restored on a running Reader. The factory 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.

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



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: LB00017...
Reader ID: 0
Pilot ID: 0
Tag Group ID: 45

Reader Date/Time: Mon Feb 10 2014 03:06 pm
FPGA Firmware:
Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Manage Config

Site Name: LB000173
Ethernet 1 (LAN 10Gbps) IP Address: 148.186.225.179
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.61
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.55
Default Gateway IP: 0.0.0.0
Suppress Non-LAN Tags: ☐
Diagnostics Port Band Rate: 115200

Reader Sync:
Enable Reader Sync: ☒
Superframe Sync Skip: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:
0 - Interior EPT Delay [ms]: 0
1 - Exterior EPT Delay [ms]: 0
2 - Exterior LPT Delay [ms]: 0
3 - LCD Display Delay [ms]: 0
4 - Commercial Vehicle (CV) Delay [ms]: 0
5 - OBU Feedback Tag Delay [ms]: 0
6 - HOT Tag Delay [ms]: 0

Primary/Secondary:
Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:
Use database: ☒
Maximum record count: 10000

2. Click the **Manage Config** tab.

Result: The following screen appears.



Kapsch Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: Regional
Reader ID: 0
Pilot ID: 0
Tag Group ID: 45

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Balance | Channel | LC | LC Extended | Serial | Group | Manage Config

Reset config to defaults
Reset Parameters to Default Values

- 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
- Software management
- User admin
- Manage log files

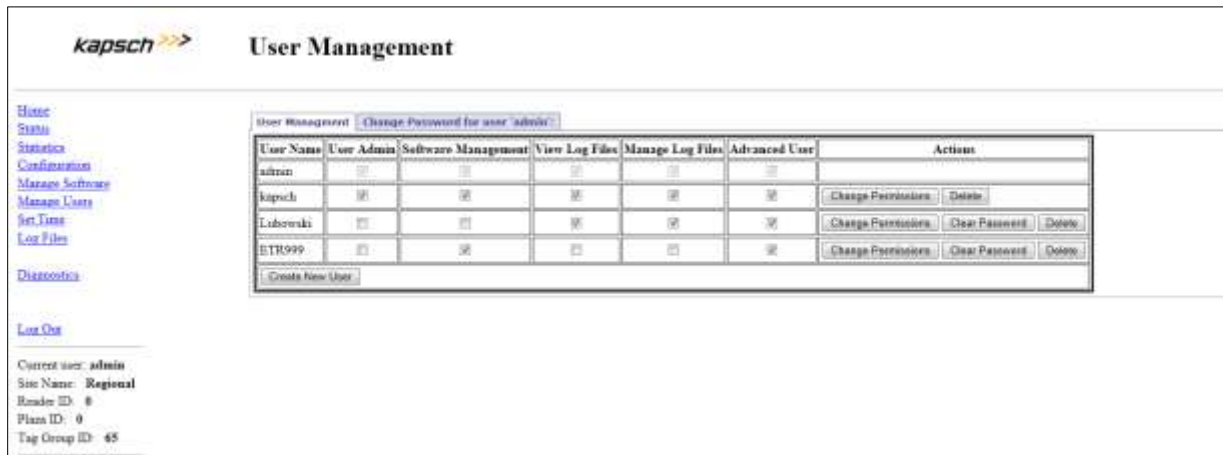
Creating a new user

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 a USB port of the CTM. Refer to Connecting a service laptop to the Reader, page 40. You must have **User Admin** permissions.

- Click on the **Manage Users** link on the left side panel

Result: The following screen appears.



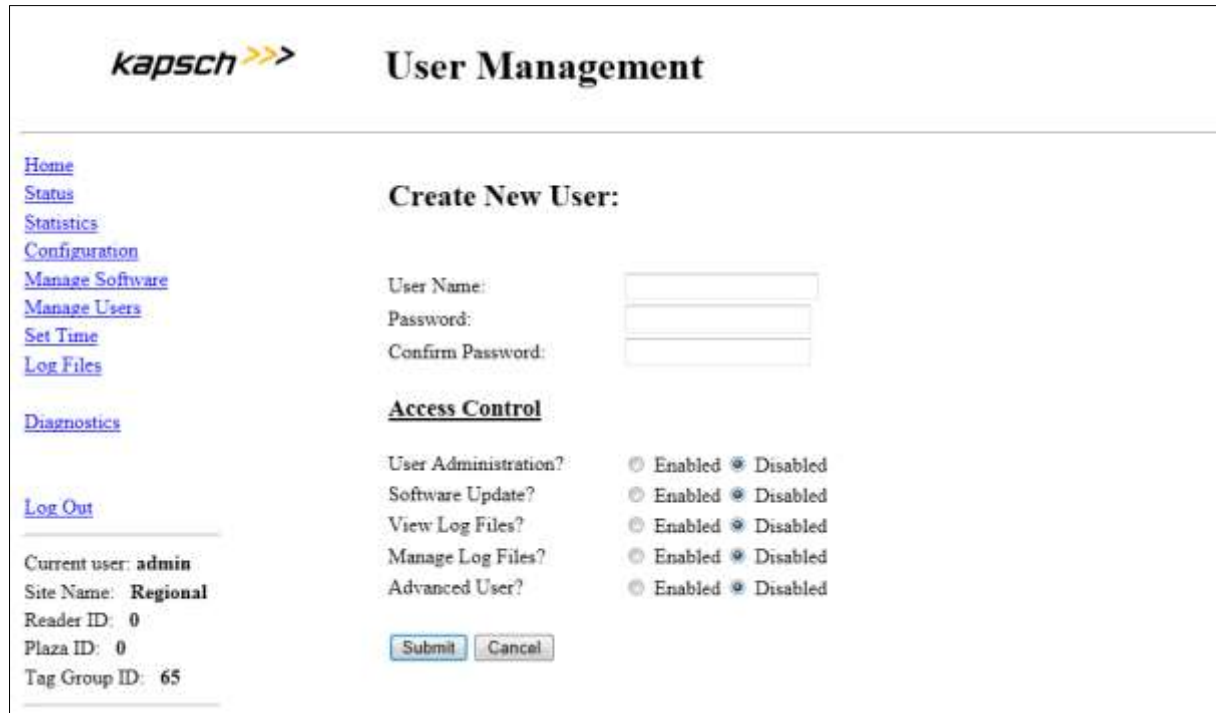
The screenshot shows the 'User Management' page of the Kapsch interface. On the left is a navigation menu with links: Home, Status, Statistics, Configuration, Manage Software, Manage Users, Set Time, Log Files, and Diagnostics. The 'Manage Users' link is selected. The main content area has a 'User Management' tab and a 'Change Password for user 'admin'' link. Below this is a table with the following data:

| User Name | User Admin | Software Management | View Log Files | Manage Log Files | Advanced User | Actions |
|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| admin | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| kapsch | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Delete |
| Lubowski | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Clear Password Delete |
| ETR999 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Clear Password Delete |

At the bottom of the table is a 'Create New User' button. On the left side of the page, there is a 'Log Out' link and a status box showing: Current user: admin, Site Name: Regional, Reader ID: 8, Plaza ID: 0, Tag Group ID: 65.

- A **Create New User** form will appear on the **User Management** tab.
- Click the **Create New User** button.

Result: The following screen appears.



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

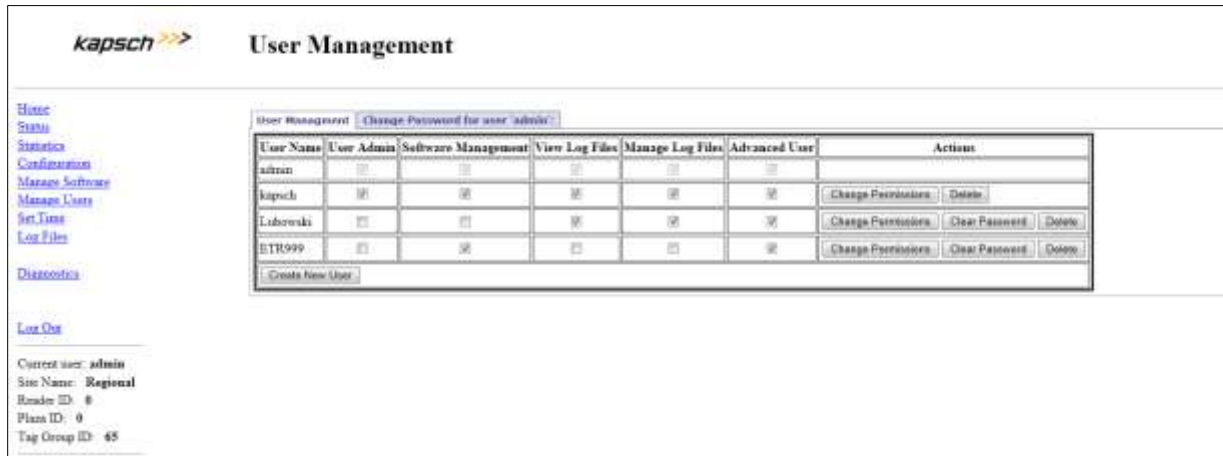
Changing a user's access permissions

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 a USB port of the CTM. Refer to Connecting a service laptop to the Reader, page 40. You must have **User Admin** permissions.

1. Click on the **Manage Users** link on the left side panel

Result: The following screen appears.

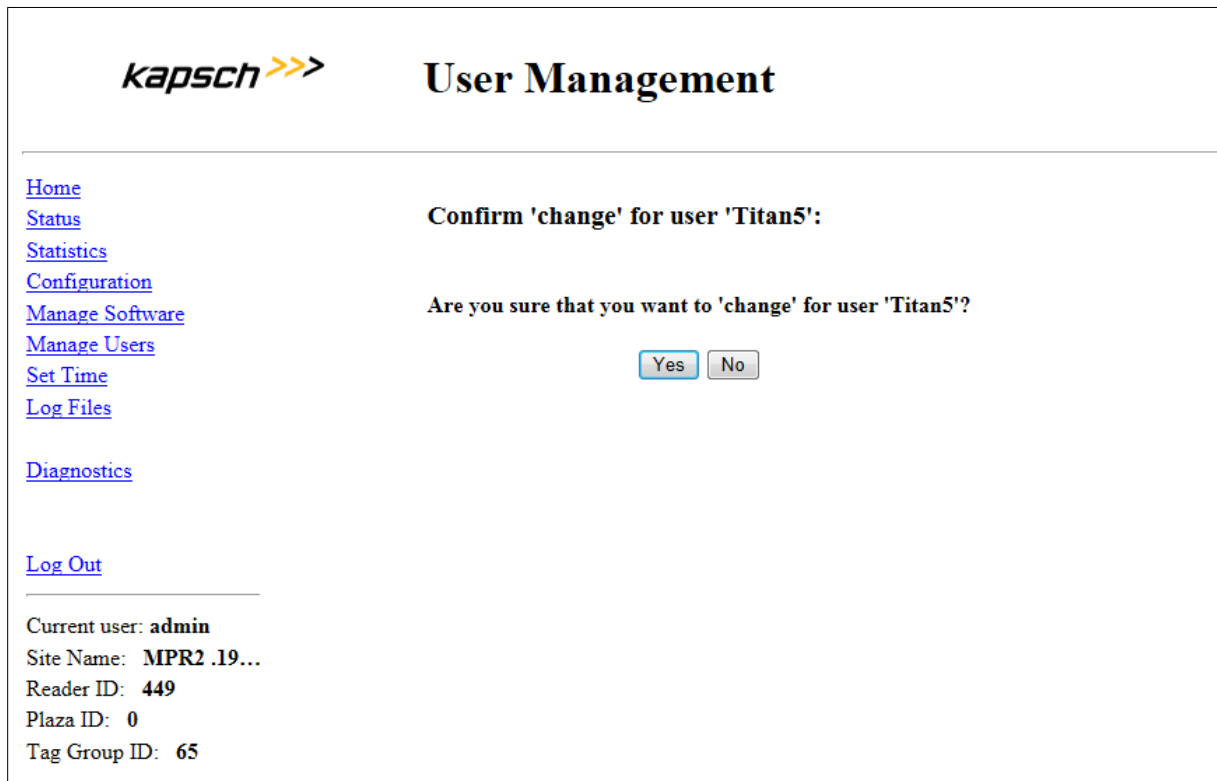


2. Identify the user whose access permissions need changing.
3. Select the corresponding check box to give access to a particular area; clear the corresponding check box to deny access.

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.



- Click **Yes** to confirm.

Result: The user access permissions update.

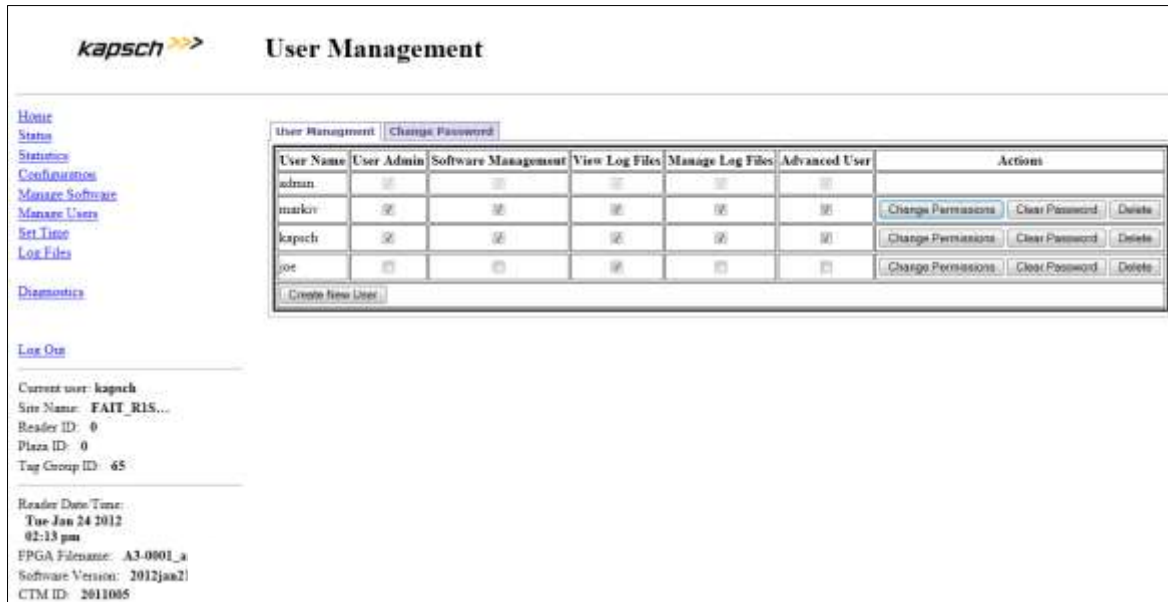
Deleting a user

Note: A deleted user will no longer be able to access the CTM web interface.

Prerequisites: A service laptop connected to Ethernet 1 or a USB port of the CTM. Refer to Connecting a service laptop to the Reader, page 40. You must have **User Admin** permissions.

- 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"/> | Change Permissions Clear Password Delete |
| markiv | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Clear Password Delete |
| kapsch | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Clear Password Delete |
| joe | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Change Permissions Clear Password Delete |

[Create New User](#)

Log Out

Current user: kapsch
 Site Name: FAIT_R1S...
 Reader ID: 0
 Plaza ID: 0
 Tag Group ID: 65

Reader Date/Time:
 Tue Jan 24 2012
 02:13 pm
 FPGA Filename: A3-0001_a
 Software Version: 2012jan21
 CTM ID: 2011005

- Click the corresponding **Delete** button.
Result: A dialog box appears for delete confirmation.
- Click **Yes** to confirm.

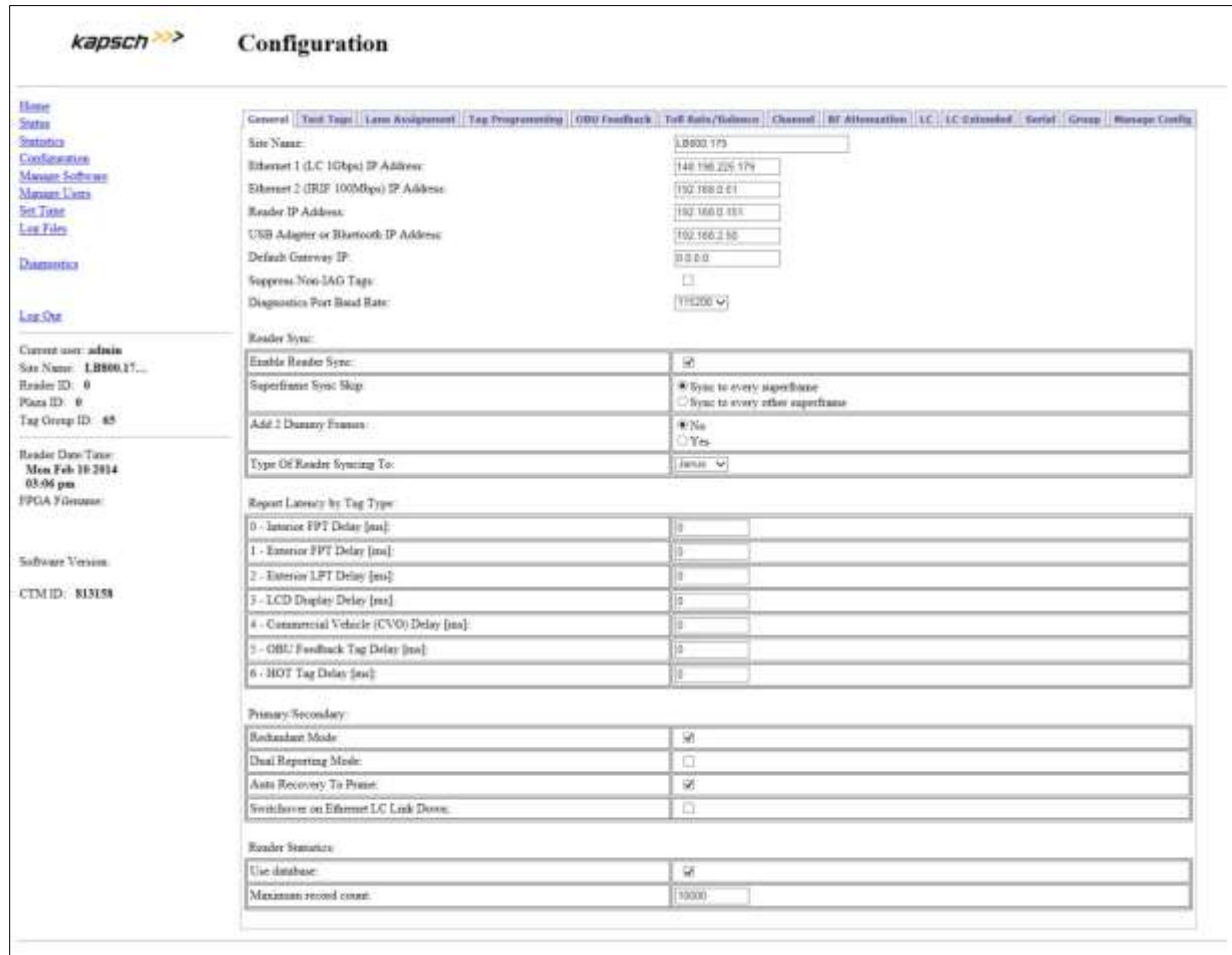
Verifying a computer is communicating with a specific CTM

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 a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40.

- Click on the **Configuration** link on the left side panel of the CTM web Interface.

Result: The following Configuration page appears.



Configuration

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: 18800.17...
Reader ID: 0
Place ID: 0
Tag Group ID: 45

Reader Date/Time:
Mon Feb 10 2014
03:06 pm
FPGA Firmware:

Software Version:
CTM ID: 813158

General | Test Tags | Lane Assignment | Tag Programming | OBU Feedback | Toll Rate/Volume | Channel | RF Attenuation | LC | LC Extended | Serial | Group | Message Config

Site Name: 18800.175
Ethernet 1 (LC 10Gbps) IP Address: 148.198.225.175
Ethernet 2 (RJ45 100Mbps) IP Address: 192.168.0.01
Reader IP Address: 192.168.0.101
USB Adapter or Bluetooth IP Address: 192.168.2.50
Default Gateway IP: 0.0.0.0
Suppress Non-LAG Tags: ☐
Diagnostics Port Baud Rate: 115200

Reader Sync:

Enable Reader Sync: ☒
Superframe Sync Mode: ☒ Sync to every superframe
☐ Sync to every other superframe
Add 2 Dummy Frames: ☒ No
☐ Yes
Type Of Reader Syncing To: Janus

Report Latency by Tag Type:

| | |
|---|---|
| 0 - Interior EPT Delay [ms] | 0 |
| 1 - Exterior EPT Delay [ms] | 0 |
| 2 - Exterior LPT Delay [ms] | 0 |
| 3 - LCD Display Delay [ms] | 0 |
| 4 - Commercial Vehicle (CVO) Delay [ms] | 0 |
| 5 - GBU Feedback Tag Delay [ms] | 0 |
| 6 - HOT Tag Delay [ms] | 0 |

Primary/Secondary:

Redundant Mode: ☒
Dual Reporting Mode: ☐
Auto Recovery To Prime: ☒
Switchover on Ethernet LC Link Down: ☐

Reader Statistics:

Use database: ☒
Maximum record count: 10000

2. Click the **Status** link on the left panel.
Result: The following screen appears.



Status

Home | Status | Statistics | Configuration | Manage Software | Manage Users | Set Time | Log Files | Diagnostics | Log Out

Current user: admin
Site Name: Regisaa
Reader ID: 0
Place ID: 0
Tag Group ID: 45

Communications | Power Supply Modules | Miscellaneous Information

More Controller Serial Link: **Down**

Inter-Reader Ethernet Link: **Disabled**

LAN Controller Serial Link: **Down** **Down** **Down** **Down** **Down** **Down** **Down** **Down**

LAN Controller Ethernet Link: **Up** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled**

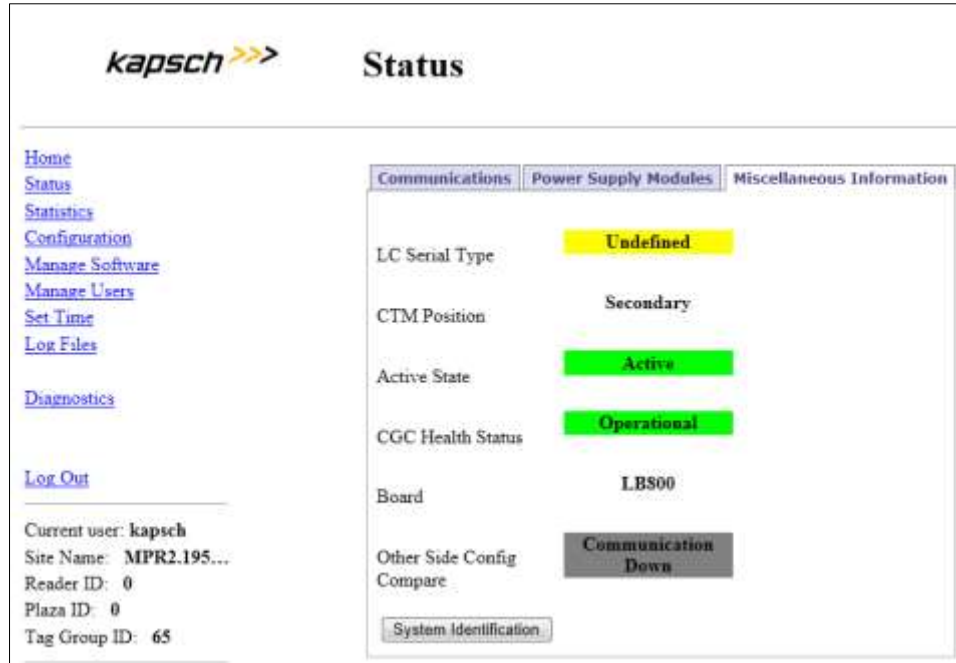
Dual Destination LAN Controller Ethernet Link: **Disabled** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled** **Disabled**

Test Tags: **Disabled**

Synchronization Status: **Disabled**

- Click the Miscellaneous Information tab

Result: The following screen appears.



| Status | |
|---------------------------|--------------------|
| LC Serial Type | Undefined |
| CTM Position | Secondary |
| Active State | Active |
| CGC Health Status | Operational |
| Board | LBS00 |
| Other Side Config Compare | Communication Down |
| System Identification | |

Home
Status
Statistics
Configuration
Manage Software
Manage Users
Set Time
Log Files
Diagnostics
Log Out

Current user: kapsch
Site Name: MPR2.195...
Reader ID: 0
Plaza ID: 0
Tag Group ID: 65

- Click the System Identification button.

Result: The CTM MC LED flashes green – red – amber – green three times.

Note: If the CTM MC LED does not flash correctly, the service laptop is not communicating with that CTM.

Using an NTP Server to synchronize the clocks of Readers in an IR network

Readers can use NTP servers to accurately regulate the time of all Readers in an IR network. 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.

Prerequisites: The Reader must be on a network connected to the Internet. A service laptop connected to Ethernet 1 or a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. You must have **Advanced User** permissions.

- Visit <http://support.ntp.org/bin/view/Servers/StratumTwoTimeServers> to see a list of NTP servers.
- Identify an NTP server in your geographic region (the **ISO** column) that has an **OpenAccess** policy (the **AccessPolicy** column).
- Click on the host name of the NTP server (the **HostName** column). The **ServerForm** table appears.
- Record the IP address of the NTP server.

Note: The following step is optional.

- Repeat steps 2 through 4 to obtain a total of three (3) IP addresses, each from a different NTP server.
- Click on the **Set Time** link on the left side panel of the CTM web interface.

Result: The following screen appears.



7. From the **Time Management** 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.

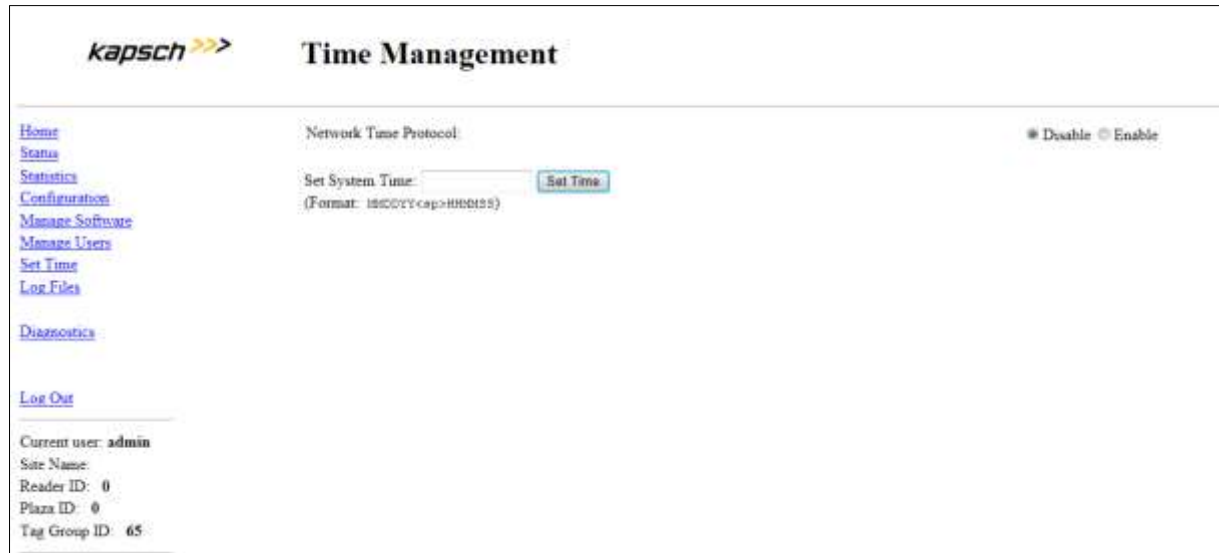
Manually setting the Reader time and date

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 a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40.

1. Click the **Set Time** link on the left side of the panel.

Result: The following screen appears.



2. 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.
3. Click the **Set Time** button.

Result: The Reader updates to the time entered in the field.

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 40.

see Using PuTTY to connect to the DIAGNOSTIC PORT, page 260, or,

see Using HyperTerminal to connect to the DIAGNOSTIC PORT, page 260.

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.

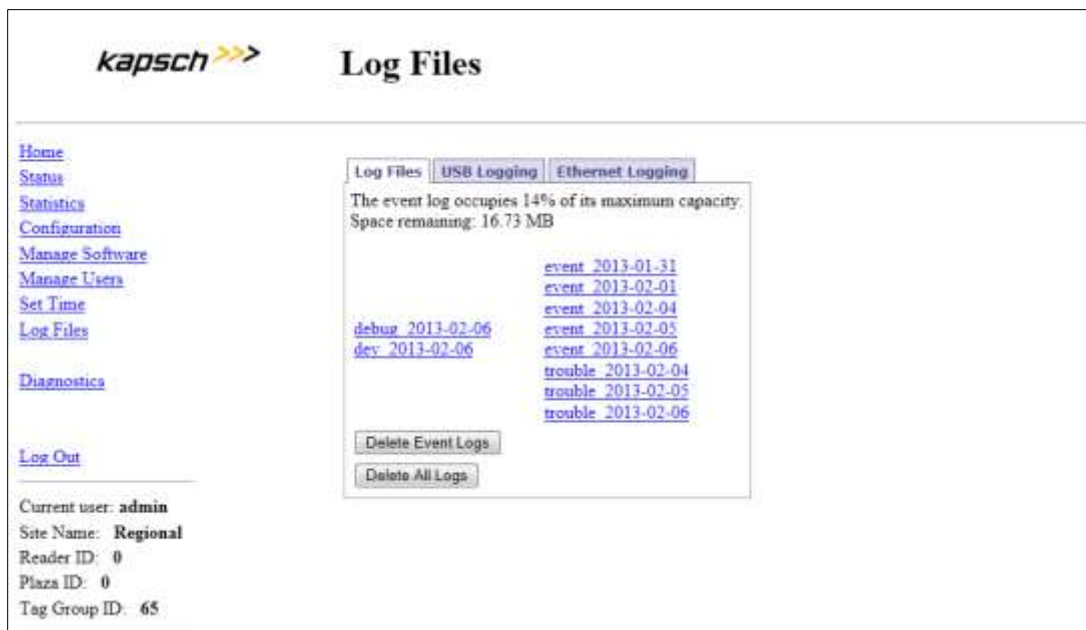
Saving Reader log files to a computer

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 a USB port of the CTM and accessing the CTM web interface. Refer to Connecting a service laptop to the Reader, page 40. You must have **View Log Files** and **Manage Log Files** permissions.

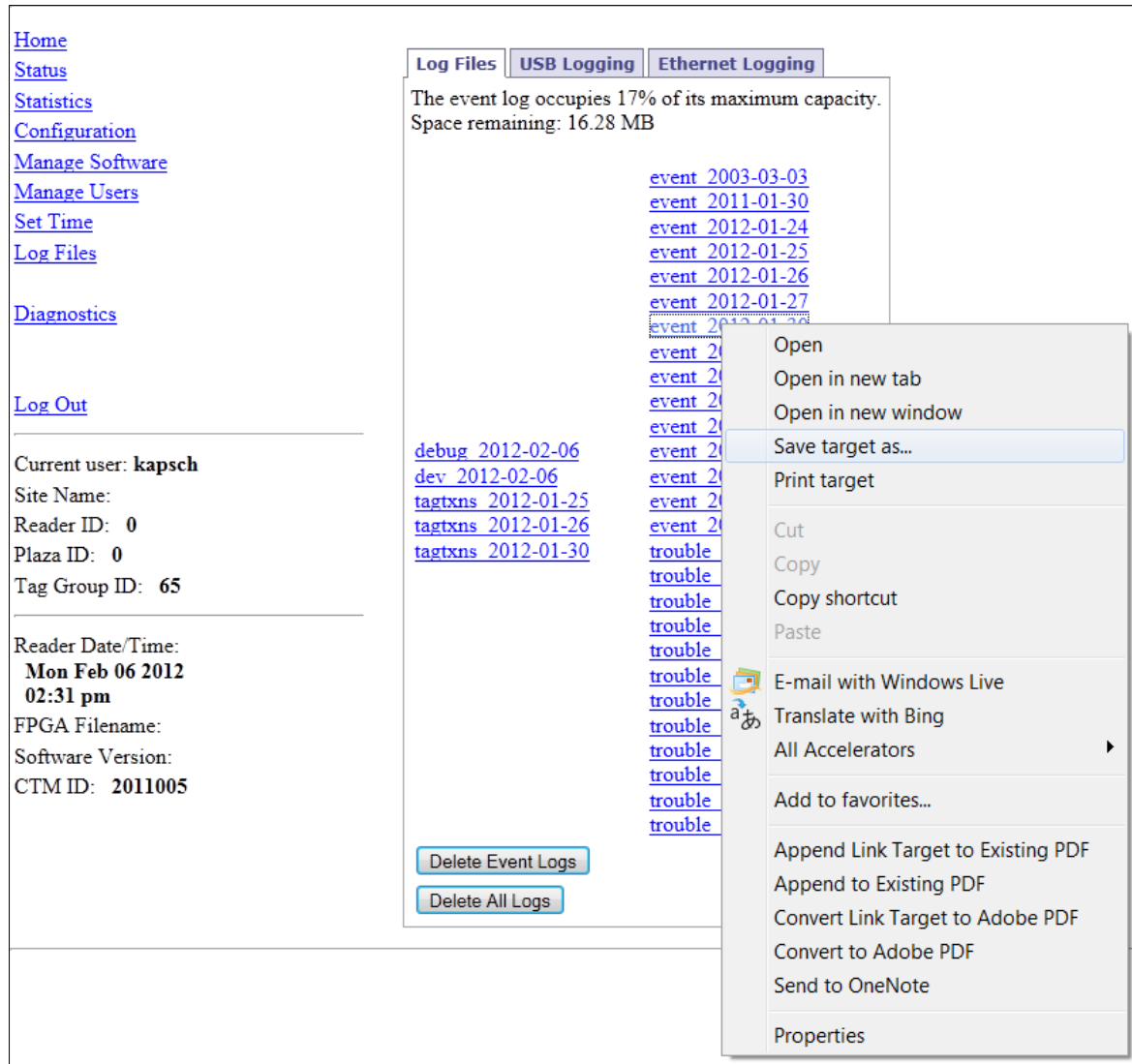
1. Select the **Log Files** link on the left side panel of the CTM web interface.

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:

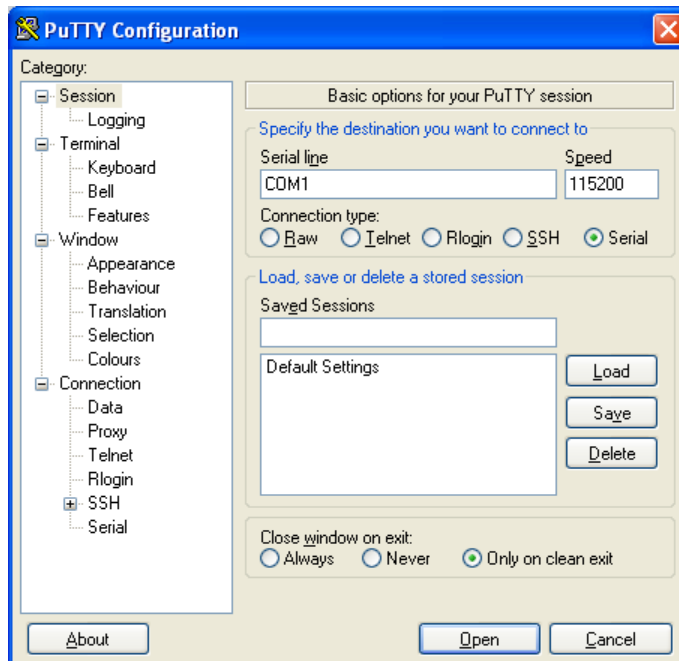
1. Click the Copy Log Files to USB device button.
2. Click the **Safely Remove Hardware** and **Eject Media** icon on the taskbar tray and select **Eject USB device**.
3. Remove the USB memory stick.

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.

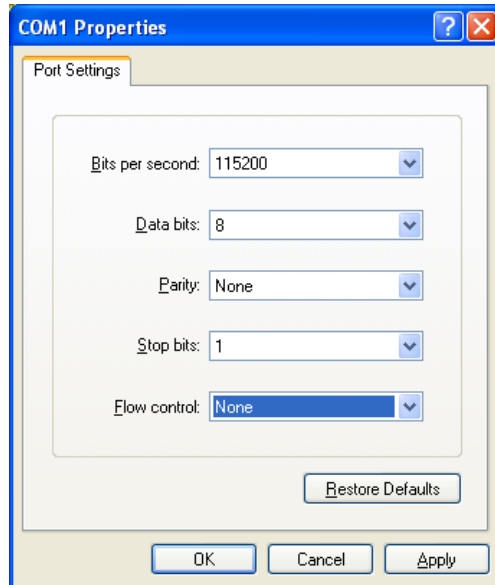
Using HyperTerminal to connect to the DIAGNOSTIC PORT


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**.

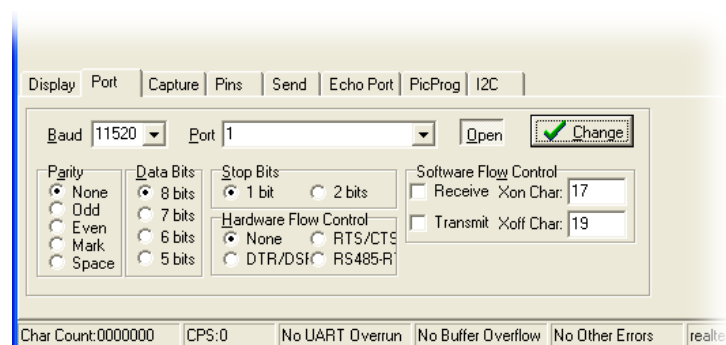
Using RealTerm to connect to the MRFM-S

1. Connect a serial cable from the MRFM LC COM port to a port on your computer.
2. Launch RealTerm.
3. From the **Port** tab, select 115200 from the **Bits per second** drop-down box, set **Data Bits** to 8, set **Parity** to **None**, **Stop Bits** to 1, **Flow Control** to **None**.

Example: The following example is shown.



4. Select the COM port number of the computer port you connected to in Step 1 from the **Port** drop-down box.
5. Click the  **Change** button.



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 JANUS® Multi-Protocol Reader Ver. 2 online at <http://dds.kapsch.ca>

A Username and Password can be obtained from Kapsch Service.

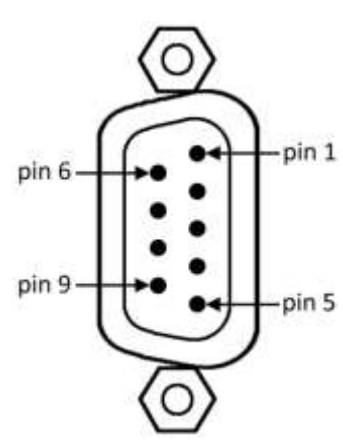
The documentation package includes the following.

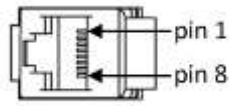
- Bill of Materials
- Assembly Drawings
- Schematic Drawings
- Parts Specifications (for purchased items)
- Operator and Maintenance Manuals
- Installation Instructions
- Training slides
- Software Design Documents: Context Diagrams, Data Flows
- As-built installation drawings (services)

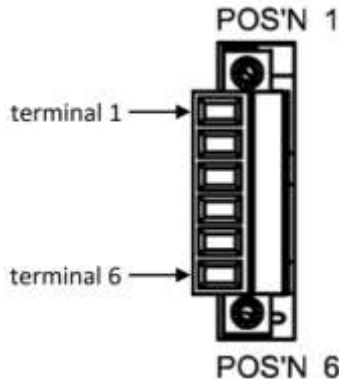
Technical Specifications and Pin outs

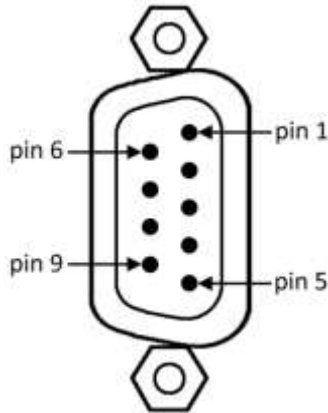
| JANUS® Multi-Protocol Reader Ver. 2 Technical Specifications | | |
|--|--------------------|--------------------|
| Operation subject to FCC Site licensing (per FCC Part 90, Subpart M) | | |
| Dimensions (excluding enclosure) | | |
| Height = 17.5 inch | Width = 19.06 inch | Depth = 11.30 inch |
| 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 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 | | |
| 95-135 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 | | |
| 400,000 buffered transactions. | | |
| RF Channel Capacity | | |
| Lane-based channels: maximum of 8. ORT channels: maximum of 5. | | |

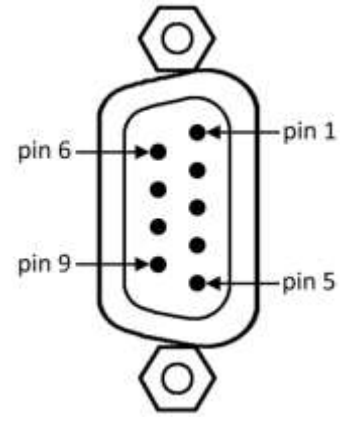
| NEMA 4 Enclosure Specifications | | |
|--|-----------------|--------------------------|
| Kapsch TrafficCom Field Cabinet Part Numbers | | |
| Left hinged: 800127-101 | | Right hinged: 800127-102 |
| Dimension | | |
| Height = 36 inch | Width = 30 inch | Depth = 20 inch |
| Enclosure Requirements | | |
| 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 # | | 801692-019 |
| Description | 3x3 patch | 3x4 dipole array |
| Width (inch) | 34.75 | 34.5 |
| Length (inch) | 31.75 | 21.25 |
| Thickness (in inches) | 2.3 | 3.13 |
| Weight ¹ (lbs) | 33 | 19 |
| Mounting | horizontal | horizontal |
| Application | standard width or ORT lane | Standard Width or ORT lane |

Note: Mounting information is provided as a guideline.

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 IVHS 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 - IAG | 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 specifications

Belden 9730 or 89730 cable or equivalent as determined by Kapsch TrafficCom engineering. Detailed specifications available from manufacturer.

An example of the wiring detail is shown in Figure 5-9: Synchronization circuit schematic for three Readers, page 159. 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)

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 5-9, page 159.

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 |
| 801693-003 | Sync port module, 4-wire RS422 - SPM |
| 802284-TAB | Controller module, RS422 - CTM |
| 802284-TAB | Controller module, RS232 - CTM |
| 802344-001 | Lane kit, IAG-3 |
| 800260-011 | Antenna, IAG-1 |
| 800260-015 | Antenna, IAG-3 |
| 800125-001 | Adapter cable, RF |

| Part Number | Description |
|-------------|---------------|
| 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 360430-111 | Interface Control Document for the Next Generation Reader External Hardware Interface |
| 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

Belden 89730 Multi-Conductor - Multi-Pair Snake Cable Detailed Specifications and Technical Data

Belden 9730 Paired - Multi-Pair Snake Cable Detailed Specifications and Technical Data

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 CGC2 and MC |

| Term | Meaning | Reference or example |
|----------|---------------------------------------|--|
| CTS | Clear to send | RS232 pin assignment |
| DA | data | |
| DB or dB | decibel(s) | unit of measurement of RF signal strength |
| 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 Domain Module | An RF module that is able to scan multiple OBUs from the frequency being emitted by them. |

| Term | Meaning | Reference or example |
|-------|--|--|
| 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 |
| GND | ground | |
| HS | handshake | |
| HTTPS | Hypertext Transfer Protocol Secure | |
| Hz | Hertz | Cycles per second |
| I/O | input/output | |
| IAG | Inter-Agency Group | A group of toll highway agencies regulating common tag content and use |
| 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 |

| Term | Meaning | Reference or example |
|--------|---|---|
| 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 Ver. 2 |
| LPM | Lane Controller Port Module | In the JANUS® Multi-Protocol Reader Ver. 2, 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) |
| 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 |

| Term | Meaning | Reference or example |
|------------|-------------------------------------|---|
| 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 Ver. 2 | |
| RF | radio frequency | Broadcast band transmission frequencies |
| 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 | |

| Term | Meaning | Reference or example |
|----------|---|---|
| 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 Domaine Module | An RF module that is able to scan OBUs through time sequencing by using time difference between one OBU and another. |
| 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 wherein 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 |
| Dynamic Voting | <p>Channel 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 Configuration page - Channel tab. The voting timeout is either;</p> <ol style="list-style-type: none"> 1. Set manually by the operator, or 2. dynamically set according to prevailing traffic speeds on a channel-by-channel basis. |
| 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-IAG 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 |

| Name Term or Component | Alias or explanation |
|-------------------------|--|
| 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 |
| 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. |
| Superframe | 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 the Badger and JANUS® Readers

ATTENTION: A JANUS® Multi-protocol Reader Ver. 2 (MPR2) that is non-redundant uses primary-side hardware components whereas the JANUS® non-redundant reader uses secondary-side hardware components.

ATTENTION: The software of a JANUS® Multi-protocol Reader Ver. 2 (MPR2) 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 Kapsch TrafficCom's 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 has been reduced to 5 ms for the JANUS® Reader. It 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 |
|---|-------|--------|---|
| Performance Features | | | |
| Synchronization | Y | Y | Compatible performance with Badger Reader 4 wire sync circuit. (Not compatible with IAG Reader 2 wire sync circuit) |
| 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 |
| Lane Controller & Reporting Features | | | |
| 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: 400K 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. |

| Feature | JANUS | Badger | Notes |
|--|-------|--------|---|
| Remote reset (reboot) | Y | | reset via a lane controller or the web interface |
| Firmware download | Y | | |
| Maintain multiple firmware images | Y | | At least 6 versions, including factory image. |
| Automatic switchover recovery | Y | | Reader will return control to Primary without operator intervention. |
| USB stick transaction logging | Y | | |
| Diagnostics | | | |
| 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 |
| Other | | | |
| 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). |

| Feature | JANUS | Badger | Notes |
|---|-------|--------|---|
| HARDWARE | | | |
| The JANUS® non-redundant Reader uses the secondary side components. The JANUS non-redundant MPR2 reader uses the primary side components. | Y | N | 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 MPR2 reader software is locked in Primary mode; the mode switch mechanical position is ignored. | Y | N | The Badger non-redundant Reader mode switch is mechanically locked in the “primary” position. |

Appendix B 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.

