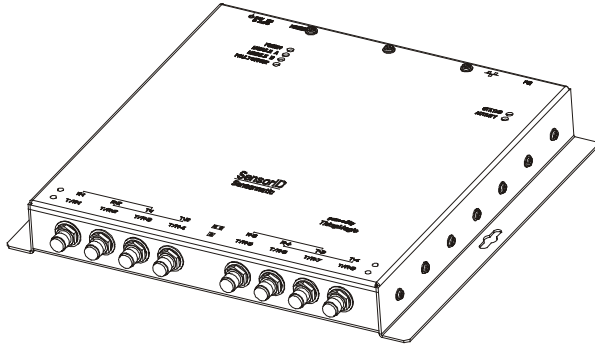# Mercury4 RFID Reader

Installation and Service Guide

TM-M4-NA-01   2 Port UHF – NA 1/0

TM-M4-NA-02   4 Port UHF – NA 1/0

The ThingMagic Mercury4 RFID Reader uses RFID (radio frequency identification) technology to read data stored on RFID tags and labels. The reader operates as an SQL (structured query language) server, providing tag data in response to requests from another application. A separate software application may be used to direct its operation and provide a user interface.

The reader supports UHF (ultra high frequency) antennas, which are available separately. The reader supports multiple configurations of UHF antenna ports and transfers data to a remote computer through a wired 10/100 Ethernet connection.

If you need assistance...

Call the RFID support line at 1-800-555-RFID.

Contents

About this Guide

This installation and service guide explains how to install the Mercury4 Reader and use the browser-based interface.

Use the instructions provided with the antennas to install and service the antennas.

Other related Mercury4 Reader documents are:

- Regulatory Information for the User, TM-M4-X-REG

- Query Protocol Reference Guide, TM-M4-X-RQL

- Industrial Enclosure Installation Guide, tm p/n

Note: Because customer requirements dictate the placement of reader and antenna components, your ThingMagic representative will supply this information separately.

Before You Begin

Installation Requirements

- The reader is shipped with a certified limited power source with a cable length of 1.8m (6ft).

- Use only authorized antennas and cables to maintain FCC approval (see page 3).

- In order to comply with FCC requirements for RF exposure safety, a separation distance of at least 22 cm (8.7 in) needs to be maintained between the radiating elements of the antenna and the bodies of nearby persons.

- Provide strain relief for all reader connections.

- A shielded Ethernet cable must be used to communicate with other devices.

- Multiple readers and antennas can be used in combination to enhance detection at specific locations provided the software application is able to synchronize antenna operation.

- Recommended minimum configuration for a computer running an application that interfaces with the Mercury4 Reader:

  – Pentium® 400 MHz processor
  – 128MB memory
  – 10 GB hard drive
  – Microsoft® Windows® 2000 or Windows XP operating system
  – T-10/100 Ethernet® port
  – CD-ROM drive

Performance Considerations

Reader performance may be affected by external factors including tag variables and environment.

Performance tests conducted under typical operating conditions at your site are recommended to help you optimize system performance.

Tag Variables

There are several variables associated with tags that can affect reader performance:

- Application surface — Some materials interfere with tag performance including metal and moisture. Tags applied to items made from or containing these materials may not perform as expected.

- Tag orientation — Reader performance is affected by the orientation of the tag in the antenna field.

- Tag model — many tag models are available. Each model has its own performance characteristics.

Environment

Reader performance may be affected by the following:

- Metal surfaces such as desks, filing cabinets, bookshelves, and wastebaskets may enhance or degrade reader performance.

  Mount antennas as far as possible from metal surfaces that are adversely affecting system performance.

- Devices that operate at 900MHz, such as cordless phones and wireless LANs, can interfere with reader performance.

  These devices may degrade performance of the reader. The reader may also adversely affect performance of 900MHz devices.

- Antennas operating in close proximity may interfere with one another, thus degrading reader performance.

- Interference from other antennas may be eliminated or reduced by using either one or both of the following strategies:

  – Affected antennas may be synchronized by a separate user application using a time-multiplexing strategy.

  – Antenna power can be reduced by reconfiguring the RF Transmit Power setting for the reader.

Product Configuration and Part Numbers

Mercury4 Reader Description /Part Number	Analog Modules	Addressable Read Points	Protocol Support		
			Class 1	Class 0	ISO 18000
UHF 2-Readpoint TM-M4-NA-01	1	2	Yes	Yes	Yes
UHF 4-Readpoint TM-M4-NA-02	2	4	Yes	Yes	Yes

Authorized Antennas

The only antennas authorized by the FCC for use with the Mercury4 Reader are listed below. Detailed information on each antenna is available from their respective manufacturers.

IMPORTANT: No other antennas may be used with the Mercury4 Reader without violating FCC regulations. It is the responsibility of the user to comply with this requirement.

ThingMagic Dual Antenna

Model: TM-ANT-2
Gain: 6 dBi max.
Connector: Reverse TNC

Sensormatic OMNIPOINT Antenna

Model: IDANT10LNA25
Gain: 5.75 dBi max.
Connector: Reverse TNC

M/A-Com Dual-Polarization Antenna

Model: MAANAT0116
Gain: 6 dBi max.
Connector: Reverse TNC

Matrics General Purpose Antenna

Model: ANT-GPHP
P/N: 250012-001
Gain: 5.75 dBi max.
Connectors: Type N

Alien Dual Antenna Circular/Linear)

Model ALR9611-C+L
Gain: 6 dBi max.
Connectors: integral 20' cable with reverse TNC

Alien Dual Antenna (RH/LH Circular)

Model ALR9611-CR+CL
Gain: 6 dBi max.
Connectors: integral 20' cable with reverse TNC

Antenna Cables

The only cables authorized by the FCC for use with the Mercury4 are listed below:

Long TNC/TNC

ThingMagic P/N: TM-M4CAB-TT-P25
Length: 25'
Insertion Loss: 2.5 dB min.
Cable Type: LMR-195
Connectors: Reverse TNC to Reverse TNC

Long TNC/N

ThingMagic P/N: TM-M4CAB-TN-P25
Length: 25'
Insertion Loss: 2.5 dB min.
Cable Type: LMR-195
Connectors: Reverse TNC to Type N

Short TNC/TNC

ThingMagic P/N: TM-M4CAB-TT-P6
Length: 6'
Insertion Loss: 0.6 dB min.
Cable Type: LMR-195
Connectors: Reverse TNC to Reverse TNC

Short TNC/N

ThingMagic P/N: TM-M4CAB-TN-P6
Length: 6'
Insertion Loss: 0.6 dB min.
Cable Type: LMR-195
Connectors: Reverse TNC to Type N

The two Alien antennas have permanently attached LMR-195 cables with reverse TNC connectors. The loss of the cable is 2.2 dB minimum at 902 to 928 MHz. Do not use these antennas with additional cables.

Setting the Reader RF Power

During initial installation, the reader must be properly configured to use the correct RF power to comply with FCC regulations. DO NOT increase the power beyond this level.

The maximum RF power is determined from antenna gain and antenna cable loss using the formula:

Pmax = 36 dBm - Antenna Gain + Cable Loss

For example, if the antenna has a maximum gain of 6 dBi, and the cable has a minimum loss of 0.6 dB, the maximum RF power that may be set is (36-6 + 0.6) = 30.6 dBm.

The Reader RF Power is set through the Settings Page as described on Page 5. Note that in no case may the power be set higher than 32.5 dBm.

Reader Installation

The following parts are provided with the reader:

| Part	Qty.	Part Number
Multi-frequency RFID Reader	1	TM-M4-NA-0x
Power Supply	1	TM-M4-PS
Installation and Service Guide	1	TM-M4-X-INSTALL
Regulatory Information for the User	1	TM-M4-X-REG
Query Protocol Reference Guide	1	TM-M4-X-RQL

IMPORTANT: Be sure the user receives *Mercury4 Reader Regulatory Information for the User*.

Install the Reader

You can place the reader on a shelf or mount it to a wall.

To mount the reader on a wall:

1. Hold the reader in its mounting location and mark the position of the mounting screws (2).

Mounting holes
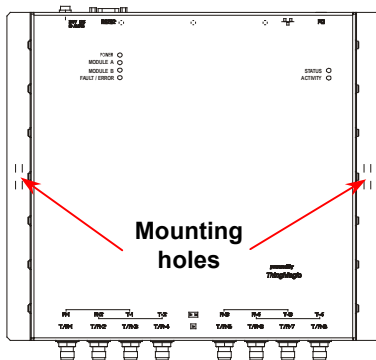
2. Drill holes for the screws and install wall anchors if required.

3. Insert the screws and tighten until almost flush with the wall.

4. Slip the reader over the screws and slide down to lock the screws in the keyhole openings.

5. Tighten the screws.

Install the Antennas

The antennas can be mounted directly to a variety of surfaces. Follow the installation instructions provided with the antennas.

Connect the Reader

A = RJ-45 Ethernet port   **C** = RS-232
B = Safe Mode button   **D** = DC power input

One to four dual antennas can be connected to the reader, depending on the number of cards installed. Silk-screen markings on the reader identify the cards installed.
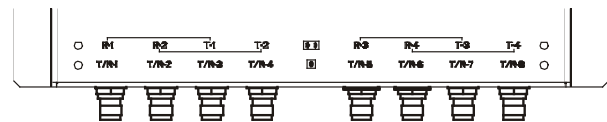
1. Connect required UHF antennas to the ports on the reader (see **Antenna Connection Options** on page 5).

   IMPORTANT: Connect antennas to the ports before applying power to the reader. Any port not having an antenna connected to it will be disabled when the reader is powered on.

2. Verify that all antennas are securely connected.

3. Connect the reader to the network by plugging an Ethernet cable into the Ethernet port.

   or

   Connect the reader to a PC (personal computer) by plugging a crossover Ethernet cable into the Ethernet port.

   [If DHCP is to be used, then the network must be connected **before** powering up the reader.]

4. Plug the transformer provided with the reader into the DC power input connector. Then connect the transformer to a power outlet.

   While the reader is powering up, one green, one yellow, and one red light will be on. After approximately 30 seconds, all lights except the green one should go out; the green light will blink after the reader finishes its power-on selftest. The reader is now ready for operation.
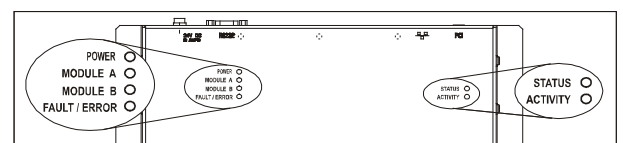
Antenna Connection Options
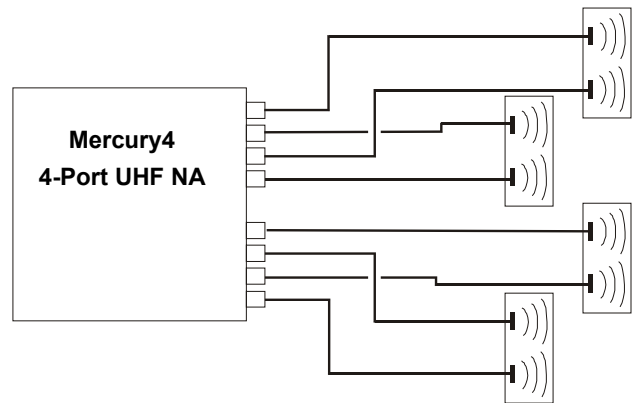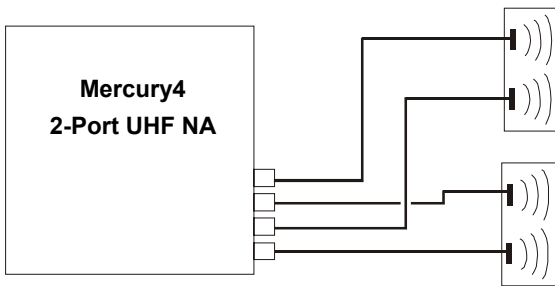
Reader Configuration

In some cases, the application software may provide support for reader configuration. If so, follow the instructions provided with the application.

The following procedure describes how to configure the reader directly from a network PC using the browser-based interface.

The reader is shipped with the following default network configuration:

IP Address:	10.0.0.101
Subnet Mask:	255.0.0.0
Gateway:	10.0.0.1

You must know the IP address and subnet mask settings for the network environment in which the reader will be running.

1. Exit any reader applications that are running on the network.

    IMPORTANT: Running another reader application while using the browser-based interface may cause a reader error. If this happens, reboot the reader or restart the system using the browser-based interface.

2. Verify that the reader is operational. All LED's should be out except for the green power LED which should be pulsing.

3. Start a Java-enabled web browser from any network-enabled PC.

This PC must be configured with an IP address and subnet mask compatible with the reader default settings. For example:

IP address 10.0.0.10
Subnet mask 255.0.0.0

4. Browse to…

    http://10.0.0.101

    The *Mercury4 Reader* browser-based interface to the tag reader is displayed.

5. Click the **Settings** link in the navigation menu. The Modify Settings page appears.

6. These setting apply to both the LAN interface and the wireless interface. If you wish to use DHCP select the DHCP? Yes radio button; otherwise, enter the required network settings in the IP Address, Subnet Mask, and Gateway fields. The fields will turn red if the gateway is not on the same subnet as the IP address. Then, click the **Save Changes** button.

    IMPORTANT: Do not disconnect power until the save process is complete.

7. Set the reader RF power per instructions on page 3 to correspond to antenna and cable types.

8. Verify that the settings shown are correct. Then, restart the reader by disconnecting the power cable and then reconnecting it (see Rebooting the Reader on page 10).

    It may take several seconds for the reader to restart. If the IP address was changed, you must type the new address into the browser address field to communicate with the reader.

9. Once the system restarts, click **Save Changes**. You are taken to the Settings Modified page. Your changes will be saved and then applied. After the reader reconfigures its network interfaces, it will automatically redirect you to its status page. There is no need to restart the reader.

    IMPORTANT: Do not disconnect power while the reader is saving its new configuration.

    The reader is now ready to receive commands from the network.

10. Use the Query page of the browser-based interface to verify antenna operation.

11. Close the browser window. Start the reader application on the network.

Reader Service

Using the Browser-Based Interface

The Mercury4 Reader browser-based interface communicates directly with the RFID reader. It includes several tools that enable you to monitor reader performance, change reader settings, and upgrade reader firmware.

A navigation menu provides access to the following pages:

- **Status**—Displays current operational settings.

- **Query**—Allows the user to set frequency of operation, set antennas, set RF air interface protocols, and read tags.

- **Write**—Allows the user to write tags; this is only applicable to tags that are writeable.

- **Settings**—Allows the user to modify network settings.

- **Firmware**—This page can be used to upgrade the tag reader with new firmware images supplied by ThingMagic.

- **Restart**--allows the user to restart the reader.

- **Diagnostics**--this page provides the current operating settings of the reader.

- **Help**—This page provides information that is helpful in operating the tag reader.

The browser-based interface can be run from any PC on the network. Care must be taken to configure the PC with an IP address and subnet mask compatible with the current operational settings of the reader.

To start the browser-based interface:

1. Exit all reader applications on the network.

    IMPORTANT: Running another reader application while using the browser-based interface may cause a reader error. If this happens, reboot the reader or restart it using the browser-based interface.

2. Start a Java-enabled web browser from any network-enabled PC.

3. Type the IP address of the reader you want to communicate with in the Address field of the browser.

4. A navigation menu and the Current Operational Settings page appear in the browser.

Status Page

The Reader Status page shows the current settings of the reader.

1. Click the Status link in the navigation menu to display the Current Operational Settings page.

2. Close the browser window if you are finished using the browser-based interface.
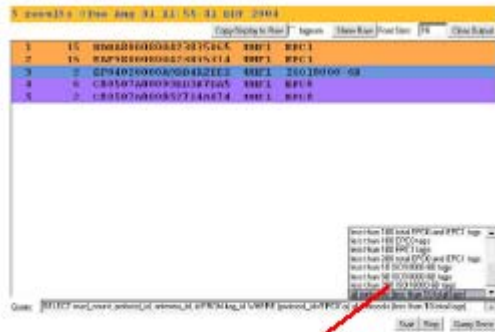
Query Page

Use the Query page to monitor reader performance. The Query page is useful for verifying performance when installation is complete and for troubleshooting performance issues.

The Query field includes a drop-down list (at the bottom-right of the screen) that enables you to specify the operating mode. The operating mode specifies the tag protocols and antenna ports to be used in conjunction with the Query page.

**Note:** The selected settings DO NOT affect reader performance associated with other applications.

Operating mode pull-down list

The following operating modes are available for use with the Query page:

Selection	Description
EPC1	CC915 protocol tags using both UHF antenna ports
CC915@UHF1	CC915 protocol tags using UHF port 1
CC915@UHF2	CC915 protocol tags using UHF port 2
ALL	All protocols using all ports

1. Click the **Query** link on the navigation menu. The Query page appears.

2. Select the operating mode from the pull-down list.

3. Click the **Start** button to begin reading tags.

    Tag data is displayed. Each entry shows sequential tag number, number of times tag was read, tag data, antenna, and protocol.
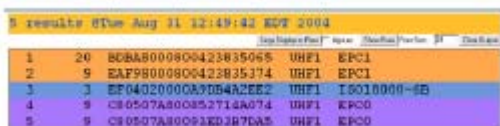
4. Click **Stop** to stop the tag search.

IMPORTANT: You MUST stop the query before exiting the browser-based interface or the reader will continue to poll antennas.

The Query page provides additional options that enable you to control the data that is gathered and how it is displayed:

*   **Bignum** checkbox (when checked) displays the total number of unique tags read. The total is displayed in large red numbers directly over the tags read list.
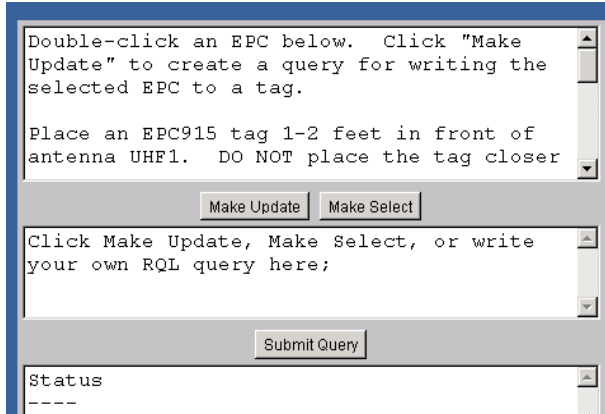

*   **Show Raw** button displays raw tag data on the Query page. Each entry shows reader, protocol, antenna, and tag data.

*   **Hide Raw** button stops the display of raw tag data.

*   **Clear Output** button clears the data displayed.

*   **Query Once** button initiates a single search cycle after clicking **Start**.

Write Page

Use the Write page to replace the EPC data that is encoded on a 915 MHz EPC Class 1 tag.

```
Double-click an EPC below.  Click "Make
Update" to create a query for writing the
selected EPC to a tag.

Place an EPC915 tag 1-2 feet in front of
antenna UHF1.  DO NOT place the tag closer
```

Make Update   Make Select

```
Click Make Update, Make Select, or write
your own RQL query here;
```

Submit Query

```
Status
----
```

Consider the following guidelines when writing to tags:

- Always place a tag 0.3–0.6m (1–2ft) from the antenna when writing data. The tag may be damaged if it is too close to the antenna.

- Only unlocked 915 MHz tags can be used. The write function is not supported for 13.56 MHz tag protocols.

- The data to be written must be exactly 16 hexadecimal characters (numerals from 0–9 and letters from A–F).

- Always place only one tag in the antenna's field when writing. If multiple tags are present, they will all be encoded with the same EPC data.

- Use the antenna connected to UHF1.

To write data to a tag:

1. Click the **Write** link on the navigation menu. The Write page appears.

2. In the top pane, type or paste the 16-character hexadecimal data to be written to the tag.

3. Highlight the hexadecimal data.

4. Click the **Make Update** button. A query designed to write the highlighted data to the tag appears in the center pane.

5. Place the tag 0.3–0.6m (1–2ft) from the antenna connected to UHF1.

   Verify that no other tags are in the antenna's field.

6. Click the **Submit Query** button to write the data. If the write was successful, the new tag data appears in the bottom pane.

To read data from a tag:

1. Display the Write page (click the Write link on the navigation menu).

2. Click the Make Select button. A query designed to read data from the antenna connected to UHF1 appears in the center pane.

3. Place the tag to be read within the detection zone of the antenna.

4. Click the Submit Query button to read tag data. Query results appear in the bottom pane.

Settings Page

Use the **Modify Settings** page to change network settings.
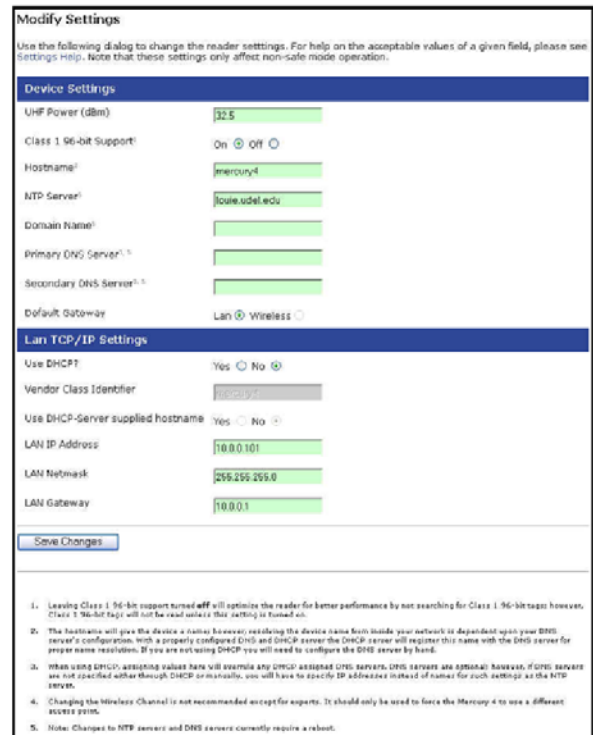
1. Click the **Settings** link on the navigation menu. The Modify Settings page appears.

2. Enter the required settings.

3. Click the **Save** button to save the new settings.

   IMPORTANT: Do not disconnect power until the save process is complete.

   The new settings DO NOT take effect until the reader is restarted by rebooting the reader (see **Rebooting the Reader** on page 10).

Instructions for Modifying the Settings

Changing these parameters changes the values used on startup. The set of variables that can be changed affects both the network settings and radio settings. Even though basic validity checking is performed, care must be taken to use correct values. Changing between static network settings and DHCP will change what fields are valid--static network settings are ignored when in DHCP mode, and DHCP related settings are ignored when in static IP mode.

dhcp?	This radio button determines whether the tagreader uses DHCP to obtain an IP address or static networking.The default value is Yes.
dhcpcd_ixp1	This parameter sets the flags passed to the dhcpcd process. Typical settings include -h hostname and -t timeout_in_secs. The default value is -t 15 -h mercury4.
ipaddr_ixp1	This setting specifies the IP address used when the reader uses static addressing. It is an IP address in dotted-quad notation. The default value is 10.0.0.101.
netmask_ ixp1	This setting specifies the netmask used when the reader uses static addressing. It is specified in dottedquad notation. The default value is 255.255.255.0.
broadcast_ixp1	This setting specifies the broadcast address used when the reader uses static addressing. It is specified in dotted-quad notation. The default value is 255.255.255.0.
gateway	This setting specifies the gateway to use when the reader uses static addressing. It is specified as device_name/gateway_ip_addres s. The default value is ixp1/10.0.0.1.
uhf_power_centi dbm	This setting specifies the UHF power output level, measured in centidBm. The default value is 3000 (equal to 30.00 dBm.)

Firmware Upgrade Page

1. Click the **Firmware** link on the navigation menu. The Firmware Upgrade page appears.

2. Place the cursor in the Filename field and type the complete network pathname of the firmware file or click the **Browse** button to locate the new firmware file.

3. Click the **Upgrade** button to download the new firmware to the reader.

   The status frame at the bottom of the page displays the progress of the upgrade if the web browser supports automatic page reload. Click the **Refresh** button to update the status bar if the web browser does not support automatic page reload.
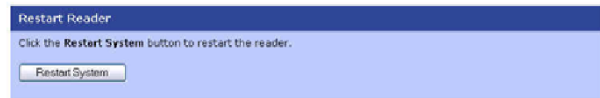
   Downloaded firmware IS NOT implemented until the reader is restarted.

   If an error occurs during the firmware upgrade, use Safe Mode to recover.

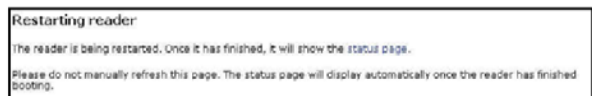## Restart Page

Use the Restart Page to restart the reader.

1. Click the Restart link on the navigation menu.The Restart Reader page appears.

2. To restart the reader, click the Restart System button. The following dialog boa appears.

3. Click OK. The following message appears and remains on the screen until the reader restarts. Then the Status page appears.

Diagnostics Page

The diagnostics page provides a wealth of information, including the current setings of the

reader, comprenhensive version information, and current status of network interfaces.

Mercury4 Diagnostics

Help Page

Use the Help page to view descriptions of system operations.

Quick Reference

Rebooting the Reader

Use this procedure to recover from a reader error.

4. Disconnect power from the reader.

5. Re-connect reader power.

    Wait for at least 60 seconds for the reader to boot up. The Power/Heartbeat LED is solid green while the reader boots. When the LED begins blinking, the boot process is complete.

Using Safe Mode

Use the Safe Mode button on the reader connector panel to recover from errors that disable the reader.

Safe mode operation restores factory default settings as follows:

Firmware Version: ...... factory installed version

UHF (915 MHz) RF Transmit Power: 30

IP Address: 10.0.0.101

Subnet Mask: 255.0.0.0

Gateway: 10.0.0.1

Although the browser-based interface pages are displayed in red when operating in Safe mode, the reader is fully functional. In most cases, the reader

will need to be reconfigured for operation with the reader application after starting in Safe mode.

1. Disconnect power from the reader.

2. Depress and hold the Safe Mode button while restoring power to the reader. Keep the Safe Mode button depressed until the reader boots completely (the green Power/Heartbeat LED blinks).

Safe Mode button

3. Factory-default settings are restored.

4. Use the browser-based interface to configure the reader for use with your system.

   This PC must be configured with an IP address and subnet mask compatible with the reader default settings. For example: IP address 10.0.0.10, net mask 255.0.0.0.

5. Click the **Settings** link on the navigation menu and verify the new settings.

6. Restart the reader with the new settings. Once the restart is complete, the reader is no longer in Safe Mode.

Specifications

Electrical

Reader

UHF operating frequency................... 902–928MHz
Input voltage 24Vdc, 2.0A

Separate Power Supply

Input voltage ....Nominal 100–240Vac, 50/60Hz
AC line current ....Nominal 0.5A at 120V
Output voltage............... Nominal 24Vdc, 2.5A peak
Certified limited power source
Class 2

Environmental

Operating temperature:....0° to 40°C (32° to 104°F)
Relative humidity:............0 to 90% non-condensing

Mechanical

Reader

Length 26.5cm (10.4in)
Width..26.6cm (10.4in)
Width (with mounting bracket) 30.5cm (12in)
Depth 3.8cm (1.5in)
Weight... 1.4kg (3 lbs)

Supported Tag Protocols

915 MHz... EPC Class 1
EPC Class 0
ISO 18000-6B

Declarations

Regulatory Compliance

EMC... 47 CFR, Part 15

Safety ....UL 60950
Can/CSA C22.2 No 60950
EN 60950

FCC COMPLIANCE: This equipment complies with Part 15 of the FCC rules for intentional radiators and Class A digital devices when installed and used in accordance with the instruction manual. Following these rules provides reasonable protection against harmful interference from equipment operated in a commercial area. This equipment should not be installed in a residential area as it can radiate radio frequency energy that could interfere with radio communications, a situation the user would have to fix at their own expense.

EQUIPMENT MODIFICATION CAUTION: Equipment changes or modifications not expressly approved by ThingMagic LLC, the party responsible for FCC compliance, could void the user's authority to operate the equipment and could create a hazardous condition.

IMPORTANT USER INFORMATION: In order to comply with FCC requirements for RF exposure safety, a separation distance of at least 22 cm (8.7in) needs to be maintained between the radiating elements of the antenna and the bodies of nearby persons.

Other Declarations

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