



# Mercury<sup>®</sup>4 / MERCURY<sup>®</sup>5

## User Guide



Intelligent.  
Network Ready.  
Reads Any Tag.



Ignores Interference.  
Gets More 100% Reads.





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Mercury4/5 User Guide: (TM-M4/5-X-INSTALL) Rev. 2.4.5 February, 2007

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# Mercury4 & 5 Reader User Guide

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## About This Guide

This guide explains how to set up the Mercury4 or Mercury5 Reader, how to configure it for network operation, and how to use the browser-based interface. Separate appendices contain specifications and antenna information specific to each reader.

To learn more about the software operation of the Mercury 4 and Mercury5 readers, a Reader Query Language (RQL) Reference Guide is available at <http://www.thingmagic.com/html/support/manuals.htm>. RQL queries for accessing tags are built into the reader's web interface but you can get more out of your reader by modifying them.

ThingMagic's low-level application programming interfaces (APIs) provide fine control over all aspects of the reader. A separate API Programming Guide and software developer kit (SDK) is available upon request from [support@thingmagic.com](mailto:support@thingmagic.com).

# Setting Up For Single Reader Operation

The following section describes how to setup the reader for single reader operation. To setup the reader as part of a larger scale deployment, see the section [Networking the Reader](#) on page 14.

## Required Equipment

Enclosed with your Mercury4 and 5 reader are the following parts:

- ◆ A Mercury4 (TM-M4-NA-02) or Mercury5 Reader (TM-M5-NA-02)
- ◆ Power converter with extension power cable (3m (10ft)) (TM-M4-PS)
- ◆ Shielded ethernet crossover cable (CAT5:TM-CAB-CROSS5)
- ◆ This Mercury4 and 5 User Guide (TM-M4/5-X-INSTALL)

You'll also need the following additional hardware:

- ◆ Up to four Bistatic antennas
- ◆ Two antenna cables for each antenna
- ◆ A computer with a java-enabled web browser

### Note

There is no software to install.

## Set Up Procedure

The following pages detail these steps and show how to get you up and running quickly.

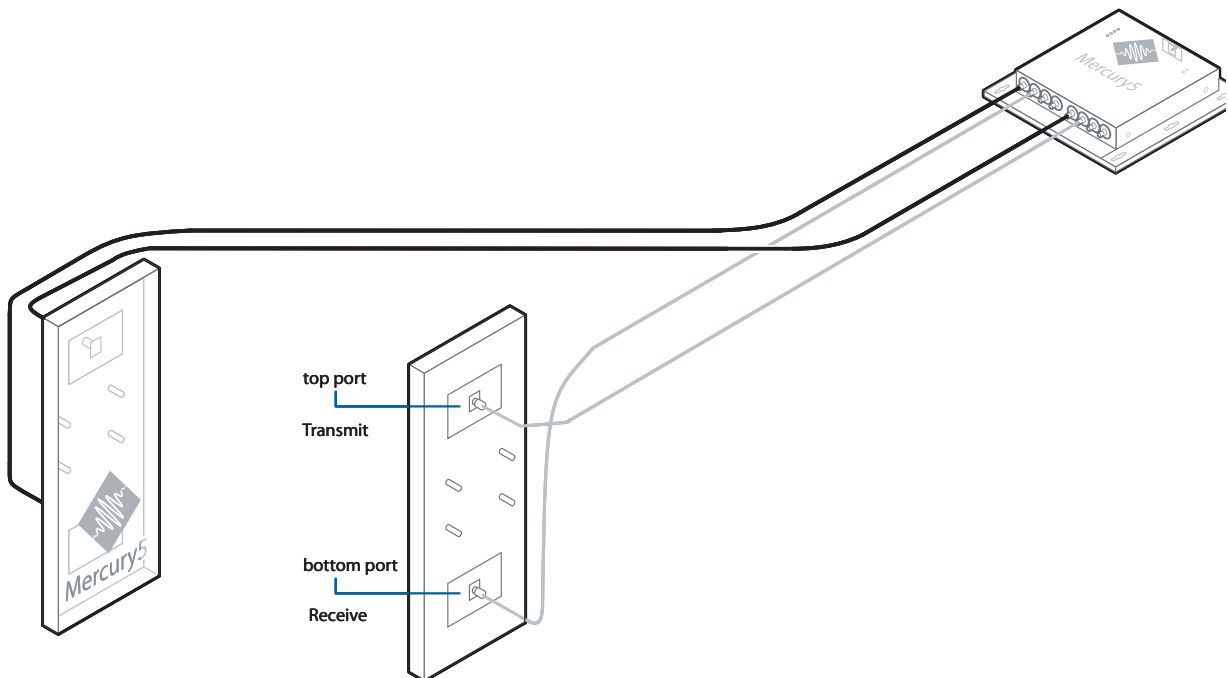
1. [Connect the Antenna\(s\) to the Reader](#) on page 3
2. [Power-Up the Reader](#) on page 5
3. [Connect Your PC to the Reader](#) on page 8
4. [Set Your PC's TCP/IP Setting](#) on page 9
5. [Log On to Reader](#) on page 12

## Connect the Antenna(s) to the Reader

### Note

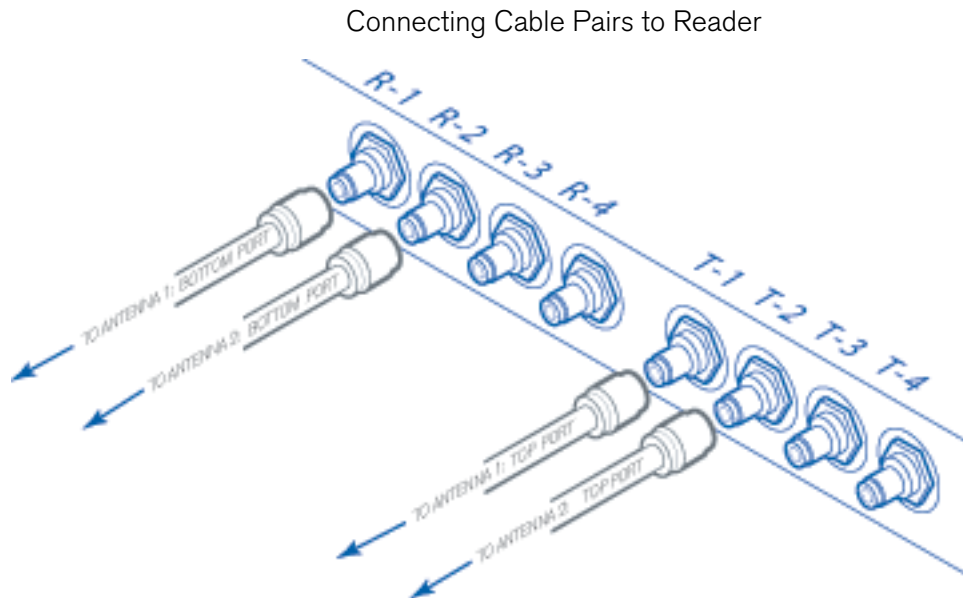
Use only authorized antennas and cables to maintain FCC approval. See [Appendix A: Mercury4 Antenna Information](#) on page 1.

- ◆ 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. See [Authorized Antennas](#) in [Appendix A: Mercury4 Antenna Information](#) for details on antennas.
- ◆ Up to four antennas can be connected to the reader. Each antenna has two ports which are connected in pairs to the reader: one for transmitting, the other for receiving.
- ◆ While either port can be used to transmit or receive, for best performance we recommend using the top port for Transmit and the bottom for Receive. See the figure.





1. Place the antennas upright.
2. When connecting each pair of antenna cables, follow the labels on the reader faceplate as shown below.



3. Connect the top port of the antenna to the T-1 (transmit) port on the reader. Connect the bottom port of the antenna to the R-1 (receive) port on the reader.
4. Repeat for the second through fourth antenna, if supplied, using T2 and R2, etc.

## Power-Up the Reader

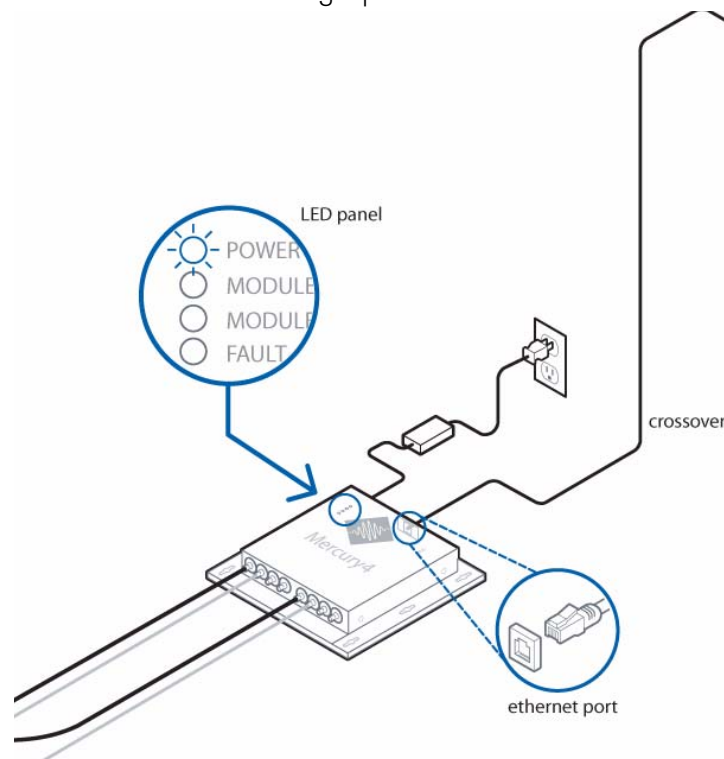
1. Plug the power supply into the reader's power port. DC power input connector.
2. Connect the extension cord to the power supply and plug it into a 100-240VAC power outlet. The reader will immediately begin powering up.

### Note

There is no on/off switch on the reader.

3. While the reader is powering up, the power LED is be solid green. After approximately 60 seconds, the power LED will begin to pulse. The reader is now ready for operation.

Powering Up the Reader

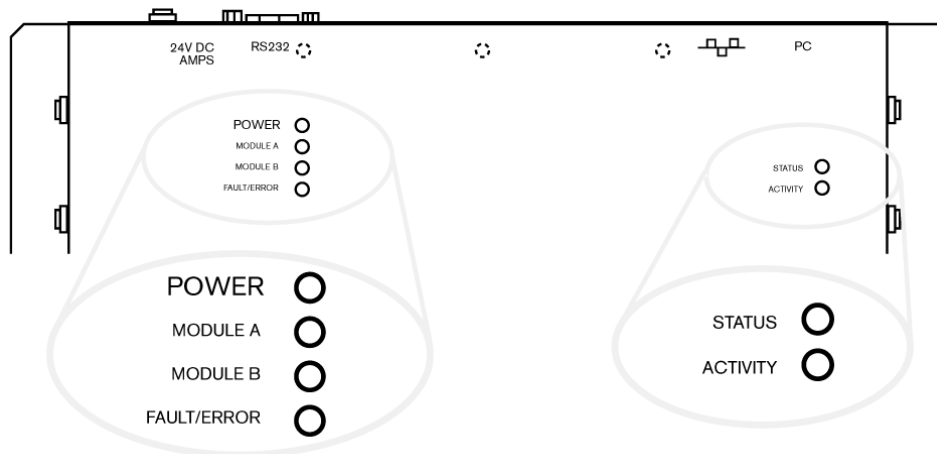




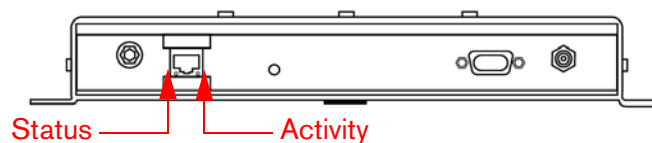
## Interpreting the Reader Indicator LEDs

There are four LEDs on the reader indicating reader activity:

- ◆ **Power** – When solid, the reader is booting. When pulsing, reader is ready for operation.
- ◆ **Module A** – Operational only on older model Mercury4 readers.
- ◆ **Module B** – Flashes continuously when RF is transmitting on any antenna.
- ◆ **Fault/Error** – When solid red, the reader has crashed.
- ◆ Two LEDs on top of the reader, labeled **Status** and **Activity**, are not currently operational. See the figure.



- ◆ Two small LEDs adjacent to the Ethernet port indicate Status (left) and Activity (right) when connected to a PC or network plug. See the figure.



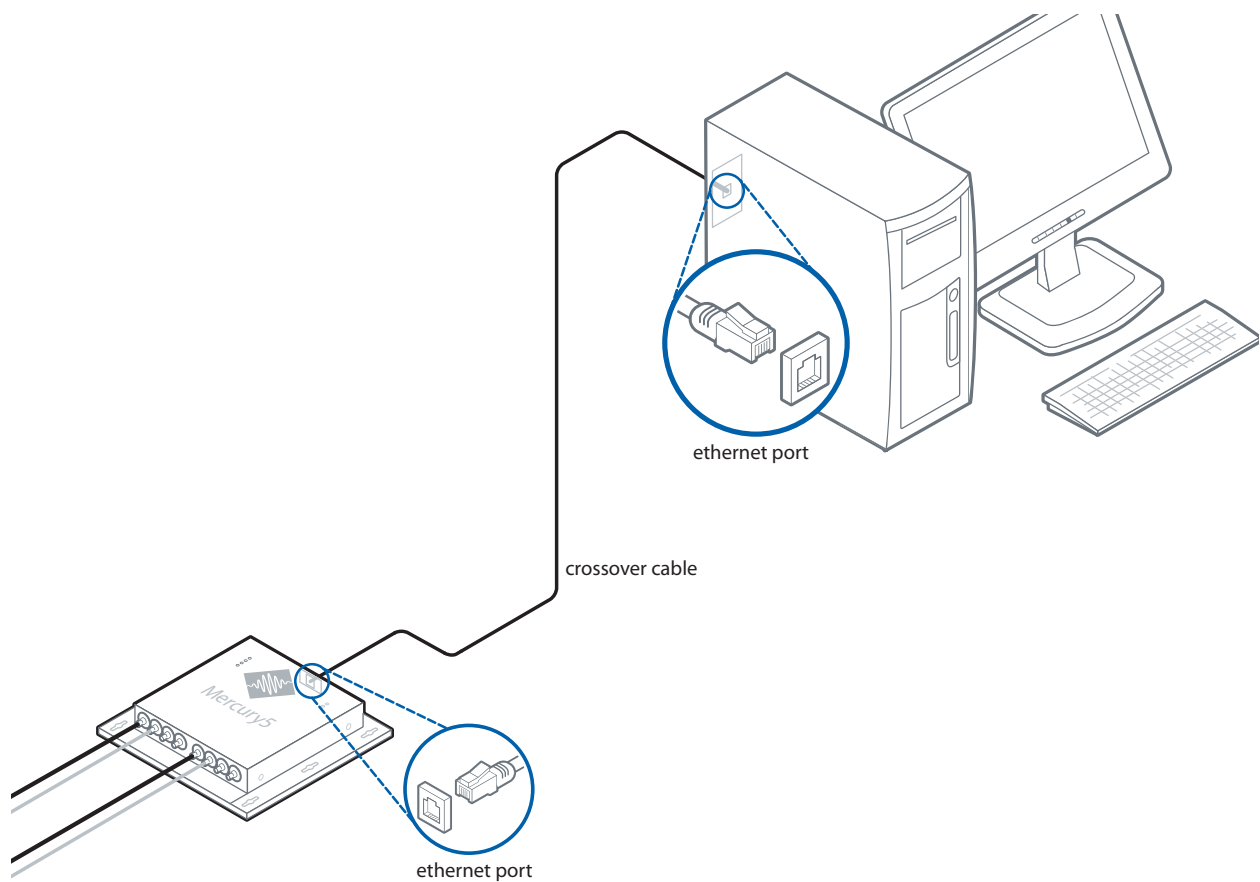
## Connect Your PC to the Reader

These instructions are for directly connecting your computer to the reader. For instructions on connecting the reader to a network, see the section [Networking the Reader](#) on page 14.

1. Connect the enclosed shielded Ethernet crossover cable to your PC and to the reader.

### Note

Straight-through shielded Ethernet cables are fine for connecting the reader to a network.



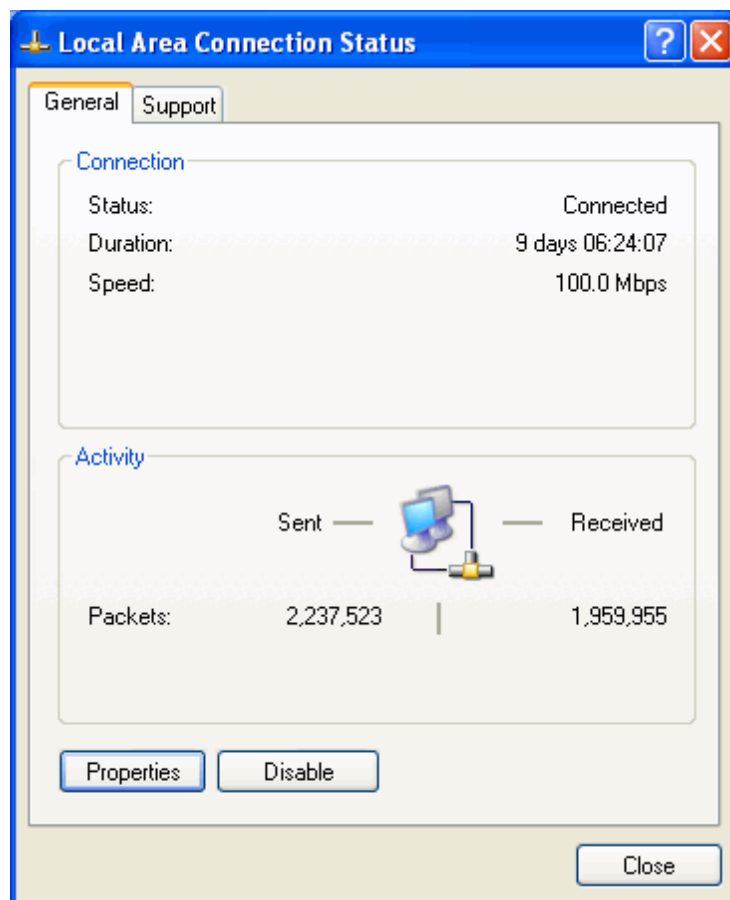
The reader is now ready for operation.

## Set Your PC's TCP/IP Setting

These instructions assume you are using Windows XP. For other operating systems, consult your network administrator.

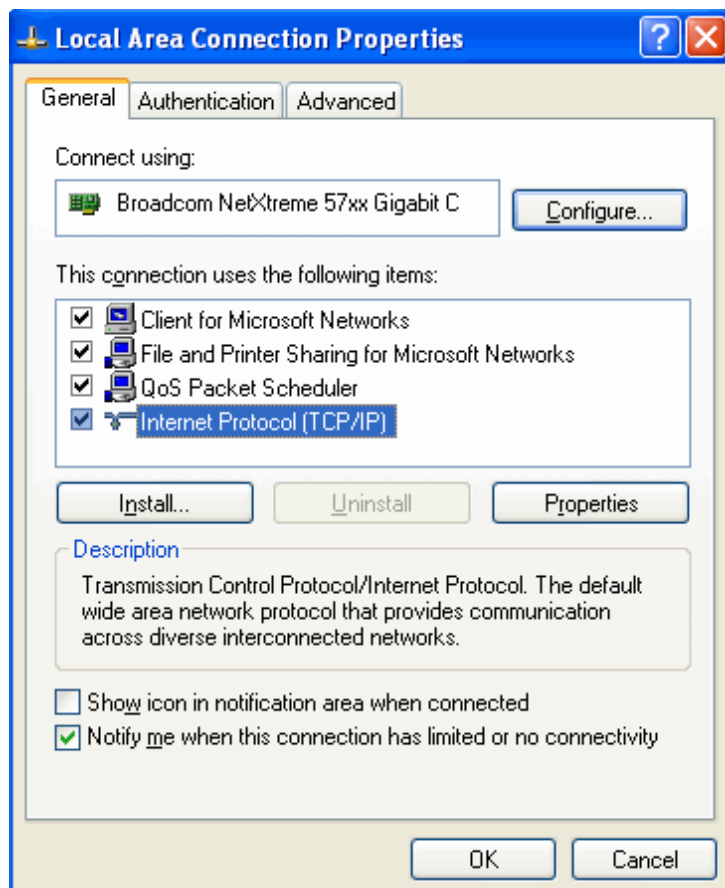
To set your PC's TCP/IP setting use the following steps:

1. From the start bar, select Start →Control Panel.
2. Double-click the Network Connections icon.
3. Disable your PC's wireless connection.
4. Double-click the the Local Area Connection icon. The Local Area Connection Status window appears. See the figure.

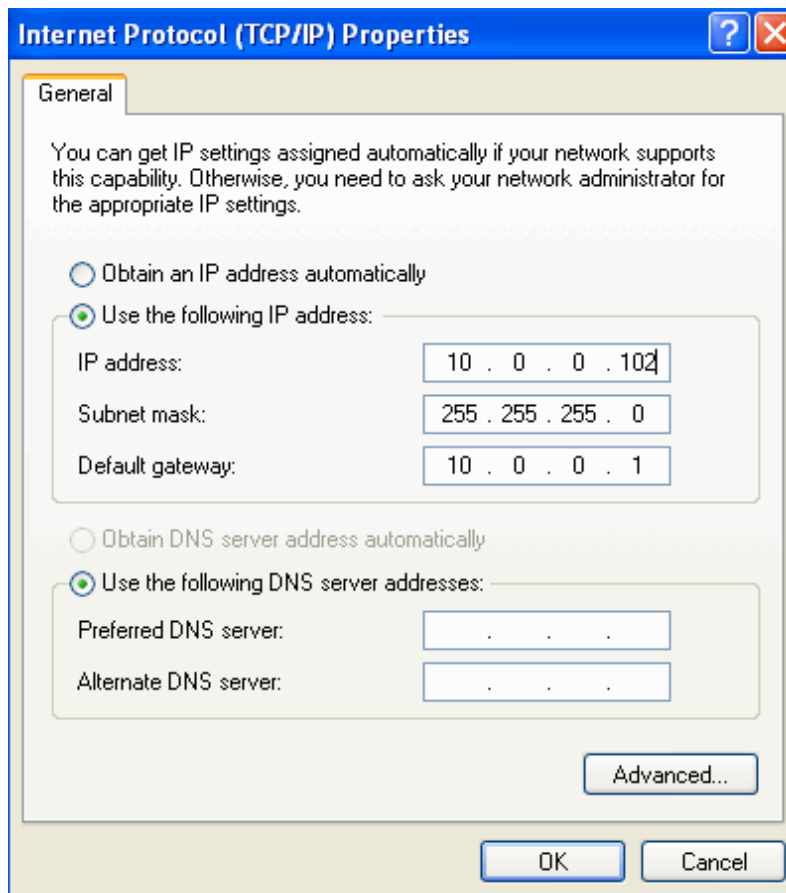


5. Click the Properties button.

6. Scroll down to the bottom of the list and select the Internet Protocol (TCP/IP) item.



7. Click on the Properties button.
8. The Internet Protocol (TCP/IP) Properties window appears. (see below).



9. Select the radio button labeled “use the following IP address:”
10. Enter the settings as shown below.  
IP address: 10.0.0.102  
Subnet Mask: 255.255.255.0  
Default Gateway: 10.0.0.1
11. Click OK to save and exit the window.
12. Click OK at the Local Area Connection Properties window.

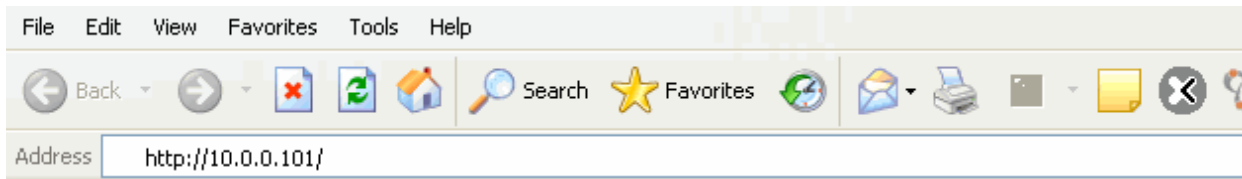


## Log On to Reader

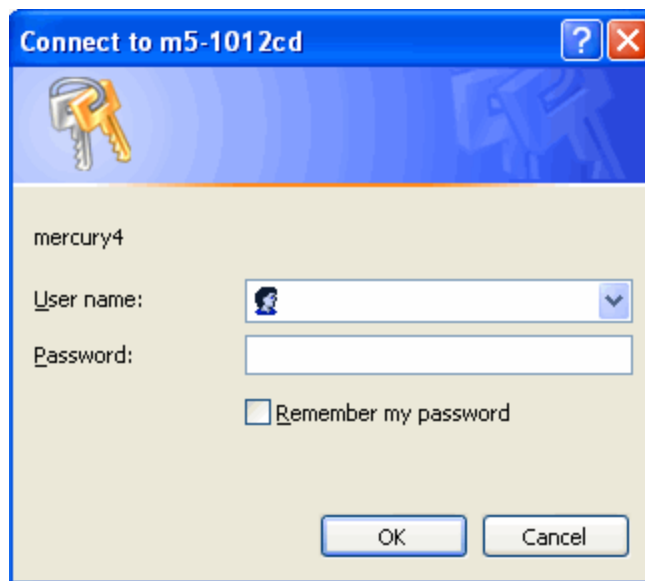
You may use any java-enabled web browser to log on to the reader.

Use the following steps to logon to the reader:

1. Launch your web browser and log on to the reader by entering the reader's default IP address of **http://10.0.0.101/** in the address bar and pressing ENTER.



2. The log on dialog screen appears.



3. Enter the default User name: "web" and Password: "radio" (all lower-case). Click OK.

- The Mercury4 or Mercury5 reader displays its browser-based interface. The Status Page is the initial page which appears.

#### Mercury5 Status Page

Status	<b>Mercury5 Status</b>	
Query	<b>Device Status</b>	
Write	LAN Connection:	<b>Online</b>
Settings	Wireless Connection:	<b>Disabled</b>
Firmware	Connected Antenna Ports:	Port 1: <b>Connected</b>
Restart		Port 2: <b>Connected</b>
Diagnostics		Port 3: <b>Not Connected</b>
		Port 4: <b>Not Connected</b>
Help	<b>MercuryOS and AFE Versions</b>	
	MercuryOS Version:	2.3.28
	Slot 1:	None
	Slot 2:	M5 915 Bistatic
	<b>LAN Configuration</b>	
	LAN IP Address:	10.0.0.101
	LAN Subnet Mask:	255.255.255.0
	LAN Gateway:	10.0.0.1
	LAN MAC Address:	00:12:A4:10:12:C6

- Check the Connected Antenna Ports. **Green**=Connected

#### Next Steps

- To connect the reader to a network and log in remotely, see the section [Networking the Reader](#) on page 14.
- To start reading tags and control the reader, see the section [Controlling the Reader](#) on page 22: it guides you through all the available reader functions including how to read and write tags, change settings, load firmware and reboot the reader in safe mode.

## Networking the Reader

You can set up the reader to use either manual IP addressing or DHCP. By default, the reader has automatic addressing enabled: it boots up looking for a DHCP server.

DHCP can be used to automatically assign the reader's IP address, subnet mask, default gateway, NTP Server, DNS server and hostname. If the reader does not get a DHCP-assigned IP address during its initial boot sequence, it defaults to the static IP address of 10.0.0.101, but will periodically check to see if a DHCP server is available.

The following sections detail how to set up your PC and reader for automatic DHCP configuration, as well as manually configuring the reader without a DHCP server and using the ZeroConf protocol – Bonjour™ – for subnet reader discovery without a DHCP server.

- ◆ [DHCP](#) on page 15
- ◆ [Bonjour](#) on page 20

## Hardware Setup

Whether you use DHCP or static network addressing, make sure the network is connected before powering up the reader. If the reader does not get a lease from a DHCP server, it falls back to its static IP address of 10.0.0.101, subnet mask 255.255.255.0 and gateway 10.0.0.1.

### **Before Setting Your Network Settings:**

- ◆ Connect one end of the Ethernet cabling to the reader and the other end to the Ethernet switch or hub
- ◆ Check that all antennas are securely connected, and power up your reader
- ◆ Connect your computer to the same network as the reader

### Note

To connect the reader to a network hub or switch, we recommend using shielded UTP-Cat5 straight through Ethernet patch cabling.

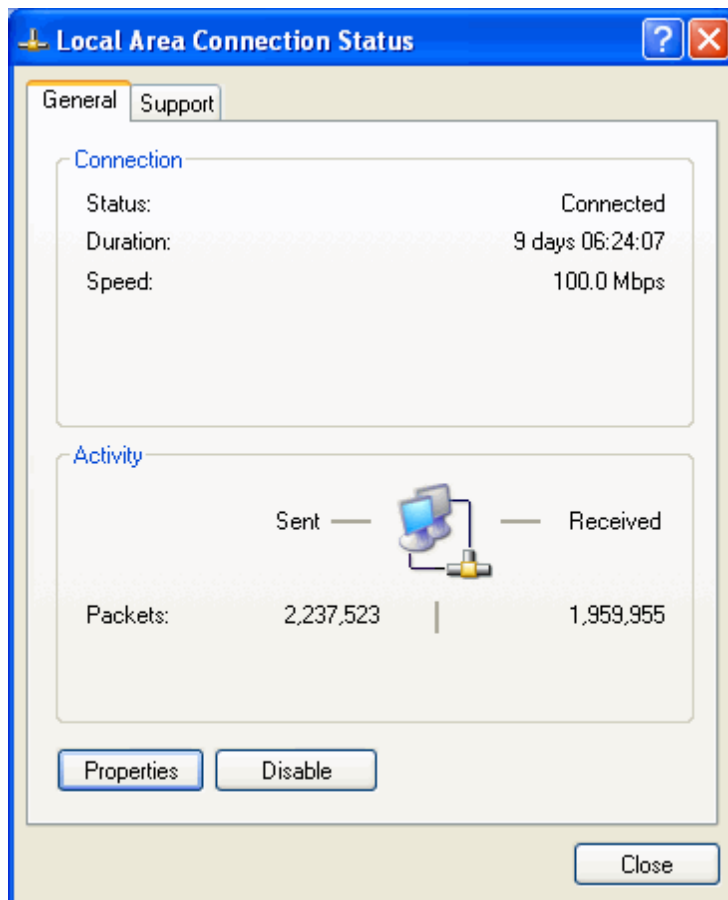
### Note

Some older 10baseT network hubs do not work properly with the reader. If you encounter connectivity problems we recommend using nothing below 10/100baseT hubs/switches.

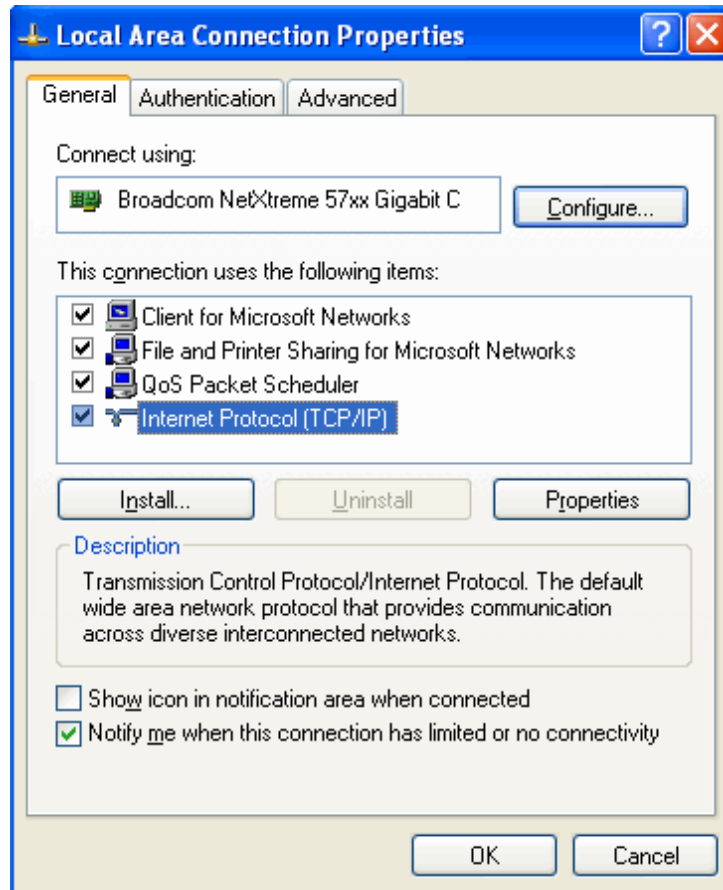
## DHCP

To enable automatic assigning of your PC's IP address by DHCP, use the following steps.

1. From the Start bar, select Start → Control Panel.
2. Double click the Network Connections icon.
3. Disable your PC's wireless connection, if one exists.
4. Double click the Local Area Connection icon.
5. The local area Connection Status window appears.

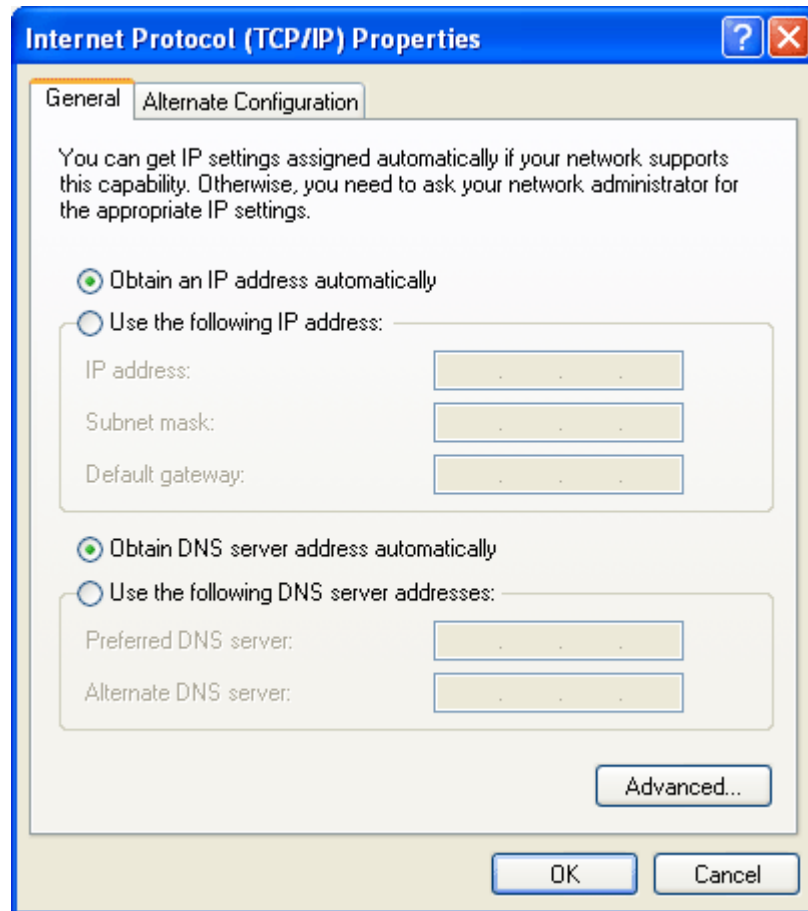


6. Click the Properties button. The Local Area Connection Properties window appears.



7. Scroll down to the bottom of the list and select the Internet Protocol (TCP/IP) item.
8. Click on the Properties button.

9. The Internet Protocol (TCP/IP) Properties window appears.



10. Select the radio button "Obtain an IP address automatically".
11. Click the OK button to save and exit the Internet Protocol Properties window.
12. Click the OK button at the Local Area Connection Properties window.
13. Click the Close button at the Local Area Connection Status window.
14. Several moments pass as the PC saves its new network settings.

## Automatic Hostname: m5-xxxxxx

By default at startup, the reader generates an 'automatic hostname' by appending the last three bytes of its MAC address to its hostname, such as m5-6b3043.

Please note that your network needs to have properly configured DNS servers if you wish to connect to the reader via its hostname.

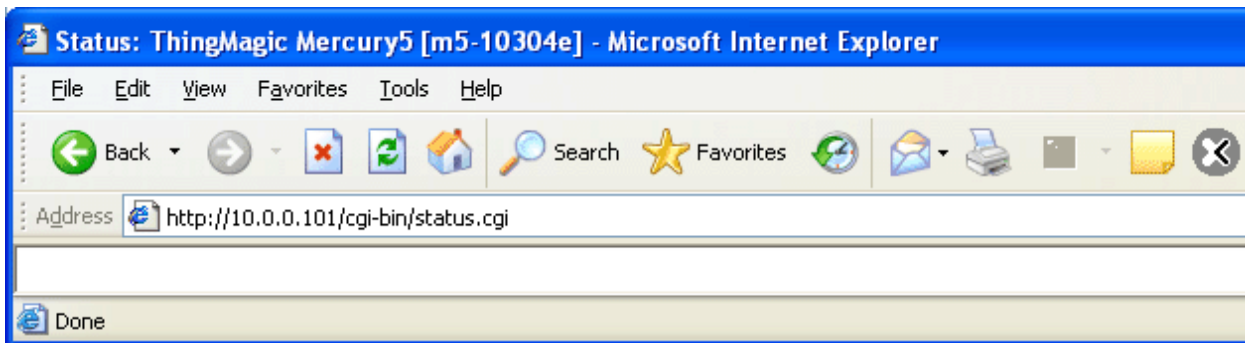
Typically, when using DHCP the DHCP server adds the hostname to the DNS server's database periodically.

## MAC Address

The reader's MAC address can be found on the back of the reader on a white label next to the Ethernet port. You can also find the reader's MAC address on the Status page.

The first 6 characters of the MAC address are ThingMagic's manufacturer's code. The last 6 characters of the MAC address are specific to the ThingMagic reader and are used for automatic hostname addressing.

1. Obtain the reader's MAC address, then launch your web browser and log on to the reader by entering its automatic hostname in the address bar:
  - For Mercury4: **http://m4-xxxxxx** (the last 6 characters of the reader's MAC address) and press Enter.
  - For Mercury5: **http://m5-xxxxxx**.



2. The reader's logon dialog screen appears.
3. Enter "web" and "radio" in the User name and Password fields and click OK.

- The reader's Status page appears.

Status	<b>Mercury5 Status</b>
Query	<b>Device Status</b>
Write	LAN Connection: <b>Online</b>
Settings	Wireless Connection: <b>Disabled</b>
Firmware	Connected Antenna Ports: Port 1: <b>Connected</b>
Restart	Port 2: <b>Connected</b>
Diagnostics	Port 3: <b>Not Connected</b>
Help	Port 4: <b>Not Connected</b>
	<b>MercuryOS and AFE Versions</b>
	MercuryOS Version: 2.3.28
	Slot 1: None
	Slot 2: M5 915 Bistatic
	<b>LAN Configuration</b>
	LAN IP Address: 10.0.0.101
	LAN Subnet Mask: 255.255.255.0
	LAN Gateway: 10.0.0.1
	LAN MAC Address: 00:12:A4:10:12:C6

- Check to see that all the Antenna ports are connected. **Green** = Connected.




## Bonjour

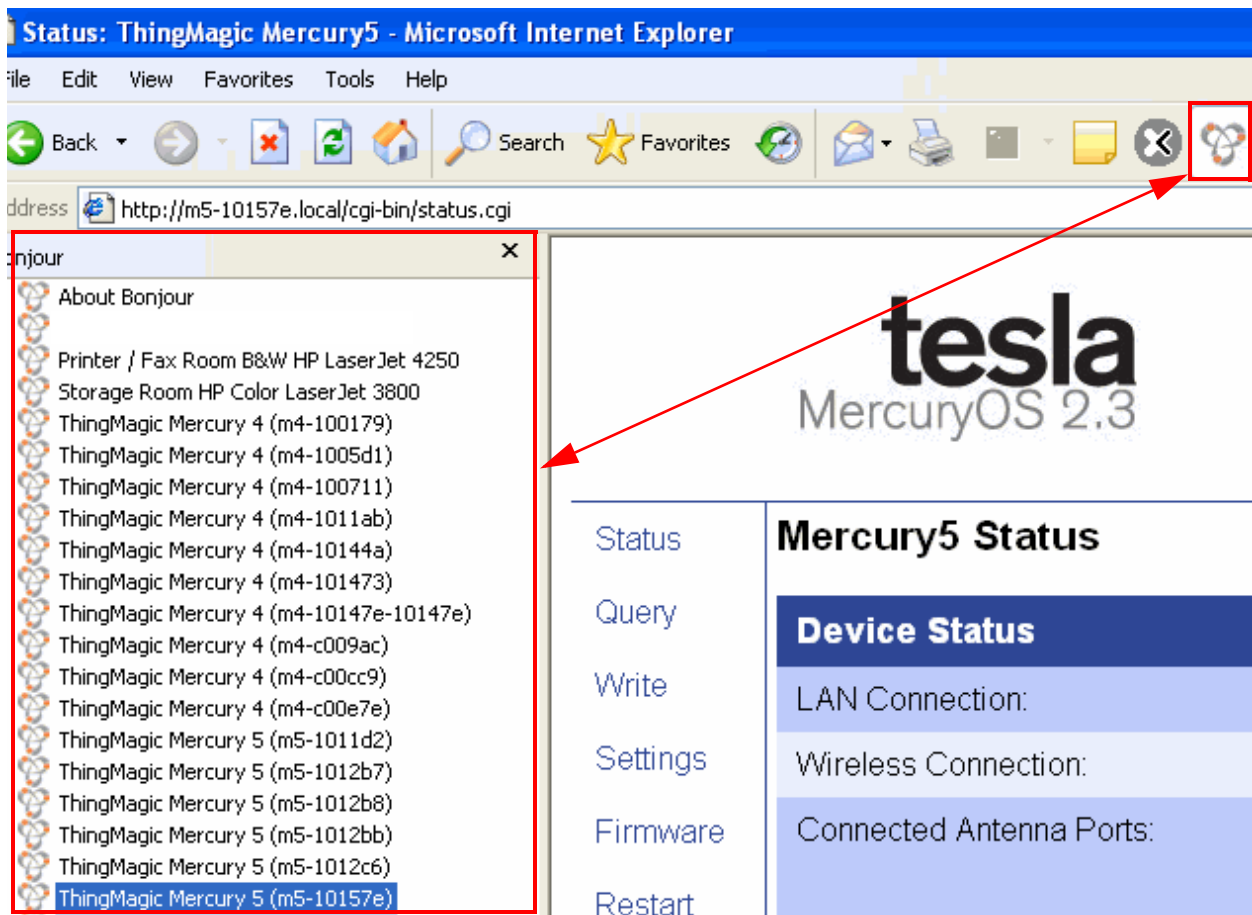
Another way of finding readers on a network is to use the Zeroconf protocol, which Apple calls Bonjour™ (formerly called Rendezvous).

Bonjour works on networks without a DHCP server.

Apple provides a downloadable Bonjour plug-in for Windows Internet Explorer at their web site: <http://www.apple.com/macosx/features/bonjour/>).

Once you have installed Bonjour, reboot your PC and launch Internet Explorer.

1. Click on the Bonjour icon  at the top of the IE browser. See the figure.



### Note

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Notice that each ThingMagic reader in the Bonjour frame on the left side of the page is referenced by the domain name — ThingMagic — followed by the hostname — Mercury4 and Mercury5 — followed by an m4 or m5 and the last six characters of the device's MAC address, such as 10148c.

- 2.** A device frame on the left side of the browser opens and lists the names of all active Bonjour devices available.
- 3.** Double-click on the name of the reader you want to access. The login dialog for that specific reader appears.
- 4.** Type in the factory-default name and password: “web” / “radio” and click the OK button. The status page of the selected reader appears.

This listing is periodically refreshed so that new Bonjour-enabled devices will appear as they come on-line.

## Controlling the Reader

The Reader uses RFID (radio frequency identification) technology to read and write data stored on RFID Tag(s).

The reader provides three levels of access to RFID Tag(s):

- ◆ Browser-Based Interface—A web browser controls high-level reader operations via a Java applet.

See [Using the Browser-Based Interface](#) of this manual.

- ◆ RQL—An intermediate form of accessing the tags is available via the RQL (reader query language) application, operating similarly to an SQL (structured query language) database server.

See the [Reader Query Protocol and RQL](#) manual or download it from ThingMagic at <http://www.thingmagic.com/html/support/manuals.htm>

- ◆ API—Finally, low-level APIs (application programming interface) provide fine control over all aspects of the reader. The reader supports UHF antennas, which are available separately. The reader supports multiple configurations of UHF antenna ports and transfers data to a remote computer over a network connection.

See the [Yagi 2.4 API Setup & Reference Guide](#).

## Using the Browser-Based Interface

The Mercury4 or Mercury5 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.

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.

A navigation menu provides access to the following pages:

- ◆ [Status Page](#) on page 26—Displays current operational settings.
- ◆ [Query Page](#) on page 27—Allows the user to perform Anti-Collision RFID tag searches and to specify the constraints used in the search.
- ◆ [Write Page](#) on page 37—Allows the user to write tags; this is only applicable to tags that are writeable.
- ◆ [Settings Page](#) on page 39—Allows the user to modify reader network settings.
- ◆ [Firmware Update Page](#) on page 47—This page can be used to upgrade the tag reader with new firmware images supplied by ThingMagic.
- ◆ [Restart Page](#) on page 49—Allows the user to restart the reader via a “warm boot.”
- ◆ [Diagnostics Page](#) on page 51—This page provides the current operating settings of the reader.

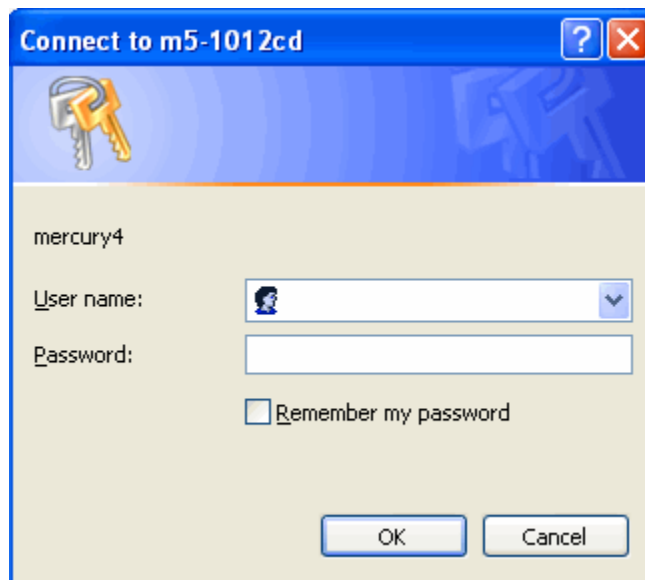
To start the browser-based interface:

1. Exit all reader applications on the network.

Note

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 to which you want to communicate in the address field of the browser or use Apple's [Bonjour™](#) protocol to browse to it.
4. A log-in dialog appears. Enter the factory-installed User name: "web" and Password: "radio" (all lower-case). Click OK.



- A navigation menu and the Status page appear in the browser.

**tesla**  
MercuryOS 2.3



Status	<b>Mercury5 Status</b>
Query	<b>Device Status</b>
Write	LAN Connection: <b>Online</b>
Settings	Wireless Connection: <b>Disabled</b>
Firmware	Connected Antenna Ports: Port 1: <b>Connected</b>
Restart	Port 2: <b>Connected</b>
Diagnostics	Port 3: <b>Not Connected</b>
Help	Port 4: <b>Not Connected</b>
	<b>MercuryOS and AFE Versions</b>
	MercuryOS Version: 2.3.28
	Slot 1: None
	Slot 2: M5 915 Bistatic
	<b>LAN Configuration</b>
	LAN IP Address: 10.0.0.101
	LAN Subnet Mask: 255.255.255.0
	LAN Gateway: 10.0.0.1
	LAN MAC Address: 00:12:A4:10:12:C6

## Status Page

The Mercury4 or Mercury5 Status page indicates the connected antennas, software version and LAN configuration of the reader.

### Note

Check to see that at least one antenna port is connected before performing any tag queries or tag write operations.

Status	<b>Mercury5 Status</b>	
Query	<b>Device Status</b>	
Write	LAN Connection:	Online
Settings	Wireless Connection:	Disabled
Firmware	Connected Antenna Ports:	Port 1: Connected
Restart		Port 2: Connected
Diagnostics		Port 3: Not Connected
		Port 4: Not Connected
Help	<b>MercuryOS and AFE Versions</b>	
	Region:	North America
	MercuryOS Version:	2.3.30 (2006-08-10T12:52:58-04:00 Tesla )
	Slot 1:	None
	Slot 2:	US DRM 4x2-port UHF (4x2-drm-9)
	<b>LAN Configuration</b>	
	Host Name:	m5-10144a
	LAN IP Address:	10.0.0.101
	LAN Gateway:	255.255.255.0
	LAN Subnet Mask:	10.0.0.1
	LAN Gateway:	00:12:A4:10:14:4A

## Query Page

The Query page is mainly used to set up and run Anti-Collision searches quickly and give you immediate feedback. This can be useful for verifying performance when installation is complete and for debugging.

- 1.** Click the Query link in the navigation menu.
- 2.** Wait a few moments until the Java applet finishes loading, and prepare some tags for testing.
- 3.** The screen will be blank except for the controls. You are now ready to read tags.

### Note

If the Query page does not load and you do not see the Java logo, you may need to install the Java Runtime Environment for Windows and restart your PC.



## Read Tags

1. Position one or more tags a few feet in front of one of the antennas connected to the reader.
2. Select an appropriate built-in query from the pull-down list.

For instance:

- If you are using GEN2 tags, select “fewer than 10 GEN2 tags” from the list.
- If you are using other types of tags, select an appropriate query.
- If you don’t know what type of tags you have, select “fewer than 10 tags, any protocol”. Using “any protocol” will slow the search somewhat since the reader will spend time looking for tag types which may not be in the field.

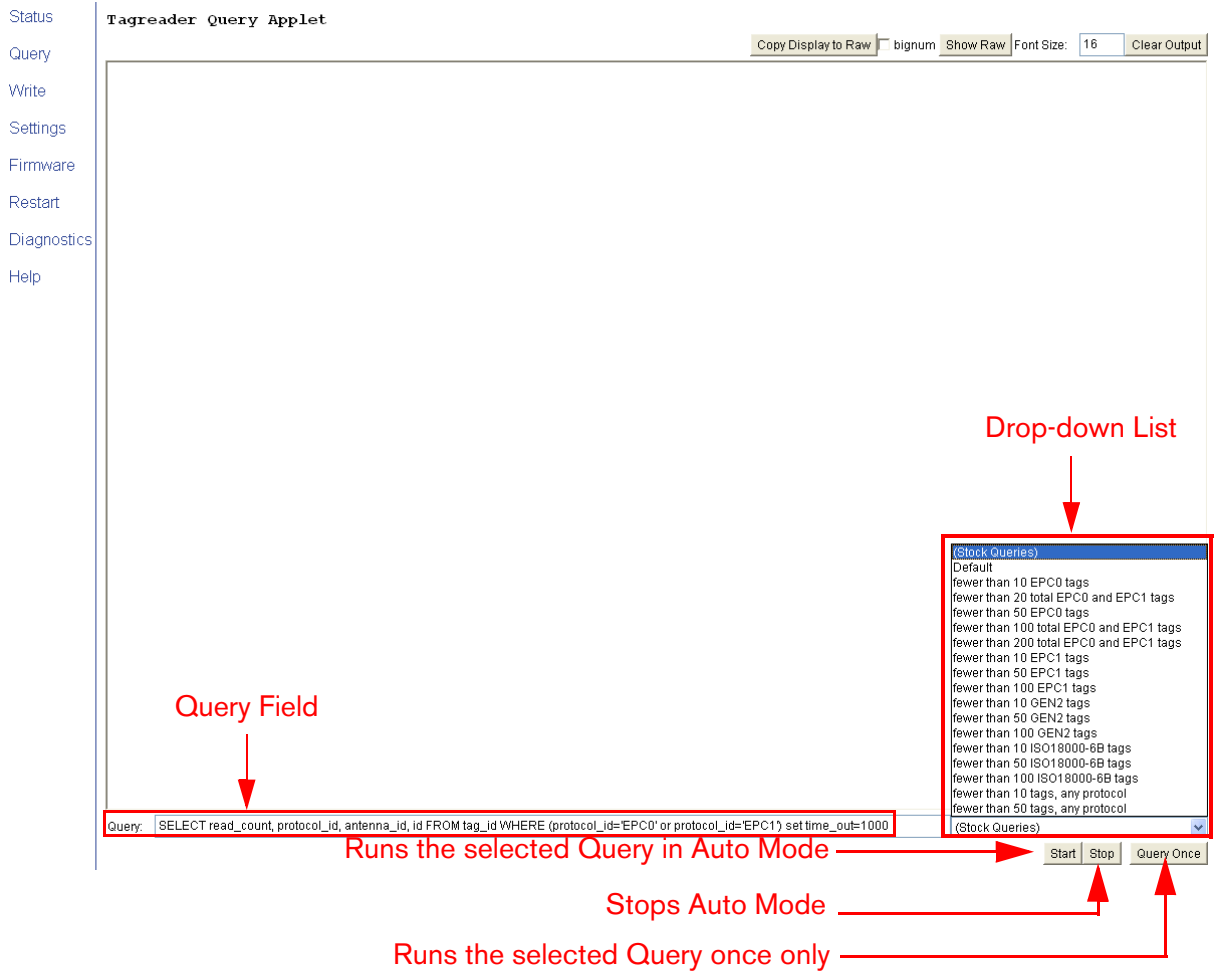
### Note

Reader performance is optimal when the most appropriate query is selected.

### Note

Depending on your region and firmware version loaded on the reader, the list of available built-in queries may vary.

## Query Screen



The screenshot shows the 'Tagreader Query Applet' interface. On the left is a sidebar menu with options: Status, Query, Write, Settings, Firmware, Restart, Diagnostics, and Help. The main window has a title bar 'Tagreader Query Applet' and a toolbar with 'Copy Display to Raw', 'bignum', 'Show Raw', 'Font Size: 16', and 'Clear Output'. The main area contains a 'Query Field' with the text: `Query: SELECT read_count, protocol_id, antenna_id, id FROM tag_id WHERE (protocol_id='EPC0' or protocol_id='EPC1') set time_out=1000`. To the right is a 'Drop-down List' titled '(Stock Queries)' containing a list of queries such as 'Default', 'fewer than 10 EPC0 tags', 'fewer than 20 total EPC0 and EPC1 tags', etc. Below the query field are three buttons: 'Start', 'Stop', and 'Query Once'. Red annotations include: 'Query Field' pointing to the text input; 'Drop-down List' pointing to the stock queries menu; 'Runs the selected Query in Auto Mode' pointing to the 'Start' button; 'Stops Auto Mode' pointing to the 'Stop' button; and 'Runs the selected Query once only' pointing to the 'Query Once' button.

At the bottom of the screen is the Query field in which RQL search statements can be entered or selected from the stock queries found in the drop-down list to the right of the Query field.

The RQL search statement in the Query field specifies which tag protocols will be read, which antenna ports are to be used, how long the query is to be run, and other read operation parameters. The query can be run once or continuously. See the figure for a list of available stock queries.

- 3.** Click the Start button at the bottom right to begin continuously reading tags. Tag data is displayed. Each row in this example shows sequential tag number, number of times tag was read, tag data, antenna, and protocol.
- 4.** Click Stop to stop the tag search.

#### Note

---

**IMPORTANT:** Click the Stop button before exiting. You **MUST** stop the query before exiting the query page or the reader will continue to transmit RF energy on its antennas.

## Query Results

The displayed tag data contains a lot of useful information. Each row shows sequential tag number, number of times tag was read, tag data, antenna, and protocol. See the figure.

### Query Page Detail

Total Tags Seen  
During Current  
Search

Number of Times Tag Was Read

Show Raw Button

Date and Time on Reader

34 results Tue Aug 08 13:14:37 EDT 2006

Copy Display to Raw  bignum Show Raw Font Size: 16 Clear Output

1	2	9551A575FFFF8000800465365745	UHF1	EPC1	CRCs
2	1	D5D5A5A5FFFF8000800465365741	UHF1	EPC1	CRCs
3	2	EF04020000A9E2015840	UHF1	ISO18000-6B	64-bit Tag IDs
4	5	EF04020000A9E1A2B89A	UHF2	ISO18000-6B	64-bit Tag IDs
5	6	EF04020000A9A0615F48	UHF2	ISO18000-6B	64-bit Tag IDs
6	5	EF04020000A9DB57ED7E	UHF2	ISO18000-6B	64-bit Tag IDs
7	1	EF04020000A9D2C825B0	UHF1	ISO18000-6B	64-bit Tag IDs
8	3	EF04020000A9E19A0FC1	UHF2	ISO18000-6B	64-bit Tag IDs
9	4	EF04020000A9A087F2A0	UHF2	ISO18000-6B	64-bit Tag IDs
10	3	EF04020000A9C1829A1E	UHF1	ISO18000-6B	64-bit Tag IDs
11	2	EF04020000A9DB11C57C	UHF2	ISO18000-6B	64-bit Tag IDs
12	9	30182EB7000000800000585CC50	UHF2	EPC0	CRCs
13	4	30182EB70000008000005BCAAA6	UHF2	EPC0	CRCs
14	2	30182EB70000008000005C1C410	UHF1	EPC0	CRCs
15	3	30182EB7000000800000584DC71	UHF2	EPC0	CRCs
16	5	00132183F00000000000173D49C	UHF1	GEN2	96-bit Tag IDs
17	5	00132183F000000000001A8AE6A	UHF1	GEN2	96-bit Tag IDs
18	5	00132183F000000000001CE9289	UHF2	GEN2	96-bit Tag IDs
19	4	0F04028F4F2778F60100001ED183	UHF1	GEN2	96-bit Tag IDs
20	4	00132183F0000000000001822BA2	UHF1	GEN2	96-bit Tag IDs
21	3	00132183F000000000001B47D37	UHF1	GEN2	96-bit Tag IDs
22	5	00132183F000000000001800BE0	UHF2	GEN2	96-bit Tag IDs
23	5	00132183F000000000002C32614	UHF1	GEN2	96-bit Tag IDs
24	5	0F040253F7079BDE0100001E6355	UHF2	GEN2	96-bit Tag IDs
25	3	00132183F000000000001779418	UHF2	GEN2	96-bit Tag IDs
26	12	00132183F000000000002B71807	UHF2	GEN2	96-bit Tag IDs
27	2	00132183F000000000002B248A2	UHF1	GEN2	96-bit Tag IDs
28	3	00132183F000000000001D05115	UHF2	GEN2	96-bit Tag IDs
29	4	00132183F000000000002AE9B1F	UHF2	GEN2	96-bit Tag IDs
30	4	00132183F000000000001A75F65	UHF1	GEN2	96-bit Tag IDs
31	5	00132183F000000000001ACEE0E	UHF1	GEN2	96-bit Tag IDs
32	3	00132183F000000000001AE9EE9	UHF1	GEN2	96-bit Tag IDs
33	3	00132183F0000000000018DDA4D	UHF2	GEN2	96-bit Tag IDs
34	3	00132183F000000000002B53845	UHF2	GEN2	96-bit Tag IDs

Query: SELECT read\_count, protocol\_id, antenna\_id, id FROM tag\_id set time\_out=1200

(Stock Queries)  
 Default  
 fewer than 10 EPC0 tags  
 fewer than 20 total EPC0 and EPC1 tags  
 fewer than 50 EPC0 tags  
 fewer than 100 total EPC0 and EPC1 tags  
 fewer than 200 total EPC0 and EPC1 tags  
 fewer than 10 EPC1 tags  
 fewer than 50 EPC1 tags  
 fewer than 100 EPC1 tags  
 fewer than 10 GEN2 tags  
 fewer than 50 GEN2 tags  
 fewer than 100 GEN2 tags  
 fewer than 10 ISO18000-6B tags  
 fewer than 50 ISO18000-6B tags  
 fewer than 100 ISO18000-6B tags  
 fewer than 10 tags, any protocol  
 fewer than 50 tags, any protocol  
 fewer than 10 tags, any protocol

Start Stop Query Once

Order in Which  
Tags are First Seen

Runs the Selected Query in Auto Mode

Stops Auto Mode

Runs the Selected Query Once Only

Note

Notice that EPC1 Tags display their CRC value as the first four digits of the Tag ID and not the last four as the as GEN2, EPC0 and ISO 18000-6b protocols do.

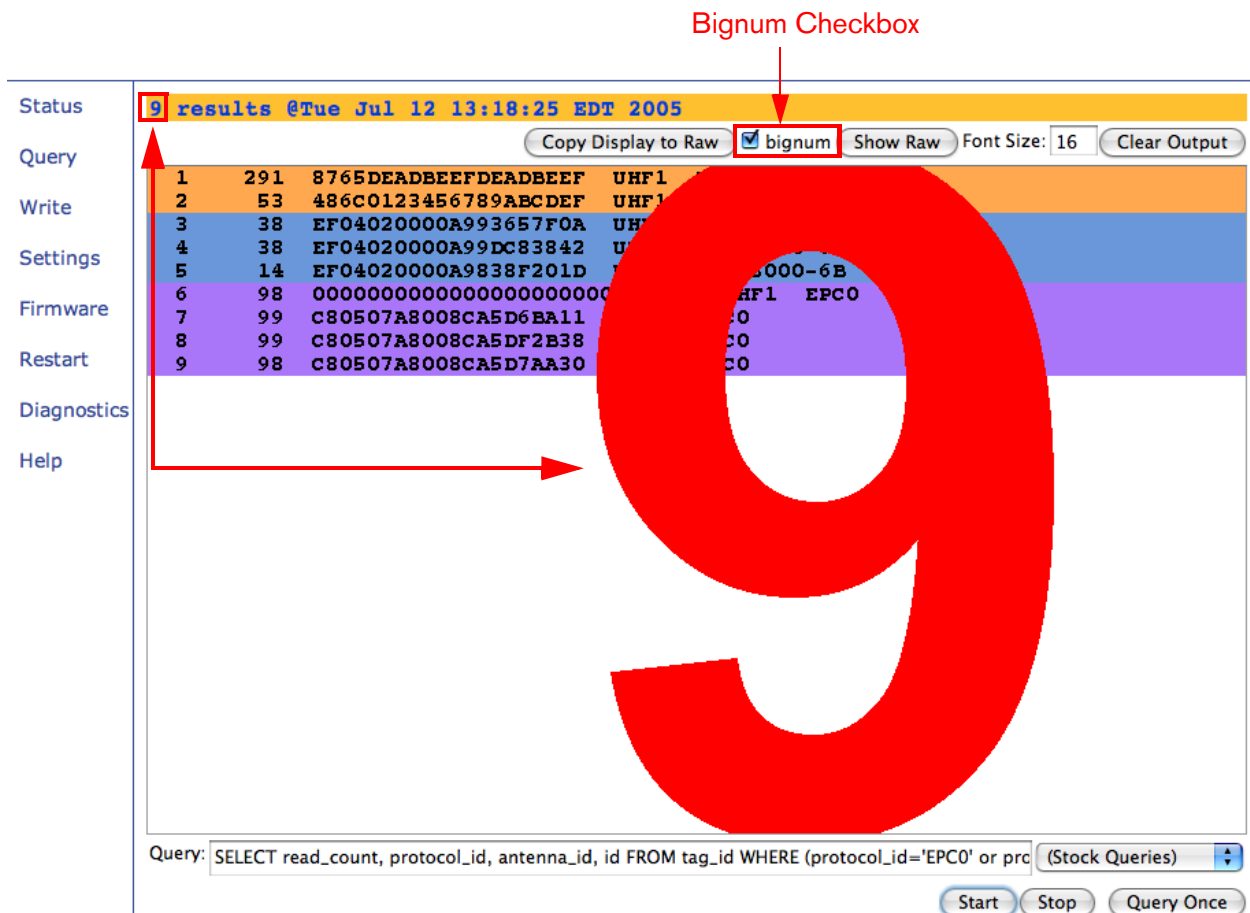
## Bignum Checkbox

The Bignum checkbox (when checked) displays the total number of unique tags read during the current query until you clear the display. The total is displayed in large red numbers directly over the tags read.

When you're operating the reader on your own, with no assistance, this feature can come in handy so you can watch the screen as you move tags and antennas around to check read rates.

The total is displayed in large red numbers directly over the tags read. Each row in this example shows sequential tag number, number of times tag was read, tag data, antenna, and protocol. See the figure below.

Bignum Checkbox



The screenshot shows the ThingMagic interface with the following elements:

- Status Bar:** 9 results @Tue Jul 12 13:18:25 EDT 2005
- Controls:** Copy Display to Raw,  bignum, Show Raw, Font Size: 16, Clear Output
- Table:**

Seq	Reads	Tag Data	Antenna	Protocol
1	291	8765DEADBEEFDEADBEEF	UHF1	UHF1
2	53	486C0123456789ABCDEF	UHF1	UHF1
3	38	EFO4020000A993657FOA	UHF1	UHF1
4	38	EFO4020000A99DC83842	UHF1	UHF1
5	14	EFO4020000A9838F201D	UHF1	UHF1
6	98	00000000000000000000	UHF1	EPC0
7	99	C80507A8008CA5D6BA11	UHF1	EPC0
8	99	C80507A8008CA5DF2B38	UHF1	EPC0
9	98	C80507A8008CA5D7AA30	UHF1	EPC0
- Query:** SELECT read\_count, protocol\_id, antenna\_id, id FROM tag\_id WHERE (protocol\_id='EPC0' or pro...
- Buttons:** Start, Stop, Query Once

By default, font size is set for 16 points. This can be increased to meet your viewing requirements, such as displaying the results with an LCD projector. Enter a larger font number in the font size field to increase the size of the font displaying tag data.

## Show Raw

The “Show Raw” button displays raw tag data on the Query page. This is the actual console output returned from the query. Each row in this example shows reader, protocol, antenna, tag ID and CRC for each tag found. A space separates groups of tags found during each query. Raw data can be easily copied and pasted into other documents. See the figure below.

Raw Data

8 results @Mon Sep 25 13:33:10 EDT 2006

Copy Display to Raw  bignum Hide Raw Font Size: 16 Clear Output

```

1 1 1 0xE70EA5A500000000610162041291
2 8 2 0xEF040200009A26DC34F5
2 9 2 0xAAA12345678912306C64
2 9 2 0x03080507A8020010001AEA3791D6
9 12 2 0x00132183F00000000000035D7752
10 12 2 0x0FE7B9096B8956220101000B6404
4 12 2 0x00132183F000000000000130AC3B
10 12 2 0x300833B2DDD901403505000042E7
1 1 1 0xE70EA5A500000000610162041291
2 8 2 0xEF040200009A26DC34F5
2 9 2 0xAAA12345678912306C64
2 9 2 0x03080507A8020010001AEA3791D6
3 12 2 0x00132183F000000000000130AC3B
8 12 1 0x300833B2DDD901403505000042E7
7 12 1 0x00132183F00000000000035D7752
7 12 1 0x0FE7B9096B8956220101000B6404

```

Query: SELECT read\_count, protocol\_id, antenna\_id, id FROM tag\_id set time\_out=1200 fewer than 10 ta...  
Start Stop Query Once

← CRC  
← Tag ID

## Raw Tag Data

Depending on the fields included in the query, you may display a variety of tag data:

- ◆ **id**: Tag id (in hex) and trailing 4-digit (16-bit) CRC cyclical redundancy check. Note: EPC1 tag ids' CRCs are the leading 4 digits of the tag id.
- ◆ **read\_count**: Number of times the tag was seen during query.
- ◆ **protocol\_id**: EPC1 = 1; ISO18K = 8; EPC0 = 9; GEN2 = 12
- ◆ **antenna\_id**: From 1 to 4 depending on which antenna saw the tag.
- ◆ **frequency**: frequency in KHz in hop table at which tag was seen.

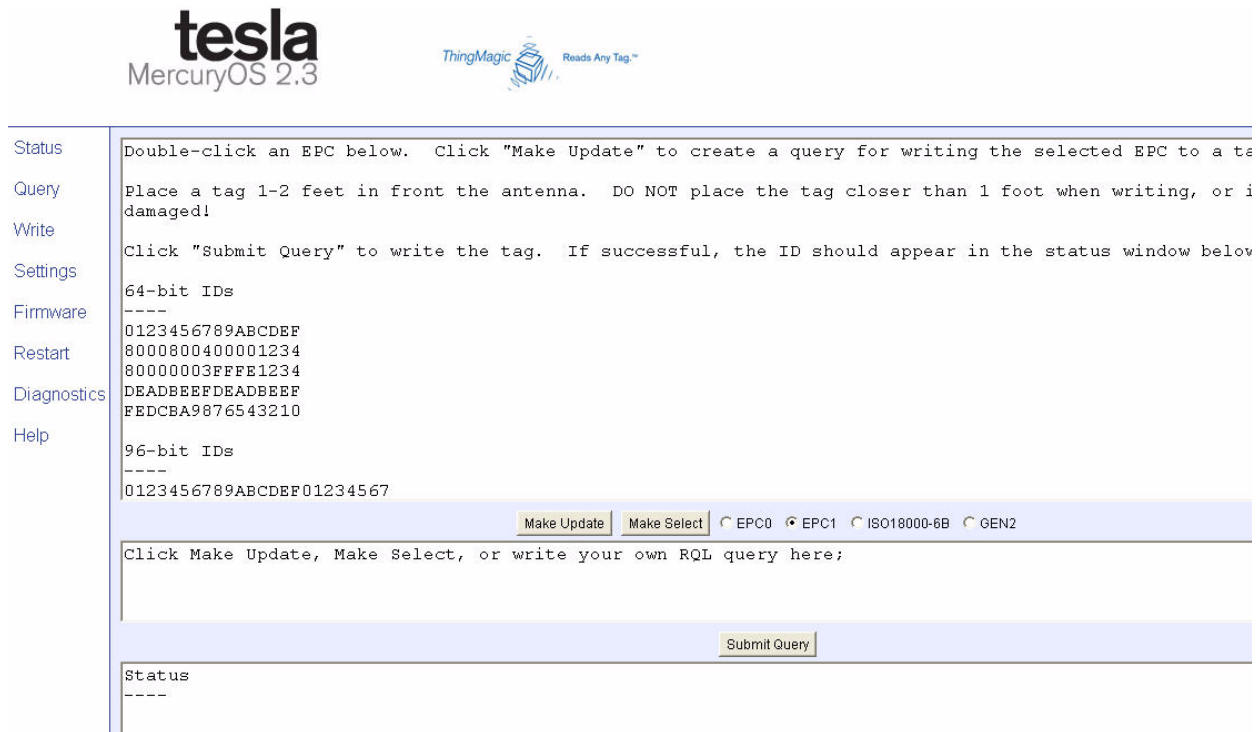


- ◆ **timestamp:** Unix time in seconds and microseconds from 1-1-1970 when tag was seen. Ex: 3004832.188394
- ◆ **dspmicros:** microseconds after start of reading out the tag cache – per protocol.

## Write Page

Use the Write page to replace the id or data that is encoded on a tag.

### Write Screen



Consider the following guidelines when writing to tags:

- ◆ Always place a tag 0.3-0.6m (1-2ft) from the antenna when writing. The tag may be damaged if it is too close to the antenna
- ◆ Only unlocked EPC0+, EPC1, ISO18000-6b, or GEN2 tags can be written. EPC0 tags are always locked and cannot be recommissioned.
- ◆ The ID to be written must match exactly the number of hexadecimal characters (numerals from 0-9 and letters from A-F) specified by the tag's protocol. For example: 96-bit tag ids are 20 hexadecimal characters long; 64-bit EPC1 tag IDs are 16 hexadecimal characters long
- ◆ Clear Output button clears the data displayed
- ◆ Always place only one tag in the antenna's field when writing. If multiple tags are present, they may all be encoded with the same EPC data, or the write may fail.

- ◆ Use the antenna connected to port 1 as it is used as the default antenna for writing tags

### Write an ID to a Tag

1. Click the Write link on the navigation menu. The Write page appears.
2. In the middle pane, type or paste a hexadecimal tag id to be written to the tag in the RQL statement after tag\_id=0x . For example: 16 hex characters for 64-bit tags, 20 characters for 96-bit tags, etc.)
3. Click the Make Update button. A query designed to write the highlighted data to the tag appears in the center pane.
4. Place the tag 0.3-0.6m (1-2ft) from the antenna connected to port 1. Verify that no other tags are in the antenna's field.
5. Click the Submit Query button to write the data. If the write was successful, the new tag id appears in the bottom pane.

### Search For 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 port 1 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 find the selected tag type. Query results appear in the bottom pane. Note that the query can be run only once, unlike on the Query page.

## Settings Page

Use the Modify Settings page to change RFID protocol, network and reader security settings. The page is divided into five sections:

- ◆ [RFID Protocol Settings](#) on page 42
- ◆ [Network Settings](#) on page 43
- ◆ [Network Settings: All Interfaces](#) on page 43
- ◆ [Network Settings: Ethernet Interface](#) on page 44
- ◆ [Boot Option Settings](#) on page 45
- ◆ [Security Settings](#) on page 46

Changing these parameters changes the reader's settings used on startup. RFID protocol settings, boot options and network settings can be modified. Care must be taken to use correct values or you might be unable to connect the reader without restarting into safe mode.

### Note

Do not disconnect power until the save process is complete. Note that new RFID, network and security settings take effect after saving. Boot-related options are saved but DO NOT take effect until the reader is restarted (see [Restarting the Reader](#)). Therefore, to ensure that all new settings take effect, it is recommended that you restart the reader whenever reconfiguring and after saving the new settings.

1. Click the Settings link on the navigation menu. The Modify Settings page appears.

**RFID Protocol Settings**

UHF Power (dBm)	<input type="text" value="32.5"/>
EPC1 Tag ID length <sup>1</sup>	64-bit/96-bit <input checked="" type="radio"/> 96-bit <input type="radio"/> 64-bit <input type="radio"/>
EPC0 Search Depth	<input type="text" value="80"/>
Gen2 Init Q	<input type="text" value="5"/>
Gen2 DRM On	No <input checked="" type="radio"/> Yes <input type="radio"/>
Default RQL Query	<input type="text"/>

**Network Settings: All Interfaces**

Automatic Hostname <sup>2</sup>	On <input checked="" type="radio"/> Off <input type="radio"/>
Hostname <sup>3</sup>	<input type="text" value="m5"/>
NTP Server	<input type="text" value="pool.ntp.org"/>
Domain Name	<input type="text" value="thingmagic.com"/>
Primary DNS Server <sup>4</sup>	<input type="text" value="10.0.0.1"/>
Secondary DNS Server <sup>4</sup>	<input type="text"/>

**Network Settings: Ethernet Interface**

Use DHCP?	Yes <input checked="" type="radio"/> No <input type="radio"/>
Vendor Class Identifier	<input type="text" value="mercury5"/>
Use DHCP-Server supplied hostname	Yes <input type="radio"/> No <input checked="" type="radio"/>
LAN IP Address	<input type="text" value="10.0.0.101"/>
LAN Netmask	<input type="text" value="255.255.255.0"/>
LAN Gateway	<input type="text" value="10.0.0.1"/>
Fallback IP Address	<input type="text"/>
Fallback Netmask	<input type="text"/>
Fallback Gateway	<input type="text"/>

**Boot Options**

Boot Config Options	<input type="text"/>
Boot Config	<input type="text"/>
Boot Firmware Options	<input type="text"/>
Boot Firmware	<input type="text"/>
Syslog Host	<input type="text"/>

**Security Settings**

Secure Shell Only (disable telnet)	Yes <input type="radio"/> No <input checked="" type="radio"/>
Secure Web Only (disable standard http)	Yes <input type="radio"/> No <input checked="" type="radio"/>
Secure RQL Only (disable non-tunneled RQL)	Yes <input type="radio"/> No <input checked="" type="radio"/>

- 2.** Enter the required settings.
- 3.** Click the Save button to save the new settings. Saving overwrites the reader's configuration file with the current settings.

## RFID Protocol Settings

The RFID protocol settings take effect immediately on the reader upon saving them. A restart is not required. The Default RQL Query runs continuously at startup and thus a change to this setting requires a restart of the reader.

RFID Protocol Settings

Setting	Description
UHF Power (dBm)	This field contains the UHF Output power measured in dBm. This setting must be adjusted carefully to comply with FCC regulations. See the section <a href="#">Setting the Reader RF Power</a> .
EPC1 Tag ID Length	These radio buttons enable combined 96- and 64-bit tag support or single tag id lengths. If the reader will only be reading 96- or 64-bit tags, select the 96-bit or 64-bit radio button to optimize read rates.
EPC0 Search Depth	This field contains the maximum number of EPC0 tags to be singulated on each query.
Gen2 Init Q	This field contains the initial value of Q when a search on a GEN2 target begins for the first time.
Gen2 DRM On	This field controls whether the Dense Reader Mode (DRM) is on or off when performing Generation 2 searches.
Default RQL Query	This field contains the initial query that is run continuously when reader starts up.

## Network Settings

Static network settings are ignored when in DHCP mode, and DHCP related settings are ignored when in static IP mode. Please note that your network needs to have properly configured DNS servers if you wish to connect to the reader via its hostname. Usually when using DHCP, the DHCP server will add the hostname to the DNS server's database.

### Network Settings: All Interfaces

Setting	Description
Automatic Hostname	Turning on automatic hostname will append the last six numbers (3 bytes) of the reader's address to the text in the hostname field. For example, given a hostname of mercury(4)or(5) and a MAC Address of 00:12:A4:13:47:AC, the automatic hostname would be mercury(4)or(5)-1347ac.
Hostname	This field contains the name of the reader
NTP Server	This field contains the address of any network time protocol server(s). (Optional)
Domain Name	This field contains the network domain name.
Primary DNS Server	This field allows the Mercury4 or Mercury5 to resolve hostnames to IP addresses
Secondary DNS Server	This field allows the Mercury4 or Mercury5 to resolve hostnames to IP addresses



Network Settings: Ethernet Interface

<b>Setting</b>	<b>Description</b>
Use DHCP?	If set to Yes, the reader will automatically look for its LAN IP, Netmask and Gateway addresses from a DHCP Server.
Vendor Class Identifier	This radio button that enables 96-bit tag support. To optimize the reader keep this setting turned off unless it is needed.
Use DHCP Server-supplied Hostname?	If set to Yes, the manually supplied hostname (see Hostname) will be overridden by the hostname supplied by the DHCP Server.
LAN IP Address	If "Use DHCP?" is set to Yes, the LAN IP, Netmask and Gateway values will be supplied by the DHCP Server. Default or manually entered addresses will be dimmed out and bypassed. If Use DHCP? is set to No, you should manually enter the LAN IP, Netmask and Gateway settings.
LAN Gateway	This is the gateway IP address for the local network, typically the IP address of a router.
LAN Netmask	This is the subnet mask IP address used to determine to which TCP/IP subnet the reader belongs. Devices in the same subnet can be communicated with locally without going through a router.

## Boot Option Settings

The boot option settings specify the location of downloadable firmware and configuration files and their optional parameters, and the location of a syslog server to which all reader events may be sent.

### Boot Options

Setting	Description
Boot Config Options	Optional parameters used when downloading a new configuration file to the reader. -f : force a downgrade if config file version is lower than that currently running on the reader. -p : preserve configuration settings under a wipe -w : wipe flash memory and settings -a : add the reader's MAC Address to download filename
Boot Config	URI to the tm.conf file to be downloaded on startup. Specify local:default for local tm.config file.
Boot Firmware Options	Same as Boot Config Options. Used when downloading new firmware to the reader.
Boot Firmware	URI to the firmware file to be downloaded at startup.
Syslog Host	Name of host for remote logging. All log levels in syslog will be sent to this host.

## Security Settings

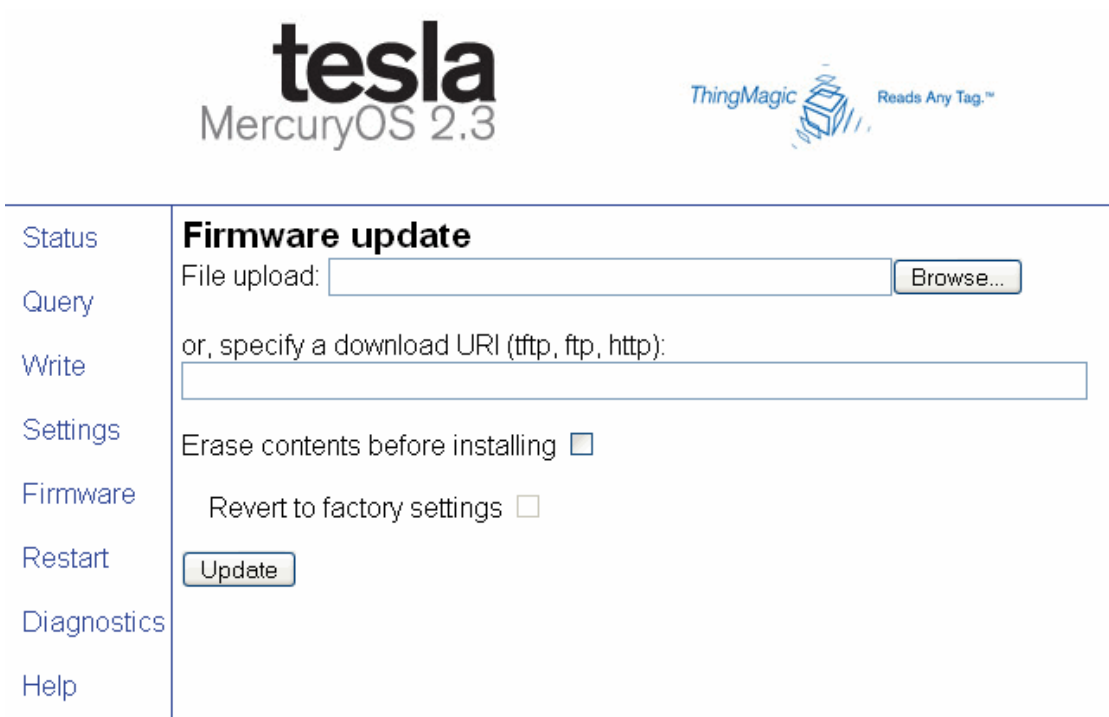
These settings control secure access to the reader using a combination of SSH (Secure Shell), HTTPS and secure RQL calls.

Setting	Description
Secure Shell Only (disable telnet)	If Yes, the telnet server is disabled, and reader access can only be performed via a secure shell (SSH (Secure Shell)).
Secure Web Only (disable standard http)	If Yes, reader will only respond to requests using https URLs.
Secure RQL Only (disable non-tunneled RQL)	If Yes, RQL no longer listens on Port 8080 for remote access. RQL is still accessible via an SSH tunnel.

## Firmware Update Page

1. Click the Firmware link on the navigation menu.

The Firmware Upgrade page appears.



**tesla**  
MercuryOS 2.3

ThingMagic Reads Any Tag.™

Status  
Query  
Write  
Settings  
Firmware  
Restart  
Diagnostics  
Help

### Firmware update

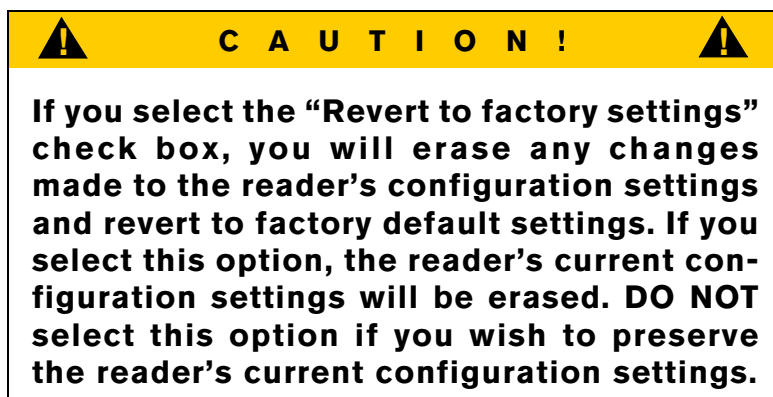
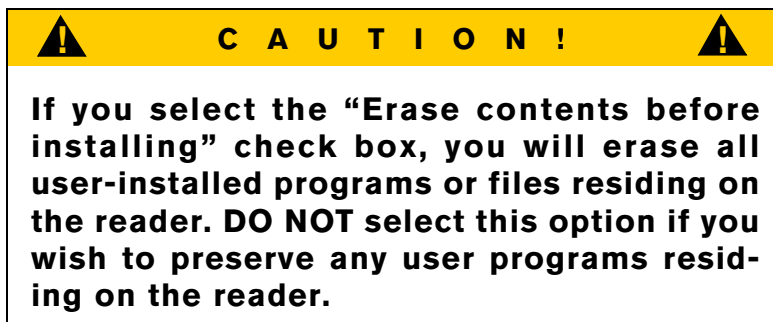
File upload:

or, specify a download URI (tftp, ftp, http):

Erase contents before installing

Revert to factory settings

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



3. Click the Update button to download the new firmware to the reader. The status frame at the bottom of the page displays the progress of the update.
4. To activate the new firmware, restart the reader. Until the reader is restarted, the old firmware will still be active.

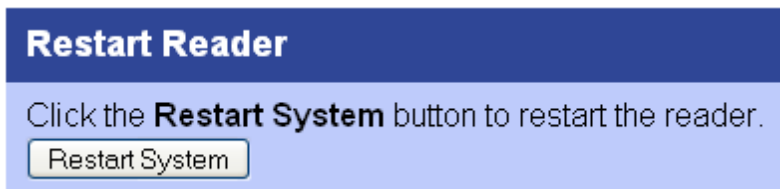
Note

If, for any reason, a firmware update fails, the device may restart in Safe Mode.

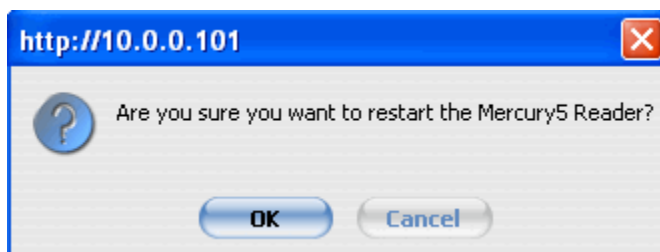
## Restart Page

Use this procedure to activate reconfigured network reader settings or to recover from a reader error.

1. Click the Restart link on the navigation menu; the Restart Reader page appears. See the figure.



2. To restart the reader, click the Restart System button. The following dialog box appears. See the figure.



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

### Restarting reader

The reader is being restarted. Once it has finished, it will show the [status page](#).

Please do not manually refresh this page. The status page will display automatically once the reader has finished booting.

## Restarting the Reader

1. Click the restart link on the navigation menu.
2. Click the restart button and the OK button on the confirmation dialog.

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.

## Diagnostics Page

The diagnostics page expands on information found on the [Status Page](#), including the current settings of the reader, comprehensive version information, and current status of network interfaces.



status	<b>Mercury5 Diagnostics</b>
query	<b>Device Status</b>
write	LAN Connection: <b>Online</b>
settings	Wireless Connection: <b>Disabled</b>
firmware	Connected Antenna Ports: Port 1: <b>Connected</b>
restart	Port 2: <b>Connected</b>
diagnostics	Port 3: <b>Not Connected</b>
	Port 4: <b>Not Connected</b>
help	<b>MercuryOS and AFE Versions</b>
	MercuryOS Version: 2.3.28
	Slot 1: None
	Slot 2: M5 915 Bistatic
	Kernel Version: Linux 2.4.27-uc1 2006-07-25T14:52:11-0400
	<b>LAN Configuration</b>
	LAN IP Address: 10.0.0.101
	LAN Subnet Mask: 255.255.255.0
	LAN Gateway: 10.0.0.1
	LAN MAC Address: 00:12:A4:10:30:4E
	<b>Other Settings</b>
	Primary DNS Server: 10.0.0.6
	Secondary DNS Server:
	NTP server: 10.0.0.6 maxpoll 6 iburst
	Uptime: 15:37:54 up 2:20, load average: 0.00, 0.00, 0.00
	<b>View Log File</b>
	Click the <b>View Log</b> button to view the log file.



## Using Safe Mode

There are two reasons to enter Safe Mode:

- ◆ To perform a firmware update to repair a corrupted filesystem.
- ◆ To change settings that are preventing the reader from operating normally.

Both of these tasks can be performed via the web interface.

Use the recessed Safe Mode button on the reader connector panel to recover from errors which prevent the reader from operating in normal mode. In Safe Mode the reader is configured with a static IP address of 10.0.0.102. Safe mode uses the following network settings:

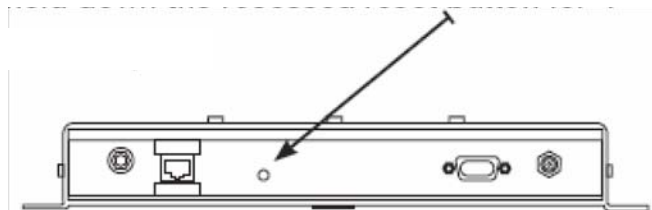
**IP Address: 10.0.0.102**

**Hostname: Mercury(4) or (5)**

Although the browser-based interface pages are displayed in red when operating in safe mode, the reader is still functional, although it cannot read or write tags. In most cases, the reader will need to be reconfigured for operation with the reader application after starting in Safe Mode.

To manually reboot into Safe Mode use the following procedure:

1. With the reader running (green LED is pulsing), use a non-conductive object to hold down the recessed reset button for 4 seconds.
2. Release the button.



3. The green LED should turn solid as soon as the button is released, indicating the reader is rebooting. It should take approximately 30 seconds to boot into Safe Mode.

### Note

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The green LED stays solid in safe mode.

4. Once the maintenance has been performed, restart the reader to activate the changes.

The web server, telnet server and SSH (Secure Shell) server run in Safe Mode, however none of the RFID features are activated. To communicate with the reader in Safe Mode,

a PC must have an IP address and subnet mask that are compatible with the reader settings, for example:

IP address: 10.0.0.10

Netmask: 255.255.255.0

## 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:

$$P_{\max} = 36 \text{ dBm} - \text{Antenna Gain} + \text{Cable Loss}$$

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  $(36 - 6 + 0.6) = 30.6 \text{ dBm}$ .

### Reader RF Power Example

Using ThingMagic shielded 25 ft. coaxial antenna cables TM-M5CAB-TT-P25 type LMR-195 and ThingMagic Dual Antenna TM-ANT-NA-2CX.

Total 25 ft. cable insertion loss = 3.1 dB.

Antenna gain = 7.0 dB

$$P_{\max} = 36 \text{ dBm} - 7.0 \text{ dB} + 3.1 \text{ dB} = 32.1 \text{ dB maximum reader RF power.}$$

Cable Loss Values for Shielded Coaxial Cable Provided by ThingMagic

Cable Length (in ft.)	Insertion Loss (in dB)
6	.9
20	2.5
25	3.1

The Reader RF Power is set through the [Settings Page](#). Note that in no case may the power be set higher than 32.5 dBm.

#### Note

Be sure to read the section [Compliance, Warranty and IP Notices](#) on page 66 to maintain compliance with FCC regulations.

## Setting the Reader RF Power

The Reader RF Power can be set using the [Settings Page](#) of the browser-based interface.

Note that in no case may the power be set higher than 32.5 dBm.

1. Log on to the reader using your browser. The reader's [Status Page](#) appears.
2. Click on the Settings tab. The first field on the Settings page is UHF Power dBm – the maximum RF power. Its factory default value is 32.5 dBm.
3. Enter the maximum setting based on your cable type, length and antenna type.
4. Scroll down to the bottom of the [Settings Page](#) on page 39, and click Save changes button to save the settings.
5. The [Status Page](#) on page 26 will reload automatically after the settings been saved.

### Note

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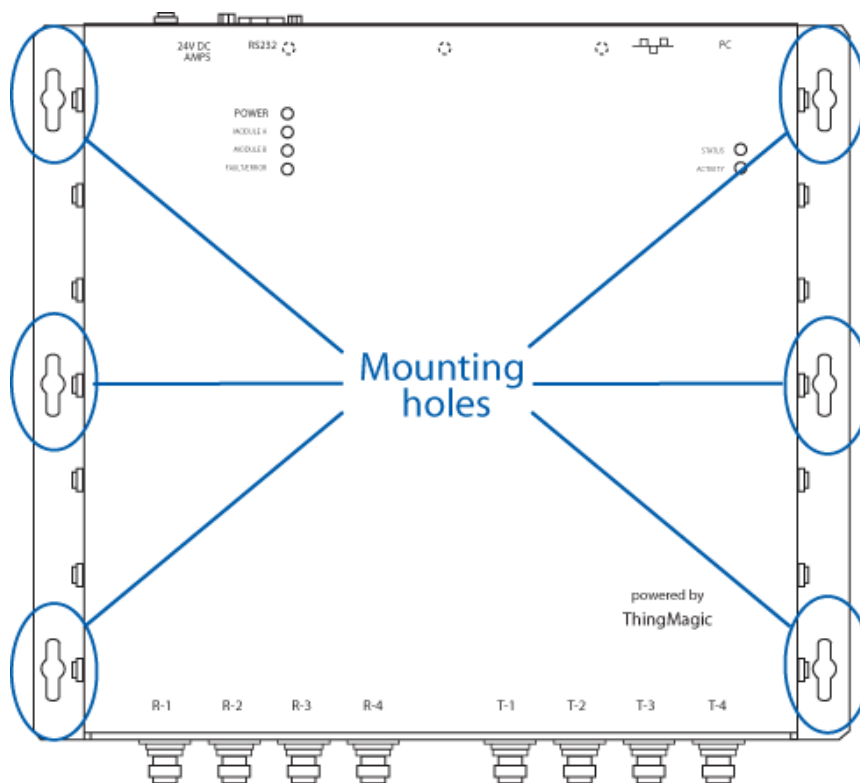
If the Status page does not appear after a few moments, manually recycle the power on the reader. After repowering, load the settings page again and check the new maximum RF power setting.

# Mounting the Reader

To install the Mercury reader, use the following steps:

You can place the reader on a shelf or mount it to a wall. To mount the reader on a wall use the following steps:

1. Hold the reader in its mounting location and mark the position of the two mounting screws. Minimum screw size is #12.



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

## Mounting the Antennas

The antennas can be mounted directly to a variety of surfaces or mounting brackets. Up to 4 antennas can be connected to the reader.

### Note

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

## Authorized Antenna and Antenna Cables

For information on the only antennas authorized by the FCC for use with the Mercury4 and Mercury5 Readers, see [Appendix A: Mercury4 Antenna Information](#). Detailed information on each antenna is available from their respective manufacturers.

## Variables Affecting Performance

Reader performance may be affected by the following variables, depending on the site where your RFID solution is being deployed:

- ◆ [Environmental Conditions](#)
- ◆ [Tag Considerations](#)
- ◆ [Multiple Readers](#)

## Environmental Conditions

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 900 MHz, 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 900 MHz devices.
- ◆ Avoid mounting reader antennas in close proximity to fluorescent lighting where possible, and test reader performance with moving machinery turned off.
- ◆ Fluorescent lighting fixtures are a source of strong electromagnetic interference and should be replaced if possible, or if not, keep cables and antennas away from them.
- ◆ Uncoil completely all coaxial cables leading from readers to antennas: they can be a strong source of electromagnetic radiation and should be laid flat and not coiled up.



## Tag Considerations

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. The ThingMagic antenna is circularly polarized, so it reads face-to but not edge-to.
- ◆ **Tag Model** - Many tag models are available. Each model has its own performance characteristics.

## Multiple Readers

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

- ◆ The reader should be set to use Dense Reader Mode (DRM) or Dense Interrogator Channelized Signaling for GEN2 tags.
- ◆ Antennas on other readers 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.
- ◆ When operating the reader with EPC Global Class 1 GEN2 2 tags, ensure that DRM is turned on for best interference protection. See the [Settings Page](#).

### Note

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

# Mercury4 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: 30.5cm (12in)

Width (with mounting bracket): 30.5cm (12in)

Depth: 4.4cm (1.75in)

Weight: 2.95kg (6.5lb)

## Supported UHF Tag Protocols

EPC Class 1, GEN2EPC Class 0

ISO 18000-6BEPC Class 1

## User Memory

64MB DRAM16MB Flash

# M5 Specifications

## Electrical

### Reader

UHF operating frequency: 902-928MHz (NA)

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: 30.5cm (12in)

Width (with mounting bracket): 30.5cm (12in)

Depth: 4.4cm (1.75in)

Weight: 2.95kg (6.5lb)

## Supported UHF Tag Protocols

EPC Class 1, GEN2EPC Class 0

ISO 18000-6BEPC Class 1

## User Memory

128MB DRAM32MB Flash

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# Compliance, Warranty and IP Notices

## Regulatory Compliance

EMC FCC 47 CFR, Part 15  
Industrie Canada RSS-210  
Safety UL 60950  
CSA C22.2 No 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, Inc., 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.

## Warranty Disclaimer and IP Notices

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# Appendix A: Mercury4 Antenna Information

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## Authorized Antennas

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.

### Note

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

### Note

**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.



**Mercury4 Approved Antennas**

<b>Item</b>	<b>ThingMagic Dual Antenna</b>	<b>Mercury Compact Antenna</b>
Model	TM-ANT-NA-2C	MT-262010-TRLH/K
Gain	6 dBi max	6 dBi max
Connector	Reverse TNC	Reverse TNC
<b>Item</b>	<b>M/A-COM Dual Antenna</b>	<b>Matrics General Purpose Antenna</b>
Model	MANNAT0141	ANT-GPHP
Gain	5.9 dBi max.	5.75 dBi max.
Connector	Reverse TNC	Type N
<b>Item</b>	<b>Alien Dual Antenna (Circular/Linear)</b>	<b>Matrics General Purpose Antenna</b>
Model	ALR9611-CR+CL	ALR9611-CR+CL
Gain	6 dBi max.	6 dBi max.
Connector	Integral 20 ft. cable with Reverse TNC	Integral 20 ft. cable with Reverse TNC
<b>Item</b>	<b>Cushcraft Circular Polarity Antenna</b>	<b>Sensormatic OMNIPOINT Antenna</b>
Model	S9028PCL	ID-ANT-20TNA25
Gain	8 dBic, 6 dBi max.	5.75 dBi max
Connector	Reverse TNC	Reverse TNC
<b>Item</b>	<b>Cushcraft Circular Polarity Antenna</b>	
Model	S9028PCR	
Gain	8 dBic, 6 dBi max.	
Connector	Reverse TNC	

# Antenna Cables

The only cables authorized by the FCC for use with the Mercury Readers are in the table below:

	<b>25 Foot TNC/TNC</b>	<b>25 Foot TNC/N</b>
ThingMagic Part No.	TM-CAB-TT-P25	TM-CAB-TN-P25
Length	25 ft.	25 ft.
Insertion Loss	3.1 dB min.	3.1 dB min.
Connectors	Reverse TNC to Reverse TNC	Reverse TNC to Type N
	<b>6 Foot TNC/TNC</b>	<b>6 Foot TNC/N</b>
ThingMagic Part No.	TM-CAB-TT-P6	TM-CAB-TN-P6
Length	6 ft.	6 ft.
Insertion Loss	0.9 dB min.	0.9 dB min.
Connectors	Reverse TNC to Reverse TNC	Reverse TNC to Type N

Note

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

# Appendix B: M5 Antenna Information

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## Authorized Antennas

- ◆ 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.

### Note

The only antennas authorized by the FCC for use with the Mercury5 reader are in the tables below. Detailed information on each antenna is available from their respective manufacturers.

### Note

**IMPORTANT:** No other antennas may be used with the Mercury5 reader without violating FCC regulations. It is the responsibility of the user to comply with this requirement.



**Mercury5 Approved Antennas**

<b>Item</b>	<b>ThingMagic Dual Antenna</b>	<b>Mercury Compact Antenna</b>
Model	TM-ANT-NA-2CX	MT-262010-TRLH/K
Gain	7 dBi max	6 dBi max
Connector	Reverse TNC	Reverse TNC
<b>Item</b>	<b>M/A-COM Dual Antenna</b>	<b>Matrics General Purpose Antenna</b>
Model	MANNAT0123	ANT-GPHP
Part No.		250012-001
Gain	6 dBi max.	6 dBi max.
Connector	Reverse TNC	Type N
<b>Item</b>	<b>Cushcraft Circular Polarity Antenna</b>	<b>Cushcraft Circular Polarity Antenna</b>
Model	S9028PCL	S9028PCR
Gain	8 dBic, 6 dBi max.	8 dBic, 6 dBi max.
Connector	Reverse TNC	Reverse TNC

# Antenna Cables

The only cables authorized by the FCC for use with the Mercury Readers are in the table below:

	<b>25 Foot TNC/TNC</b>	<b>25 Foot TNC/N</b>
ThingMagic Part No.	TM-CAB-TT-P25	TM-CAB-TN-P25
Length	25 ft.	25 ft.
Insertion Loss	3.1 dB min.	3.1 dB min.
Connectors	Reverse TNC to Reverse TNC	Reverse TNC to Type N
	<b>6 Foot TNC/TNC</b>	<b>6 Foot TNC/N</b>
ThingMagic Part No.	TM-CAB-TT-P6	TM-CAB-TN-P6
Length	6 ft.	6 ft.
Insertion Loss	0.9 dB min.	0.9 dB min.
Cable Type	LMR-195	LMR-195
Connectors	Reverse TNC to Reverse TNC	Reverse TNC to Type N
	<b>20 Foot TNC/TNC</b>	<b>20 Foot TNC/N</b>
ThingMagic Part No.	TM-CAB-TT-P20	TM-CAB-TN-P20
Length	20 ft.	20 ft.
Insertion Loss	2.5 dB min.	2.5 dB min.
Connectors	Reverse TNC to Reverse TNC	Reverse TNC to Type N