



875-0058-03 RevA

# Mercury6(M6) User Guide

**Government Limited Rights Notice:** All documentation and manuals were developed at private expense and no part of it was developed using Government funds.

The U.S. Government's rights to use, modify, reproduce, release, perform, display, or disclose the technical data contained herein are restricted by paragraph (b)(3) of the Rights in Technical Data – Noncommercial Items clause (DFARS 252.227-7013(b)(3)), as amended from time-to-time. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings. Any person, other than the U.S. Government, who has been provided access to such data must promptly notify ThingMagic.

ThingMagic, Mercury, Reads Any Tag, and the ThingMagic logo are trademarks or registered trademarks of ThingMagic, A Division of Trimble.

Other product names mentioned herein may be trademarks or registered trademarks of Trimble or other companies.

©2012 ThingMagic – a division of Trimble Navigation Limited. ThingMagic and The Engine in RFID are registered trademarks of Trimble Navigation Limited. Other marks may be protected by their respective owners. All Rights Reserved.d

ThingMagic, A Division of Trimble  
One Cambridge Center, 11th floor  
Cambridge, MA 02142  
866-833-4069

03 Revision A  
January, 2012

---

# Contents

---

## **Introduction 5**

## **Hardware Overview 7**

What's in the Box 7

M6 Reader 7

Ports and Connectors 7

Antenna Connections 7

Ethernet/PoE 8

USB Accessory 8

Console 8

GPIO 9

DC Power 9

Reset Button 9

## **Programming Interfaces 10**

MercuryAPI 10

Demo Applications 10

LLRP 10

On-Reader Applications 11

## **Setting Up for Single Reader Operation 12**

Equipment Required 12

Setup Procedure 13

Connecting Antenna(s) to the Reader 13

Powering Up the Reader 14

Interpreting the Reader Indicator LED 14

Connecting Your PC to the Reader 15

Setting Up Your PC's TCP/IP Connection 15

Logging On to the Reader 19

## **Networking the Reader 22**

Setting Up the Network Hardware 22

Using the Wireless Network 22

- Using Power Over Ethernet (PoE) 25
- Using DHCP 26
  - M6 Setup 26
  - PC Setup 26
  - Automatic Hostname: M6-xxxxxx 28
  - MAC Address 28
- Fallback Interface Options 29
  - Fallback to the Same Physical Interface 29
  - Fallback to the Other Physical Interface 29
- Reader Discovery 32
  - Using mDNS 32
  - Reader Listing 32

## **Connecting to the M6 USB Console Port 35**

### **Using GPIO 36**

- Inputs 36
- Outputs 36
- Connector Pinout 37

### **Controlling the Reader 38**

- Using the Browser-Based Interface 38
  - Status Page 39
  - Query Page 40
  - Settings Page 44
  - Restart Page 51
  - Diagnostics Page 52
  - Statistics Page 53
  - Firmware Upgrade Utility 54
- Using Safe Mode 56
  - Force M6 to boot in safe mode 57

### **Advanced Reader Functionality 58**

- Protocol Support 58
  - ISO 18000-6C (Gen2) 58
  - ISO 18000-6B 59
    - Protocol Configuration Options 59
    - Tag Read Meta Data 59

### **Reader RF Power 61**

- Power Settings for Authorized Antennas and Cables 61
- Setting the Reader RF Power 62

### **Mounting the Reader 63**

- Variables Affecting Performance 64

Environmental 64  
Tag Considerations 65  
Multiple Readers 65

**M6 Specifications 66**

UHF RFID Antenna Interface 66  
Power 66  
Environmental 67  
Physical Dimensions 67  
Supported UHF Tag Protocols 67  
Data/Control/Wireless Interfaces 67  
Performance 68  
Regulatory & Safety 68

**Compliance and IP Notices 69**

Regulatory Compliance 69  
    Federal Communication Commission Interference Statement 69  
    Industry Canada 69

**Appendix A: M6 Antenna and Cable Information 72**

Authorized Antennas 72  
Authorized Cables 73

**Appendix B: M6 Dimensions 74**

**Appendix C: Advanced Administration 76**

Changing the Web Interface uid/passwd 76  
Changing console/root password: 77

**Appendix D: Troubleshooting 78**

Troubleshooting Table 78  
Reset to the Default Configuration 78  
Collecting Diagnostic Data for ThingMagic Support 79  
Analyzing the Boot Logs 80



# M6 User Guide

---

## Introduction

This document assumes usage of an M6 with firmware version 4.9.2 or later.

This document explains how to set up the Mercury6 (M6) Reader, how to configure it for network operation, and how to use the browser-based interface. See the corresponding *M6 Firmware Release Notes* for operational differences that what is in this User Guide specific to a firmware version.

Separate appendices contain specifications and antenna information that are specific to the M6 Reader.

Applications to control the M6 can be written using the high level MercuryAPI. The MercuryAPI supports Java, .NET and C programming environments. The MercuryAPI Software Development Kit (SDK) contains sample applications and source code to help developers get started demoing and developing functionality. For more information on the MercuryAPI see the *MercuryAPI Programmers Guide* and the *MercuryAPI SDK*, available on the ThingMagic website.

This document is broken down into the following sections:

- ◆ [Hardware Overview](#) - Provides detailed specifications of the M6 hardware and physical interfaces.
- ◆ [Programming Interfaces](#) - Describes the programming interfaces, including on-reader applications, where to find code samples, and the LLRP interface.
- ◆ [Connecting to the M6](#) - Describes the methods available for connecting to the M6 over the ethernet, WiFi and USB Console interfaces.
  - [Setting Up for Single Reader Operation](#) - Connect using a direct ethernet connection from a Host PC to the M6.
  - [Networking the Reader](#) - Connect over ethernet LAN or WiFi using DHCP or static IP settings.

- [Connecting to the M6 USB Console Port](#) - Connect to the M6 console for command-line interface access and troubleshooting.
- ◆ [Using GPIO](#) - Details the GPIO physical interface specs and how to control it via the MercuryAPI.
- ◆ [Controlling the Reader](#) - Describes the browser-based interface and the configuration and testing options available through it.
- ◆ [Advanced Reader Functionality](#) - Provides descriptions of the M6 advanced protocol specific configuration options that are supported through the use of the MercuryAPI
- ◆ [Reader RF Power](#) - Provides guidelines and limitations for setting the RF Power of the M6.
- ◆ [Mounting the Reader](#) and [Appendix B: M6 Dimensions](#) - Provides details of the physical dimensions of the M6.
- ◆ [M6 Specifications](#)
- ◆ [Compliance and IP Notices](#)
- ◆ [Appendix A: M6 Antenna and Cable Information](#) - Lists the authorized Antennas and cables which can be used with the M6-NA in FCC regions.
- ◆ [Appendix C: Advanced Administration](#) - Provides the steps for some advanced administration settings, such as changing reader passwords.
- ◆ [Appendix D: Troubleshooting](#) - Provides recommended debugging steps for common problems along with data to gather when submitting a problem case to ThingMagic support.

# Hardware Overview

## What's in the Box

### M6 Reader

- M6 Reader
- WiFi antenna (with Wifi enabled M6 only)
- Ferrite Bead (to be applied when [Using Power Over Ethernet \(PoE\)](#))

## Ports and Connectors

### Antenna Connections

The M6 supports four monostatic bidirectional RF antennas through four Reverse Polarity TNC (RP-TNC or R-TNC) connectors: labeled RFID1 through RFID4 on the M6.

**Figure 1: M6 RFID Antenna Ports**



The maximum RF power that can be delivered to a 50 ohm load from each port is 1.4 Watts, or +31.5 dBm (regulatory requirements permitting).

The RF ports can only be energized one at a time.

### Antenna Requirements

The performance of the M6 is affected by antenna quality. Antennas that provide good 50 ohm match at the operating frequency band perform best. Specified sensitivity performance is achieved with antennas providing 17 dB return loss or better across the operating band. Damage to the reader will not occur for any return loss of 1 dB or greater.

**W A R N I N G !**

**Damage may occur if antennas are disconnected during operation or if the M6 sees an open or short circuit at its antenna port.**

**W A R N I N G !**

**To comply with FCC's RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 25cm is maintained between the radiator (antenna) & user's/nearby people's body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.**

### Antenna Detection

To minimize the chance of damage due to transmitting on open ports or antenna disconnection, the M6 supports antenna detection. Detection is performed automatically at startup and before RF operations. In order to be detectable antennas must present a DC resistance of ~10k Ohms or less.

**Figure 2: M6 Digital Connectors**



### Ethernet/PoE

See [Using Power Over Ethernet \(PoE\)](#).

### USB Accessory

Reserved for future use.

### Console

See [Connecting to the M6 USB Console Port](#).

## GPIO

See [Using GPIO](#)

## DC Power

See [Power](#) for DC Power supply requirements. The connector used (*Switchcraft Inc. 761KS12*) has the following specifications:

- 2.5mm hollow center pin
- Lock Ring Thread Size: 7/16-32 UN2B thread
- Handle Thread Size: 5/16-24 UNF 2A
- Electrical: Current (carry) 5A at 65°C
- IP68 Rated

## Reset Button

Using a non-conductive object press and hold for 2 seconds to perform a soft reset. Press and hold for 4 seconds to [Force M6 to boot in safe mode](#)

---

# Programming Interfaces

## MercuryAPI

Applications to control the M6 reader, and all ThingMagic Reader products, can be written using the high level MercuryAPI. The MercuryAPI supports Java, .NET and C (for on-reader applications) programming environments. The MercuryAPI Software Development Kit (SDK) contains sample applications and source code to help developers get started demoing and developing functionality. For more information on the MercuryAPI see the *MercuryAPI Programmers Guide* and the *MercuryAPI SDK*, available on the ThingMagic website.

## Demo Applications

The primary, “Quick Start”, demo for reading tags is the [Query Page](#) of the Web Interface.

For more advanced functionality, and also a starting place for building custom applications, a demo application which supports reading and writing is provided in the MercuryAPI SDK package. The executable for this example is included in the MercuryAPI SDK package (available on [rfid.thingmagic.com/devkit](http://rfid.thingmagic.com/devkit)) under */cs/samples/exe/Universal-Reader-Assistant.exe*.

See the *Readme.txt* in */cs/samples/Universal-Reader-Assistant/Universal-Reader-Assistant* for usage details.

## LLRP

LLRP is the EPCglobal standard ([http://www.epcglobalinc.org/standards/llrp/llrp\\_1\\_0\\_1-standard-20070813.pdf](http://www.epcglobalinc.org/standards/llrp/llrp_1_0_1-standard-20070813.pdf)) used for communication between the M6 and a client application. The M6 should be “drop-in compatible” with systems supporting the standard LLRP protocol. Middleware such as BizTalk and WebSphere have standard LLRP adapters that can work with the M6. In many cases custom extensions are implemented to support non-standard configuration options and commands, which are often reader specific. If your LLRP based client uses such custom extensions it is likely that modifications will need to be made to support the M6. In addition some M6 functionality is only available through the use of custom extensions.

For more information on direct use of LLRP, the ThingMagic custom extensions and the open source LLRP ToolKit please contact ThingMagic support ([support@thingmagic.com](mailto:support@thingmagic.com)).

## On-Reader Applications

The M6 Reader, starting with firmware v4.9.2 and MercuryAPI v1.11.1, supports running custom applications on the reader, built using the MercuryAPI C Language interface. Most programs written using the C API can be compiled to run as a client application or run on the reader.

Please see the *MercuryAPI Programmers Guide | On-Reader Applications Guide*, available for download from <http://rfid.thingmagid.com/devkit>.

# Setting Up for Single Reader Operation

This section describes how to set up the Reader for Single Reader Operation using AC power.

## Equipment Required

To set up Single Reader Operation, you need the and some additional hardware.

The additional hardware required includes:

- ◆ A computer with a Java-enabled web browser
- ◆ Ethernet cross-over cable (CAT5e, shielded, 5')
- ◆ Wideband antenna(s)
- ◆ Coax cable(s) (with RP-TNC connectors)

### Note

To install the M6 Reader, no software is required.

To set up the Reader as part of a larger scale deployment that uses Wireless Network (WLAN) connection or Power Over Ethernet (PoE), refer to [Networking the Reader](#).

## Setup Procedure

The steps required to set up and run the M6 Reader are:

1. [Connecting Antenna\(s\) to the Reader](#)
2. [Powering Up the Reader](#)
3. [Connecting Your PC to the Reader](#)
4. [Setting Up Your PC's TCP/IP Connection](#)
5. [Logging On to the Reader](#)

### Connecting Antenna(s) to the Reader

The M6 Reader supports up to four monostatic antennas. The default power setting that you configure is applicable to all antennas, although per-antenna settings are supported. See [Settings Page](#) for configuration options.

Before you apply power to the Reader, you must connect at least one antenna to an RFID antenna port. When the Reader is powered on, any port that is not connected and meeting the M6 [Antenna Detection](#) requirements is disabled.

#### Note

Use only authorized antennas and cables. See [Appendix A: M6 Antenna and Cable Information](#).

## Powering Up the Reader

You can power up the M6 Reader using:

- ◆ DC power supply - *NOTE: Sold separately*
- ◆ Power over Ethernet (PoE) - *NOTE: Required cable sold separately*

To power up the M6 Reader using a DC power supply:

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

There is no on/off switch on the Reader. While the Reader is powering up, the power LED is solid amber. The Reader is ready for operation after approximately 60 seconds when the power LED changes to solid green.

To power-up the Reader using PoE, see [Using Power Over Ethernet \(PoE\)](#).

By default, if both DC power supply and PoE are provided to the M6 Reader, the Reader will use only the DC power supply as the source of power. In this situation, if DC power is turned off, then the Reader requires a hard power cycle (a software or reset button reboot are not sufficient) in order to function properly and use PoE (even if it is already plugged in).

## Interpreting the Reader Indicator LED

The M6 Reader has one main multi-color LED that indicates Reader activity. By observing the color and the state of the LED, you can determine the current operational status of the M6 Reader.

The colors displayed by the LED include:

- ◆ Solid Amber: Indicates that the Reader is starting up.
- ◆ Solid Green: Indicates that the Reader has a valid IP address and is ready for operation.
- ◆ Blinking Green: Indicates that the RF field is ON and the unit is reading/writing tags.
- ◆ Solid Red: Indicates that there is a failure in the RFID subsystem.

Additionally, when the Reader is connected to a PC or a network outlet, the two small LEDs adjacent to the Ethernet (POE LAN) port indicate Network Status and Network Activity.

## Connecting Your PC to the Reader

You can provide network connectivity to the M6 Reader using either Ethernet or WIFI. For instructions on connecting the Reader to a network using WLAN or PoE, see the section [Networking the Reader](#).

To connect your PC to the Reader:

1. Connect an Ethernet crossover cable to your PC.
2. Connect the other end of the Ethernet crossover cable to the Reader's POE LAN port.

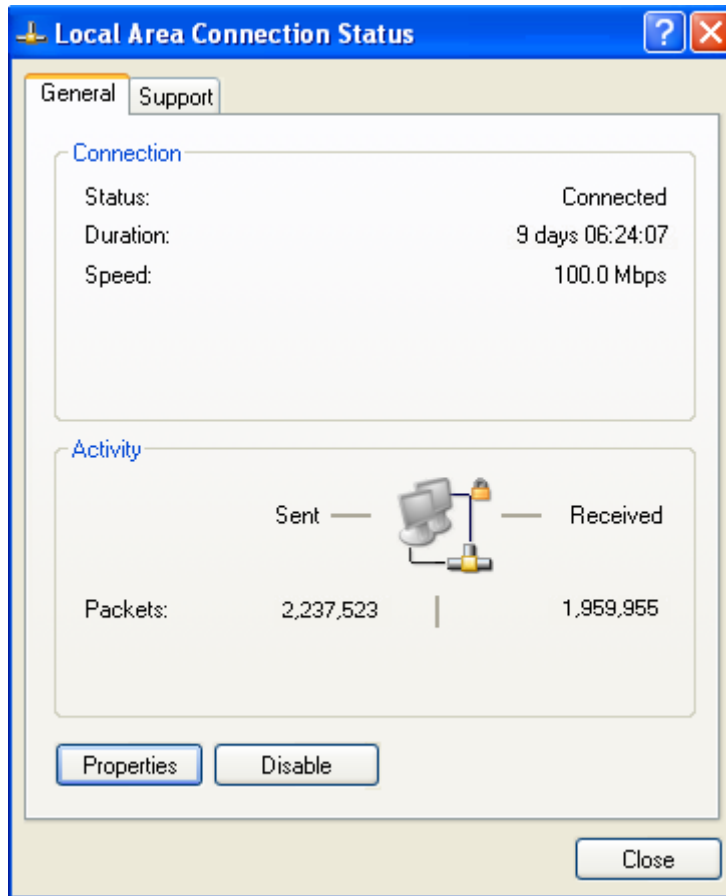
## Setting Up Your PC's TCP/IP Connection

If you are using an operating system other than Windows XP, consult your network administrator regarding how to set up your PC's TCP/IP connection.

If you are using Windows XP, perform the following steps to set up your PC's TCP/IP connection:

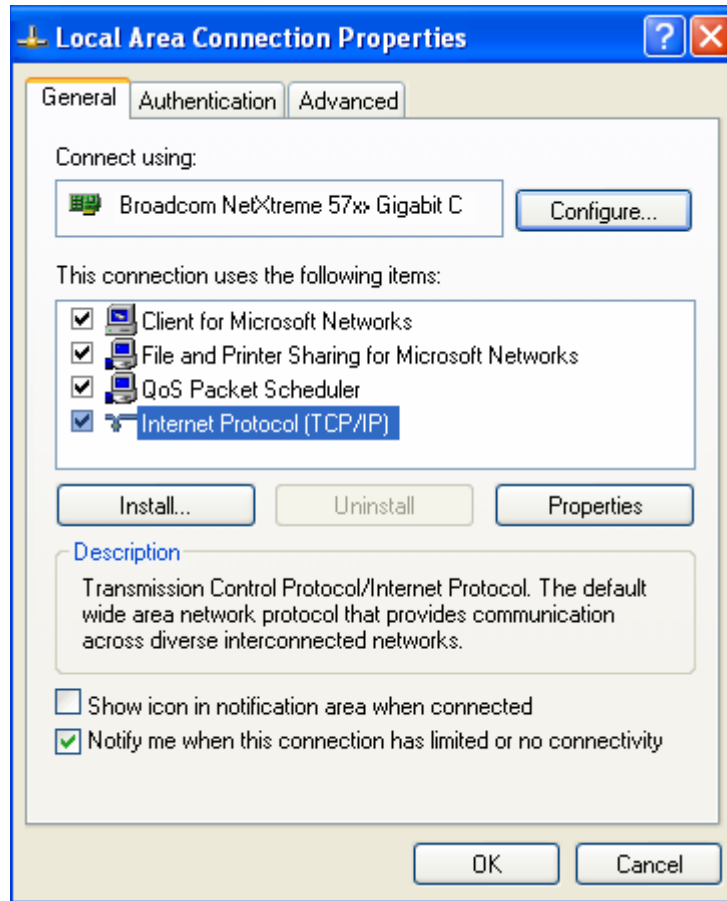
1. Select Start from the Start bar, and then select Control Panel.
2. Double-click the Network Connections icon.
3. Disable your PC's wireless connection.
4. Double-click the Local Area Connection icon.  
The Local Area Connection Status window appears, as shown in *Figure 3*.

**Figure 3: Local Area Connection Status Window**



- Click the Properties button.  
The Local Area Connections Properties window appears, as shown in *Figure 4*.

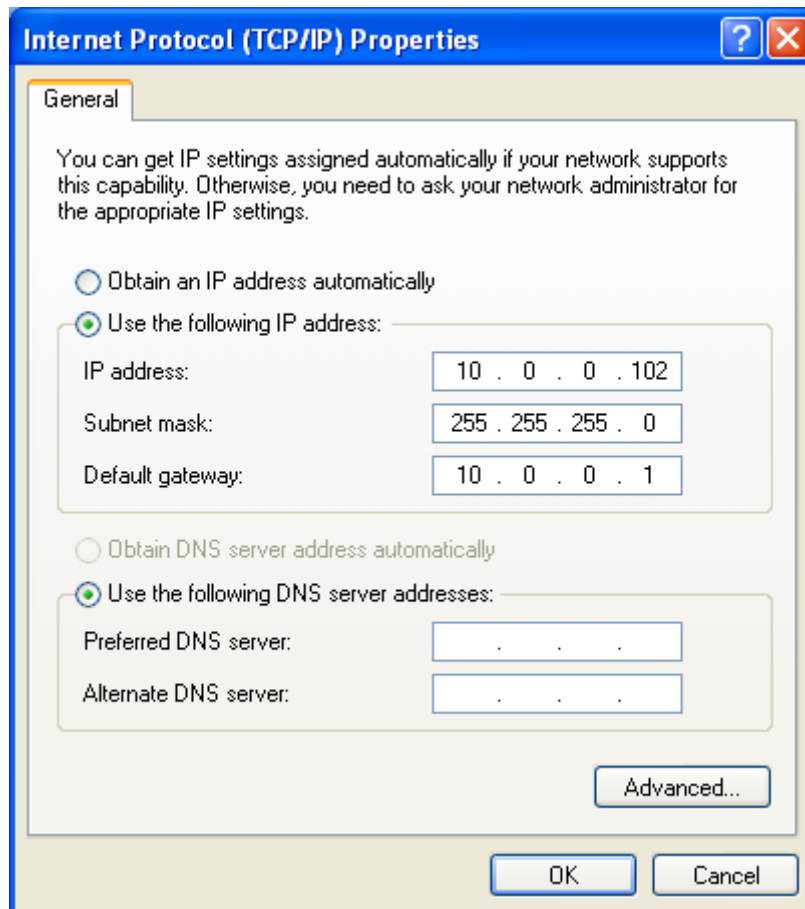
**Figure 4: Local Area Connection Properties Window**



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

- Click on the Properties button.  
The Internet Protocol (TCP/IP) Properties window appears, as shown in *Figure 5*.

**Figure 5: Internet Protocol TCP/IP Properties Window**



- Select the Use the following IP address: button.  
Enter these settings:  
IP address: 10.0.0.102  
Subnet mask: 255.255.255.0  
Default gateway: 10.0.0.1
- Click OK to save and exit the window.
- Click OK in the Local Area Connection Properties window.


## Logging On to the Reader

You may use any Java-enabled web browser to log on to the Reader.

To log on to the Reader:

1. Launch your web browser and log on to the Reader by entering the Reader's default IP address <http://10.0.0.101/> in the address bar.
2. Press Enter.  
The Login dialog box appears.
3. Enter the following:  
Default user name: "web"  
Password: "radio" (all lower-case).
4. Click OK.  
The Reader displays its browser-based interface. The initial page that appears is the Status page, as shown in *Figure 6*.

**Figure 6: M6 Status Page**

<b>Mercury6 Status</b>	
<b>Device Status</b>	
Status:	 Idle
Lan Connection:	<b>Online</b>
Wireless Connection:	<b>Disabled</b>
Connected Antenna Ports:	Antenna 1: <b>Connected : MonoStatic</b>
	Antenna 2: <b>Not Connected</b>
	Antenna 3: <b>Not Connected</b>
	Antenna 4: <b>Not Connected</b>
Power Supply:	<b>DC power connector</b>
<b>MercuryOS and AFE Versions</b>	
Region:	North America
MercuryOS Version:	4.7.1 (2011-01-26T03:34:50-0500 build 52 trunk)
AFE Version:	M6E HWVer:18.00.00.01 BootVer:10.11.16.00 AppVer:01.0
<b>LAN Configuration</b>	
Host Name:	mercury-21071f
LAN IP Address:	10.0.0.181
LAN Subnet Mask:	255.255.255.0
LAN Gateway:	10.0.0.2
MAC Address:	00:12:A4:21:07:1F
<b>Wireless Configuration</b>	
MAC Address:	Card Not Present

5. Check the Connected Antenna Ports fields. If the text is green, it indicates that antenna is connected.
6. Do one of the following steps:
  - ♦ To connect the Reader to the network and log in remotely, see [Networking the Reader](#).
  - ♦ To start reading tags and controlling the Reader, see [Controlling the Reader](#). This section guides you through all the available Reader functions available through the web interface, including how to read tags, change settings, load firmware, and reboot the Reader into Safe Mode.

# Networking the Reader

You can set up the M6 Reader to use either manual IP addressing or DHCP. By default, the Reader has automatic addressing enabled that boots up 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. During the initial boot sequence, if the Reader does not get a DHCP-assigned IP address, the static IP address 10.0.0.101 is assigned by default. However, the Reader will periodically check to see if a DHCP server is available.

The following section explains how to set up your PC and Reader [Using DHCP](#). This section also explains how to manually configure the Reader without a DHCP server, how to setup advanced [Fallback Interface Options](#) (wired and wireless) and how to use the ZeroConf protocol, Bonjour™, for subnet [Reader Discovery](#), without a DHCP server.

## Setting Up the Network Hardware

Whether you use DHCP or static network addressing, make sure that the network is connected before powering up the Reader. If the Reader does not automatically get the address from a DHCP server, then, by default, the static IP address 10.0.0.101, subnet mask 255.255.255.0, and gateway 10.0.0.1 is used.

Before setting up your network:

- ◆ Connect one end of an Ethernet cable to the Reader and the other end to an Ethernet switch or hub.
- ◆ Check that all antennas are securely connected, and then power-up the Reader.
- ◆ Connect your PC to the same network as that of the Reader.

### 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.

## Using the Wireless Network

You can connect the M6 Reader through the wireless network, only if the WiFi SKU is purchased. In this configuration, the Ethernet cable connection is not used.

To connect the M6 Reader to a wireless network:

1. Click on Settings in the Web Interface navigation menu to access the Modify Settings Page, as shown in *Figure 7*.
2. Select *Network Interface | Wireless (802.11)* radio button.
3. Enter the appropriate information into the *Wireless Authentication Mode*, *Wireless SSID*, and *Wireless Key* for the *Wireless Interface* fields.
4. Click the *Save Changes* button at the bottom of the page.
5. Restart the M6 Reader.
6. Do the following:
  - a. Click the Restart link on the navigation menu.  
The Restart Reader page appears, as shown in *Figure 15*.
  - b. Click the Restart System button
  - c. Click OK.  
The following message appears, as shown in *Figure 16* and remains on the screen until the Reader restarts.



C A U T I O N !



**Once the reader Network Interface is switched to wireless it will no longer be accessible on the wired interface by default. During initial configuration, prior to switching to wireless, it maybe useful to configure the wired interface as a fallback as described in [Fallback Interface Options](#). If the wireless settings were not configured correctly and no fallback setup, the reader will not be accessible over the network interfaces. In that case the only methods of recovery is by [Connecting to the M6 USB Console Port](#) or [Using Safe Mode](#).**

**Figure 7: M6 Modify Settings Page**

Network Settings: All Interfaces	
Network interface	Wired (Ethernet) <input checked="" type="radio"/> Wireless (802.11) <input type="radio"/>
Automatic Hostname <sup>1</sup>	On <input checked="" type="radio"/> Off <input type="radio"/>
Hostname <sup>2</sup>	<input type="text"/>
NTP Server	<input type="text" value="pool.ntp.org"/>
Domain Name	<input type="text" value="thingmagic.com"/>
Primary DNS Server <sup>3</sup>	<input type="text" value="10.0.0.1"/>
Secondary DNS Server <sup>3</sup>	<input type="text"/>
Network Settings: Ethernet Interface	
Use DHCP?	Yes <input checked="" type="radio"/> No <input type="radio"/>
Use Fallback Interface	Yes <input type="radio"/> No <input checked="" type="radio"/>
Fallback Network interface	Wired (Ethernet) <input type="radio"/> Wireless (802.11) <input checked="" type="radio"/>
Vendor Class Identifier	<input type="text" value="mercury6"/>
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"/>
Network Settings: Wireless Interface	
Use DHCP?	Yes <input checked="" type="radio"/> No <input type="radio"/>
Use Fallback Interface	Yes <input type="radio"/> No <input checked="" type="radio"/>

## Using Power Over Ethernet (PoE)

Another way of powering up the M6 Reader is to use a single Ethernet cable that is connected to a Power over Ethernet (PoE) network. In this configuration, a power converter not used.

To power up the M6 Reader over a PoE network:

1. Connect one end of an Ethernet cable to the M6 Reader
2. Connect the other end to a certified PoE port.  
ThingMagic recommends using a PowerDsine 3006 or similar PoE Hub.

### Note

For operation in the EU region (applies to M6-EU hardware SKU only) you must use the Ferrite Bead included with the M6 Reader when powering-up the Reader over a PoE network in order to meet ETSI regulatory requirements. For proper operation, you must install the Ferrite Bead on the Ethernet cable at the end closest to the M6 Reader, as shown in *Figure 8*. For proper installation, the Ferrite Bead should not be more than two inches away from the connector

**Figure 8: Ferrite Bead**



**W A R N I N G !**



**When using PoE as a power source, the PoE must be supplied by a UL Listed ITE device.**



**W A R N I N G !**



**When using PoE as a power source the unit cannot be connected to an Ethernet network with outside plant routing, including a campus environment. The network must be contained within a single building.**

## Using DHCP

### M6 Setup

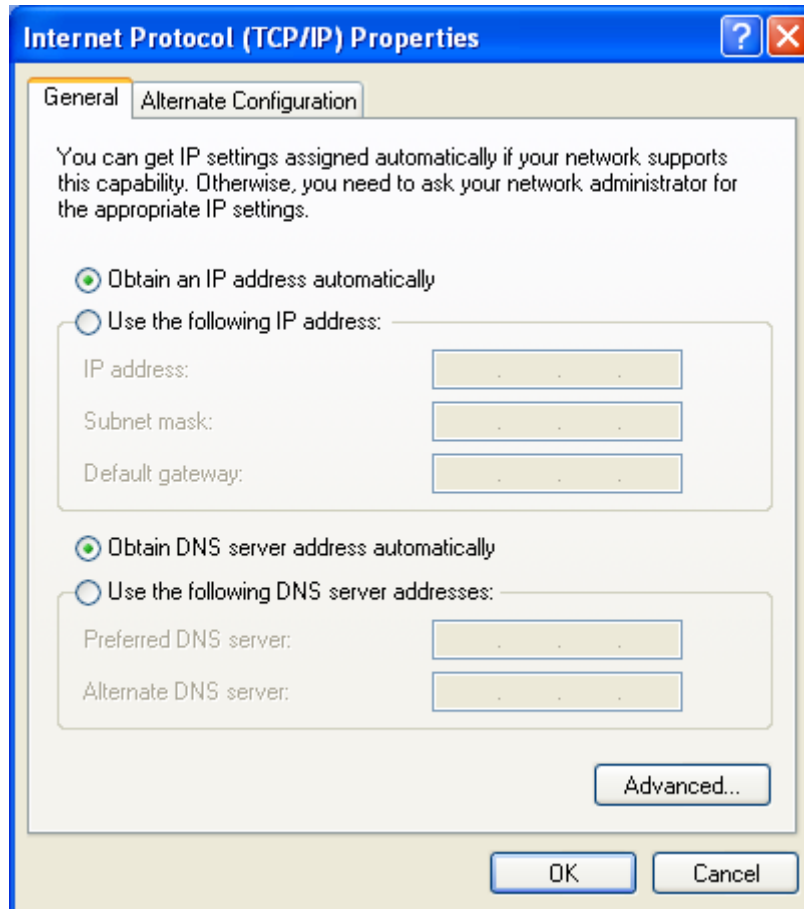
DHCP addressing can be used with either physical interface. To enable DHCP:

1. Click on Settings in the Web Interface navigation menu to access the Modify Settings Page, as shown in *Figure 7*.
2. Select *Use DHCP? | Yes* radio button under the settings section of the selected Network Interface.
3. Click the *Save Changes* button at the bottom of the page.

### PC Setup

To use DHCP to automatically assign your PC's IP address to insure common configuration with the M6 Reader:

1. Select Start from the Start bar, and then select 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.  
The local area Connection Status window appears, as shown in *Figure 3*.
5. Click the Properties button.  
The Local Area Connection Properties window appears, as shown in *Figure 4*.
6. Scroll down to the bottom of the list and select Internet Protocol (TCP/IP).
7. Click on the Properties button.  
The Internet Protocol (TCP/IP) Properties window appears, as shown in *Figure 9*.

**Figure 9: Internet Protocol (TCP/IP) Properties Window**

8. Select the Obtain an IP address automatically button.
9. Click OK to save and exit the window.
10. Click OK, in the Local Area Connection Properties window.
11. Click OK, in the Local Area Connection Status window.  
The PC may take few minutes to save the new network settings.

## Automatic Hostname: M6-xxxxxx

At startup, the Reader, by default, generates an 'automatic hostname' by appending the last three bytes of its MAC address to its hostname, such as *M6-210027*.

### Note

---

Your network must have properly configured DNS servers if you wish to connect to the Reader through its hostname. When using DHCP, the DHCP server periodically adds the hostname to the DNS server's database.

## MAC Address

The Reader's MAC address is printed on a white label on the side of the Reader, as LAN: #...#. You can also find the Reader's MAC address on the Status page.

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

To log on to the Reader using the MAC address:

1. Obtain the Reader's MAC address, launch your web browser, and then log on to the Reader by entering its automatic hostname in the address bar, such as <http://M6-xxxxxx> (the last six characters of the Reader's MAC address).
2. Press Enter.  
The Reader's Login dialog box appears.
3. Enter the following:  
User name: web  
Password: radio
4. Click OK.  
The Reader displays the [M6 Status Page](#).
5. Check the Connected Antenna Ports fields. If the text is green, that antenna is connected.

## Fallback Interface Options

In addition to selecting the primary physical interface to Wired (Ethernet) or Wireless (802.11, if option was purchased), the M6 can be configured to fallback to one of a variety of alternative network configurations in case of failures on the primary. Each physical interface can be configured to fallback to the other physical interface or to a different, static configuration on the same physical interface. See *Figure 10* for a flowchart showing the various fallback behaviors. See [Network Settings: All Interfaces](#) and the following Network Settings tables for more details on the settings.

Fallback settings are configured using the *Web Interface | Settings* page, as show in *Figure 7*. To enable the use of fallback select:

- ◆ *Use Fallback Interface = Yes*

Once fallback is enabled the fallback interface can be selected using:

- ◆ *Fallback Network interface = Wired | Wireless*

### Fallback to the Same Physical Interface

If the *Fallback Network interface* selected is the same as the Interface being configured, for example

- ◆ Network Settings: Ethernet Interface
  - *Fallback Network interface = Wired* is selected

Then the Fallback IP Address, Fallback Netmask and Fallback Gateway must be configured and when a fallback occurs those static settings will be used.

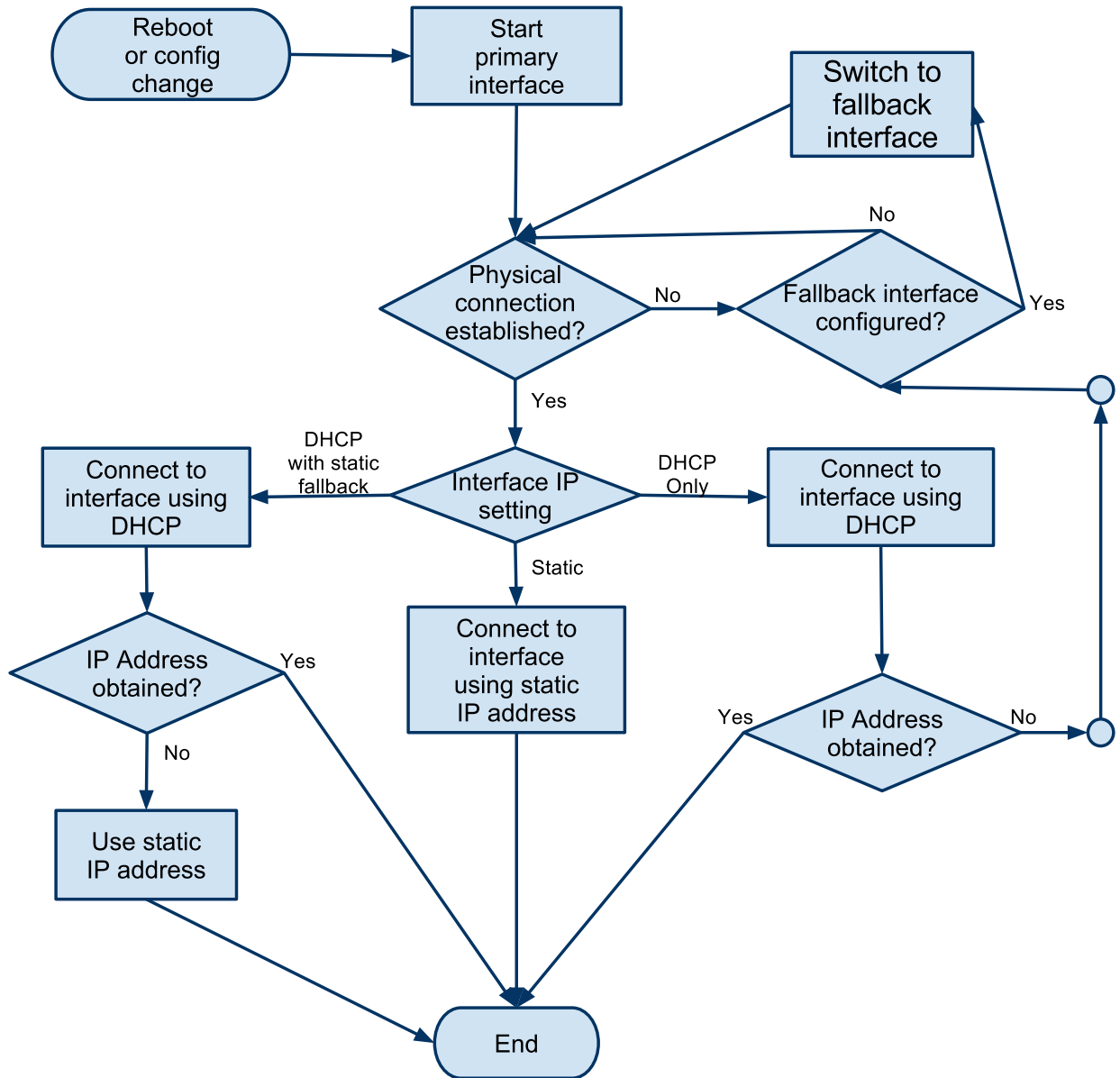
### Fallback to the Other Physical Interface

If the *Fallback Network interface* selected is different than the Interface being configured, for example

- ◆ Network Settings: Ethernet Interface
  - *Fallback Network interface = Wireless* is selected

Then the Fallback IP Address, Fallback Netmask and Fallback Gateway are not used. Instead, if a fallback occurs the physical interface will switch to using the other interface as if it were primary.

**Figure 10: Fallback Interface Flowchart**



**C A U T I O N !**

**Its is not advisable to configure both interfaces to fallback to the other physical interface. If neither is able to connect it will continue to “ping pong” back and forther between the. One of the two should always fallback to a known static configuration.**

**C A U T I O N !**

**When setting up and testing the Wirelss interface as the primary interface it is strongly advisable to configure it to fallback to the wired interface and the wired falling back to a static wired IP address. This will make it easier to recover if the wireless configuration is not done correctly.**

## Reader Discovery

You can find the available Readers on the network by using the Multicast DNS (mDNS) protocol (<http://multicastdns.org/>) and Reader Listing.

### Using mDNS

To find Readers on a network, you can use any client or client API that allows discovery of services using mDNS (a part of the Zero Configuration Network Standard). One common client implementing the Zero Configuration Network Standard is called Bonjour™, developed by Apple. Bonjour works on networks without a DHCP server and is included in the Apple Safari web browser (it must be selected during the Safari install).

After you have installed Safari the Bonjour icon appears under Bookmarks | Collections. You can select the Bonjour tool to discover other Readers available on the network.

#### Note

---

Each ThingMagic Reader in the Bonjour frame is referenced by the domain name (ThingMagic) followed by the hostname (M6) and the last six characters of the device's MAC address (such as 210027).

A device frame on the left side of the browser opens and lists the names of all active Bonjour devices available.

1. Double-click on the name of the Reader that you want to access.  
The Login dialog box for that specific Reader appears.
2. Enter the following:  
User name: web  
Password: radio
3. Click OK.  
The Reader displays the Status page of the selected Reader.

The list of Bonjour devices displayed on the screen is refreshed periodically so that new Bonjour-enabled devices appear as they come online.

### Reader Listing

The Reader Listing Page allows you to find Readers including ThingMagic M6, Astra, and Mercury5, that run on the network. It uses the same Multicast DNS(mDNS) protocol used by the Bonjour.

In the case of Reader Listing Page, no plugin is required and works in any browser. The Reader Listing Page contains a list of the Readers found on the network and additional information on each Reader including:






















- ◆ A link to the Reader's web interface
- ◆ Reader's IP address
- ◆ Firmware version it is running
- ◆ Number of connected antennas
- ◆ Status information

To enable Reader Listing to discover Readers available on the network:

Click on the Reader List link in the navigation menu.

The M6 Reader Listing Page appears, as shown in the *Figure 11*.

**Figure 11: M6 Reader Listing Page**

Reader Listing								
Type	Reader	Update Time	Uptime	Status	Version	IP Address	Antennas	Last Re Time
 ThingMagic	m6-21071f	18:39:51	up 4 min		4.7.1	10.0.0.35	MonoStatic: 1	Fri Feb 4 18:39:51
 ThingMagic	m6-21071e	13:47:01	up 1 min		4.7.1	10.0.0.36	MonoStatic: 1,2,3,4	
 ThingMagic	m6-21070e	13:55:58	up 15:28		4.7.1	10.0.0.34	MonoStatic: 1,3	
 ThingMagic	m6-210720	00:00:44	up 0 min		4.7.1	10.0.0.90	MonoStatic: 2	
	astra-21052a	21:20:48	up 35 min		4.1.21	10.0.0.43	MonoStatic: 1	Tue Dec 21:20:12
 ThingMagic	m6-210716	18:07:37	up 1:32		4.7.1	10.0.0.29	MonoStatic: 1	Fri Feb 4 18:06:37
 ThingMagic	m6-210715	18:15:03	up 2:08		4.7.1	10.0.0.164	MonoStatic: 1,2,3,4	Fri Feb 4 18:14:03
	astra-210018	18:51:23	up 14 min		4.1.21	10.0.0.31	MonoStatic: 1	Mon Jan 18:50:32
 ThingMagic	M6-210717	11:23:04	up 23:33		4.7.1	10.0.0.23	MonoStatic: 1,2,3,4	Wed Feb 11:15:23
 ThingMagic	m6-21071b	18:36:13	up 17 min		4.7.1	10.0.0.38	MonoStatic: 1	Fri Feb 4 18:35:13
	m4-1013fa							
	m5-10157e							

---

# Connecting to the M6 USB Console Port

M6 supports communication over its USB Console port to enable you to:

- ◆ Access the boot logs.
- ◆ Access the console for emergency recovery into Safe Mode.

Before you connect to the M6 USB Console port, ensure that you have:

- ◆ A PC with a USB port.
- ◆ A serial terminal program (such as HyperTerminal or Putty).
- ◆ A USB cable (with USB Mini-B plug)
- ◆ [FTDI USB to Serial Drivers](#)

Once the USB cable is connected you must determine the port name used by the host OS to connect. On Windows it will be assigned a "COM#" and Macintosh, and other unix based systems will see it as "/dev/tty.usbserial0" or similar.

When you have completed setting up the serial port, you must set the following four parameters to allow the terminal program to talk to the Reader:

- Data Rate: 115200
- Parity: None
- Data Bits: 8
- Stop Bits: 1

The procedure for connecting to a specific port is different for each terminal emulation program. Check the documentation for your program for information on setting these parameters.

Once you have set up the USB connection, reboot the Reader, and the boot logs begin to display. If not, recheck the terminal program configuration and try again.

## [FTDI USB to Serial Drivers](#)

The console port requires the host has FTDI USB to serial virtual COM port drivers installed. Most OSes have them pre-installed but if not they can be found at

<http://www.ftdichip.com/Drivers/VCP.htm>.

Please follow the instructions in the installation guide appropriate for your operating system.

## Using GPIO

The M6 Reader includes a 15-pin D-Sub connector (also commonly referred to as a VGA connector). This connector is used to support four opto-isolated general purpose inputs and four opto-isolated general purpose outputs. The values of the GPIO lines can be Get and Set using the MercuryAPI. See the respective guide for more details on software control of these signals. For ease of testing the following parts (included in M6 devkit) can be used to provide a terminal block interface to the GPIO pins:

- VGA male to male connector (for GPIO) [L-Com Part# DMB520M]
- VGA to terminal block (for GPIO) [L-Com Part# DGBH15FT]

### Inputs

The four opto-isolated inputs support the following input levels:

V-low (Logic 0) = 0-0.8V

V-high (Logic 1) = 3-30V

5mA max current with 24V input

It is recommended that external devices guarantee a minimum pulse width of at least 100ms.

### Outputs

The four opto-isolated outputs support power sourcing, up to +30V with current sink up to 200mA, through an external power supply connected between V-GPO and ISO-GND (pins 5 and 6).

Using the MercuryAPI the output signals (see note under [Connector Pinout](#) for enumeration values) can be set as follows:

`gpoSet(GPIO_#, 0)` sets pin corresponding to GPIO enumeration to Vhigh through 10kohm pull up resistor to V-GPO.

`gpoSet(GPIO_#, 1)` sets pin corresponding to GPIO enumeration to Vlow through effective short (through isolated FET switch) to ISO-GND.

All outputs have an active pull down to ISO-GND.

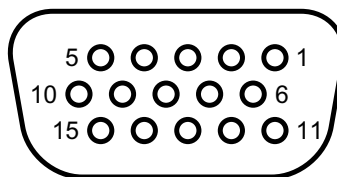
### Note

For non-isolated applications connect grounds together (pin6 and 7) and V-GPO to M6+5V (pins 1 and 5). With this configuration the reader provides the +5V supply and can sink up to 200mA, total.

## Connector Pinout

The following are the pin-outs of the 15-pin connector:

**Figure 12: DE15 GPIO Pinout**



1. **M6+5V** - non-isolated power from M6
2. N/A
3. N/A
4. **User Output 2** (*GPIO\_1*)
5. **V-GPO** - Isolated source power for outputs
6. **ISO-GND** - Isolated ground for outputs
7. **M6 Ground** - non-isolated ground
8. **User Output 1** (*GPIO\_0*)
9. **User Output 2** (*GPIO\_1*)
10. **User Output 3** (*GPIO\_2*)
11. **User Output 4** (*GPIO\_5*)
12. **User Input 1** (*GPIO\_3*)
13. **User Input 2** (*GPIO\_4*)
14. **User Input 3** (*GPIO\_6*)
15. **User Input 4** (*GPIO\_7*)

**Note:** The values in parentheses indicate the enumeration used by the MercuryAPI for each GPIO line.

**Note:** Note that Pin 9 is normally not populated on standard VGA cables. The M6 internally connects Pin 9 to Pin 4 to permit the use of such cables.

# Controlling the Reader

The Reader uses RFID (Radio Frequency Identification) technology to read and write data stored on RFID Tag(s).

The M6 Reader provides three levels of access to controlling read/write operations of RFID tag(s):

1. [Using the Browser-Based Interface](#)  
A web browser controls high-level Reader operations through a Java Applet. See [Status Page](#) for information about how to access the browser-based interface.
2. [MercuryAPI](#)  
High-level APIs (Application Programming Interface) provide fine control over all aspects of the Reader.  
See the MercuryAPI Programmers Guide at <http://rfid.thingmagic.com/devkit>.
3. [LLRP](#)  
EPCglobal ratified protocol used for communication between the M6 and a client application. The M6 should be “drop-in compatible” with systems supporting the standard LLRP protocol.

## Using the Browser-Based Interface

The M6 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.

You can run the browser-based interface from any PC on the network. Carefully configure the PC with an IP address and subnet mask compatible with the current operational settings of the Reader.

The Reader navigation menu provides access to the following pages:

- ◆ [Status Page](#)- Displays the current operational settings.
- ◆ [Query Page](#)- Allows the user to perform Anti-Collision RFID tag searches and to specify the constraints used in the search.
- ◆ [Settings Page](#)- Allows the user to modify Reader configuration and network settings.

- ◆ [Firmware Upgrade Utility](#)- Upgrades the tag Reader with new firmware images provided by ThingMagic.
- ◆ [Restart Page](#)- Allows the user to restart the Reader through a "warm boot."
- ◆ [Diagnostics Page](#)- Provides the current operating settings and access to the status logs of the Reader.
- ◆ [Statistics Page](#)- Provides the statistics that are defined by the EPCglobal Reader Management Standard v1.0.1

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. You can also use [Reader Discovery](#) methods to browse to it.  
A log-in dialog appears.
4. Enter the following:  
User name: "web"  
Password: "radio" (all lower-case).
5. Click OK.  
A navigation menu and the Status page appear in the browser, as shown in the *Figure 6*.

## Status Page

The M6 Status Page, as shown in the *Figure 6*, 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 query operations.

## Query Page

Use the M6 Query Page to set up and run Anti-Collision Searches quickly, and to obtain immediate feedback. This is useful for debugging as well as for verifying performance after installation is completed.

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

## Read Tags

The Query Page enables you to read tags and select an appropriate query.

To read tags:

1. Click 'Connect' to reader. A connection will not be successful if other clients are connected to the reader.
2. Position one or more tags, in front of one of the antennas connected to the Reader.
3. Set the Query timeout duration.
4. Click 'Query Once'.

The selected Query will be run on all connected antennas (checked antennas) in the default configuration. If [RFID Protocol Settings](#) | *Antenna Detection = Off* then the antennas to query on must be selected. The query can be run once or continuously.

To initiate and stop a query:

1. Click the Start button at the bottom right of the Query Page.  
The Reader will continuously read the tags and display the tag data. Each row in this example shows sequential tag number, number of times tag was read, tag EPC ID, antenna, and protocol.
2. Click Stop to stop the tag search.

### Note

You must click Stop to stop the query before exiting. Otherwise, the Reader will continue to transmit RF energy on its antennas.

## Query Results

As shown in *Figure 13*, the displayed tag data contains useful information, including the tag number, number of times a tag is read, tag data, antenna, and protocol.

**Figure 13: Query Results**

The screenshot displays the following interface elements:

- Header:** "56 tags" (highlighted), "@Mon Oct 24 16:14:31 EDT 2011" (highlighted).
- Buttons:** "Copy Display to Raw", "bignum", "Show Raw", "Font Size: 16", "Clear Output".
- Table:**

Line #	Count	EPC ID	Protocol	Protocol
1	1	E20068696919006911809EA7	UHF1	GEN2
2	2	300833B2DDD9014000000000	UHF2	GEN2
3	1	111122223333444455556666	UHF1	GEN2
4	1	100000000000000024CCFE04	UHF2	GEN2
5	1	1000000000000000224CFD8B	UHF2	GEN2
6	1	1000000000000000214CFC99	UHF2	GEN2
7	1	1000000000000000210CFD44	UHF2	GEN2
8	1	1000000000000000204CFDC3	UHF2	GEN2
9	1	1000000000000000238CFCC7	UHF2	GEN2
10	1	100000000000000026CCFDDB	UHF2	GEN2
11	1	10000000000000002A8CFCEE	UHF2	GEN2
12	1	10000000000000002ACCFD6F	UHF2	GEN2
13	1	1000000000000000248CFE04	UHF2	GEN2
- Control Panel:** "Disconnect",  ANT1,  ANT2,  ANT3,  ANT4, "Start", "Stop", "Query Once", "1000 ms".

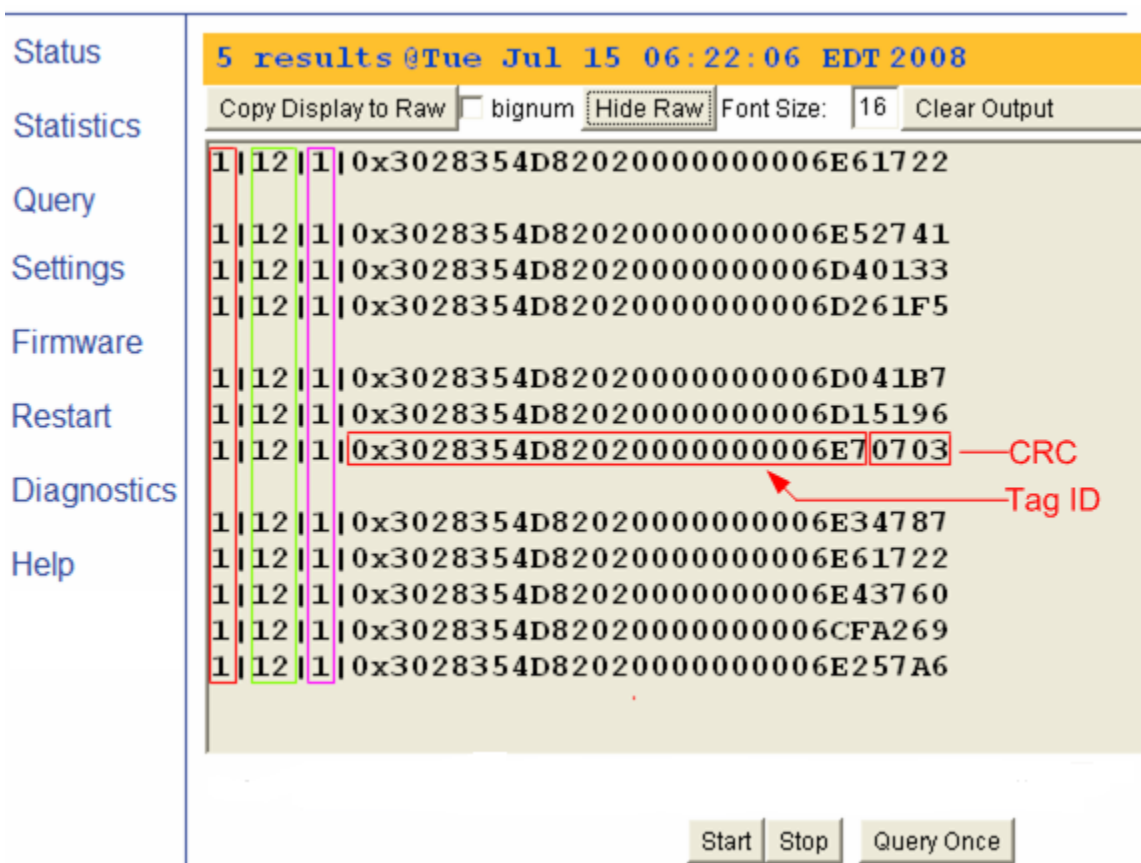
Annotations in the image:

- "Tags read during current search" points to "56 tags".
- "Reader date & time" points to "@Mon Oct 24 16:14:31 EDT 2011".
- "Last antenna to read tag" points to the "ANT2" checkbox.
- "Tag Protocol" points to the "GEN2" column.
- "EPC IDs" points to the EPC ID column.
- "# of times tag was read" points to the first column of the table.
- "Detected and enabled antennas" points to the ANT1 and ANT2 checkboxes.
- "No antenna detected" points to the ANT3 and ANT4 checkboxes.
- "Query timeout" points to the "1000 ms" input field.

## Show Raw

The Show Raw button displays raw tag data on the Query page, as shown in *Figure 14*. This is the actual console output returned from the query. As shown in figure each row lists the Reader, protocol, antenna, tag ID, and CRC for each tag found. A space separates the groups of tags found during each query. You can easily copy and paste the raw data into other documents.

**Figure 14: M6 Raw Data Page**



**5 results @Tue Jul 15 06:22:06 EDT 2008**

Copy Display to Raw  bignum  Font Size: 16 Clear Output

1	12	1	0x3028354D82020000000006E61722
1	12	1	0x3028354D82020000000006E52741
1	12	1	0x3028354D82020000000006D40133
1	12	1	0x3028354D82020000000006D261F5
1	12	1	0x3028354D82020000000006D041B7
1	12	1	0x3028354D82020000000006D15196
1	12	1	0x3028354D82020000000006E70703
1	12	1	0x3028354D82020000000006E34787
1	12	1	0x3028354D82020000000006E61722
1	12	1	0x3028354D82020000000006E43760
1	12	1	0x3028354D82020000000006CFA269
1	12	1	0x3028354D82020000000006E257A6

Start Stop Query Once

## Raw Tag Data

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

- ◆ id: Tag id (in hex) and trailing 4-digit (16-bit) CRC cyclical redundancy check.
- ◆ read\_count: Number of times the tag was seen during the query.
- ◆ protocol\_id: GEN2 = 12.
- ◆ antenna\_id: From 1 to 4 depending on which antenna saw the tag.

## Settings Page

The M6 Modify Settings Page enables you to change network and Reader security settings. The page is divided into seven sections:

- ◆ [RFID Protocol Settings](#)
- ◆ [Network Settings: All Interfaces](#)
- ◆ [Network Settings: Ethernet Interfaces](#)
- ◆ [Network Settings: Wireless Interfaces](#)
- ◆ [Boot Option Settings](#)
- ◆ [Reader Identification Settings](#)
- ◆ [Security Settings](#)

Changing these parameters changes the settings the Reader uses on startup. Although boot options and network settings can be modified, be careful to use correct values or you may not be able to connect to the Reader without restarting in 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 [Restart Page](#)). Therefore, to ensure that all new settings take effect, it is recommended that you restart the Reader after saving the new settings and after reconfiguring.

## RFID Protocol Settings

The RFID protocol settings take effect on the Reader, immediately after saving the settings. A restart is not required for RFID protocol settings to take effect.

**Table 1: RFID Protocol Settings**

Setting	Description
UHF Power	This is the global power setting for all antenna(s) for both read and write operations. The maximum is 31.5dBm.
Antenna # Read Power (dBm)	The power setting used for Read operations on antenna #. This setting overrides the UHF Power setting for this antenna. When set to '0' or '-1' the UHF Power setting will be used. SEE CAUTION below
Antenna # Write Power (dBm)	The power setting used for Write operations on antenna #. This setting overrides the UHF Power setting for this antenna. When set to '0' or '-1' the UHF Power setting will be used. SEE CAUTION below
Antenna Detection	Controls whether the reader will automatically detect connected antenna and only allow those ports to be used: <ul style="list-style-type: none"> <li>• <b>On</b> - Only ports with antennas that meet the <a href="#">Antenna Detection</a> requirements will be active.</li> <li>• <b>Off</b> - All ports are available for use. The user <b>MUST</b> specify the specific antennas to transmit on and is responsible for ensuring transmits do not occur on ports without connected antennas.</li> </ul>

 **C A U T I O N !** 

**Due to a bug in the v4.9.2 M6 firmware, if power is being set per antenna using each *Antenna # Read/Write Power*, they all must be set and saved together. The default to the *UHF Power* setting when left as '0' or '1' does not reliably work.**

### Network Settings: All Interfaces

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, to connect to the Reader through its hostname. Usually when using DHCP, the DHCP server will add the hostname to the DNS server's database.

**Table 2: Network Settings: All Interfaces**

Setting	Description
Network Interface	Select between Wired (Ethernet) and Wireless (802.11).

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 M6 and a MAC Address of 00:12:A4: 13:47:AC, the automatic hostname would be M6-1347ac.
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 M6 Reader to resolve hostnames to IP addresses.
Secondary DNS Server	This field allows the M6 Reader to resolve hostnames to IP addresses.

## Network Settings: Ethernet Interfaces

**Table 3: Network Settings: Ethernet Interface**

Setting	Description
Use DHCP?	If set to Yes, the Reader will automatically look for its LAN IP, Netmask, and Gateway addresses from a DHCP Server.
Use Fallback Interface	If set to Yes, the specified Fallback Network Interface will be used in case of failure on this interface's primary configuration.
Fallback Network Interface	If set to Wired then the static Fallback IP, Netmask and Gateway will be used in case of failure of the primary configuration on this interface. If set to Wireless the interface will switch to wireless in case of failure.
Vendor Class Identifier	This radio button enables 96-bit tag support. To optimize the Reader, keep this setting turned off unless it is needed.
Use DHCP Server- supplied Host- name?	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.
Fallback IP Address	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.
Fallback Netmask	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.
Fallback Gateway	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.

## Network Settings: Wireless Interfaces

These wireless interfaces apply only when your reader supports Wi-Fi.

**Table 4: Network Settings: Wireless Interface**

Setting	Description
Use DHCP?	If set to Yes, the Reader will automatically look for its LAN IP, Netmask, and Gateway addresses from a DHCP Server.
Use Fallback Interface	If set to Yes, the specified Fallback Network Interface will be used in case of failure on this interface's primary configuration.
Fallback Network Interface	If set to Wireless then the static Fallback IP, Netmask and Gateway will be used in case of failure of the primary configuration on this interface. If set to Wired the interface will switch to wired in case of failure.
Vendor Class Identifier	This radio button enables 96-bit tag support. To optimize the Reader, keep this setting turned off unless it is needed.
Use DHCP Server- supplied Host- name?	If set to Yes, the manually supplied hostname (see Hostname) will be overridden by the hostname supplied by the DHCP Server.
WLAN 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.
WLAN Gateway	This is the gateway IP address for the local network, typically the IP address of a router.
WLAN 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.
Wireless Fallback IP Address	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.
Wireless Fallback Netmask	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.
Wireless Fallback Gateway	This network configuration will be used by the Reader if DHCP is enabled but fails to acquire an IP address.

Wireless Authentication Mode	Select WEP, WPAPSK, or WPA2PSK for authentication.
Wireless SSID	This field will contain the SSID of the wireless network to which the M6 will connect.
Wireless Key	This field will contain the Key for the wireless network to which the M6 will connect.

## Boot Option Settings

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

**Table 5: Boot Option Settings**

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 the 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	URL to the firmware file to be downloaded at startup.
Syslog Host	Hostname for remote logging. All log levels in syslog are sent to this host.

## Reader Identification Settings

The Reader identification settings show the user-defined identifier strings.

**Table 6: Reader Identification Settings**

Setting	Description
Reader Description	This is a user-defined identifier string to describe the Reader that gets echoed back verbatim via the web interface, SNMP, or the API.
Reader Role	This is a user-defined identifier string to describe the Reader's role in a system that gets echoed back verbatim via the web interface, SNMP, or the API.
Ant# Description	This is a user-defined identifier string to describe the default Antenna # that gets echoed back verbatim via the web interface, SNMP, or the API.

## Security Settings

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

**Table 7: Security Settings**

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 Web Only (disable standard http)	If Yes, the Reader will only respond to requests using https URLs.
SNMP Enabled	Enables access to the reader statistics as defined by the EPC Global Reader MIB via Simple Network Management Protocol (SNMP).
MDNS enabled	Enables reader discovery via Multicast DNS.

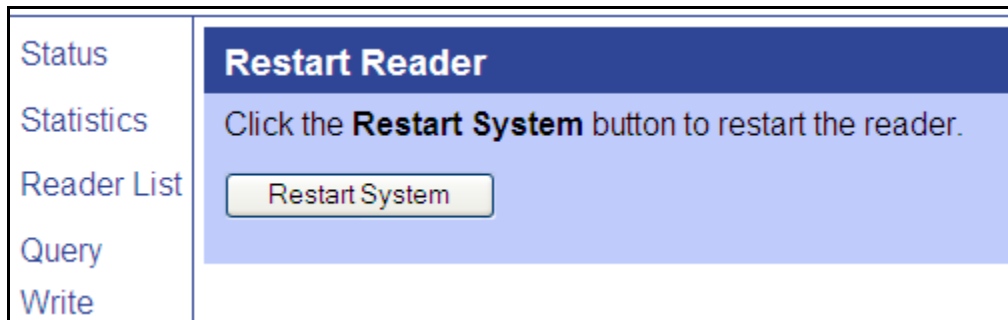
## Restart Page

The M6 Restart Page enables you to activate reconfigured network Reader settings or to recover from a Reader error.

To restart the Reader:

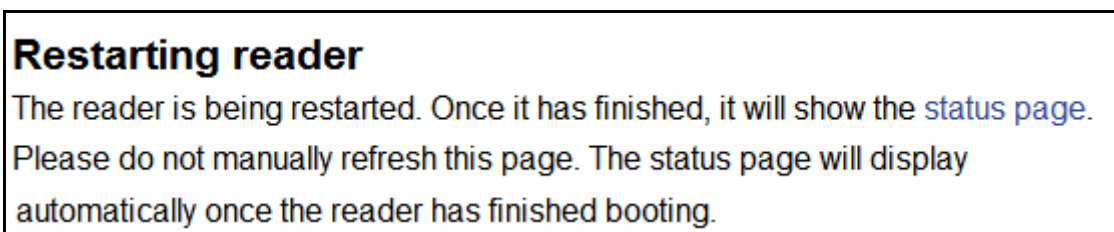
1. Click the Restart link on the navigation menu.  
The Restart Reader page appears, as shown in *Figure 15*.

**Figure 15: M6 Restart Reader Page**



2. Click the Restart System button.
3. Click OK.  
The following message appears, as shown in *Figure 16* and remains on the screen until the Reader restarts.

**Figure 16: Restarting Reader**



### Note

It takes at least 60 seconds for the Reader to boot up. During this time the Power/Heartbeat LED is solid amber. When the LED is solid green, 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 the current status of network interfaces.

## Statistics Page

The Statistics Page, as shown in *Figure 17*, displays the M6 Reader statistics. These statistics are defined by the EPCglobal Reader Management Standard v1.0.1, specifically, the statistics defined in sections 5.5 *AntennaReadPoint* and 5.6 *Source Object*. These same statistics are available through the SNMP interface.

**Figure 17: M6 Statistics Page**

<b>Statistics Times</b>		
Reader Current Time:	2008-7-6,23:29:27.0	
Reset Statistics Time:	0-1-1,0:0:0.0	
<b>Antennas Statistics</b>		
<b>Statistics Object</b>	<b>Antenna 1</b>	<b>Antenna 2</b>
Tags Identified	75877	---
Tags Not Identified	0	---
Memory Read Operations	0	---
Memory Read Failures	0	---
Write Operations	0	---
Write Failures	0	---
Kill Operations	0	---
Kill Failures	0	---
Erase Operations	0	---
Erase Failures	0	---
Lock Operations	0	---
Lock Failures	0	---
Noise Level	42	---
Time Energized	19203110	---
<b>Reader Statistics</b>		
Read Cycles Per Trigger:	0	

More information on these statistics can be found at the following URL:

[http://www.epcglobalinc.org/standards/rm/rm\\_1\\_0\\_1-standard-20070531.pdf](http://www.epcglobalinc.org/standards/rm/rm_1_0_1-standard-20070531.pdf)

## Firmware Upgrade Utility

M6 provides Firmware Upgrade Utility for updating the firmware.

1. Click the Firmware link on the navigation menu.  
The Firmware Update page appears, as shown in *Figure 18*.

**Figure 18: M6 Firmware Update Page**

<b>Status</b>	<b>Firmware update</b>
<b>Statistics</b>	File upload: <input type="button" value="Choose File"/> No file chosen
<b>Reader List</b>	or, specify a download URI (tftp, ftp, http): <input type="text"/>
<b>Query</b>	Erase contents before installing <input type="checkbox"/>
<b>Settings</b>	Revert to default settings <input type="checkbox"/>
<b>Firmware</b>	<input type="button" value="Update"/>
<b>Restart</b>	
<b>Diagnostics</b>	
<b>Help</b>	

2. Do one of the following:
  - ◆ In the File upload field, enter the complete URL network pathname of the firmware file.
  - ◆ Click Browse... to locate the firmware file.

 **C A U T I O N !** 

If you select the "Erase contents before installing" check box, you will erase all user-installed programs or files residing on the reader. **DO NOT** select this option if you wish to preserve any user programs residing on the reader.

 **C A U T I O N !** 

If you select the "Revert to default settings" check box, you will erase any changes made to the reader's configuration settings and revert to factory default settings. If you select this option, the reader's current configuration settings will be erased. **DO NOT** select this option if you wish to preserve the reader's current configuration settings.

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. Restart the reader to activate the new firmware.  
The old firmware remains active until the Reader is restarted.

Note

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

## Using Safe Mode

There are two reasons to enter Safe Mode:

- ◆ To perform a firmware update for repairing a corrupted filesystem.
- ◆ To change settings that prevent the Reader from operating normally.

### Note

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

Safe Mode is used to recover from errors that prevent the Reader from operating in normal mode. In Safe Mode the Reader is configured to try DHCP and fallback with a static IP address of 10.0.0.101. For the static fallback safe mode uses the following network settings:

- ◆ IP Address: 10.0.0.101
- ◆ Hostname: M6

When in Safe Mode the browser-based interface pages navigation menu will display “Safe Mode” at the top and the Status page will indicate it is “Unable to communicate with the MercuryOS server”. In this mode the Reader is still functional though it cannot read or write tags. The web server, telnet server, and SSH (Secure Shell) server run in Safe Mode, however none of the RFID features are activated.

In most cases, after starting in Safe Mode, the Reader will need to be reconfigured for operation with the Reader application, after starting in Safe Mode. To communicate with the Reader in Safe Mode, your PC must have an IP address and subnet mask that are compatible with the Reader settings. You can then reconfigure the desired settings through the web interface. After you have completed the maintenance, restart the Reader to activate the changes.

## Force M6 to boot in safe mode

The M6 Reader can be forced to boot into Safe Mode in one of two ways:

### Physically pressing the [Reset Button](#):

1. With the reader running (green LED is solid), use a non-conductive object to hold down the recessed reset button for 4 seconds.
2. The green LED should turn solid Amber as soon as the button is ready to boot and the button can be released. It should take approximately 30 seconds to boot into Safe Mode.
3. Once the maintenance has been performed, restart the reader to activate the changes.

### Command line interface (through console port or telnet/ssh):

1. Connect to the Readers serial port  
(See [Connecting to the M6 USB Console Port](#).)  
  
Enter the following to log into the console  
Default UserID: *root*  
Password: *secure*
2. Type the command: *touch /tm/etc/safe-boot*
3. Click the Enter button.
4. Type the command: *reboot*
5. Click the Enter button.  
Reader reboots.

In both methods the M6 will now boot into Safe Mode and you can connect to it using the steps defined in [Connecting Your PC to the Reader](#).

# Advanced Reader Functionality

## Protocol Support

Using the MercuryAPI ReadPlan classes the M6 can be configured to perform various Read operations. The following describes protocol specific configuration options supported on the M6. See the *MercuryAPI Programmers Guide* and language specific reference guides for details on supported Gen2 command functionality.

### ISO 18000-6C (Gen2)

#### Protocol Configuration Options

The M6 supports multiple ISO-18000-6C profiles including the ability to specify the Link Frequency, encoding schemes, Tari value and modulation scheme. The protocol options are set in the MercuryAPI Reader Configuration Parameters (/reader/gen2/\*). The following table shows the supported combinations:

**ISO-18000-6C Protocol Options**

<b>Backscatter Link Frequency (kHz)</b>	<b>Encoding</b>	<b>Tari (usec)</b>	<b>Modulation Scheme</b>
250	Miller (M=8)	12.5	PR-ASK
250	Miller (M=4)	12.5	PR-ASK
250	Miller (M=2)	12.5	PR-ASK
250	FM0	12.5	PR-ASK
250	Miller (M=8)	25	PR-ASK
250	Miller (M=4)	25	PR-ASK
250	Miller (M=2)	25	PR-ASK
250	FM0	25	PR-ASK
250	Miller (M=8)	25	PR-ASK
640	FM0	6.25	PR-ASK

## ISO 18000-6B

### Protocol Configuration Options

The M6, with appropriate license purchase, supports multiple ISO-18000-6B profiles including the ability to specify the Return Link Frequency, encoding, Forward Link Rate and modulation scheme. The protocol options are set in the MercuryAPI Reader Configuration Parameters (/reader/iso18000-6b/\*). The following table shows the supported combinations:

**ISO-18000-6B Protocol Options**

<b>Return Link Freq (kHz)</b>	<b>Return Encoding</b>	<b>Forward Link Freq (kHz)</b>	<b>Forward Encoding</b>
40	FM0	10	Manchester
40	FM0	10	Manchester
160	FM0	40	Manchester
160	FM0	40	Manchester

### Tag Read Meta Data

When tags are being inventoried by the M6, in addition to the tag EPC ID resulting from inventory operation each `TagReadData` (see MercuryAPI for code details) contains meta

data about how, where and when the tag was read. The specific meta data available for each tag read is as follows:

### Tag Read Meta Data

Meta Data Field	Description
Antenna ID	The antenna on which the tag was read. If the same tag is read on more than one antenna there will be a tag object returned for each antenna on which the tag was read.
Read Count	The number of times the tag was read on [Antenna ID].
Timestamp	The time the tag was read. For accurate time an NTP server should be configured.
Tag Data	When reading if an embedded <code>TagOp</code> is specified for a <code>ReadPlan</code> the <code>TagReadData</code> can contain up to 32 bytes of data returned for each tag. <b>Note:</b> Tags with the same <code>TagID</code> but different <code>Tag Data</code> can be considered unique and each get a <code>Tag Buffer</code> entry if set in the reader configuration parameter <code>/reader/tagReadData/uniqueByData</code> . By default it is not.
Frequency	The frequency on which the tag was read
Tag Phase	Average phase of tag response in degrees (0°-180°)
LQI/RSSI	The receive signal strength of the tag response in dBm.
GPIO Status	The signal status (High or Low) of all GPIO pins when tag was read.

## Reader RF Power

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

The M6 supports separate read and write power level which are command adjustable via the MercuryAPI. Power levels must be between:

- Minimum RF Power = +5 dBm
- Maximum RF Power = +31.5 dBm (+0.0/- 0.5 dB accuracy above +15 dBm)

**W A R N I N G !**

**Operation using an RF Power setting above 30 dBm requires a professional installer.**

### Power Settings for Authorized Antennas and Cables

This device has been designed to operate with the antennas listed in [Authorized Antennas](#) list using the cables in the [Authorized Cables](#) list. For any combination of antenna and cable the maximum RF power is determined from antenna gain (Max Linear Gain value from antenna list) and antenna cable loss (Insertion Loss value from cable list) using the formula:

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

For example, for the Laird S8658WPL and the ThingMagic CBL-P6 6ft cable the following calculation can be performed:

$$\text{Max linear antenna gain} = 6 \text{ dBiL}$$

$$\text{Minimum cable insertion loss} = 0.8 \text{ dB}$$

$$P_{max} = 36 - 6 + 0.8 = 30.8 \text{ dBm}$$

The maximum RF power that may be set using this configuration is 30.8 dBm (see Warning above).

For more information about setting the RF power, refer to [Setting the Reader RF Power](#).

#### Note

Be sure to read [Compliance and IP Notices](#) to maintain compliance with FCC or other applicable regional regulations.

---

## Setting the Reader RF Power

To set the Reader RF power:

1. Log on to the Reader using your browser.  
The M6 [Status Page](#) appears, as shown in the *Figure 6*.
2. Click on the Settings tab.  
The first field on the Settings page is UHF Power. Its factory default value is 30 dBm.
3. Enter the maximum setting based on your cable type, length, and antenna type.
4. Scroll down to the bottom of the [M6 Modify Settings Page](#), and click Save changes button.  
The Settings Page will reload automatically after the settings have been saved.

### Note

If the Status page does not appear after a minute, 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

See [Appendix B: M6 Dimensions](#) for mounting hole locations and dimensions.

When mounting the M6 reader it is recommended to use four #10 x  $\frac{3}{4}$  in. min. screws or M5 x 20 mm screws, with washers min.  $\frac{1}{2}$  in. in diameter. Nylon plastic expansion wall anchors shall be suitable for the screw size. The mounting surface should be minimum  $\frac{1}{2}$  in. drywall. If mounting to the ceiling use nylon hollow wall anchors suitable for the screw size and application. As an alternative, # 10 x 1-1/2 in. screws and washers may be used if mounting directly to a wall stud.

Follow these steps to mount the reader on a ceiling or wall:

1. Hold the reader in its mounting location and mark the position of the four mounting screws.
2. Drill holes for the screws and install wall or ceiling anchors if required. For ceiling mount, use only anchors specifically designed for ceilings.
3. Hold reader over holes and insert the screws and tighten until almost flush with the wall.
4. Tighten the screws.



**C A U T I O N !**



**If there is any chance of dust or water exposure, the M6 should be mounted with the Ethernet, USB, Console, Power and GPIO ports facing down to prevent ingress.**

## Variables Affecting Performance

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

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

## Environmental

Reader performance may be affected by the following environmental conditions:

- ◆ Metal surfaces such as desks, filing cabinets, bookshelves, and wastebaskets may enhance or degrade Reader performance.
- ◆ Antennas should be mounted far away from metal surfaces that may adversely affect the system performance.
- ◆ Devices that operate at 900 MHz, such as cordless phones and wireless LANs, can degrade Reader performance. The Reader may also adversely affect the performance of these 900 MHz devices.
- ◆ Moving machinery can interfere the Reader performance. Test Reader performance with moving machinery turned off.
- ◆ Fluorescent lighting fixtures are a source of strong electromagnetic interference and if possible should be replaced. If fluorescent lights cannot be replaced, then keep the Reader cables and antennas away from them.
- ◆ Coaxial cables leading from the Reader to antennas can be a strong source of electromagnetic radiation. These cables should be laid flat and not coiled up.



**W A R N I N G !**



**The M6 antenna ports may be susceptible to damage from Electrostatic Discharge (ESD). Equipment failure can result if the antenna or communication ports are subjected to ESD. Standard ESD precautions should be taken during installation to avoid static discharge when handling or making connections to the M6 reader antenna or communication ports. Environmental analysis should also be performed to ensure static is not building up on and around the antennas, possibly causing discharges during operation.**

## Tag Considerations

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

- ◆ Application Surface: Some materials, including metal and moisture, interfere with tag performance. 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

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

- ◆ Antennas on other Readers operating in close proximity may interfere with one another, thus degrading performance of the Readers.
- ◆ 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.

### Note

---

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

# M6 Specifications

The following are the specifications for the M6 Reader.

## UHF RFID Antenna Interface

*Interface:* Four RP-TNC Connectors

*RF Power Output:* Separate read and write levels, adjustable from 5 dBm to 31.5 dBm\* (1.4W) from 5 dBm to 31.5 dBm\* (1.4W)

*Frequency:* Hop table with up to 62 entries, configurable in 50KHz steps, accommodating the following ranges (hardware dependant):

- 902-928 MHz (FCC; NA, SA)
- 865.6-867.6 MHz (ETSI; EU)
- 865-867 MHz (MCIT; India)
- 917-920 MHz (KCC; KR)<sup>1</sup>

**Note:** 1 - The first frequency channel (917,300kHz) of the KR2 region will be derated to +22dBm to meet the new Korea regulatory requirements. All other channels operate up to +30dBm. In the worst case scenario, each time the derated channel is used it will stay on that channel for 400ms. The fastest it will move to the next channel, in the case where no tags are found using that frequency, it will move to the next channel after 10 empty query rounds, approximately 120ms.

## Power

*Power over Ethernet:* PoE 802.3af in both modes A and B (Supports 100m cable) Will supply 2.5 W to either USB external device or internal WiFi adapter

*Optional External DC Power:* 10- 30 VDC supply voltage. Maximum DC power: 15 W

### Note

If a DC Power supply is used it must meet the following criteria:

- Be UL Listed
- Meet the above operating specs
- The output must comply with SELV and LPS characteristics
- Have a maximum operating ambient temperature that meets or exceeds the intended M6 operating temperatures as covered under the UL Listing of the power supply.

## Environmental

*Operating Temperature:* -20°C to +50°C

### Note

If an external DC power supply with a lower operating ambient temperature, as covered under the UL Listing of the power supply, is used then the operating ambient temperature of the M6 would be reduced accordingly.

*Storage Temperature:* -40°C to +85°C

## Physical Dimensions

19 cm L x 17.8 cm W x 3.4 cm H

(7.5 in L x 7.0 in W x 1.3 in H)

2 lbs (0.9kg)

## Supported UHF Tag Protocols

- ◆ EPC Class 1 GEN2 (ISO 18000-6C) with DRM
- ◆ ISO 18000-6B (Optional)
- ◆ IP-X: EM 412x (Optional)

## Data/Control/Wireless Interfaces

### *Connectors:*

- RJ45 (10/100 Base-T Ethernet)
- USB Type B (console port)
- USB Type A (accessory port)
- HD15 (GPIO interface)
- 2.5 mm screw-lock barrel (DC power)
- Female SMA (optional WiFi antenna)

### *Wireless:*

- Internal 802.11 b/g (optional)

- WEP 40-bit and 104-bit keys
- WPA & WPA2 with TKIP and AES algorithms with pre-shared keys or EAP-TLS
- USB type A interface permits future support for external wireless technologies.

*Indicators, switches, and GPIOs:*

- 1 two-color LED status indicator
- reset switch
- Isolated GPIOs: 4 Inputs & 4 Outputs plus +5 VDC and ground references

## Performance

- ◆ Over 400 tags/second
- ◆ Over 30 ft (9m) read distance with 6dBi antenna (36 dBm EIRP)

## Regulatory & Safety

- ◆ FCC 47 CFR Ch. 1 Part 15
- ◆ Industrie Canada RSS-21 0
- ◆ ETSI EN 302 208 V1.1.1 and V1.2.1 (with corresponding M6-EU hardware)
- ◆ ROHS Compliant, UL Listed

---

# Compliance and IP Notices

## Regulatory Compliance

EMC FCC 47 CFR, Part 15

Industrie Canada RSS-210

### Federal Communication Commission Interference Statement

**This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.** These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- ◆ Reorient or relocate the receiving antenna.
- ◆ Increase the separation between the equipment and receiver.
- ◆ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ◆ Consult the dealer or an experienced radio/TV technician for help.

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.

**FCC Caution:** Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

### Industry Canada

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its

gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed in [Authorized Antennas](#) and [Authorized Cables](#) tables with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

To comply with IC RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 25 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

## Industrie Canada

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

Le fonctionnement de l'appareil est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas perturber les communications radio, et

2. cet appareil doit supporter toute perturbation, y compris les perturbations qui pourraient provoquer son dysfonctionnement.

Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas celle nécessaire pour une communication réussie.

Au but de conformer aux limites d'exposition RF pour la population générale (exposition non-contrôlée), les antennes utilisés doivent être installés à une distance d'au moins 25 cm de toute personne et ne doivent pas être installé en proximité ou utilisé en conjonction avec un autre antenne ou transmetteur.

**W A R N I N G !**

**Operation of the M6 at RF power above 30dBm requires professional installation to correctly set the TX power for the RF cable and antenna selected.**

# Appendix A: M6 Antenna and Cable Information

## Authorized Antennas

To comply with FCC requirements for RF exposure safety, a separation distance of at least 25 cm (8.7 inches) must be maintained between the radiating elements of the antenna and nearby people. You must also provide strain relief for all Reader connections.

The only antennas authorized by the FCC for use with the M6 Reader are listed in the table below. Detailed information on each antenna is available from their respective manufacturers. Antennas not included in this list or having a gain greater than 6 dBiL are strictly prohibited for use with this device. The required antenna impedance is 50 ohms

**Table 8: Authorized Antennas**

Manufacturer	Type	Manufacturer Part Number	Max. Linear Gain (dBiL)
Laird	Patch	S9025P	4.3
Laird	Patch	S8658WPL	6.0
Laird	Patch	DCE8658WPR	6.0 dBiL
Laird	Patch	PEL90206	4.7 dBiL
Laird	Patch	S9026X	4.5 dBiL
MTI	Patch	MT-262013	6.0 dBiL
MTI	Patch	MT-242043	6.0 dBiL
MTI	Patch	MT-242042	4.1 dBiL
MTI	Patch	MT-241026	0.2 dBiL
Poynting	Patch	A-PATCH-0025	5 dBiL
Mobile Mark	Patch	PN8-915	6.0 dBiL
Mobile Mark	Patch	PN7-915	4.5 dBiL
Mobile Mark	Patch	PN6-915	4.0 dBiL

### Note

**IMPORTANT:** No other antennas may be used with the M6 Reader without violating FCC regulations. It is the responsibility of the user to comply with this requirement.

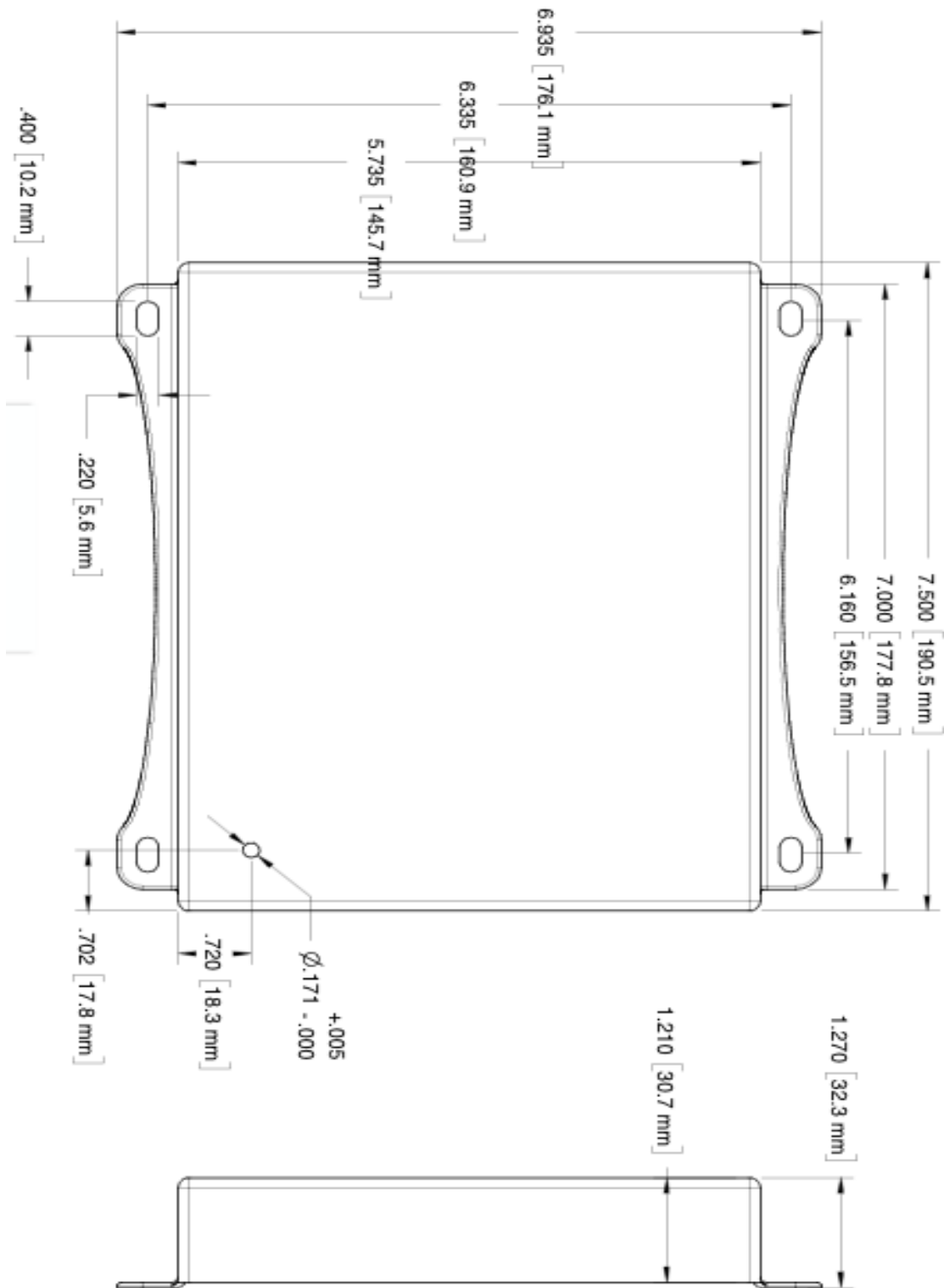
## Authorized Cables

The following table contains the cable loss values for authorized shielded coaxial cables provided by ThingMagic

<b>Cable Description</b>	<b>ThingMagic Part Number</b>	<b>Insertion Loss</b>
6' RTNC to RTNC Cable	CBL-P6	0.8 dB
12' RTNC to RTNC Cable	CBL-P12	1.5 dB
20' RTNC to RTNC Cable	CBL-P20	2.4 dB
20' RTNC to RTNC Plenum Cable	CBL-P20-PL	2.4 dB
25' RTNC to RTNC Cable	CBL-P25	3.0 dB

## Appendix B: M6 Dimensions

***Figure 19: M6 Dimensions***



# Appendix C: Advanced Administration

## Changing the Web Interface uid/passwd

This steps below describe how to add/change the User/Password for the Web Interface. This can also be done by [Connecting to the M6 USB Console Port](#) and following these steps.

1. Connect to the reader using SSH or Telnet

```
> telnet [reader IP address]
User: root
Pass: secure
```

2. Use the httpPassword command:

Usage: *httpPassword <filename> <realm> <username>*

To create a new userid/password file:

```
[root@m6-21071f] $ cd /tmp
[root@m6-21071f] $ httpPassword -c users.db thingmagic rfid_user
New password:
Confirm password:
[root@m6-21071f] $ mv /tmp/users.db /etc/appWeb/users.db
```

To add a user to an existing file:

```
[root@m6-21071f] $ cd /tmp
[root@m6-21071f] $ cp /etc/appWeb/users.db /tmp/users.db
[root@m6-21071f] $ httpPassword users.db thingmagic another_user
New password:
Confirm password:
[root@m6-21071f] $ mv /tmp/users.db /etc/appWeb/users.db
```

**Note:** don't use "-c" when adding users as this creates a new password file.

3. Verify the file contains the new information

```
[root@m6-21071f] $ cd /etc/appWeb
[root@m6-21071f] $ cat users.db
1: another_user: thingmagic: d7828175fdbf4f733c356b50a6706b24
1: web: thingmagic: 92801793e4875ae8da987402c3dd468f
```

4. Reboot the reader; login

### Note

In the steps above, for step 2 there are two different methods of creating a new user/password. The first creates a new user/password file which means it

overwrites the existing file and deletes any existing user/passwords. That means web/radio will no longer work. In the second set of steps it adds user/passwords to the existing users.db file, so it retains existing user/passwords. You should use one or the other depending on what you want to do with existing user/passwords.

## Changing console/root password:

To change the root password, used by the command-line interface and console access, use standard linux "passwd [userid]" command.

```
[root@m6-21071f] $ passwd
Changing password for root
Enter the new password (minimum of 5, maximum of 8 characters)
Please use a combination of upper and lower case letters and numbers.
Enter new password:
Re-enter new password:
Password changed.
```

# Appendix D: Troubleshooting

## Troubleshooting Table

**Table 9: Common Problems and Solutions**

Problem	Path to Solution
Cannot connect to reader over network	<ul style="list-style-type: none"> <li>• Check your network settings by <a href="#">Analyzing the Boot Logs</a> to make sure you're trying the correct IP address.</li> <li>• If the settings are wrong, try to <a href="#">Using Safe Mode</a> to get a known network configuration,</li> <li>• or <a href="#">Reset to the Default Configuration</a> and start the configuration over.</li> </ul>
Reader is not reading tags	<ul style="list-style-type: none"> <li>• Verify LEDs are blinking according to <a href="#">Interpreting the Reader Indicator LED</a></li> <li>• If they are, indicating active RF, make sure tags are in range.</li> <li>• Check antenna cables</li> <li>• Try known good Gen2 tags</li> <li>• Increase <a href="#">Reader RF Power</a></li> </ul>
Reader error LED stays on	Following <a href="#">Collecting Diagnostic Data for ThingMagic Support</a> and send to support.
Read "Performance" is slow	<p>Performance, as it relates to tag reading, is very usecase dependent. Typically, it comes down to whether you are trying to read lots of tags once or a few tags repeatedly. If the reader settings aren't correct for your usecase the performance will appear poor.</p> <ul style="list-style-type: none"> <li>• See the <i>MercuryAPI Programmer's Guide   Performance Tuning</i> section for details about settings.</li> <li>• Use the <i>Universal Reader Assistant   Options   Advanced ...   Gen2 Settings</i> to modify the settings for your usecase.</li> </ul>
Errors after a Firmware Upgrade	<ul style="list-style-type: none"> <li>• If the upgrade was from v4.7 to a newer version make sure to read the Release Notes of the newer version. There are special steps that must be taken to make that upgrade.</li> <li>• Try reinstalling the firmware with "Revert to default settings" selected.</li> </ul>

## Reset to the Default Configuration

If you are experiencing a problem with the reader and are having difficulty pinpointing the cause, it is useful to return the reader to a known state. The easiest method of doing this is to reinstall the running version of firmware using the [Firmware Upgrade Utility](#) with "Revert to default settings" selected.

If you are not able to connect to the reader to reinstall firm you can try following the steps to [Force M6 to boot in safe mode](#), forcing a known networking configuration on the reader, then resinstalling the firmware.

**C A U T I O N !**

**If you select the "Erase contents..." and "Revert to default settings" check box, you will erase any changes made to the reader's configuration settings and revert to factory default settings. If you select this option, the reader's current configuration settings and any on-reader files and applications will be erased. DO NOT select this option if you wish to preserve the reader's current configuration settings**

## Collecting Diagnostic Data for ThingMagic Support

When experience problems connecting to the M6 or performing RF (reading, writing) operations it will be necessary to gather the following information to help diagnose the problem. This information will often be the first thing requesting when reporting a problem to ThingMagic support.

*Collect the following:*

1. **Boot Logs:** Follow the process for [Connecting to the M6 USB Console Port](#), reboot the reader and save the full output from the console.
2. **Diagnostics Status and Logs:** Save the contents of the [Diagnostics Page](#) and the output from the [Diagnostics Page](#) | *View Log* button.
3. **M6 Serial Number:** See the 2d barcode label.
4. **Controlling software:** any details about the software used to control the reader. LLRP based middleware, MercuryAPI app (what version and language), platform, etc.
5. **Physical Configuration:** any details available about the number and types of antennas connected, cables used, power supply, etc.
6. **Environment:** any details about the physical environment the M6 is being used/ tested in. Temperature, humidity, vehicle mounted, office, etc.

## Analyzing the Boot Logs

One of the most common problems is due to incorrect or unexpected network configuration, resulting in not being able to connect to the M6. The best way to start diagnosing a network problem is to understand what the M6's network settings are after its powered up. This can be done by analyzing the boot logs.

Once you've follow the process for [Connecting to the M6 USB Console Port](#), reboot the reader and look at the output from the console. Once the boot process has completed the end of the log will look something like the following:

```
Setting up local network interface
Starting network interfaces
ixp0: negotiated 100baseTx-FD, link ok
Bringing ixp0 up
Using DHCP to bring up ixp0
```

This indicates the Wired interface (ixp0) is trying to start based on the provided configuration using DHCP. Common failures are not finding a DHCP address. If the wireless interface was being used it would indicate "ath0" instead of "ixp0"

```
Setting up Bonjour
killall: dns-sd: no process killed
killall: mDNSd: no process killed
cat: /var/run/dropbear.pid: No such file or directory
Setting up ntp configuration file
20 Oct 18:21:12 ntpdate[1075]: step time server 216.144.229.211 offset
1319134848.470151 sec
Starting syslog
Starting klog
Running autoupdate
ixp0      Link encap:Ethernet  HWaddr 00:12:A4:21:07:1F
          inet addr:10.8.26.119  Bcast:10.8.27.255  Mask:255.255.254.0
```

This section shows the active network settings. In this case the wired interface "ixp0" is up and using IP Address=10.8.26.119/255.255.254.0. If failures occurred this might be using the [Fallback Interface Options](#) specified, or the default 10.0.0.101 IP address. It maybe useful to show this information to your IT administator for assistance.

```
UP BROADCAST NOTRAILERS RUNNING MULTICAST  MTU:1500  Metric:1
RX packets:33 errors:0 dropped:0 overruns:0 frame:0
TX packets:11 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:256

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0

[...snip...]
4.9.2 (2011-10-20T10:15:18-0400 build 13 Spruce)
```

