

Mercury6(M6) and Astra-EX User Guide

For firmware version 4.17 and later

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M6 and Astra-EX User Guide

Introduction

This document assumes usage of an M6 and Astra-EX with firmware version 4.17 or later.

This document explains how to set up the Mercury6 (M6) and Astra-EX Readers, how to configure them for network operation, and how to use the browser-based interface. See the corresponding *M6 and Astra-EX 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 and Astra-EX Reader.

Applications to control the M6 and Astra-EX 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 and Astra-EX 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 and Astra-EX](#) - Describes the methods available for connecting to the M6 and Astra-EX over the ethernet, WiFi and USB Console interfaces.
 - [Setting Up the Reader](#) - Connect using a direct ethernet connection from a Host PC to the M6 and Astra-EX.
 - [Networking the Reader](#) - Connect over ethernet LAN or WiFi using DHCP or static IP settings.
 - [Connecting to the USB Console Port](#) - Connect to the M6 and Astra-EX 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 and Astra-EX 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 and Astra-EX.
- ♦ [Mounting the Reader](#) and [Appendix B: M6 and Astra-EX Dimensions](#) - Provides details of the physical dimensions of the M6 and Astra-EX.
- ♦ [M6 Specifications](#)
- ♦ [Compliance and IP Notices](#)
- ♦ [Appendix A: M6 and Astra-EX Antenna and Cable Information](#) - Lists the authorized Antennas and cables which can be used with the M6 and Astra-EX-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 \(PoE\)](#))

Astra-EX Reader

- Astra-EX Reader
- WiFi antenna (with Wifi enabled Astra-EX 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*.

The Astra-EX supports two monostatic bidirectional RF antennas through one integrated antenna and one Reverse Polarity TNC (RP-TNC or R-TNC) connector: labeled RFID - *Figure 2*.

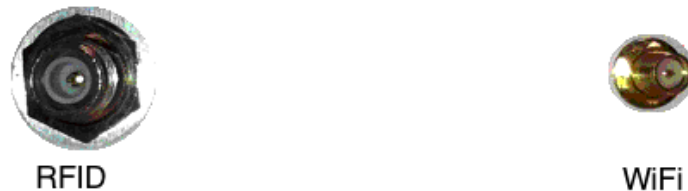
The maximum RF power that can be delivered to a 50 ohm load from the external port is 1.4 Watts, or +31.5 dBm (regulatory requirements permitting).

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

Figure 1: M6 RFID and WiFi Antenna Ports



Figure 2: Astra-EX RFID and WiFi Antenna Ports



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 and Astra-EX 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 and Astra-EX 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 3: M6 and Astra-EX Digital Connectors

Ethernet/PoE

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

USB Accessory

Reserved for future use.

Console

See [Connecting to the 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 and Astra-EX to boot in safe mode](#). For dust and

moisture protection the Reset button is covered by a screw. To press the Reset the screw must be removed.

Programming Interfaces

MercuryAPI

Applications to control the M6 and Astra-EX 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 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) under `/cs/samples/exe/Universal-Reader-Assistant2.0.exe`.

See the *Universal-Reader- Assistant 2.0 User Guide* (on rfid.thingmagic.com/devkit) for usage details.

LLRP

LLRP is the EPCglobal standard (http://www.epcglobalinc.org/standards/llrp/llrp_1_0_1-standard-20070813.pdf) used for communication between the M6 and Astra-EX and a client application. The M6 and Astra-EX 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 and Astra-EX. 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 and Astra-EX. In addition some M6 and Astra-EX 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).

On-Reader Applications

The M6 and Astra-EX Reader, starting with firmware v4.9.2 and MercuryAPI v1.11.1 (FW v4.17 and API v1.19 for Astra-EX), support 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 the Reader

This section describes the steps to setup all the necessary components and connect to the Reader's browser-based interface.

Equipment Required

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

The additional hardware required includes:

- ♦ A computer with a Java-enabled web browser
- ♦ Ethernet cable (CAT5e, shielded, 5')
- ♦ Wideband antenna(s) [*not required for Astra-EX*]
- ♦ Coax cable(s) (with RP-TNC connectors) [*not required for Astra-EX*]

Note

To install the M6 and Astra-EX 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 and Astra-EX Reader are:

1. [Connecting Antenna\(s\) to the Reader](#)
2. [Powering Up the Reader](#)
3. [Connecting Your PC to the Reader](#)
4. [Communicating with the Reader using a Link-local Address](#)
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 [Antenna Detection](#) requirements is disabled.

Note

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

Powering Up the Reader

You can power up the M6 and Astra-EX Reader using:

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

To power up the M6 and Astra-EX 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 and Astra-EX 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 and Astra-EX 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 and Astra-EX Reader.

The colors displayed by the LED include:

- ♦ **Solid Amber:** Indicates that the Reader is starting up.
- ♦ **Blinking Amber:** Indicates reader is trying to acquire an IP address using primary network configuration. If fallback address is being used LED may stay in blinking state.
- ♦ **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.
- ♦ **Blinking Green/Red:** Identify Reader function has been invoked. Should only be in this mode for about 1 minute.

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 and Astra-EX 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](#).

With a direct connection to a PC, with default/factory configuration the reader will use Zero Configuration networking (also referred to as Automatic Private IP Addressing on Windows) to get a link local address.

To connect your Reader directly to your PC:

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

Communicating with the Reader using a Link-local Address

If you are using an operating system other than Windows 7, consult your network administrator regarding how to set up your PC's TCP/IP connection.

If you are using Windows 7, perform the following steps to set up (or verify) your PC's TCP/IP connection. On most PCs this is the default configuration:

1. Select Start from the Start bar, and then select Control Panel.
2. Under Network and Internet, select "View network status and tasks".
3. In the left menu select "Change adapter settings".
4. The Local Area Connection Status window appears, as shown in *Figure 4*.

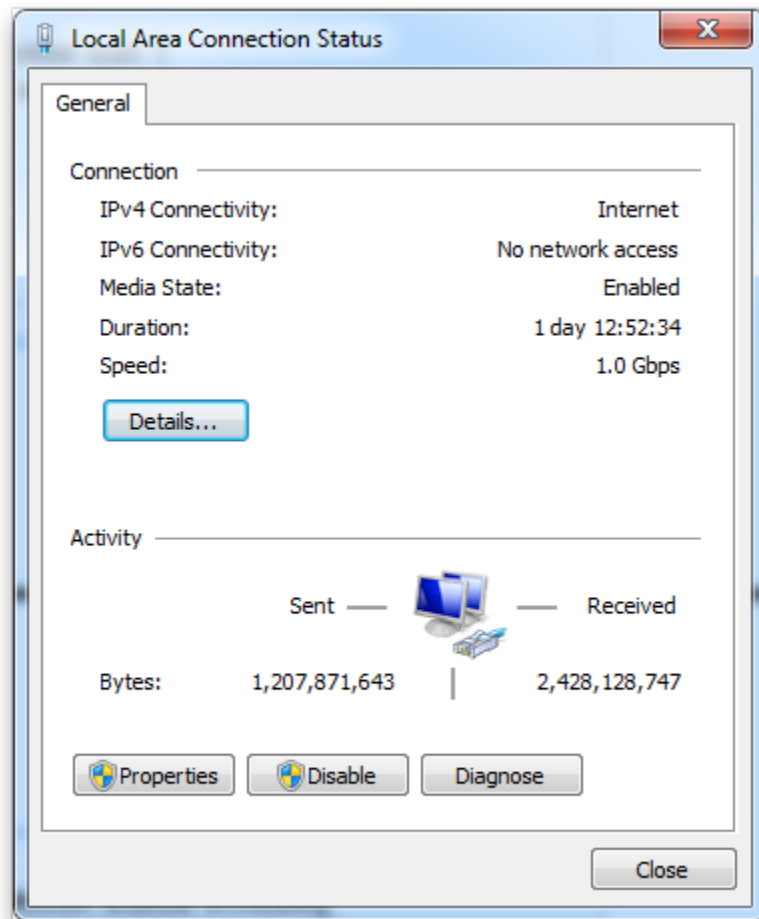
Note

Link-local addressing does not work if DHCP is disabled on the reader. If the reader's [Network Settings](#) have been modified to use a static IP address this setup will not work.

Note

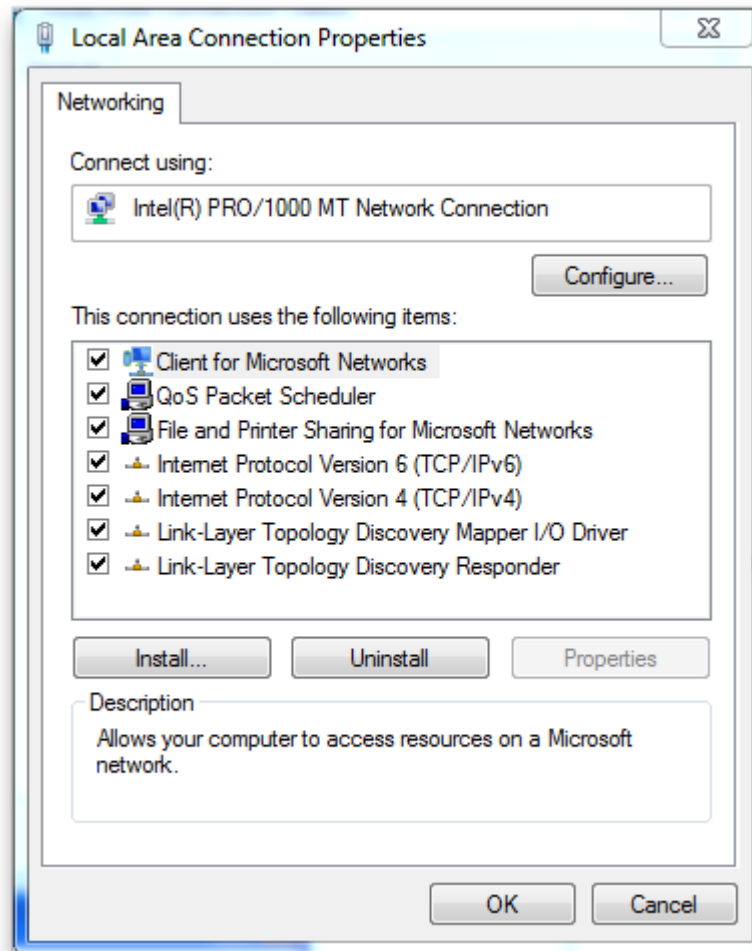
Previous M6 firmware, v4.9.3 and earlier, did not support link-local addressing. By default the reader would fallback to a static IP address, 10.0.0.101, if a DHCP server was not available. If this functionality is desired please contact ThingMagic support for assistance in enabling it.

Figure 4: Local Area Connection Status Window



5. Click the Properties button.
The Local Area Connections Properties window appears, as shown in *Figure 5*.

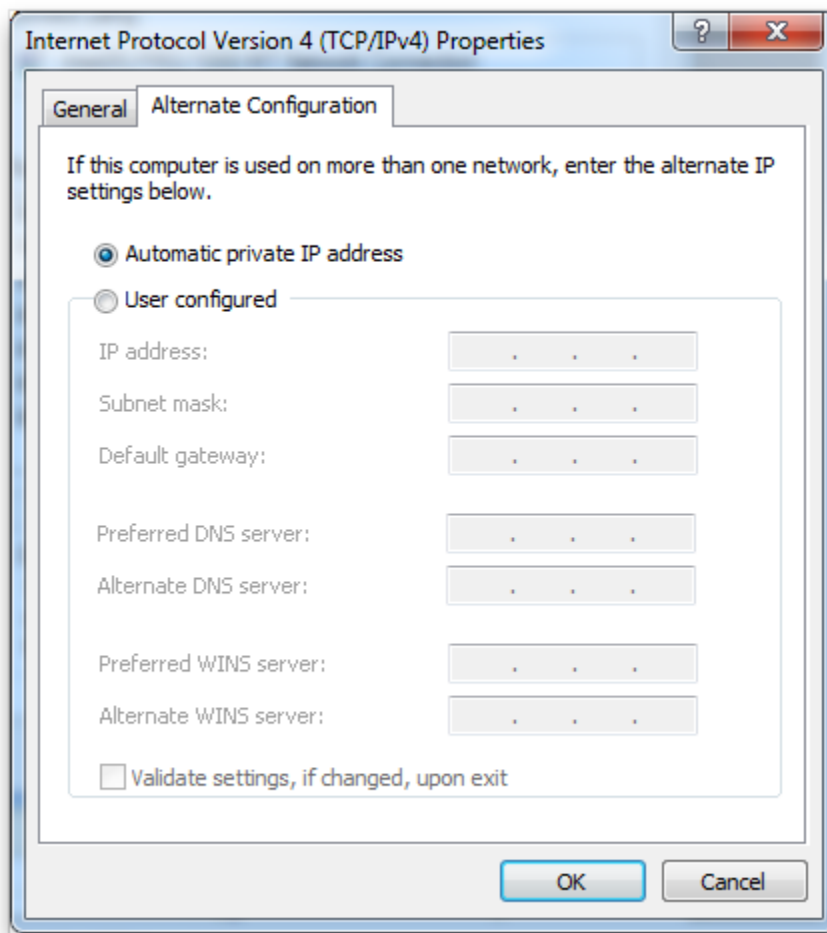
Figure 5: Local Area Connection Properties Window



6. Scroll down and select the Internet Protocol (TCP/IP) version you're using. If you don't know which, change both.

7. Click on the Properties button.
The Internet Protocol (TCP/IP) Properties window appears. The General tab should have both “Obtain an IP Address automatically” and “Obtain DNS server address automatically” selected. On the Alternate Configuration tab “Automatic private IP address” should be selected, as shown in *Figure 6*.

Figure 6: Internet Protocol TCP/IP Properties Window



8. Click OK to save and exit the window.
9. 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 [Automatic Hostname: M6-xxxxxx or Astra-EX-xxxxxx](#) 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 7*.

Note

On some systems, especially when [Communicating with the Reader using a Link-local Address](#), the hostname must end in ".local" for the connection to succeed. i.e. *m6-21071f.local*

Figure 7: M6 and Astra-EX Status Page

<ul style="list-style-type: none"> Status Statistics Reader List Query Settings Firmware Restart Diagnostics 	Device Status	
	Status:	Idle
	Lan Connection:	Online
	Wireless Connection:	Online
	Connected Antenna Ports:	Antenna 1: Connected : MonoStatic
		Antenna 2: Not Connected
		Antenna 3: Not Connected
		Antenna 4: Not Connected
	Power Supply:	DC power connector
	Temperature (°C):	28
	MercuryOS and AFE Versions	
	Region:	North America
	MercuryOS Version:	4.17.1 (2012-06-12T01:52:06-0400 build 79 trunk)
	AFE Version:	M6e HWVer:18.00.00.01 BootVer:10.11.16.00 AppVer:01.13.01.29 AppDate:2012.05.22
	LAN Configuration	
	Host Name:	m6-21071f
	LAN IP Address:	10.8.80.117
	LAN Subnet Mask:	255.255.255.0
	LAN Gateway:	10.8.80.1
	MAC Address:	00:12:A4:21:07:1F
	Wireless Configuration	
	Wireless IP Address:	0.0.0.0
	Subnet Mask:	0.0.0.0
	Wireless Gateway:	0.0.0.0
	Wireless MAC Address:	00:80:48:5E:65:B4
	SSID:	

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 and Astra-EX Reader to use either manual IP addressing or DHCP. By default, the Reader has automatic addressing enabled that boots up looking for a DHCP server. If no DHCP server is found it will use a Link-local address.

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, a link-local address will be negotiated with any connected device(s). However, the Reader will periodically check to see if a DHCP server is available. See the [Troubleshooting Table](#) for assistance determining the IP address if using the [Automatic Hostname: M6-xxxxxx or Astra-EX-xxxxxx](#) doesn't work.

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, a link-local address 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 and Astra-EX 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 and Astra-EX Reader to a wireless network:

1. Click on Settings in the Web Interface navigation menu to access the Settings Page, as shown in *Figure 8*.
2. Select the *Network Interface* tab then the *Wireless (802.11)* radio button in the *All Interfaces* section.
3. Enter the appropriate information into the *Wireless Authentication Mode*, Select the *Wireless SSID*, and *Wireless Key* for the *Wireless Interface* fields.
4. Once the wireless settings are entered click the *Test Wifi* button. This will temporarily bring down the active network interface and try to connect to the wireless network as configured. Success or failure will be indicated and the active interface re-established. If the test fails then there is a problem with the configuration settings and they should not be saved.



C A U T I O N !



Do not navigate away from the settings page or disconnect from the network during a wifi test.

5. If the test was successful click the *Save Changes* button at the bottom of the page.
6. As soon as *Save* is clicked the new network settings will be applied. This may cause a temporary disconnect from the reader and may require a new IP address to be entered or wait until the DNS server is updated with the new IP address.

**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 may be 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 USB Console Port](#) or [Using Safe Mode](#).

Figure 8: M6 and Astra-EX Settings Page

Reader Power Settings
Gen2 Protocol Settings
Network Settings
Miscellaneous

Network Settings : All Interfaces

Network Settings : Ethernet Interface

Network Settings : Wireless Interface

Use DHCP?

☒ Yes ☐ No

Use Fallback Interface

☒ Yes ☐ No

Fallback Network interface

☒ Wired (Ethernet) ☐ Wireless (802.11)

Vendor Class Identifier

mercury6

Use DHCP-Server supplied hostname

☐ Yes ☒ No

WLAN IP Address

10.1.0.101

WLAN Netmask

255.255.255.0

WLAN Gateway

Wireless Fallback IP Address

Wireless Fallback Netmask

Wireless Fallback Gateway

Wireless SSID

DaVinci

ReScan

Wireless Authentication Mode

Wireless Key

Wireless Connection Test

Test WiFi

☐ Disconnected

Save Network Settings

Using Power Over Ethernet (PoE)

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

To power up the M6 and Astra-EX Reader over a PoE network:

1. Connect one end of an Ethernet cable to the M6 and Astra-EX 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 and Astra-EX-EU hardware SKU only) you must use the Ferrite Bead included with the M6 and Astra-EX 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 and Astra-EX Reader, as shown in *Figure 9*. For proper installation, the Ferrite Bead should not be more than two inches away from the connector

Figure 9: 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 and Astra-EX Setup

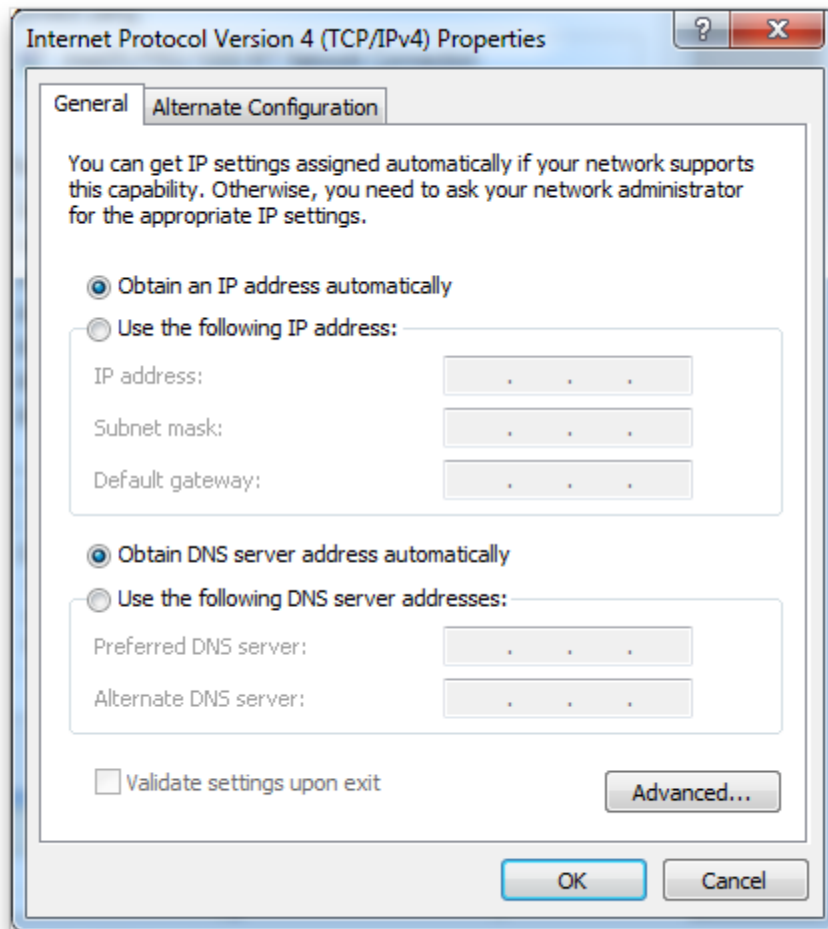
DHCP addressing can be used with either physical interface. To enable DHCP:

1. Click on Settings in the Web Interface navigation menu to access the Modify Settings Page, as shown in *Figure 8*.
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 and Astra-EX 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 4*.
5. Click the Properties button.
The Local Area Connection Properties window appears, as shown in *Figure 5*.
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 10*.

Figure 10: 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 or Astra-EX-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 or you must be [Communicating with the Reader using a Link-local Address](#) 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.

Note

On some systems, especially when [Communicating with the Reader using a Link-local Address](#), the hostname must end in “.local” for the connection to succeed. i.e. *m6-21071f.local*

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 and Astra-EX 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 and Astra-EX 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 11* 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 8*. 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.

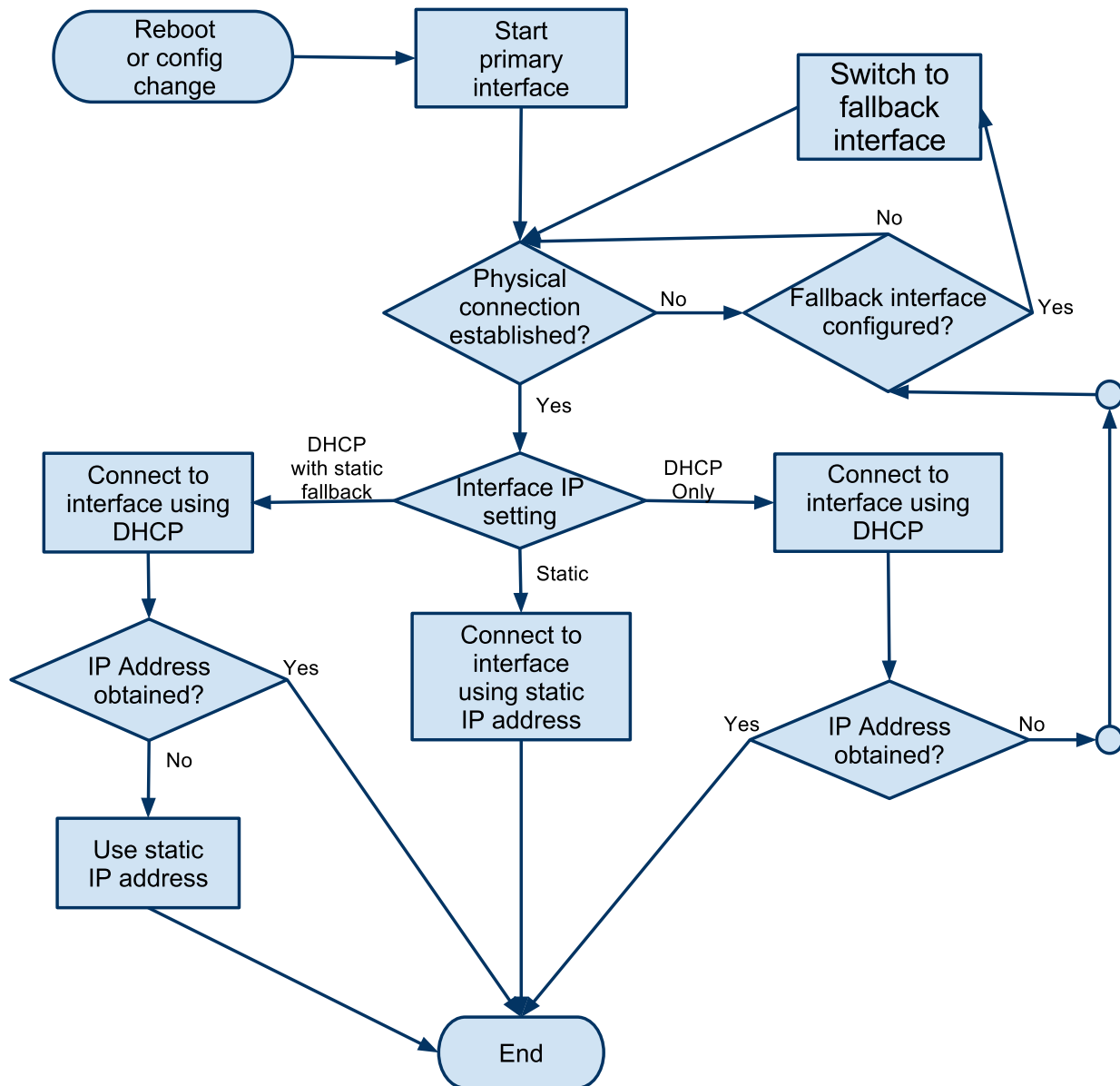
Fallback to the Other Physical Interface

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 11: Fallback Interface Flowchart



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

It 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 forth between the two interfaces. 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 Wireless 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 or Astra-EX) 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-EX, 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
- ◆ [Identify Reader](#) button.

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

Click on the Reader List link in the navigation menu.

The M6 and Astra-EX Reader Listing Page appears, as shown in the *Figure 12*.

Identify Reader

In the last column of the list of readers found there is a button labelled *IdentifyReader*. When clicked this will cause the corresponding reader's LED to flash between green and red. This provides visual confirmation of the named reader.






Note

M6 and Astra-EX readers must be using firmware version 4.17 or later to support this functionality.

Note

By default Identify Reader will not work with Windows Internet Explorer (IE). IE by default blocks URLs with username and passwords. In order to compromise that setting, Windows provides a *Fix It* solution which is provided here.
<http://support.microsoft.com/kb/834489#FixItForMeAlways>
This is a one time setup.

Figure 12: M6 and Astra-EX Reader Listing Page

Reader Listing									Refresh Reader List
Type	Reader	Update Time	Uptime	Status	Version	IP Address	Antennas	Last Read Time	Identify Reader
	m6-21071f	23:05:47	up 23:05		4.17.1.79	10.8.80.117	MonoStatic: 1	Thu Jan 1 23:05:40 1970	IdentifyReader
	m6-210717	00:00:35	up 0 min		4.17.1.56	10.8.80.91	MonoStatic: 3,4		IdentifyReader
	astra-21052a	00:00:29	up 0 min		4.1.24	10.8.80.57	MonoStatic: 1		IdentifyReader

Connecting to the USB Console Port

M6 and Astra-EX 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 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 and Astra-EX 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 and Astra-EX 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.

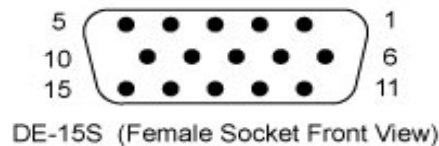
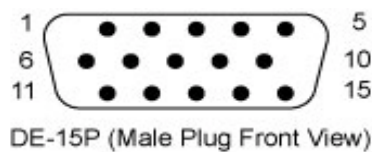
Note

For non-isolated applications connect grounds together (pin6 and 7) and V-GPO to M6 and Astra-EX+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 13: DE15 GPIO Pinout



1. **M6 and Astra-EX+5V** - non-isolated power from M6 and Astra-EX
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 and Astra-EX 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 and Astra-EX 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 and Astra-EX 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 Astra-EX and a client application. The M6 and Astra-EX should be “drop-in compatible” with systems supporting the standard LLRP protocol.

Using the Browser-Based Interface

The M6 and Astra-EX 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 7*.

Status Page

The M6 and Astra-EX Status Page, as shown in the *Figure 7*, 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 and Astra-EX 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 your platform and restart your PC.

Note

Use of the Query applet, or any Reader client application, requires port 5084 to be open on the network. If the Query applet *Connect* fails to connect it is likely either another client already has an open connection or port 5084 is being blocked by a firewall.

The basic steps to connect, read, modify the read behavior and display options are defined in the following sections:

- ◆ [Read Tags](#)
- ◆ [Query Results](#)
- ◆ [Query Settings](#)

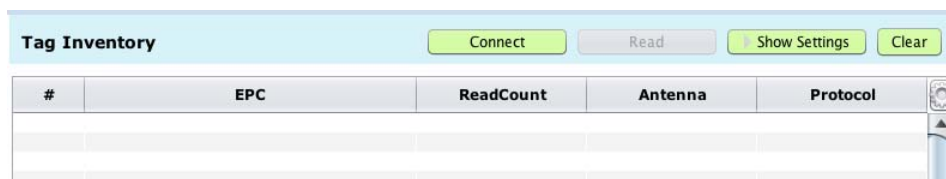
In addition to modifying the query behavior using the [Query Settings](#), the performance of the reader can be optimized for a particular usecase by making changes to the [Gen2 Protocol Settings](#).

Read Tags

To read tags under default performance and display options:

1. Click '*Connect*' to reader. A connection will not be successful if other clients are connected to the reader.

Figure 14: Query Page - Connect



2. Position one or more tags, in front of one of the antennas connected to the Reader.
3. Click '*Read*'.

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

4. Click 'Stop Reading' to end the search.

Note

You must click *Stop Reading* and *Disconnect* before exiting. Otherwise, the Reader will continue to transmit RF energy on its antennas and other clients maybe blocked.

Query Results

As shown in *Figure 15*, the default displayed tag results shows the following columns of data:

- ◆ **#** - The order each tag was read.
- ◆ **EPC** - The EPC ID of the tag, typically 96-bits of data shown in Hex.
- ◆ **ReadCount** - The number of times the tag was read on [Antenna].
- ◆ **Antenna** - The antenna on with the tag was read. If the same tag is read on more than one antenna there will be a tag entry for each antenna on which the tag was read.
- ◆ **Protocol** - The protocol of the tag.

Figure 15: Query Results

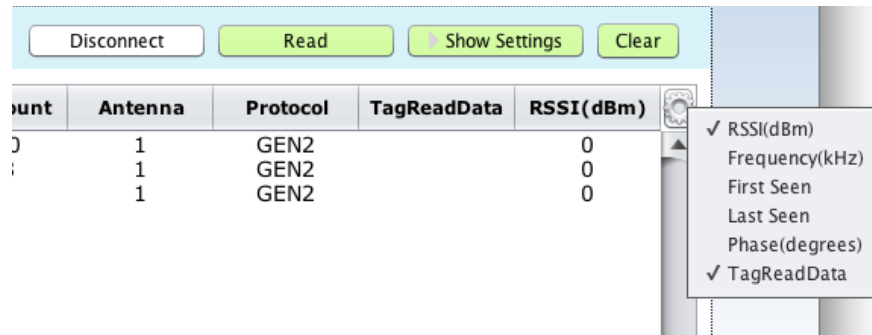
Reading started					
					<input type="button" value="Disconnect"/> <input type="button" value="Stop Reading"/> <input type="button" value="Show Settings"/> <input type="button" value="Clear"/>
#	EPC	ReadCount	Antenna	Protocol	
1	1000000000002000288DFCB9	1000	1	GEN2	
2	1000000000002000228DFC99	88	1	GEN2	
3	1000000000002000218DFC99	5	1	GEN2	

In addition to the above fields, the following fields can be displayed by right-clicking on the settings icon in the top-right corner of the display table, as shown in *Figure 16*.

- ◆ **RSSI** - The receive signal strength of the tag response, in dBm.
- ◆ **Frequency** - The frequency on which the tag was read, in kHz.
- ◆ **First Seen** - The timestamp when the tag was first seen during this query.
- ◆ **Last Seen** - The timestamp of the most recent reading during this query.

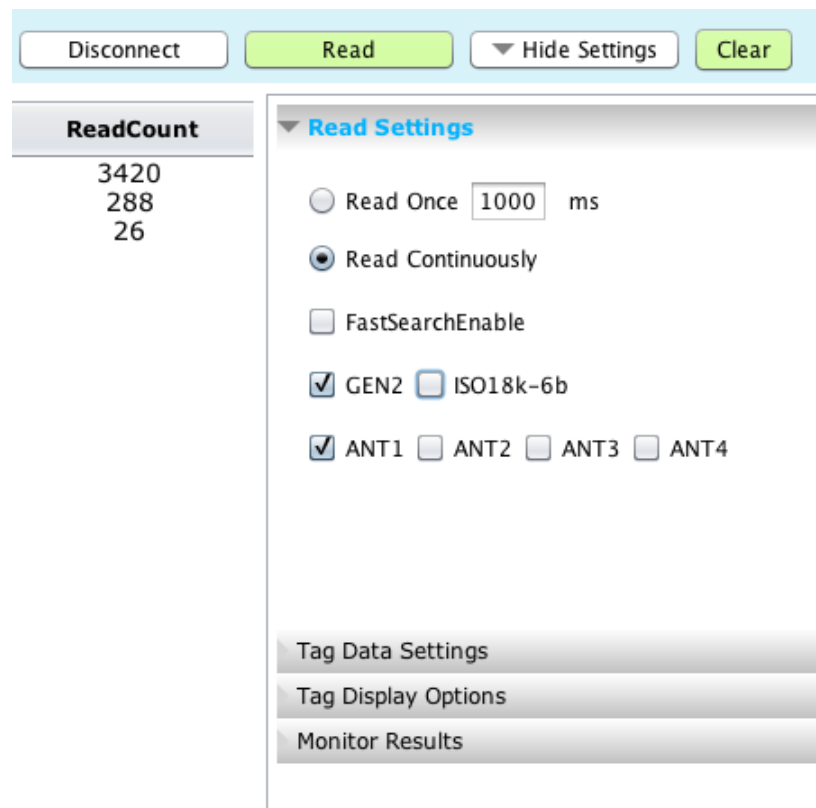
- ◆ **Phase** - Average phase of tag response in degrees (0°-180°)
- ◆ **TagReadData** - The data read when the *Tag Data Settings | Read Data* option is selected. If the tag doesn't have the requested data "*Read Data failed*" will be returned.

Figure 16: Add Meta Data Columns



Query Settings

The default reading mode of continuous reading can be changed, along with other query behavior and display options in the settings panel. To access the panel click the "Show Settings" button once connected, as shown in *Figure 17*.

Figure 17: Query Settings Panel


Disconnect Read Hide Settings Clear

ReadCount
3420
288
26

Read Settings

☐ Read Once 1000 ms

☒ Read Continuously

☐ FastSearchEnable

☒ GEN2 ☐ ISO18k-6b

☒ ANT1 ☐ ANT2 ☐ ANT3 ☐ ANT4

Tag Data Settings

Tag Display Options

Monitor Results

Once clicked the settings panel will slide out and expose several groupings of settings:

Read Settings

These settings control the behavior of the *Read* button:

- ♦ Read Once - Each click of *Read* causes a single query for the time specified.
- ♦ Read Continuously - Clicking *Read* causes a continuous read to be run until *Stop Reading* is clicked.
- ♦ Optionally select/deselect protocols, antennas, use Fast Search (optimizes performance for maximum re-reads of a few tags).

Tag Data Settings

This settings allows an additional block of data, up to 64 bytes, to be read from each tag during the query.

- ♦ **Memory Bank** - The memory bank from which to read.
- ♦ **Start Address** - The word offset in memory to start reading from.
- ♦ **Words to read** - The number of words to read, beginning at the start address. Specify '0' to read the full contents of the memory bank, from Start Address on. Up to 128 bytes.

Note

If the address and/or words to read value specified exceeds the contents of the tag, no data will be read.

Tag Display Options

Settings to optionally display various summary information, while querying, in a big number format.

Copy will copy the tag data to the clipboard.

Monitor Results

Displays of summary information when query completes.

Settings Page

The M6 and Astra-EX Settings Page enables you to change network, performance and security settings. The page is divided into four main sections:

- ◆ [Reader Power Settings](#)
- ◆ [Gen2 Protocol Settings](#)
- ◆ [Network Settings](#)
- ◆ [Miscellaneous 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

All settings set through the *WebUI / Settings* pages are **persistent**, they are retained across reboots and become the default settings of the reader for client applications. The values shown on these pages do not necessarily reflect the active settings of the Reader if configuration parameters are transiently changed through the MercuryAPI or LLRP. All changes made through MercuryAPI or LLRP client applications are **transient**.

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.

Reader Power Settings

The Reader Power Settings are used to control the amount of RF Power transmitted by the reader when active. The RF power directly relates to the range at which the reader can “see” tags, the higher the power, the longer the range.

Table 1: Reader Power Settings

Setting	Description
RF Power Setting	Controls the method used for setting power: <ul style="list-style-type: none">• Global - all antennas will use the same power setting, the value of RF Power.• Per Antenna - power for each antenna must be set individually for each and antenna and both read and write power settings, the value of Antenna # Read/Write Power.
Antenna # Read Power (dBm)	The power setting used for Read operations on antenna #. This setting is only used when RF Power Setting is set to <i>Per Antenna</i> .
Antenna # Write Power (dBm)	The power setting used for Write operations on antenna #. This setting is only used when RF Power Setting is set to <i>Per Antenna</i> .
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">• On - Only ports with antennas that meet the Antenna Detection requirements will be active.• Off - All ports are available for use. The user MUST specify the specific antennas to transmit on and is responsible for ensuring transmits do not occur on ports without connected antennas.

Gen2 Protocol Settings

The Gen2 Protocol Settings allow for optimization of the Reader's performance based on real world usecase requirements. In addition, for advanced users, direct setting of low level Gen2 protocol parameters are available using the Customize option of each section.

Table 2: Gen2 Protocol Settings

Setting	Description
Tag Reader Protocol Settings	<ul style="list-style-type: none"> • Maximum tag read rate - Performance is optimized for maximizing the speed of tag to/from reader communications, which results in more tags being read faster. OR • Maximum receive sensitivity - Performance is optimized for reading weaker, harder to read tags. <p>Note: NOTE: Mostly applicable to using Battery Assisted Passive Tags. Most Passive Tag applications are range limited by the power output from the antenna, not the reader's ability to "hear" a tag's response.</p> <ul style="list-style-type: none"> • Customize - Set low level Gen2 parameters related to tag to reader communication speed vs sensitivity. See the <i>MercuryAPI Programmers Guide Performance Tuning</i> section for more details on these settings.
Tag Population Size Settings	<ul style="list-style-type: none"> • Automatically adjust settings as tag population changes - Reader dynamically adjusts optimization setting depending on the tag population it detects in the field. • Adjust settings for an approximate population of X - If the tag population size is relatively well known and consistent, performance can be increased by optimizing for that size. In this case enter the approximate population size for increased performance. • Customize - Set low level Gen2 parameters related to tag population size. See the <i>MercuryAPI Programmers Guide Performance Tuning</i> section for more details on these settings.
Tag Repeat Rate	<ul style="list-style-type: none"> • Tags repeat as often as possible - Tags will re-respond to an on-going inventory operation as quickly as possible. • Tags wait ~0.5 seconds to repeat - Tags will sleep for their "flag persistence" period, typically 0.5 to 2.0 seconds. This is preferred when trying to inventory large populations of tags as it allows "weaker" tags a chance to respond. • Customize - Set low level Gen2 parameters related to tag response rate and session usage. See the <i>MercuryAPI Programmers Guide Performance Tuning</i> section for more details on these settings.

Network Settings

Static network settings are ignored when in DHCP mode, and DHCP-related settings are ignored when in static IP mode. Please note that your network needs to have properly configured DNS servers, 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.

Network Settings: All Interfaces

Table 3: 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 or Astra-EX and a MAC Address of 00:12:A4:13:47:AC, the automatic hostname would be M6-1347ac or Astra-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 and Astra-EX Reader to resolve hostnames to IP addresses.
Secondary DNS Server	This field allows the M6 and Astra-EX Reader to resolve hostnames to IP addresses.

Network Settings: Ethernet Interfaces

Table 4: 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

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

Table 5: 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 and Astra-EX will connect.
Wireless Key	This field will contain the Key for the wireless network to which the M6 and Astra-EX will connect.

Miscellaneous Settings

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 6: 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 7: 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 8: 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.

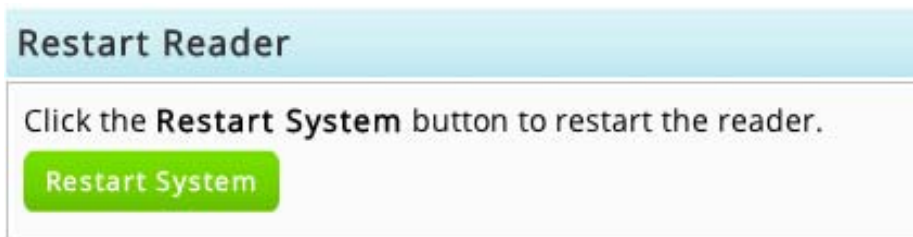
Restart Page

The M6 and Astra-EX 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 18*.

Figure 18: M6 and Astra-EX Restart Reader Page



2. Click the Restart System button.
3. Click OK.
The following message appears, as shown in *Figure 19* and remains on the screen until the Reader restarts.

Figure 19: 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 displays the M6 and Astra-EX 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.

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

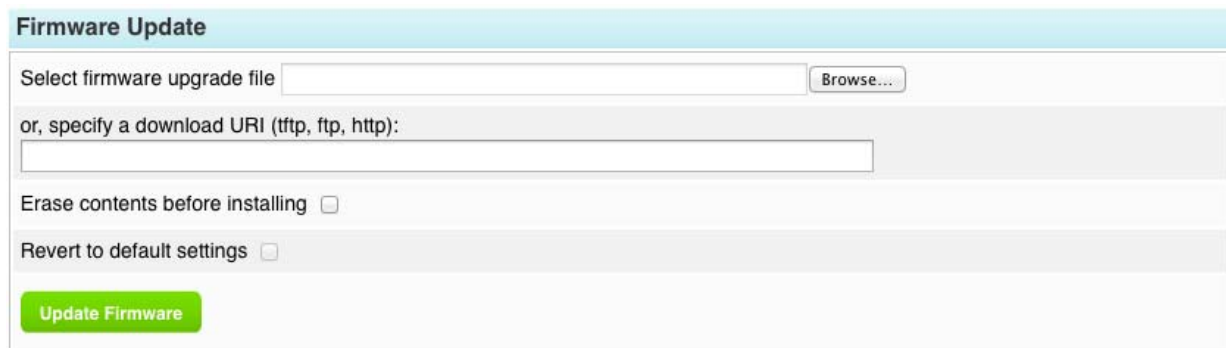
http://www.epcglobalinc.org/standards/rm/rm_1_0_1-standard-20070531.pdf

Firmware Upgrade Utility

M6 and Astra-EX provides the 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 20*.

Figure 20: M6 and Astra-EX Firmware Update Page



The screenshot shows the 'Firmware Update' page. It has a light blue header with the title 'Firmware Update'. Below the header, there is a form with the following elements: a text input field labeled 'Select firmware upgrade file' with a 'Browse...' button to its right; a text input field labeled 'or, specify a download URI (tftp, ftp, http):'; a checkbox labeled 'Erase contents before installing'; a checkbox labeled 'Revert to default settings'; and a green 'Update Firmware' button at the bottom.

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 to a link-local address (see [Communicating with the Reader using a Link-local Address](#)).

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 be configured for DHCP (and automatic private IP addressing on Windows). 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 and Astra-EX to boot in safe mode

The M6 and Astra-EX 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 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 and Astra-EX 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 and Astra-EX can be configured to perform various Read operations. The following describes protocol specific configuration options supported on the M6 and Astra-EX. 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 and Astra-EX 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

Backscatter Link Frequency (kHz)	Encoding	Tari (usec)	Modulation Scheme
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 and Astra-EX, 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

Return Link Freq (kHz)	Return Encoding	Forward Link Freq (kHz)	Forward Encoding
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 and Astra-EX, 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 with 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 Read Meta Data

Meta Data Field	Description
Tag Data	When reading if an embedded TagOp is specified for a Read-Plan the TagReadData can contain up to 128 bytes of data returned for each tag. Note: Tags with the same TagID but different Tag Data can be considered unique and each get a Tag Buffer entry if set in the reader configuration parameter /reader/tagReadData/uniqueByData. 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.

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 and Astra-EX 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)

Note

The maximum RF Power setting for the Astra-EX integrated antenna is 30dBm.



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 and Astra-EX [Status Page](#) appears, as shown in the *Figure 7*.
2. Click on the Settings tab.
The first field on the Settings page is RF 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 and Astra-EX 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 and Astra-EX Dimensions](#) for mounting hole locations and dimensions.



C A U T I O N !



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

M6

When mounting the M6 reader it is recommended to use four #10 x 1/2 in. min. screws or M5 x 20 mm screws, with washers min. 1/2 in. in diameter. Nylon plastic expansion wall anchors shall be suitable for the screw size. The mounting surface should be minimum 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.

Astra-EX

When mounting the Astra-EX Reader it is recommend to use an NRTL approved VESA 100 mount, following the standard mounting procedure of the VESA mount referencing the Astra mounting hole locations as shown in *Figure 22*.

Alternatively you can use the centered Tripod mounting hole for 1/4"- 20 screws. This is for use with tripods shorter than one meter.

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 and Astra-EX 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 and Astra-EX 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)¹

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

User Memory

- ♦ 12MB Flash
- ♦ 64MB RAM

Astra-EX Specifications

The following are the specifications for the Astra-EX Reader.

UHF RFID Antenna Interface

Interface: One 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)¹

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 Astra-EX 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 Astra-EX would be reduced accordingly.

Storage Temperature: -40°C to +85°C

Physical Dimensions

25.9 cm L x 25.9 cm W x 7.72 cm H

(10.2 in L x 10.2 in W x 3.0 in H)

4 lbs (1.8kg)

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 Astra-EX-EU hardware)
- ◆ ROHS Compliant, UL Listed

User Memory

- ◆ 12MB Flash
- ◆ 64MB RAM

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 and Astra-EX at RF power above 30dBm requires professional installation to correctly set the TX power for the RF cable and antenna selected.

Appendix A: M6 and Astra-EX 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 and Astra-EX 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 9: 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 and Astra-EX 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

Cable Description	ThingMagic Part Number	Insertion Loss
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 and Astra-EX Dimensions

M6 Dimensions

Astra-EX Dimensions

Figure 21: M6 Dimensions

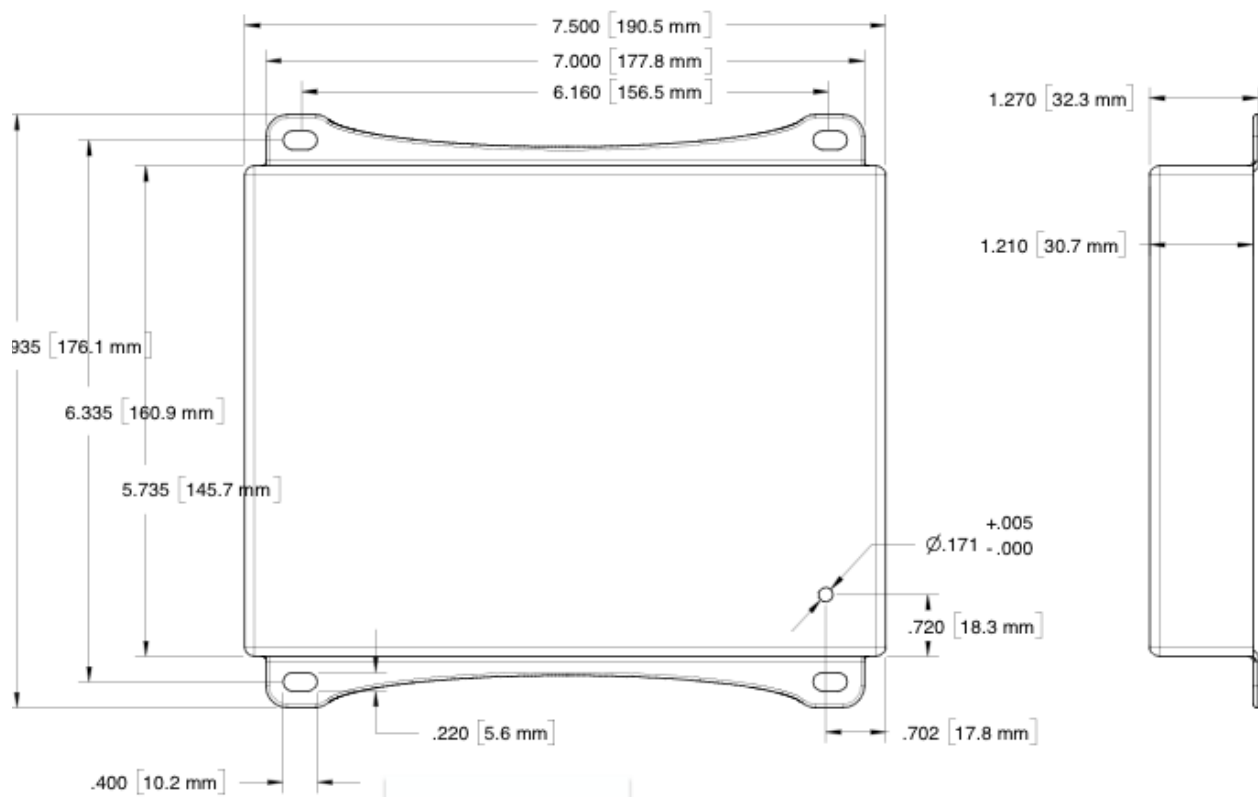
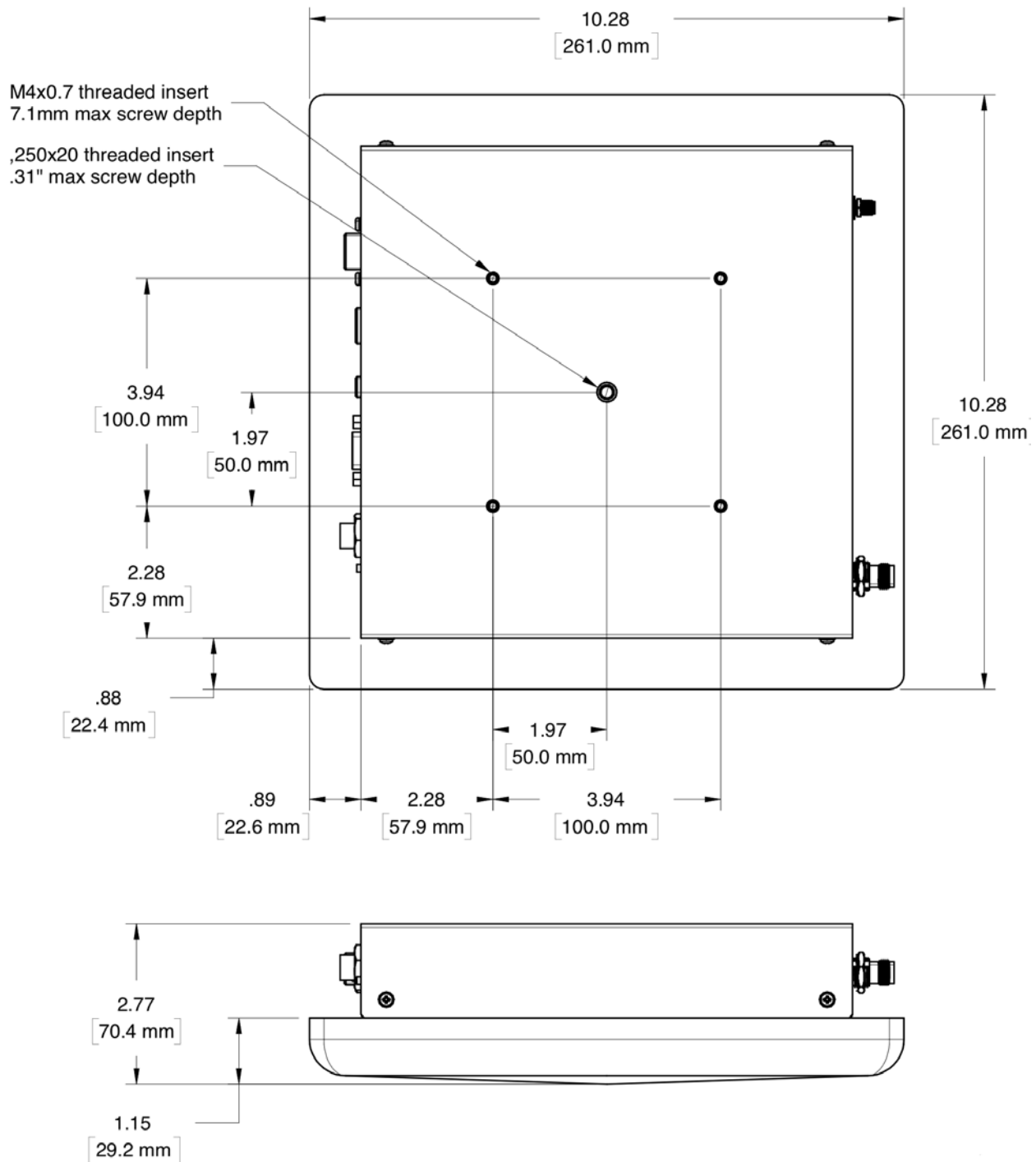


Figure 22: Astra-EX Dimensions



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 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 10: Common Problems and Solutions

Problem	Path to Solution
Cannot connect to reader over network	<ul style="list-style-type: none"> • Check your network settings by Analyzing the Boot Logs to make sure you're trying the correct IP address. • If the settings are wrong, try to Using Safe Mode to get a known network configuration, • or Reset to the Default Configuration and start the configuration over. • the MercuryAPI and Query applet communicate using the LLRP interface which uses network port 5084. Verify 5084 is not being blocked by the network firewall.
Reader is not reading tags	<ul style="list-style-type: none"> • Verify LEDs are blinking according to Interpreting the Reader Indicator LED • If they are, indicating active RF, make sure tags are in range. • Check antenna cables • Try known good Gen2 tags • Increase Reader RF Power
Reader error LED stays on	Following Collecting Diagnostic Data for ThingMagic Support 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"> • See the <i>MercuryAPI Programmer's Guide Performance Tuning</i> section for details about settings. • Use the <i>Universal Reader Assistant Options Advanced ... Gen2 Settings</i> to modify the settings for your usecase.
Errors after a Firmware Upgrade	<ul style="list-style-type: none"> • 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. • Try reinstalling the firmware with "Revert to default settings" selected.

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 and Astra-EX to boot in safe mode](#), forcing a known networking configuration on the reader, then reinstalling 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 and Astra-EX 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 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 and Astra-EX 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 and Astra-EX 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 and Astra-EX. The best way to start diagnosing a network problem is to understand what the M6 and Astra-EX'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 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)
```