HID Mercury™
Cyber Hardening Guide

PLT-05009, A.1
January 2021

Powering
Trusted Identities

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What's new

Date	Description	Revision
January 2021	Minor changes.	A.1

A complete list of revisions is available in **Revision history**.

Section **01**
Overview

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This Hardening Guide covers how to maximize security with HID Mercury controllers. This guide will identify critical information on features, suggest options that should be enabled, and include best practices for using the controller.

1.1 Intelligent controllers and interface modules

Various generations of intelligent controllers and interface modules exist within HID Mercury and the OEM branded product portfolios. Product capabilities improve over time and therefore some security parameters and hardening instructions differ across products. The following intelligent controllers and interface modules are covered in this hardening guide.

LP Series Intelligent Controllers	EP4502, LP4502, LP1501, LP1502 and LP2500
EP Series Intelligent Controllers	EP1501, EP1502, EP2500, MS-ICS, M5-IC, MI-RS4, MI-XL16
Series-3 SIO Interface Modules	MR50-S3, MR52-S3, MR16IN-S3, MR16OUT-S3, MR62e
Series-2 SIO Interface Modules	MR50, MR51e, MR52, MR16IN, MR16OUT
Bridge Controllers	MS-ICS, M5-IC, MI-RS4, MI-XL16
Honeywell Controllers	PW6K1IC, PRO32IC

Note: The Bridge and Honeywell Controllers follow the EP Series functionality in this document.

1.2 Protection levels

Depending on the system size and needs, there are different protection levels. Each level assumes the previous level's recommendation.

Protection Level	Recommendation	Procedures
Basic	Minimum protection. Small businesses or office installations where the operator is also the administrator	1. Installation (see **Installation**). Place the product on a private network, in a secured enclosure, with updated firmware and normal DIP switch settings. 2. Web Interface (see **Web interface**). Enable HTTPS. 3. User Accounts (see **User Accounts**). Remove default user login, create a unique user account with a strong password. 4. Equipment Replacement (see **Equipment replacement**). Bulk erase controller and clear downstream module EEPROM.
Intermediate	Corporations that have a dedicated system administrator	5. Web Interface (see **Web interface**). Add authorized IP addresses. 6. Web service (see **Web interface**). Disable web service. 7. Information Services (see **Information services**). Disable discovery and SNMP services. 8. USB and SD Interfaces (see **Information services**). Disable USB and SD interfaces. 9. Encrypted and Authenticated Communications (see **Encryption and authentication**). Enable AES or TLS encryption.

Enterprise	Large networks with an IT/IS department. Intended for integration into an enterprise network infrastructure.	10. Information Services (see **Information services**). Enable SNMPv3 (EP4502, LP-series). 11. Encrypted and Authenticated Communications (see **Encryption and authentication**). Generate and load customized peer certificates and enable TLS. 12. Port Based Network Access Control (see **Port based networkaccess control**). Enable 802.1X. 13. Enable data encryption at rest (EP4502, LP-series) (see **Data at rest encryption**).

Section **02**
Installation

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Recommendations include private networks, securing the enclosure, ensuring the latest firmware, and normal operation.

2.1 Private network

Do not install any Ethernet products on the public Intranet.

2.2 Securing the enclosure

Install the hardware in a secure enclosure and use a cabinet tamper to generate notifications when the enclosure is opened.

2.3 Firmware

Check with the systems software provider for the latest firmware. Update all intelligent controller and IO module firmware to the latest version to ensure the latest changes and security improvements are installed.

2.4 Normal operation

Set all dip switches to **OFF** for normal operation.

Section **03**
Web interface

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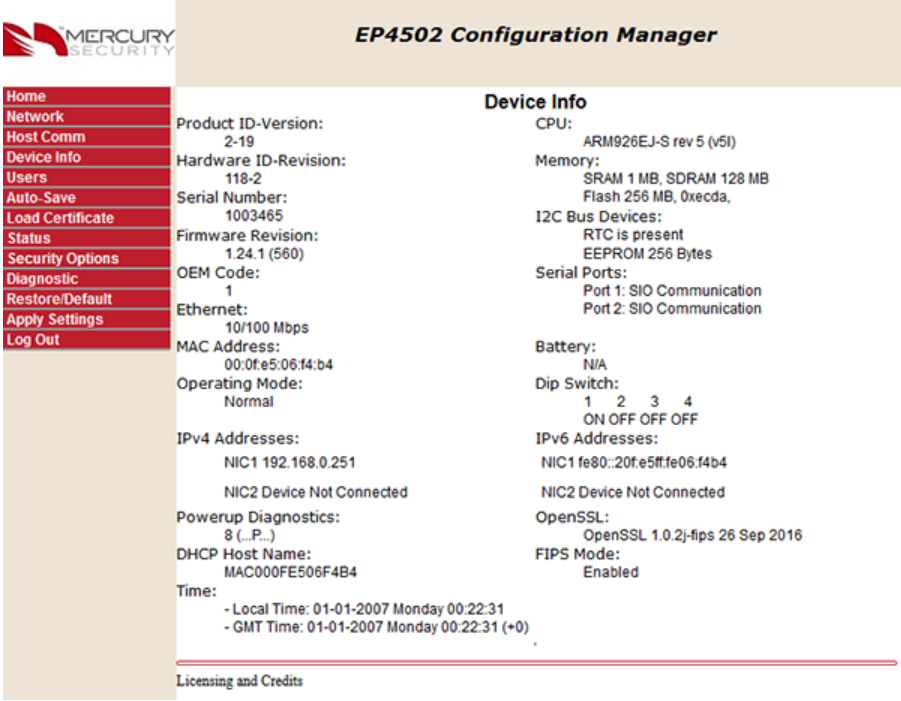
Modify the HTTPS, Session Timer, and authorized IP addresses to reduce your risk.

3.1 HTTPS

Hypertext Transfer Protocol Secure (HTTPS) is a protocol for securing communication over a network. HTTPS is a combination of HTTP and SSL/TLS protocols. It is used to provide encrypted communication with the web server. Always enable HTTPS as the default.

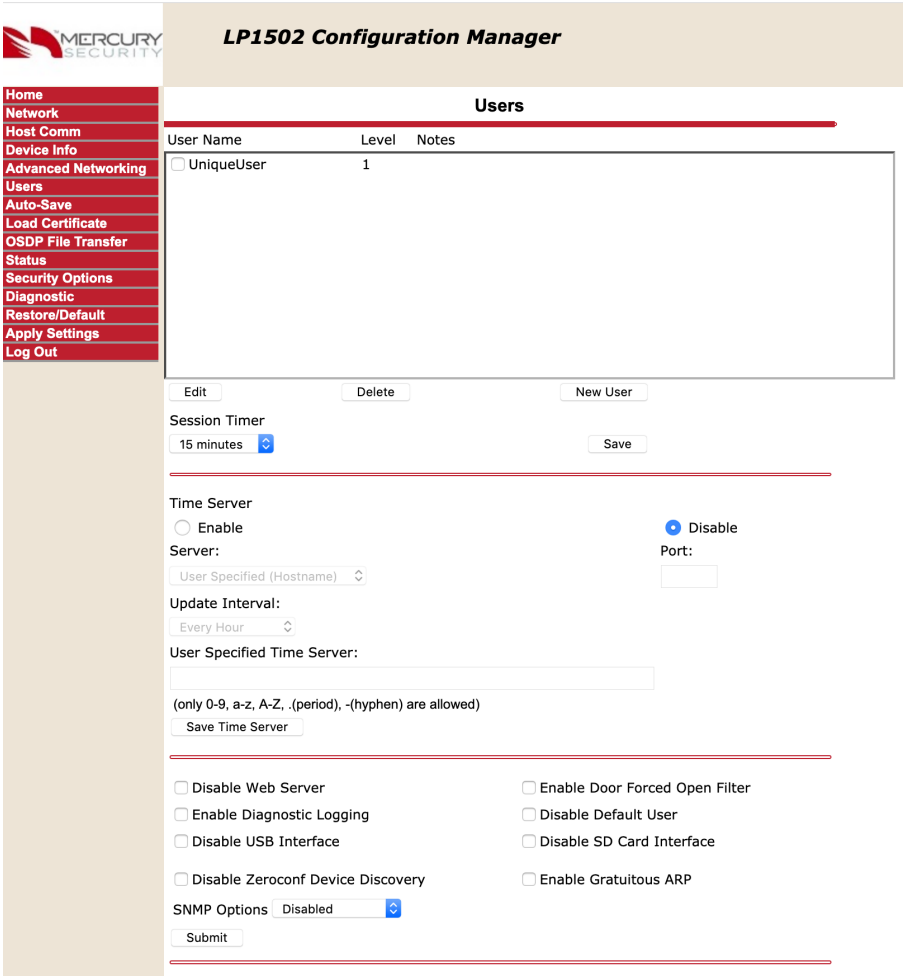
Ensure DIP SW3 is in the **OFF** position to enable HTTPS.

Note: HTTP is not supported on the EP4502 and LP Series controllers. Any HTTP request is redirected to HTTPS.



3.2 Session Timer

The session timer logs off a user after a certain period of time. A value of five minutes is recommended to minimize the risk of when an attacker can access active sessions. Values from five minutes to 60 minutes in five minute increments are allowed. Access the **Session Timer** configuration from the **Users** page of the web interface.

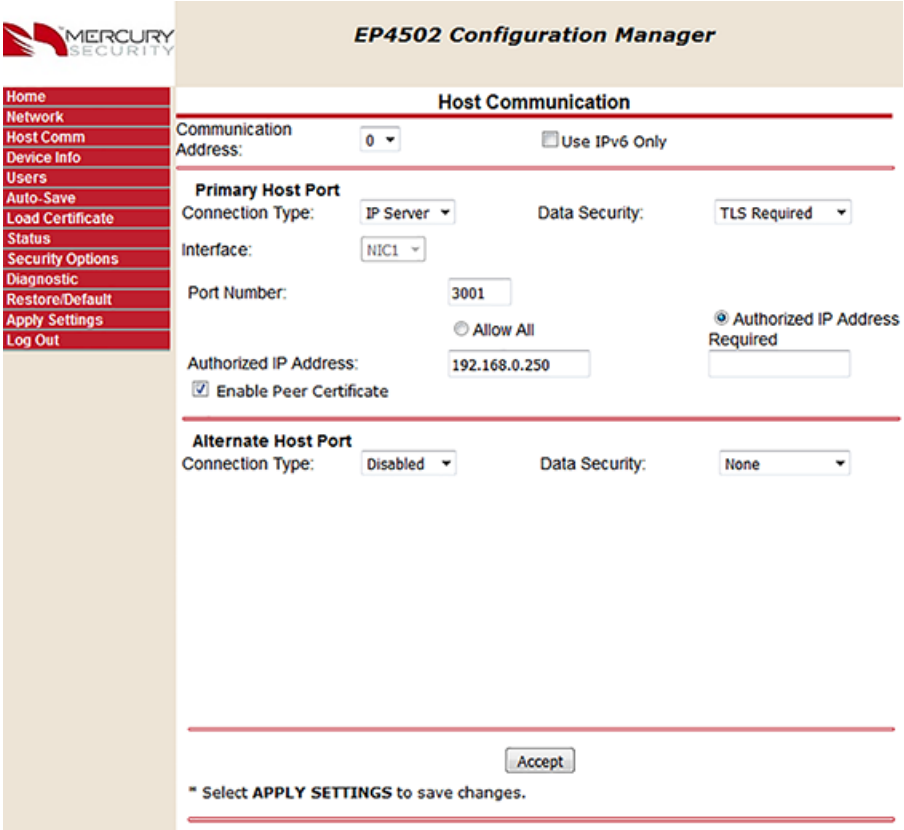


3.3 Authorized IP Addresses

Restrict accessing the controller's host communication port.

When there are only one or two IP addresses accessing the controller's host communication port, you can restrict where this connection originates. This filter applies to the communication port established by a host application configured in IP Server (host initiated connection) mode. In an IP Client (controller initiated connection) mode, the authorized IP addresses are programmed into the controller by the host application.

Select **Host Comm** > **Authorized IP Address Required** and specify the permitted one or two addresses.



3.4 Disable Web Service

The web service is used most frequently to perform initial configuration of the intelligent controller. Once the intelligent controller is configured and connected to the host, you can increase security by disabling the web service by checking the **Disable Web Service** check box at the bottom of the **Users** page. The web service can be re-enabled by the host application provided it has implemented this feature.

Section **04**
User Accounts

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Modifying user account information is paramount to the controller's security.

4.1 Default user login

The following is the default user login and password for out-of-the-box controllers:

- **Username:** admin
- **Password:** password

The default user credentials are the same for all intelligent controllers. To prevent unauthorized use, disable the default user.

For firmware 1.25.6 or later, permanently disable the default user account by clicking the **Disable Default User** check box from the **Users** page.

For firmware 1.19.4, build 0415 or later, temporarily enable the default user account (only if the default user was not permanently disabled):

1. Enable the default user by switching DIP SW1 from **OFF** to **ON**.
2. Log in to the web interface within five minutes.

   Note: A single login within the five minutes, or rebooting the board disables the ability to use the default login account until another DIP SW1 transition is performed.

For firmware before 1.19.4 build 0415, ensure DIP SW1 is **OFF** and at least one unique user account is created.

4.2 Unique user accounts

Create at least one unique user the first time you login to the web interface. This user should use a unique username and password. Each person accessing the web interface should have their own unique account for audit purposes.

4.3 Password strengths

User accounts have three levels of password strengths (Low, Medium and High). Maximize password security by ensuring the password is a high level strength.

Note: The LP Series requires a high strength password.

Note: To prevent against brute force attacks, three consecutive failed login attempts will lock the user out, preventing them from logging into the web interface for a period of time.

4.3.1 High strength passwords

- Eight character minimum
- Must not contain the username
- Meets all three criteria points (see **Password criteria**)

4.3.2 Medium strength passwords

- Six character minimum
- Meets two criteria points (see **Password criteria**)

4.3.3 Low strength passwords

1. Six character minimum

4.3.4 Password criteria

Passwords must contain three of the following categories:

- Uppercase alphabet characters (A-Z)
- Lowercase alphabet characters (a-z)
- Arabic numerals (0-9)
- Non-alphanumeric characters (!, $, #, or %)

Section **05**

Information services

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Prevent discovery services by implementing the following guidelines.

5.1 Disable discovery

By default the controllers support device discovery on Windows and Linux through Zeroconf services such as Apple Bonjour and mDSResponder. Once the controller is installed and configured it is recommended to turn-off discovery by checking the **Disable Zeroconf Device Discovery** check box at the bottom of the **Users** page. This will to prevent someone with access to the same network from discovering the controllers.

5.2 Disable SNMP

By default, SNMP is disabled. If SNMP is not used, leave this setting disabled. Disable SNMP by selecting **Disabled** from the **SNMP Option** drop-down menu at the bottom of the **Users** page.

5.3 Disable USB and SD interfaces

By default, USB and SD interfaces are enabled. The SD interface can be used to collect log dumps if an intelligent controller is malfunctioning. Disable these interfaces if not used by checking the **Disable USB Interface** and **Disable SD Card Interface** check boxes toward the bottom of the **Users** page.

Section **06**

Encryption and authentication

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Use the following settings to improve encryption and authentication methods.

6.1 Host/Controller encryption

The controller supports AES and TLS encryption for host communications. Use one of these methods to encrypt the data being transferred to and from the controller. TLS is recommended for data security over AES.

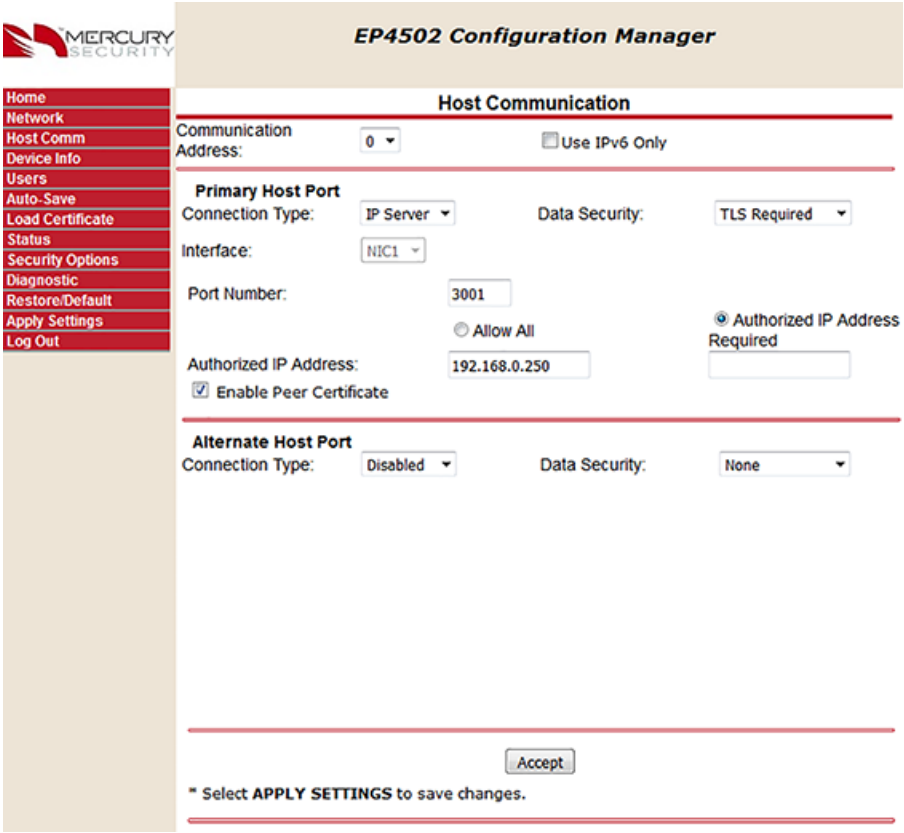
6.1.1 AES

Enable AES encryption by configuring both the host and controller. Load the encryption keys (128 or 256-bit) on both sides before enabling AES.

6.1.2 TLS

By default, unique certificates are loaded into each controller at the time of manufacture. Use these certificates to encrypt communication between the host and controller. Enable TLS encryption by selecting the required level from the **Host Comm**> **Data Security** drop-down menu:

- **TLS Required:** Only encrypted connections are established. TLS configuration of the host software is also required. TLS Required is more secure.
- **TLS if Available:** Defaults to TLS locally at the controller (if available), with no host side changes required.



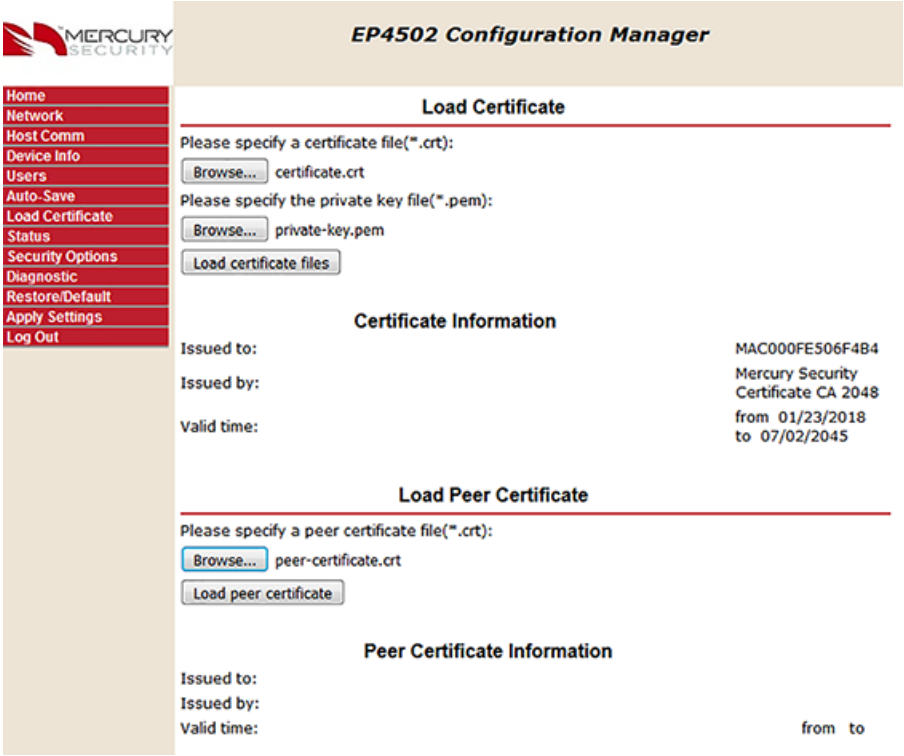
HID Mercury LP Intelligent controllers support TLS 1.2. HID Mercury EP Intelligent controllers support TLS 1.1.

6.2 Host/Controller authentication

It is recommended to also use certificates to authenticate the validity of the host and controller. One limitation of factory loaded certificates is they cannot be customized to the location where the controller is deployed. By loading customized peer certificates on the host and controller, a TLS connection proves the validity of host and controller.

For the controller, peer certificates are loaded through the **Load Certificate** page of the web interface or through the host application, if implemented.

Note: The peer certificate of the controller must also be loaded into the host's certificate store in order to mutually authenticate the validity of the controller.



EP4502 and LP Series controllers support larger key sizes and a higher SHA size.

- RSA Key Size: 3072-bit maximum (factory default is 3072-bit on LPs and 2048-bit on EP4502).
- SHA Size: SHA-384 maximum (factory default is SHA-256).
- Host and IO Module Communication TLS Ciphers: FIPS 140 cipher suite.
- Web page HTTPS/TLS Ciphers:
  - EECDH+AESGCM
  - EDH+AESGCM

EP1501, EP1502, and EP2500 controllers

- RSA Key Size: 1024-bit
- SHA Size: SHA-1
- Host, SIO Communication and Webpage HTTPS/TLS Ciphers:
  - TLS_RSA_WITH_AES_256_CBC_SHA
  - TLS_RSA_WITH_AES_128_CBC_SHA

Note: The values are recommended ONLY because these are the highest value before performance is degraded.

For more information on certificate verification (both server and controller), see the *HID Mercury TLS Encryption Support Application Note (PLT-05031)*.

6.3 Controller to downstream module communications

Enable encryption between the controller and downstream devices.

Series-3 IO Modules	Supports AES128 and AES256 encryption. ▪ For LP Series and EP4502 Intelligent Controllers, AES256 is enabled by default. ▪ For EP Series Intelligent Controllers, AES128 is available and must be configured and enabled.
Series-2 IO Modules	Supports AES128 encryption only. This must be configured and enabled.
MR51e	Supports AES128 encryption only. This is enabled by default.
MR62e	Supports either AES128 or TLS encryption. This is enabled by default.

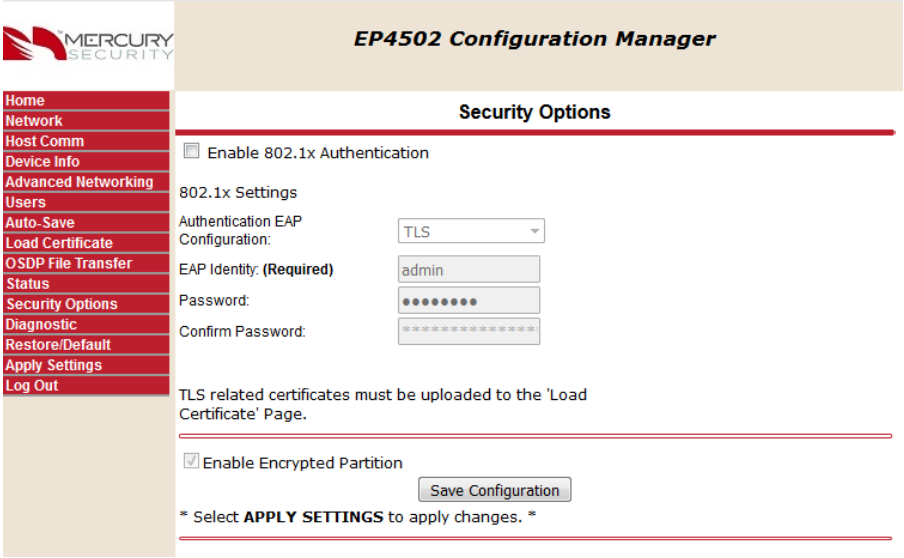
6.4 Reader communications

Use OSDP secure channel (V2) for reader communications. This bidirectional protocol is secured using symmetric keys shared between the reader and controller, and is a more secure communication method.

Note: OSDP secure channel encryption is not available on the Series 2 IO modules.

6.5 Data at rest encryption

The ability to encrypt “data at rest” has been implemented to satisfy privacy concerns for end users in the field. The encryption allows the configuration and data files to be stored in an encrypted container, with the files remaining inaccessible unless the correct procedure and password are used. To enable “data at rest” encryption, select the **Security Options** > **Enable Encrypted Partition** check box within the web interface.



6.6 Protection against Replay attacks on IP networks

6.6.1 Host / Controller Communications

The LP/EP intelligent controllers support AES and TLS encryption for host communications. These mechanisms are used to encrypt the data transferred to and from the controller. When using AES encryption (128 or 256-bit), both the host and controller are loaded with encryption keys set by the host software system.

When using TLS encryption, unique certificates are installed on every controller at the time of manufacture and are used to encrypt communication between the host and controller. Additionally, the host software system or Mercury installer web pages may be used to load customized peer certificates to the controller. Encryption and network specific mutual authentication can then be realized by loading controller peer certificates on the host software system.

Different controller models support different key lengths and ciphers. When utilizing AES or TLS, each session is protected using session keys that are generated using a FIPS 140-2 approved (and certified on the LP controller) random number generator. Additionally, only a single host connection to the controller is allowed, limiting the ability for rouge hosts to connect to the controller. Commands sent to the controller also use sequence numbers that reduce the ability to replay commands that are out of sequence.

6.6.2 Controller/IP-based downstream module communications

The MR62e and MR51e IP-enabled input/output modules support AES encryption (128-bit) between the controller and downstream module by default. Additionally, the newer MR62e supports TLS specifically for the installer web pages. The AES encryption on the MR62e and MR51e is synchronized using a combination of random seed and RSA1024 private/public key pairs generated every time after reboot. When using AES or TLS, each session is protected using session keys that are generated using an FIPS 140-2 approved random number generator. These security mechanisms help protect against replay command attacks.

Section **07**

Port based network access control

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7.1 802.1x (EP4502 and LP Series Controllers only)

Add 802.1x authentication as an added layer of LAN security to prevent unwanted access to the network. A supplicant, or device intending to connect to the network must first agree on a type of Extensible Authentication Protocol (EAP) with the authentication server that is linked to the network. The supplicant is then required to pass a series of challenges passed from the middle-man authenticator in order to communicate with the network connected to the authentication server. EAPs range from anything simple as a combination of username/password, to requiring a certificate over Transport Layer Security (TLS), or requiring both username/password and certificate over TLS. This enables the authentication server to prevent access to any supplicant that does not properly authenticate.

Note: This feature is only supported on the EP4502 (firmware 1.24.1) and the LP Series controllers.

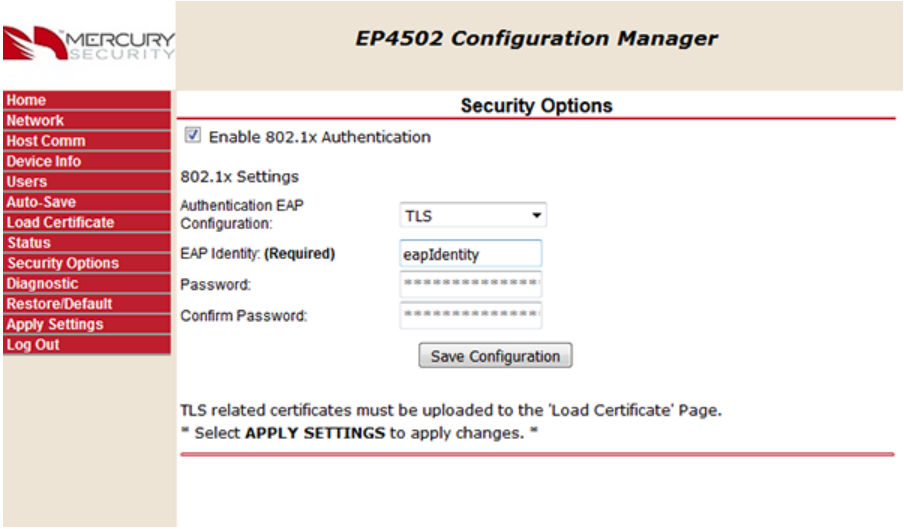
To activate, install the controller on an isolated network (or direct connect to host), configure with a static IP and connect through the web page.

If using TLS, ensure that the controller certificates are signed by the same root certificate used by the authentication server. See **Data at rest encryption** for details.

Once the controller is able to communicate using a browser,

1. Select **Security Options**.
2. Check the **Enable 802.1x Authentication** check box.
3. Enter the **Authentication EAP Configuration** and **EAP Identity** information, based on the authentication server configuration.
4. Enter the password in the **Password** and **Confirm Password** boxes.
5. Click **Save Configuration**.
6. Reboot the controller.
7. Connect to the desired network.

The controller is now authenticated using 802.1x.



Section **08**

Equipment replacement

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When replacing equipment it is recommended to clear all data from the board (if available).

8.1 Intelligent controller

8.1.1 Bulk erase

1. Disconnect power to the board.
2. Set S1 DIP switches 1 and 2 to **ON**.
3. Set S1 DIP switches 3 and 4 to **OFF**.
4. Reconnect power to the board. LEDs 1 and 2, and 3 and 4 should alternately flash at a 0.5 second rate.

IMPORTANT: DO NOT disconnect the power during the remainder of this procedure.

5. Within 10 seconds of powering up, change DIP switches 1 or 2 to **OFF**. Failure to do so results in the OEM default communication parameters being applied.
   - LED 2 flashes, indicating that the configuration memory is being erased. Full memory erase can take up to 60 seconds.
   - When complete, LEDs 1 and 4 will flash for eight seconds. The board will reboot eight seconds after LEDs 1 and 4 stop flashing (LEDs are off during this time).

8.2 IO modules

8.2.1 Clearing the EEPROM

Note: This procedure does not apply to the MR51e.

1. Set all DIP switches to **OFF** on the IO module.
2. Power cycle the IO module.
3. Within three seconds of reconnecting the power, set DIP switch 8 to **ON**.
4. Once the board completes the power up sequence, set the DIP switches to the required position.

8.2.2 MR62e bulk erase

1. Disconnect power to the board.
2. Set S1 DIP switches 1 and 2 to **ON**.
3. Set S1 DIP switches 3 and 4 to **OFF**.
4. Reconnect power to the board. LEDs 1 and 2, and 3 and 4 should alternately flash at a 0.5 second rate.

IMPORTANT: DO NOT disconnect the power during the remainder of this procedure.

5. Within 10 seconds of powering up, change DIP switches 1 or 2 to **OFF**. Failure to do so results in the OEM default communication parameters being applied.
   - LED 2 flashes, indicating that the configuration memory is being erased. Full memory erase can take up to 60 seconds.
   - When complete, LED 1 illuminates for three seconds. The board will then reboot.

Section **09**

Network ports

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9.1 EP controllers

Port	Port Type	Usage	Disable
67	UDP	DHCPS	No.
68	UDP	DHCPC	No.
80	TCP	HTTP	Yes (**Home** > **Users** > **Disable Web Server**).
161	UDP	SNMP	Yes (**Home** > **Users** > **Disable SNMP**).
443	TCP	HTTPS	Yes (**Home** > **Users** > **Disable Web Server**).
3001	TCP	Mercury Host Protocol (MSP2)	Yes (**Home** > **Host Comm** > **Connection Type**).
4001	TCP	PSIA	
5353	UDP	Zeroconf (discovery)	Yes (**Home** > **Users** > **Disable Zeroconf Device Discovery**).

Note: Configure the Mercury Host Protocol (MSP2) to use a different port. The default port is 3001.

9.2 LP controllers

Port	Port Type	Usage	Disable
67	UDP	DHCPS	No.
68	UDP	DHCPC	No.
161	UDP	SNMP	Yes (**Home** > **Users** > **Disable SNMP**).
443	TCP	HTTPS	Yes (**Home** > **Users** > **Disable Web Server**).
3001	TCP	Mercury Host Protocol (MSP2)	Yes (**Home** > **Host Comm** > **Connection Type**).
4001	TCP	PSIA	
5353	UDP	Zeroconf (discovery)	Yes (**Home** > **Users** > **Disable Zeroconf Device Discovery**).
47808	TCP	BACnet	Yes. BACnet is disabled by default.
47307	UDP	OTIS	Yes (only when OTIS integration is enabled).
45303	UDP	OTIS	Yes (only when OTIS integration is enabled).
46303	UDP	OTIS	Yes (only when OTIS integration is enabled).
46308	UDP	OTIS	Yes (only when OTIS integration is enabled).
45308	UDP	OTIS	Yes (only when OTIS integration is enabled).
10200	TCP	pivCLASS® Embedded	Yes (configure through the pivCLASS embedded web page).

9.3 MR51e

Port	Port Type	Usage	Disable
3001	TCP	Mercury SIO Communication Protocol (MSP1)	No.

9.4 MR62e

Port	Port Type	Usage	Disable
161	UDP	SNMP	Yes, off by default (**Home** > **Users** > **Disable SNMP**).
443	TCP	HTTPS	Yes (**Home** > **Users** > **Disable Web Server**).
3001	TCP	Mercury SIO Communication Protocol (MSP1)	No.
5353	UDP	Zeroconf (discovery)	Yes (**Home** > **Users** > **Disable Zeroconf Device Discovery**).

Revision history

Date	Description	Revision
January 2021	Minor changes.	A.1
April 2020	Updated to latest HID corporate template and assigned new document part number.	A.0
October 2018	Added Protection Against Replay Attacks on IP Networks.	N/A
July 2018	Added 'Encrypted Partition' option.	N/A
March 2018	Initial release (under Mercury branding).	N/A

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