User Manual UMAX141570
Version 2A
Firmware 2.xx

USER MANUAL

6-Port Automotive Gigabit Ethernet Switch

P/N: AX141570

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ACRONYMS

AF	Application Firmware
ARP	Address Resolution Protocol
AX	Axiomatic
BATT	Battery
bps	Bit per second
°C	Celsius (degree)
CQI	Channel Quality Indicator
DSCP	Differentiated Services Code Point
EMI	Electromagnetic Interference
IEEE	Institute of Electrical and Electronics Engineers
Gbps	Gigabit per second
GND	Ground
GPL	General Public License
H	Height (for size)
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
IEC	International Electrotechnical Commission
in	inch
IP	Internet Protocol or Ingress Protection (for housing)
L	Length (for size)
LAN	Local Area Network
lbs	Pounds
LED	Light-Emitting Diode
K	kilo
kOhm	kiloohm
m	meters
mA	milliamperes
MAC	Media Access Control (address)
Mbit	Megabit
Mbps	Megabits per second
MIT	Massachusetts Institute of Technology
Mpps	Mega packets per second
mm	millimetres
N/A	Not Applicable or Not Assigned
PC	Personal Computer
PHY	Physical Layer Transceiver (Ethernet chip)
P/N	Part Number
PWR	Power
PWREN	Power Enable
QoS	Quality of service
RFC	Request For Comments
RoHS	Restriction of Hazardous Substances
RTOS	Real-Time Operating System
SP	Service Pack
SSP	Software Support Package
TBD	To be Determined

TCP	Transmission Control Protocol
TDR	Time-Domain Reflectometry
TRD	Transmit/Receive Differential
UDP	User Datagram Protocol
V	Volt
VDC	Volt Direct Current
W	Width (for size)
Win	Windows

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1 INTRODUCTION

The following user manual describes architecture and functionality of the 6-Port Automotive Gigabit Ethernet Switch. It also contains technical specifications of the device.

The user manual is valid for application firmware with the same major version number as the user manual. For example, this user manual is valid for any application firmware version 2.xx. Updates specific to the user manual are done by adding letters: A, B, …, Z to the user manual version number.

The user can check the application firmware version number using the device embedded web server interface or through the RS-232 port.

2 DEVICE DESCRIPTION

The 6-Port Automotive Gigabit Ethernet Switch is designed for industrial and automotive applications requiring high performance 100/1000BASE-T1 Ethernet switch functionality.

Each switch port can be individually configured to support Master or Slave mode with 1Gbit/s or 100Mbit/s communication speed according to IEEE 802.3bp and IEEE 802.3bw standards. The Ethernet part of the switch is not configurable, resulting in unmanaged switch functionality.

An embedded web server on Port #1 allows users to configure switch ports, monitor the device performance and update application firmware. In addition, the web server interface contains a virtual cable tester that allows users to check integrity of the switch cabling and to perform basic Ethernet cable troubleshooting.

An auxiliary RS-232 port can be used as a local alternative to the remote web server interface.

A separate PWREN digital signal is used to power-up the device in applications where the switch is constantly connected to the battery.

An internal state of the switch is displayed by LEDs on the front panel of the housing.

2.1 Hardware Block Diagram

The device hardware block diagram is presented in Figure 1.

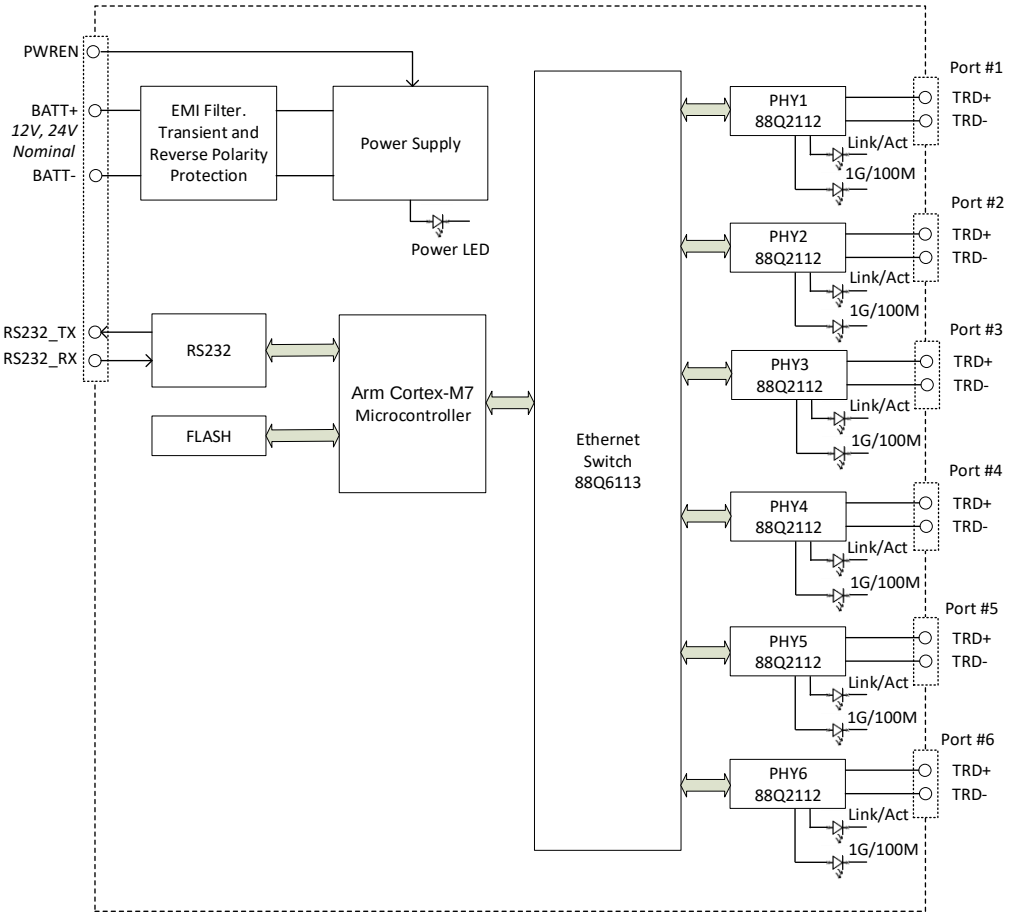


Figure 1. Device Hardware Block Diagram

The device contains six independent Gigabit Automotive Ethernet ports: Port #1…#6, an auxiliary RS-232 port, a power enable input (PWREN), and a protected power supply.

The power supply has Power LED indicator. It lights up when the device is powered, i.e. the power is applied to the switch and PWREN input is “On”. The device goes into a very low power consumption mode when PWREN is “Off”. The PWREN should be connected to BATT+ if not used.

The switch core is based on Marvell Automotive Ethernet switch 88Q6113 paired with six Marvell PHY transceivers 88Q2112. Each PHY transceiver has its own Link/Activity (Link/Act) and Speed (1G/100M) LED indicators hardwired to the PHY chip.

A separate ARM Cortex-M7 microcontroller controls the switch chip and PHY transceivers and runs an embedded web server. The device configuration parameters are stored in the internal flash memory.

2.2 Device Organization

The device internal organization is presented in Figure 2.

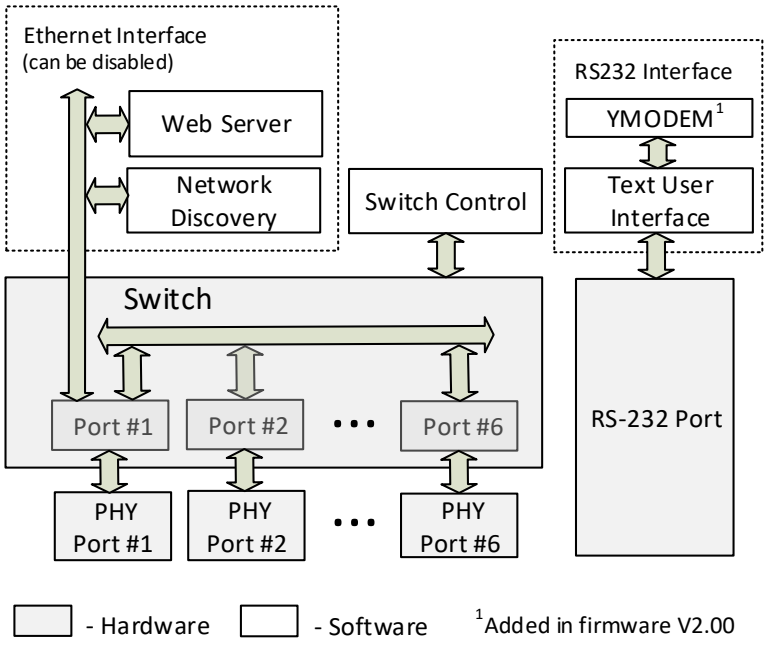


Figure 2. Device Internal Organization

The device software contains the *Switch Control* module and two user interfaces: *Ethernet Interface* and *RS-232 Interface*.

2.2.1 Ethernet Interface

The device *Ethernet Interface* is comprised of the *Web Server* and the *Network Discovery* software modules, both accessible through the switch Port #1. At the same time, the switch Port #1 can be used as a regular switch port without any restrictions.

The *Ethernet Interface* can be disabled through the RS-232 interface for security reasons. In this case, the switch will be invisible on the Ethernet.

2.2.1.1 Web Server

The device embedded web server provides a user front-end interface with the switch. It runs a dynamic website that shows the device general information, configuration parameters, and the device real-time diagnostics.

The website can be used to change, save or restore configuration parameters, change device password, and upload new firmware. It also contains a virtual cable tester for Ethernet cable diagnostics and troubleshooting.

The user's web browser should support JavaScript.

For more information, see *Device Configuration*, *Device Diagnostics*, *Virtual Cable Tester*, and *Firmware Update* sections.

2.2.1.2 Network Discovery

The device supports a proprietary Axiomatic discovery protocol. It allows to find the device IP address on the LAN using Axiomatic discovery application `AxioDisc.exe`. For more information, see *Device Discovery* section.

2.2.2 RS-232 Interface

The *RS-232 Interface* serves as a local alternative to the embedded web server. It is presented by the *Text User Interface* module accessible through an auxiliary RS-232 port located on the device *Power Connector*, see *Power Connector* subsection of this document.

For more information, see *RS-232 Interface* section.

2.2.2.1 Text User Interface

The *Text User Interface* is a simple menu-based user interface that provides the same scope of configuration, monitor and control options as the device web server. It uses the *YMODEM* module for configuration file operations[1].

[1]Added in firmware V2.00.

2.2.2.2 YMODEM

The *YMODEM* module is used by the *Text User Interface* module for configuration file upload and download operations. It interacts with the user's PC YMODEM software providing transmission of the configuration file.

3 DEVICE CONFIGURATION

The device supports configuration over the internal website running on the device embedded web server. For security reasons, the device website can be accessed only through the switch Port #1. The device web access is also password protected[1].

[1]The password protection was added in firmware V2.00.

The device web access can be disabled through the RS-232 interface by setting *Ethernet Interface Enabled* configuration parameter to “No” (default is “Yes”), see *RS-232 Interface* section of this document.

3.1 Connecting to the Device

The default *Device IP Address* is “192.168.0.34”. Please, make sure that there are no other devices on this IP address when connecting the switch for the first time to your LAN for configuration.

To connect to the device, the user should run any web browser and point it to the *Device IP Address*. After a successful connection, the user will see the device login page[1], see Figure 3.

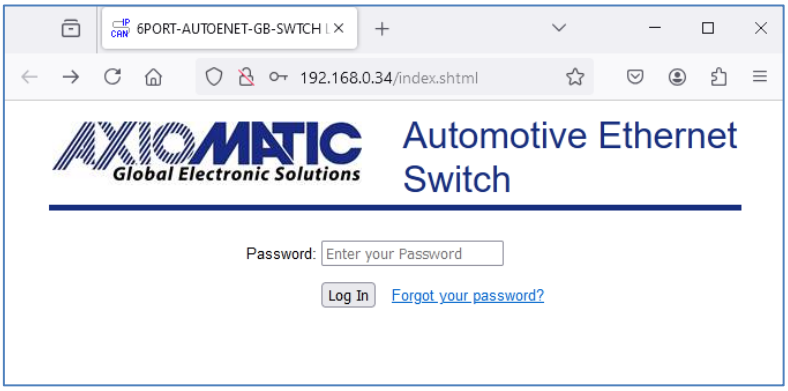


Figure 3. Device Login Page

[1]The device website login page was added in firmware V2.00.

If necessary, the user will need to allow JavaScript (this setting is default in the majority of web browsers). If JavaScript is disabled, the website will show a message asking to activate JavaScript at the top of the web page, see Figure 4.

Figure 4. Enable JavaScript Prompt

The device default password is **Axiomatic1** (case sensitive). The device home page will be shown upon entering the correct password.

To protect the device from password guessing, the number of unsuccessful attempts to connect to the device is limited. Access to the device will be denied for several minutes upon reaching this limit. Also, for security reasons, the device web session will be automatically closed and the user logged out on the user's inactivity.

In case the password is lost, the user can reset the password using RS-232 interface, see *Change Web Access Password* subsection of this document.

3.2 Device Homepage

The device home page shows the device information, including the switch part number, serial number, and firmware version, see Figure 5. It also shows the device network configuration and configuration of the automotive Ethernet ports.

The *Network* and *Automotive Ethernet Ports* configuration parameters have tooltips clarifying their meaning, see Figure 6.

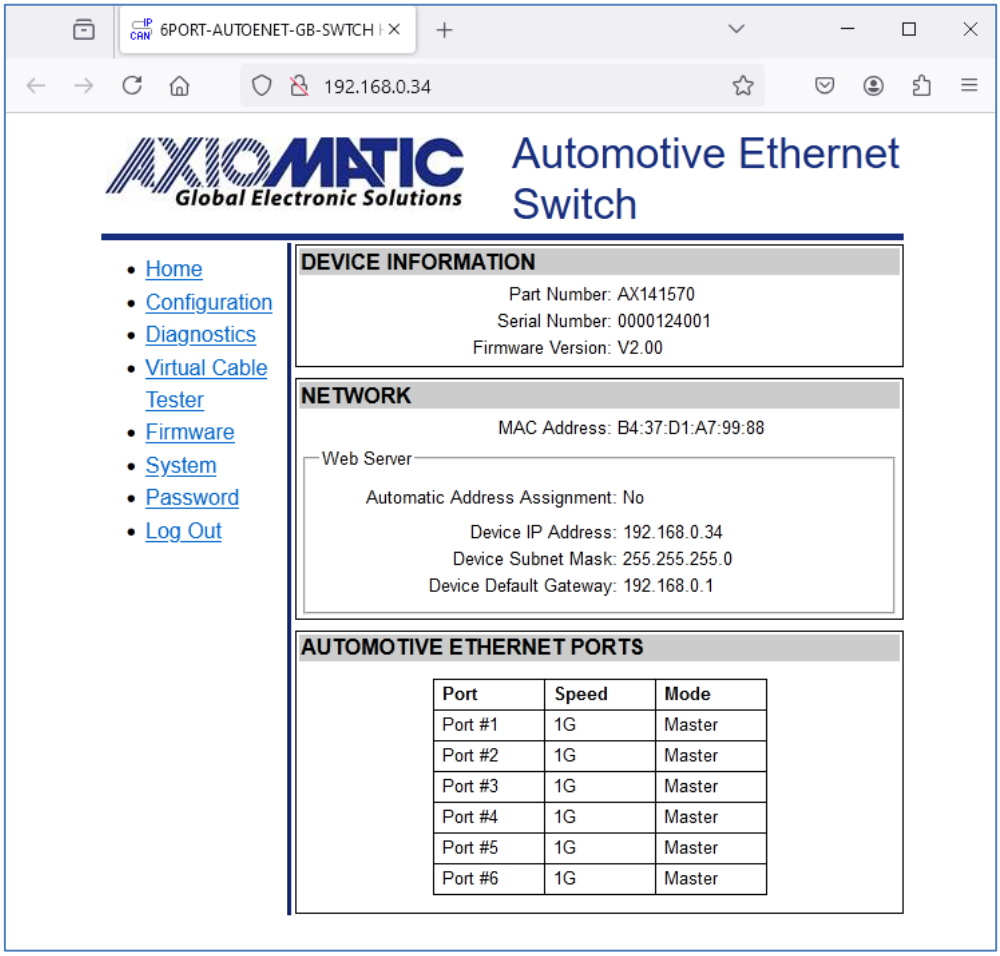


Figure 5. Device Home Page[1]

[1]The Firmware Version number may be different from the firmware version described in the manual.

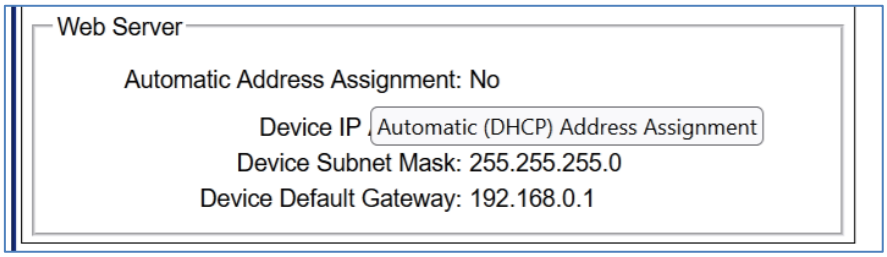


Figure 6. Tooltip for the "Auto Connect to Remote" Configuration Parameter

3.3 Changing Configuration Parameters

All configuration parameters can be changed either on an individual basis through the *Configuration* web page or by using a configuration file on the *System Settings* web page[1].

[1]*The device configuration file support was added in firmware V2.00.*

3.3.1 Configuration Web Page

The user can change configuration parameters in interactive mode using *Configuration* web page. It can be reached by clicking on the link on the left side of the website, see Figure 7.

The *Configuration* web page has fields to enter values of the configuration parameters and four buttons: *Save Settings*, *Discard Settings, Reboot Device* and *Set Defaults*. The configuration parameters have tooltips for the user convenience.

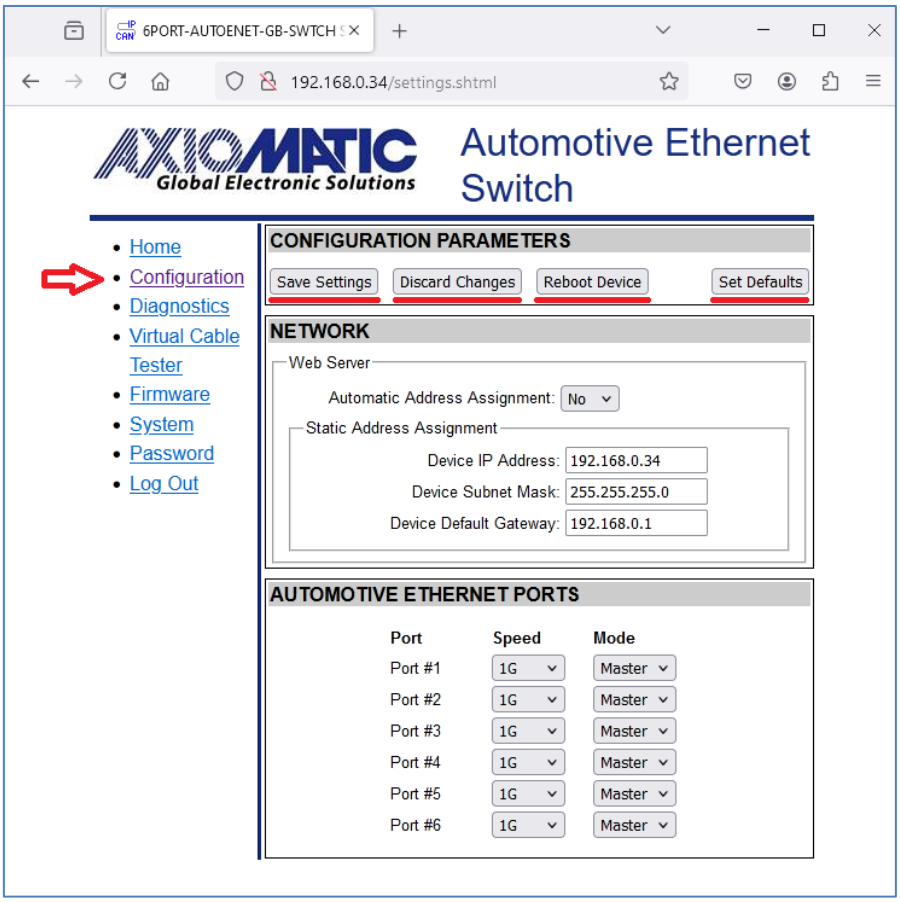


Figure 7. Configuration Web Page

The *Save Settings* button will save configuration parameters in non-volatile memory. Some changes will not be immediately applied and will require the device reboot.

The *Discard Changes* button will bring back the original device settings on the webpage before they have been changed. In case the user leaves the page without saving, all changes will be also discarded.

The *Reboot* button will reboot the device. This will activate all updates to configuration parameters stored in the non-volatile memory, if any.
The *Set Defaults* button will load default values of the configuration parameters into data fields on the configuration page. The configuration parameters will not be automatically saved.

When the user presses the *Save Settings* button, the web page runs a script to check the validity of the new configuration parameters before uploading them to the web server. For example, the following alert message will be displayed if the user enters an invalid value for the *Device IP Address*, see Figure 8.

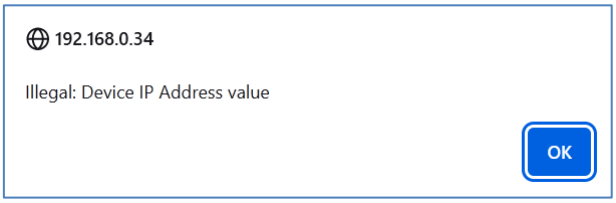


Figure 8. Settings Configuration Parameter Alert Message.
Error in Configuration Parameter

The website messages should be enabled (not suppressed) in the browser to see this and other feedback messages.

After pressing the *Save Settings* button and saving the configuration parameters in non-volatile memory, the converter replies with a confirmation message showing the result of the saving operation. For example, for operations requiring reboot, the following message will be displayed, see Figure 9.

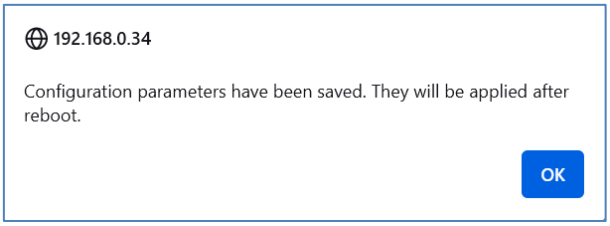


Figure 9. Settings Configuration Parameter Alert Message.
Configuration Parameters have been Changed Successfully

3.3.2 Network Configuration

Network configuration parameters include the web server configuration, see Table 1. The converter *MAC Address*, shown on the home page, is a read-only parameter.

Table 1. Network Configuration Parameters

Configuration Parameter	Default Value	Range	Description
Automatic Address Assignment	No	{No, Yes}	Automatic Address assignment using DHCP server
Device IP Address[1]	192.168.0.34	Any IP address[2]	The device static IP address
Device Subnet Mask[1]	255.255.255.0	Any IP address[3]	The device static subnet mask
Device Default Gateway[1]	192.168.0.1	Any IP address[2]	The device static default gateway

[1] Must be assigned by a network administrator when a static address assignment is used, i.e. *Automatic Address Assignment* is set to “No”.
[2]Except special addresses (broadcast, multicast, etc.). The user should ensure the correctness of the IP addresses.
[3]Use a subnet mask IP address as per RFC 1878.

The web server uses a standard port number 80.

3.3.3 Automotive Ethernet Port Configuration

The user can individually change the communication speed and the negotiation role of each automotive Ethernet port, see Table 2.

Table 2. Automotive Ethernet Port Configuration Parameters

Configuration Parameter	Default Value	Range	Description
Speed	1G	{1G, 100M}	Port communication speed
Mode	Master	{Master, Slave}	Port negotiation role

3.3.4 System Settings Web Page

The device configuration can be saved and then restored back from a configuration file. The configuration file operations are provided on the *System Settings* web page, see Figure 10, accessible by clicking on the *System* link on the left side of the web page.

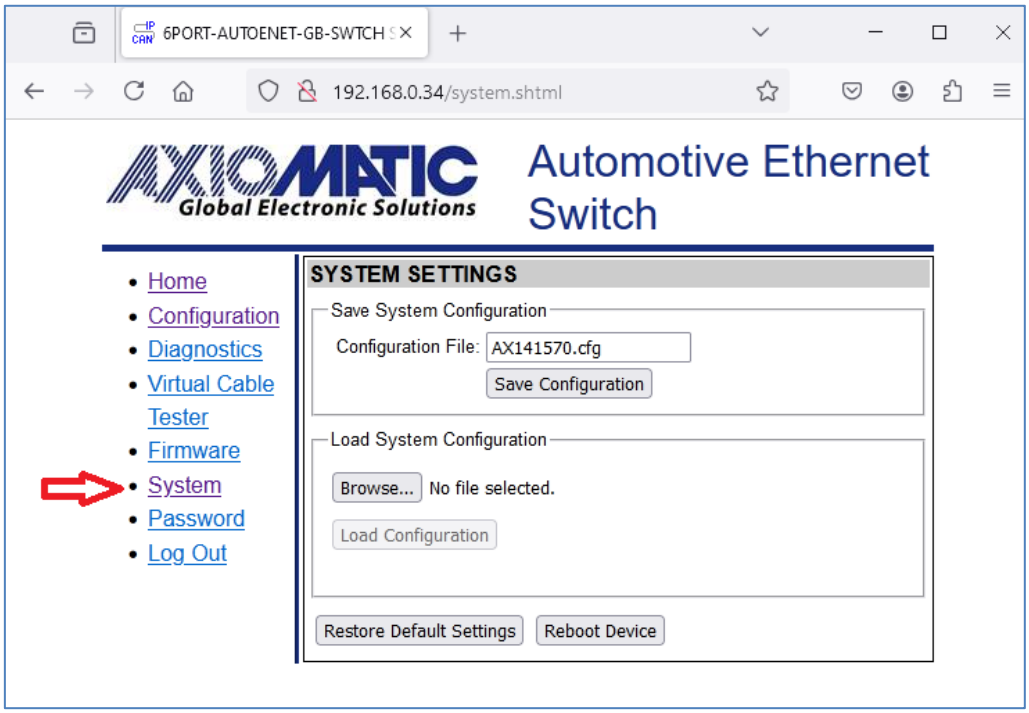


Figure 10. System Settings Web Page

3.3.4.1 Saving System Configuration

To save system configuration, the user should enter the system configuration file name in the *Configuration File* field and then press the *Save Configuration* button.

The default system configuration file name is “AX141570.cfg”. The configuration file will be generated and saved in the *Downloads* location of the web browser, see Figure 11.

In case the web session is expired on inactivity, an empty configuration file will be generated.

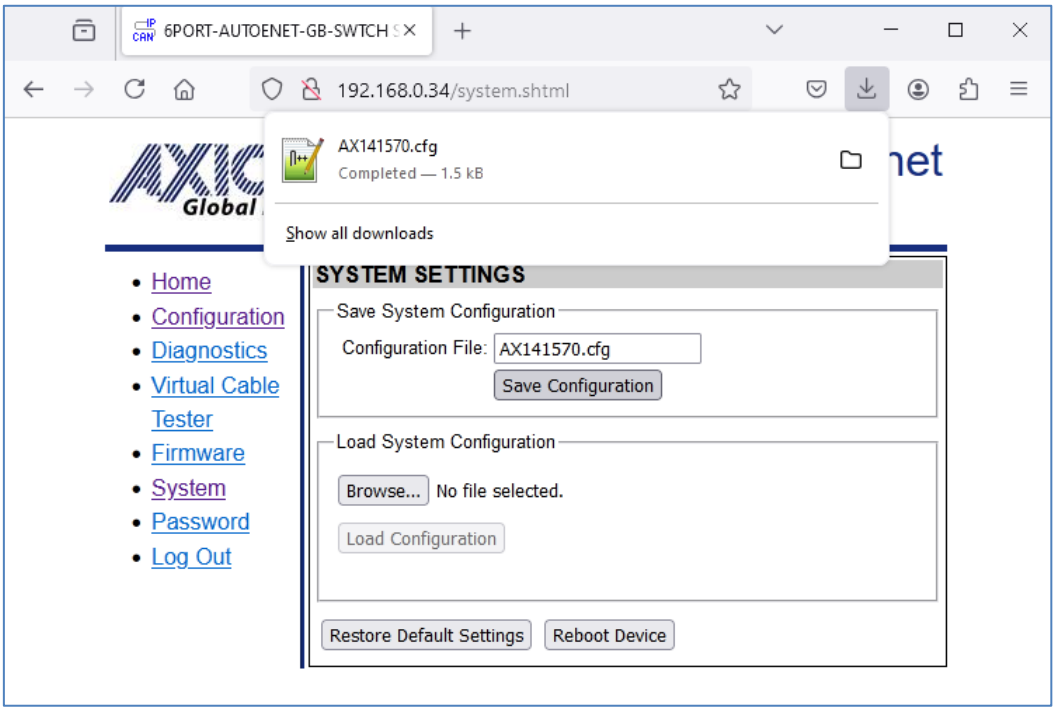


Figure 11. Saving System Configuration

3.3.4.2 Loading System Configuration

The user can restore system configuration from a configuration file. The configuration file will be processed, and configuration parameters updated during the file upload operation.

To upload the device configuration file, the user should first select the configuration file by pressing the *Browse…* button in the *Load System Configuration* section on the *System Settings* web page. Then the user should press the *Load Configuration* button to upload the selected configuration file to the device.

The result of the upload operation will be shown to the user in an alert message from the web site. For example, a successful upload of previously saved configuration parameters will result in the following message, see Figure 12.

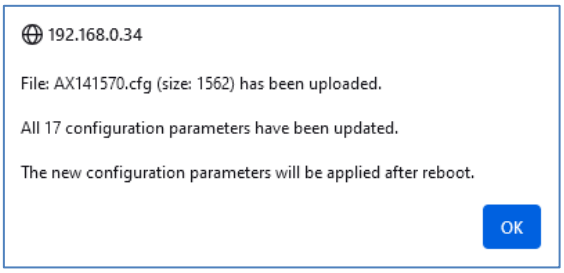


Figure 12. Loading System Configuration File Alert Message. All Configuration Parameters Have Been Updated

The device upload operation provides extended diagnostic information to the user. In case of an error in the configuration file, a detailed description and location of the error will be reported. Similarly, the exact number of the updated configuration parameters will be reported on a successful operation, together with the total number of the device configuration parameters that could have been updated.

For example, a syntax error in the *SwitchPort2Mode* configuration parameter, when instead of *SwitchPort2Mode* an incorrect *SwitchPort2Mode** name is written, will result in the following error message, see Figure 13.

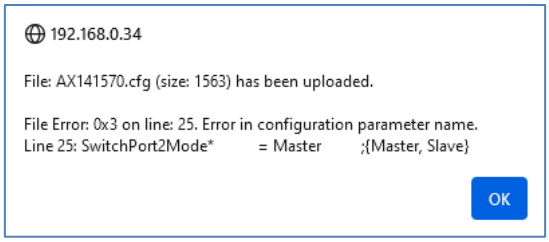


Figure 13. Loading System Configuration File Alert Message.
Error in Configuration File

This message contains a file error number, an error description, and a line number where this error was found in the configuration file. The file line content is also shown to facilitate debugging of the configuration file.

An error in a value of a configuration parameter is presented the same way. For example, if the *SwitchPort2Mode* configuration parameter has an incorrect value of “Master1” instead of “Master”, the following error message will be generated, see Figure 14.

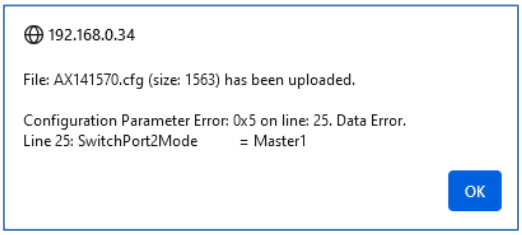


Figure 14. Loading System Configuration File Alert Message.
Error in Configuration Parameter Value

In case a configuration file has successfully updated, for example, only 16 configuration parameters out of the total 17 updatable device configuration parameters, the result message will show this information, see Figure 15.

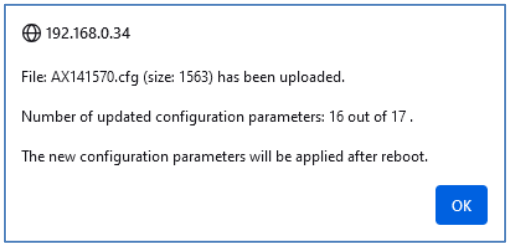


Figure 15. Loading System Configuration File Alert Message.
Configuration Parameters Have Been Partially Updated

The user will need to reboot the device to apply the new configuration parameters already saved in non-volatile memory after a successful upload operation. This can be done by using the *Reboot* button on the *System Settings* web page.

All changes in configuration parameters will be rolled back if the upload operation has failed.

3.3.4.3 Restoring Default Settings

The user can restore the device to the factory default configuration by pressing the *Restore Default Settings* button on the *System Settings* page, see Figure 16.

This operation complements the *Set Defaults* operation on the *Configuration Web Page*. The main difference is that the *Restore Default Settings* operation restores all device configuration parameters, not only the ones presented on the *Configuration Web Page*. The exception is the device password, which is not affected by this operation.

The confirmation alert message will appear to protect the device configuration from accidental modification, see Figure 17.

If the user choses to proceed, the second alert message will inform the user of the result of this operation, see Figure 18.

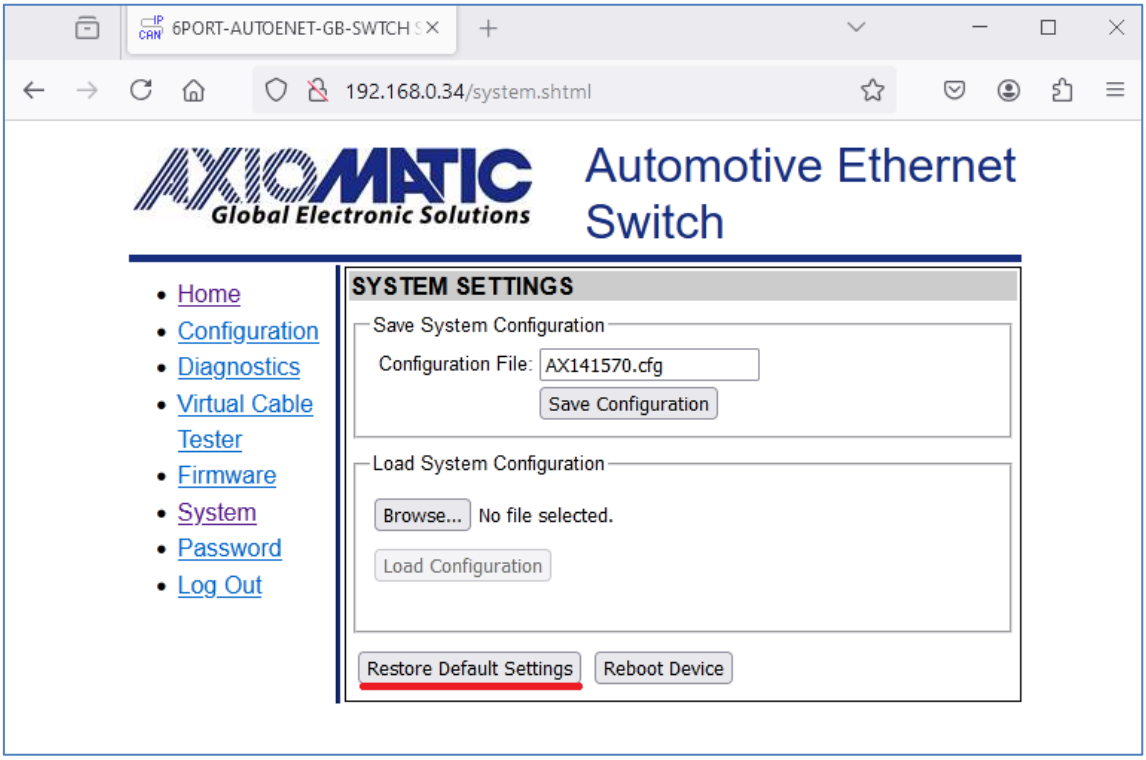


Figure 16. System Settings Page. Restore Default Settings

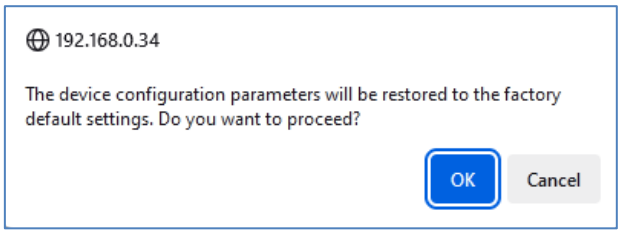


Figure 17. Restoring Default Settings Confirmation Alert Message

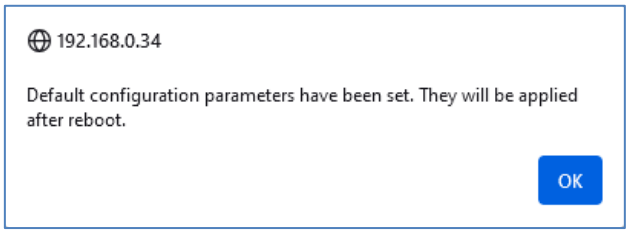


Figure 18. Restoring Default Setting Successful Result Alert Message

3.4 Configuration File Format

The device configuration is stored in a human-readable text file based on a proprietary implementation of the well known INI file format, https://en.wikipedia.org/wiki/INI_file.

The device configuration parameters are grouped in configuration parameter groups that form INI file sections. The user can edit a configuration file generated by the device in any text editor and change values of configuration parameters according to the user's requirements.

A device configuration file generated by the device with default configuration settings is presented in Figure 19.

```
; Device Configuration File
; -------------------------
; File format v1.00. Copyright (c) 2024 Axiomatic Technologies Corporation.

[Info]
; This information group was automatically generated by the device.
; All configuration parameters in the device "Info" group are read-only.
PartNumber                = AX141570
SerialNumber              = 0000124001
MACAddr                   = B4:37:D1:A7:99:88
FirmwareID                = 23024
FirmwareVersionNumber     = 2.00

[Controller]

[Ethernet]
EthIntEnable              = 1               ;{1-Yes, 0-No}
AutoAddrAssign            = 0               ;{1-Yes, 0-No}
DeviceIpAddress           = 192.168.0.34    ;{Any IP Address: x.x.x.x}
DeviceSubnetMask          = 255.255.255.0   ;{Any IP Address: x.x.x.x}
DeviceDefaultGateway      = 192.168.0.1     ;{Any IP Address: x.x.x.x}
SwitchPort1Speed          = 1G              ;{100M, 1G}
SwitchPort1Mode           = Master          ;{Master, Slave}
SwitchPort2Speed          = 1G              ;{100M, 1G}
SwitchPort2Mode           = Master          ;{Master, Slave}
SwitchPort3Speed          = 1G              ;{100M, 1G}
SwitchPort3Mode           = Master          ;{Master, Slave}
SwitchPort4Speed          = 1G              ;{100M, 1G}
SwitchPort4Mode           = Master          ;{Master, Slave}
SwitchPort5Speed          = 1G              ;{100M, 1G}
SwitchPort5Mode           = Master          ;{Master, Slave}
SwitchPort6Speed          = 1G              ;{100M, 1G}
SwitchPort6Mode           = Master          ;{Master, Slave}
```

Figure 19. Device Configuration File. Default Configuration Parameters

The *[Info]* configuration parameter group is automatically generated by the device for information purposes only. It contains read-only configuration parameters, is completely optional, and can be omitted if the file is prepared by the user.

The *[Controller]* configuration parameter group does not have any configuration parameters in this version of the firmware. It can be also omitted.

The *[Ethernet]* configuration parameter group contains all 17 updatable configuration parameters of the device. The user can change any of them.

For the user's convenience, the device automatically writes all allowed values of an updatable configuration parameter in comments beside that configuration parameter when a configuration file is generated.

For detailed information on the updatable configuration parameters, please refer to:

- Table 4. RS-232 Interface Exclusive Configuration Parameters.
- Table 1. Network Configuration Parameters.
- Table 2. Automotive Ethernet Port Configuration Parameters.

There are no specific restrictions on the number of configuration parameters in a configuration file. The file can have all or just one configuration parameter provided that the configuration parameter group of the configuration parameter is also specified. This allows creation of a configuration file that changes only a specific set of configuration parameters without affecting all other settings.

For example, a configuration file that configures port #5 of the switch to the "Slave" mode at "100Mbps" is presented in Figure 20.

```
; Device Configuration File
; -------------------------
; This file will configure port #5 to Slave mode at 100 Mbps

[Ethernet]
SwitchPort5Speed          = 100M           ;{100M, 1G}
SwitchPort5Mode           = Slave          ;{Master, Slave}
```

Figure 20. Device Configuration File to Configure Port #5

3.5 Password Update Web Page

The device password can be changed on the *Password Update* web page by clicking on the *Password* link on the left side of the device web page, see Figure 21.

Alternatively, the password can be changed through RS-232 interface, see *Change Web Access Password* subsection of this document.

To update the device password, the user should enter the current passwords and then enter and confirm the new password. The password should contain only letters and numbers with at least one number, one uppercase and one lowercase letter. The password length should be from 8 to 30 characters. The new password should be different from the old one.

The result of the password update operation will be shown to the user in an alert message from the device web site after pressing the *Change Password* button, see Figure 22.

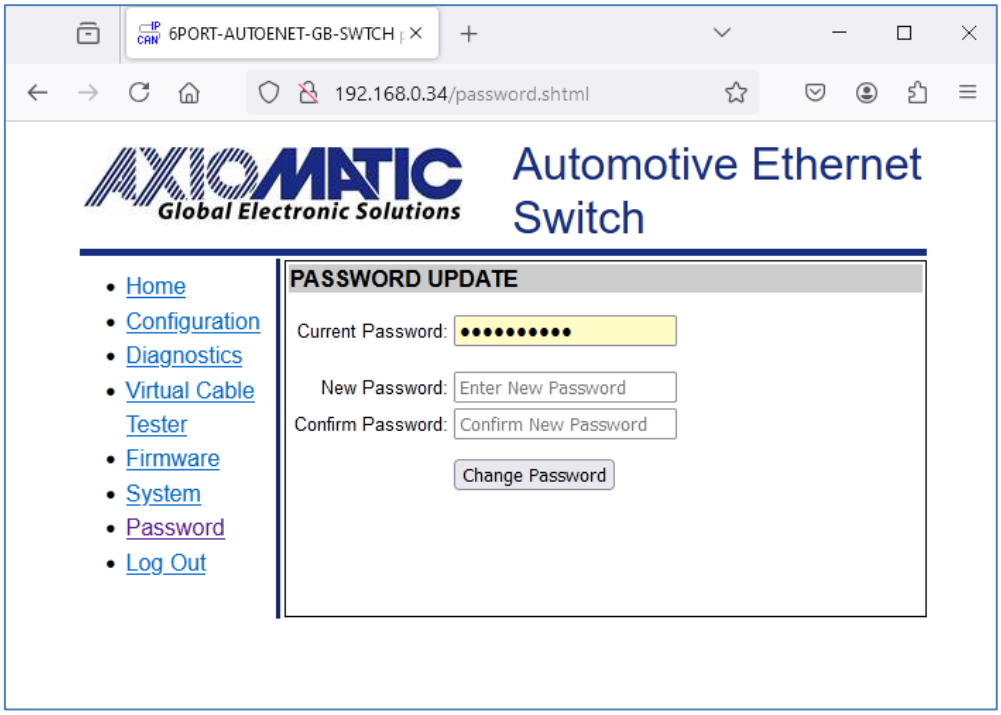


Figure 21. Password Update Web Page

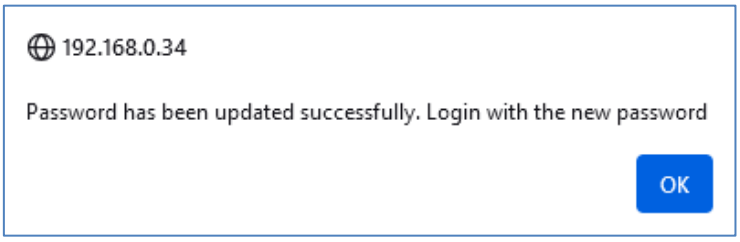


Figure 22. Password Update Alert Message

After the password has been changed successfully, the user will be automatically logged out and prompted to login again using the new password.

4 DEVICE DIAGNOSTICS

The user can see real-time diagnostic information on the *Diagnostics* web page of the device internal website.

To see the *Diagnostics* page, Figure 23, the user should click on the *Diagnostics* link on the left side of the web page.

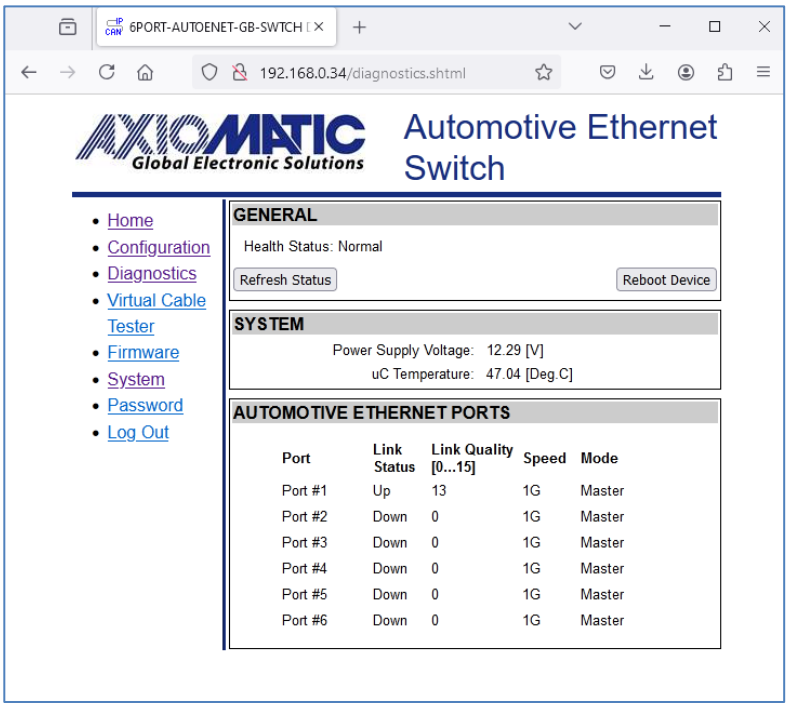


Figure 23. The Converter Diagnostics Web Page

The *Diagnostics* web page shows the *Health Status* of the device together with the *System* and *Automotive Ethernet Ports* status information.

The user can refresh the values on the page by pressing the *Refresh Status* button. The *Reboot Device* button activates the device rebooting.

4.1 Health Status

The device *Health Status* is an aggregated system real-time parameter calculated on the base of individual operational statuses of the major device hardware and software components.

The *Health Status* presents the overall operational status of the switch, based on the following rules, see Table 3.

Table 3. Health Status

Health Status	Condition
Error	“Error” is reported when at least one operational status is in “Error” state.
Warning	“Warning” is reported when at least one operational status is in “Warning” state and there are no operational statuses in “Error” state.
Undefined	“Undefined” is reported when at least one operational status is in “Undefined” state and there are no operational statuses in “Error” or “Warning” state.
Normal	“Normal” is reported when all operational statuses are in “Normal” state.

If the *Health Status* is different from “Normal”, the user will see a verbose message on the *Diagnostics* web page below the *Health Status* describing which operational status is causing a problem.

Figure 24. Health Status Message on PHY temperature error

In case several operational statuses differ from “Normal”, all of them will be shown on the *Diagnostics* page.

4.2 Automotive Ethernet Ports

Each automotive Ethernet port displays the *Link Status* of the port. For the ports participating in data communication (with *Link Status* “On”), the *Link Quality* metrics is shown on the scale of 0 to 15, where 0 is the lowest quality and 15 is the highest quality of the Ethernet connection.

4.3 Device Rebooting

The user can reboot the device, when necessary, using the *Reboot Device* button.

The switch rebooting operation takes 10 seconds. The user will see the *Reboot* screen with a countdown counter during this operation, see Figure 25.

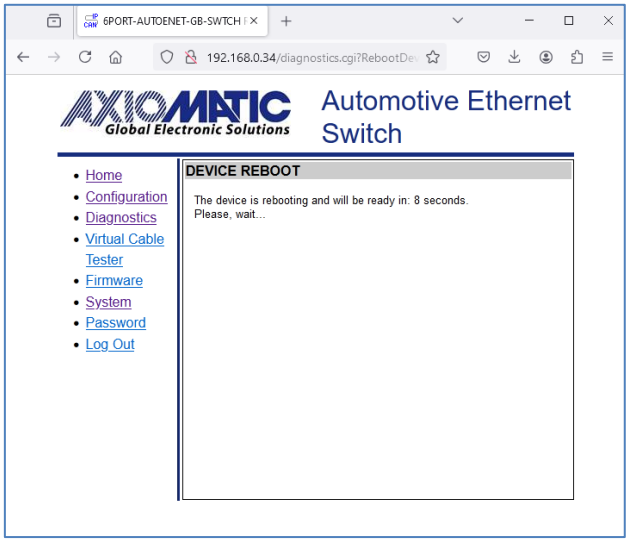


Figure 25. The Device Reboot Screen

When the rebooting operation is over, the device home page will be loaded.

5 VIRTUAL CABLE TESTER

The device has a virtual cable tester to check quality of the Ethernet switch cabling and to perform basic cable troubleshooting. It uses a time-domain reflectometry (TDR) test for testing cable integrity and a channel quality indicator (CQI) test to determine cable insertion and return losses in active Ethernet connections.

To access the virtual cable tester menu, Figure 26, the user should click on the *Virtual Cable Tester* link on the left side of the device web page.

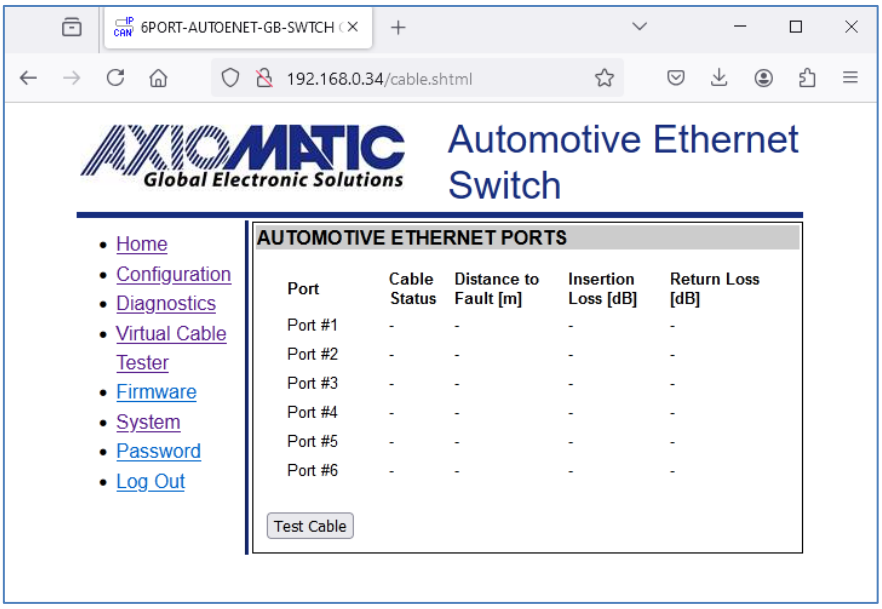


Figure 26. Virtual Cable Tester Web Page

The user activates cable testing by pressing the *Test Cable* button. The cable testing takes a couple of seconds during which the Ethernet communication will be disrupted. The results of the testing are displayed on the web page when the testing is completed, see Figure 27.

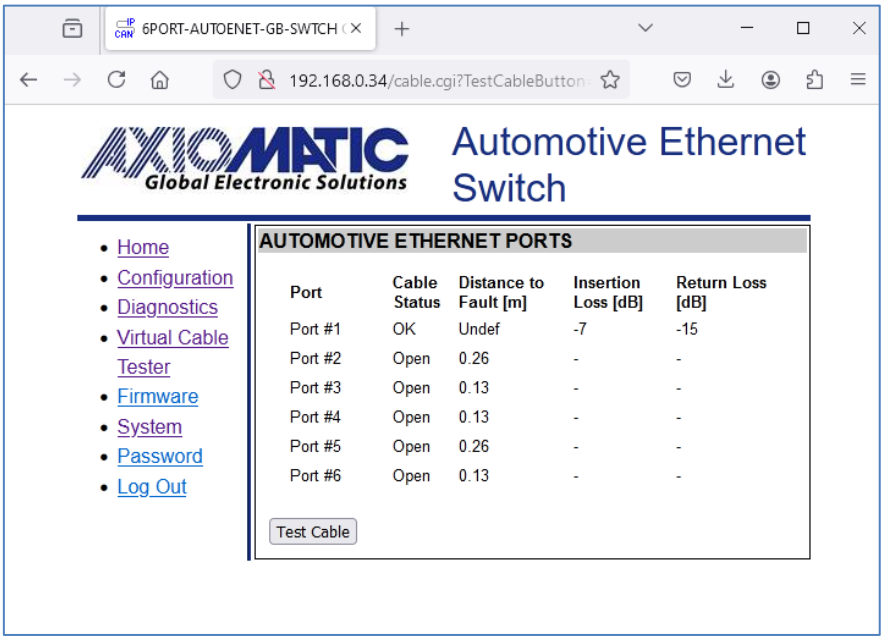


Figure 27. Virtual Cable Tester Test Results

6 FIRMWARE UPDATE

The device application firmware can be updated through the device internal website or the device auxiliary RS-232 port in the field.

The update procedure through the internal website is described below. The Ethernet interface on the device should not be disabled through the RS-232 port.

The firmware update procedure is performed in two stages. First, the application firmware is uploaded into the device internal flash. During this stage, the device checks the firmware checksum and other conditions to determine whether it can be programmed into the device microcontroller.

Then, upon the user confirmation, the firmware is programmed into the microcontroller and the device is restarted. At the end of this procedure, the user should see the new firmware version number on the device home page in the web browser.

6.1 Uploading New Firmware

To upload the new firmware, the user should activate the *Firmware Uploading* page, see Figure 28, by clicking on the *Firmware* link on the left side of the webpage[1].

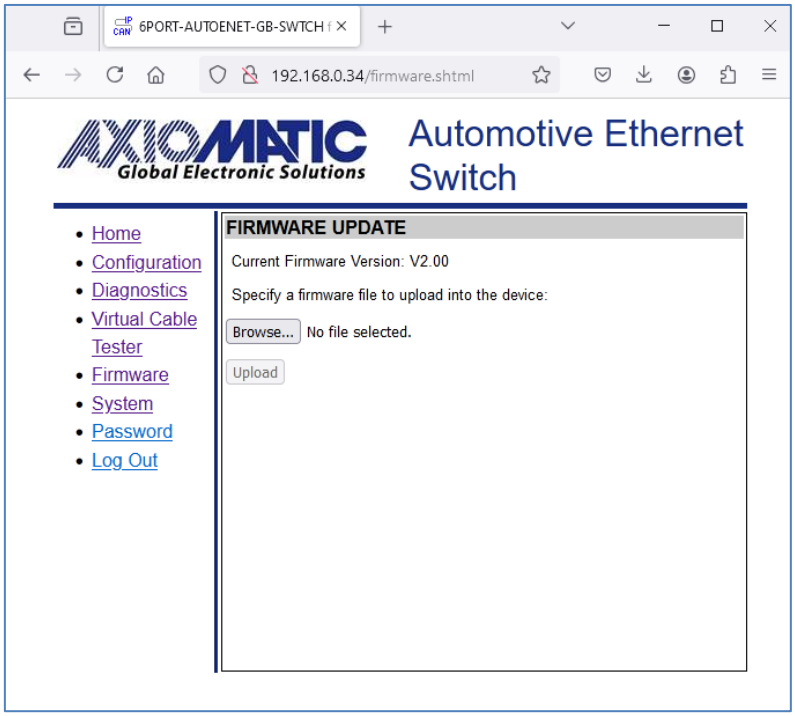


Figure 28. Firmware Uploading Page[1]

[1]The Current Firmware Version number may be different from the firmware version described in the manual.

Then the user selects the new firmware file using the ***Browse…*** button.

The firmware file is provided by Axiomatic in a proprietary binary format with extension: `.af`. The file name should have the following format: `AF-23024-X.XX.af`, where the `<X.XX>` field wildcard reflects the firmware version number[1].

[1]`AF-23024-2.00.af` file will be used for illustration of the firmware update process in this manual.

When the file is selected, the user should press the *Upload* button. The user will see the dynamic message: “Loading…” in the bottom of the screen and then, if everything is in order, the converter will switch automatically to the *Firmware Update* page.

6.2 Applying New Firmware

On the *Firmware Update* page, the user will see the new firmware file information, see Figure 29.

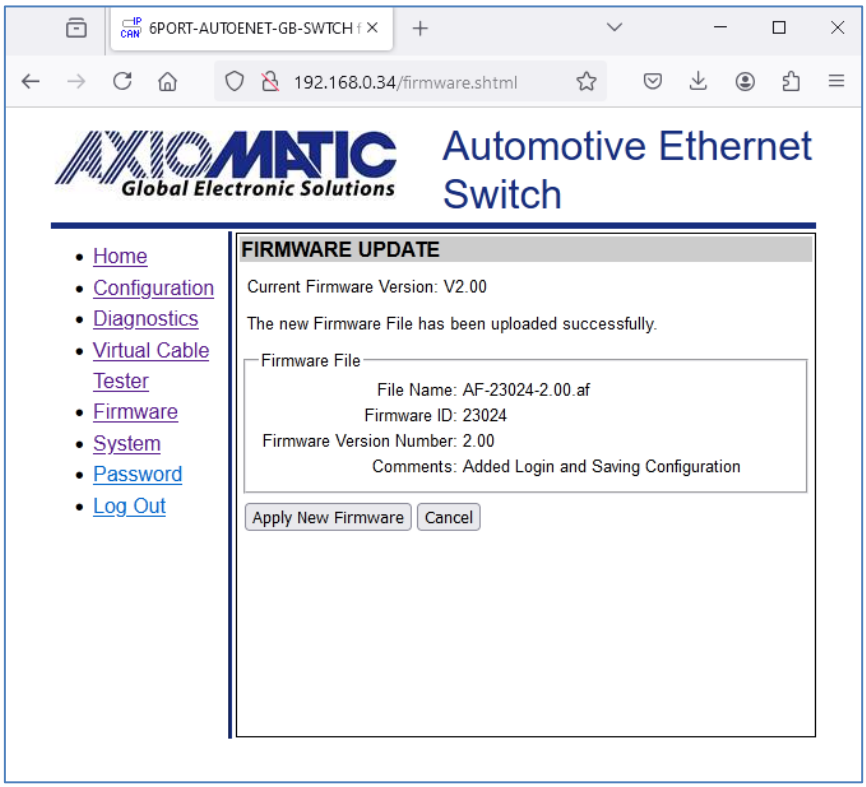


Figure 29. Firmware Update Page

From this point, the user can cancel the firmware update process and keep the old firmware or proceed with flashing the new firmware into the microcontroller by pressing the *Apply New Firmware* button.

When the user presses the *Apply New Firmware* button, the firmware update process is activated, and the *Firmware Upload* page will show a countdown timer, see Figure 30.

The countdown timer is set for 30 seconds necessary to complete the flashing process and reboot the device.

The device home page will be displayed after rebooting. The user will see the new application firmware version number in the *Device Information* section on the switch home page[1], see Figure 31.

[1]In our example, it is the same 2.00 version number since we used the firmware version 2.00 to illustrate the firmware update process.

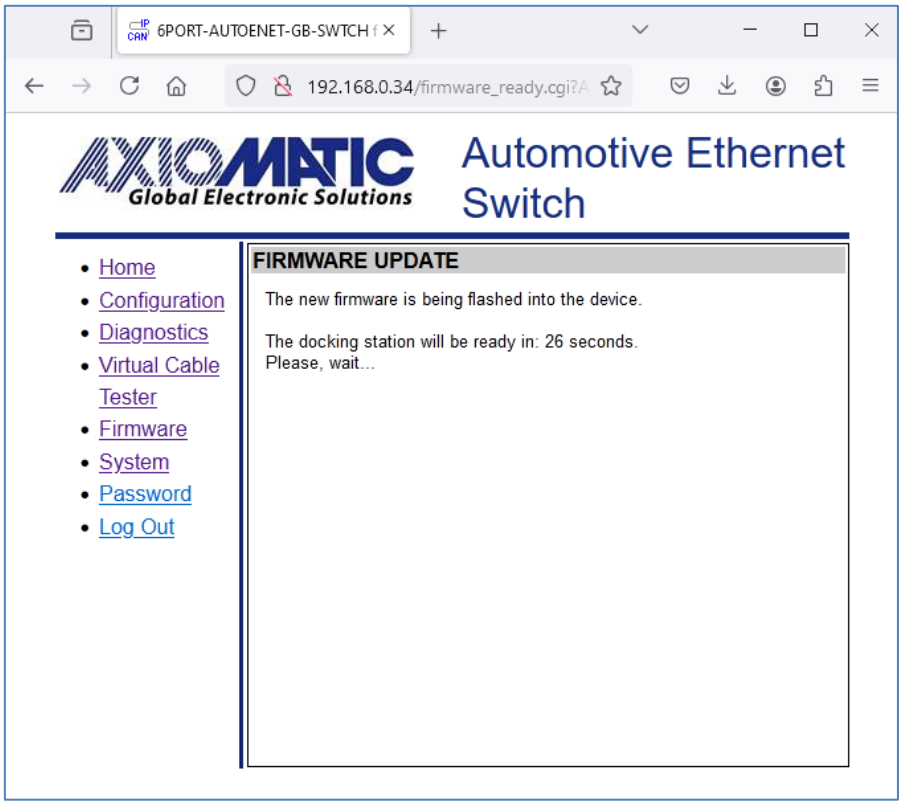


Figure 30. Firmware Update Countdown Has Been Started

Figure 31. Firmware Version Number After Flashing

When the firmware is upgraded, all configuration parameters new to that version take default values. This is also true when the firmware is downgraded and then upgraded back again. For example, when the firmware is downgraded from V2.00 to V1.00, and then upgraded back to V2.00, the device password added in V2.00 will be reset to the default value.

8 DEVICE DISCOVERY

In case the IP address of the device is unknown or has been lost, the user can recover it using the Axiomatic `AxioDisc.exe` Windows console application. The Ethernet interface on the device should be enabled.

8.1 Axiomatic Discovery Application

The `AxioDisc.exe` application uses a proprietary discovery protocol originally designed for Axiomatic converters. The application is available upon request.

The `AxioDisc.exe` application sends a UDP request to the broadcast IP address `255.255.255.255`, port `35100`, and waits for the responses from devices located on the same physical link of the LAN as the PC. The switch should be connected to the LAN through Port #1.

The device discovery response includes the unit *MAC Address*, *IP Address*, *Web Server Port*, the device *Part Number* and *Serial Number*, see Figure 32. It also includes parameters specific to Axiomatic converters that are not defined for the switch: *Device Port*, and *Device Port Type*. These parameters are set to {DevPort=0, DevPortType=UDP} and should be ignored.

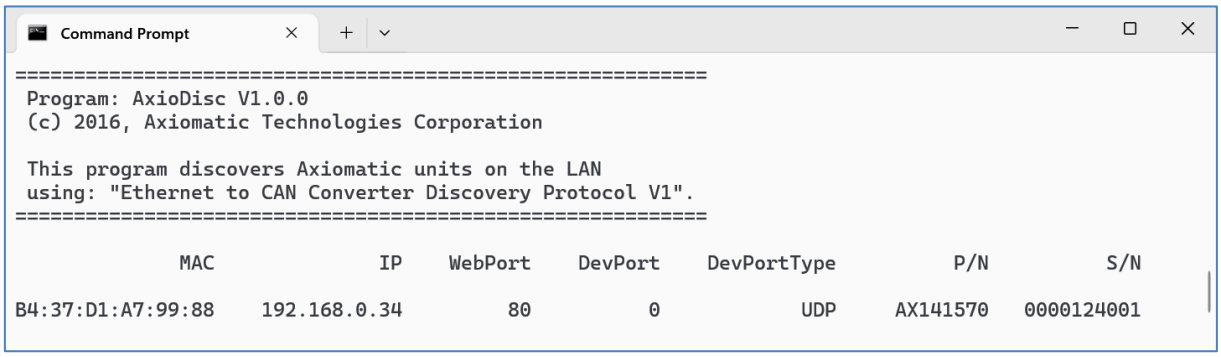


Figure 32. `AxioDisc.exe` Network Discovery Application

The `AxioDisc.exe` application can run on Windows starting from Win XP SP3. It was tested on Win XP SP3, Win 7, Win 10, and Win 11. In case the application cannot find standard dlls, the Visual C++ Redistributable for Visual Studio 2015 x86 must be installed on the user's computer from the Microsoft website:
https://www.microsoft.com/en-ca/download/details.aspx?id=48145

The Axiomatic proprietary discovery protocol is supported by the CAN-ENET Software Support Package, P/N AX140910. The Software Support Package can be used by third party software developers to implement network discovery of the device.

9 RS-232 INTERFACE

The RS-232 menu driven text user interface can be used as a local alternative to the device web interface for configuring, monitoring and controlling of the device. The user can also disable the device Ethernet Interface through the RS-232 port for cybersecurity reasons.

9.1 Main Menu

After successful connection to PC using any type of terminal emulation software (TeraTerm is preferred, https://teratermproject.github.io/index-en.html), the user will see the main menu, presented in Figure 33.

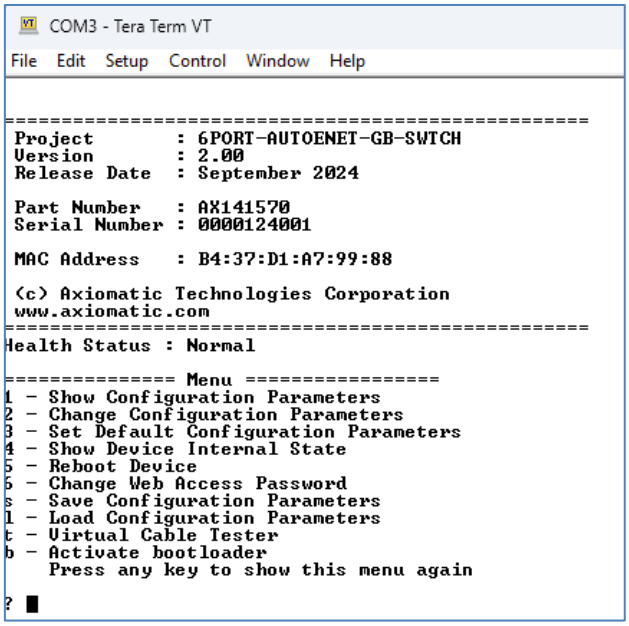


Figure 33. Main Text Menu[1]

[1]The firmware version number may be different from the firmware version described in the manual.

To activate options on the menu, the user should press the appropriate number or letter on the keyboard. For example, to show configuration parameters of the device the user should press '1', to activate the virtual cable tester – 't', etc.

9.1.1 Show Configuration Parameters

When this option is activated, the user will see values of all configuration parameters, see Figure 34. Some of them, including *Serial Number* and *MAC Address* are read-only and cannot be changed through this interface.

The updatable configuration parameters include those configurable through the web interface (described in Table 1 and Table 2), and configuration parameters exclusive to the RS-232 interface, shown in Table 4.

Table 4. RS-232 Interface Exclusive Configuration Parameters

Configuration Parameter	Default Value	Range	Description
Ethernet Interface Enabled	Yes	{No, Yes}	Enables Ethernet interface with the device on Port #1

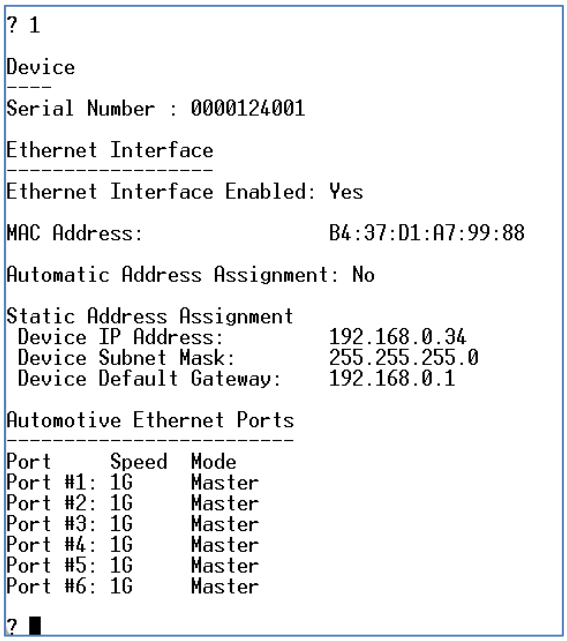


Figure 34. List of All Configuration Parameters

9.1.2 Change Configuration Parameters

The user can change a configuration parameter by activating this menu item. A list of names of all updatable through RS-232 interface configuration parameters will be presented to the user, see Figure 35.

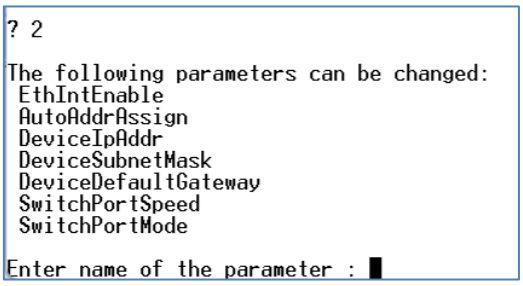


Figure 35. List of Updatable Configuration Parameters

The user then enters the name of the configuration parameter from the list and follows the prompts for changing the selected configuration parameter. For example, changing a value of the *Ethernet Interface Enabled* configuration parameter is presented in Figure 36.

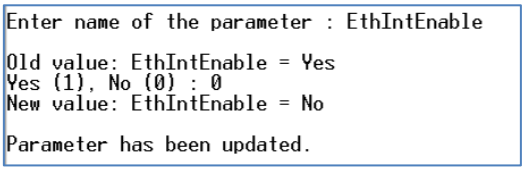


Figure 36. Changing Ethernet Interface Enabled Configuration Parameter

Once successfully changed, the new configuration parameter is applied immediately, without waiting for the device to reboot.

9.1.3 Set Default Configuration Parameters

The user can reset the device configuration parameters to their default values by activating this menu item and then confirming the decision by entering “Yes”, see Figure 37.

```
? 3

All current configuration parameters will be erased!
To continue, enter 'Yes' : Yes

Default configuration parameters have been set.

?
```

Figure 37. Setting Default Configuration Parameters

The default configuration parameters are applied immediately. No reboot is required.

9.1.4 Show Device Internal State

This menu option shows the internal state of the device, see Figure 38.

```
COM3 - Tera Term VT
File  Edit  Setup  Control  Window  Help
2 - Change Configuration Parameters
3 - Set Default Configuration Parameters
4 - Show Device Internal State
5 - Reboot Device
6 - Change Web Access Password
s - Save Configuration Parameters
l - Load Configuration Parameters
t - Virtual Cable Tester
b - Activate bootloader
    Press any key to show this menu again

? 4
Power Supply Voltage:  12.30 [V]
uC Temperature:        47.04 [Deg.C]

Ethernet Interface Enabled: Yes

Static Address Assignment:
 Device Address:         192.168.0.34
 Device Subnet Mask:     255.255.255.0
 Device Default Gateway: 192.168.0.1

Ethernet Switch ID:
 Product Number: 0x007
            Rev: 0x2

Ethernet Switch State:
 Switch Port #1   Port #1: Link=  Up Speed=  1G Duplex=Full
 Switch Port #2   Port #2: Link=Down Speed=  1G Duplex=Half
 Switch Port #3   Port #3: Link=Down Speed=  1G Duplex=Half
 Switch Port #4   Port #4: Link=Down Speed=  1G Duplex=Half
 Switch Port #5   Port #5: Link=Down Speed=  1G Duplex=Half
 Switch Port #6   Port #6: Link=Down Speed=  1G Duplex=Half

PHY ID and Temperature:
 Port #1: Model=88Q2112 Rev=A2 Temp=56 [Deg.C]
 Port #2: Model=88Q2112 Rev=A2 Temp=58 [Deg.C]
 Port #3: Model=88Q2112 Rev=A2 Temp=48 [Deg.C]
 Port #4: Model=88Q2112 Rev=A2 Temp=50 [Deg.C]
 Port #5: Model=88Q2112 Rev=A2 Temp=52 [Deg.C]
 Port #6: Model=88Q2112 Rev=A2 Temp=54 [Deg.C]

PHY State:
 Port #1: Link=  Up Speed=  1G Mode=Master SignalQuality=14 (0-min, 15-max)
 Port #2: Link=Down Speed=  1G Mode=Master SignalQuality= 0 (0-min, 15-max)
 Port #3: Link=Down Speed=  1G Mode=Master SignalQuality= 0 (0-min, 15-max)
 Port #4: Link=Down Speed=  1G Mode=Master SignalQuality= 0 (0-min, 15-max)
 Port #5: Link=Down Speed=  1G Mode=Master SignalQuality= 0 (0-min, 15-max)
 Port #6: Link=Down Speed=  1G Mode=Master SignalQuality= 0 (0-min, 15-max)


?
```

Figure 38. Device Internal State

9.1.5 Reboot Device

The device will be rebooted when the user activates this option.

9.1.6 Change Web Access Password

The user can reset the web access password using this option, see Figure 39.

The user will be prompted to enter and confirm the new password. The password should follow the password rules described in section *Device Web Access* of this document.

After successful update of the password, the user can choose to see the new password.

```
? 6
Please enter the new password   : **********
Please re-enter the new password: **********

Password has been changed successfully!

Do you want to see the new password? Yes (1), No (0) : 1

The new web access password : Axiomatic2


?
```

Figure 39. Changing Device Password

9.1.7 Save Configuration Parameters

The user can save the device configuration parameters in a file on the user's PC by activating this option. TeraTerm instructions will be provided on the screen, see Figure 40.

```
? s
Save Configuration Parameters using YMODEM protocol.
Select a folder where the file will be saved, if necessary.
In TeraTerm, to select the folder, go to: File->Change Directory...

Enter Configuration Parameter File Name : AX141570.cfg

Start file download. In TeraTerm, select: File->Transfer->YMODEM->Receive.


File: AX141570.cfg (size: 1562) has been successfully downloaded.

?
```

Figure 40. Saving Device Configuration Parameters

The device uses YMODEM protocol to download the configuration file. The user should select a directory where the configuration file will be downloaded in case it is not the default directory for file transfers. In case of TeraTerm, in the main menu, go to *File, Change Directory*…, see Figure 41.

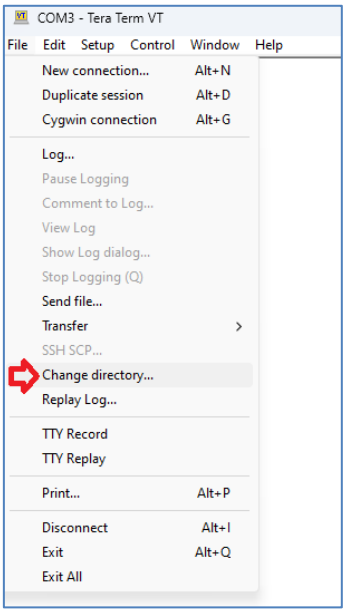


Figure 41. Changing Download Directory in TeraTerm

After entering the configuration file name, the user will be prompted to activate the YMODEM file receiving mode. In TeraTerm, in the main menu, go to *File, Transfer, YMODEM, Receive…*, see Figure 42. The device will generate and download the configuration file to the user's PC immediately after the file receiving mode is activated. The result will be shown to the user.

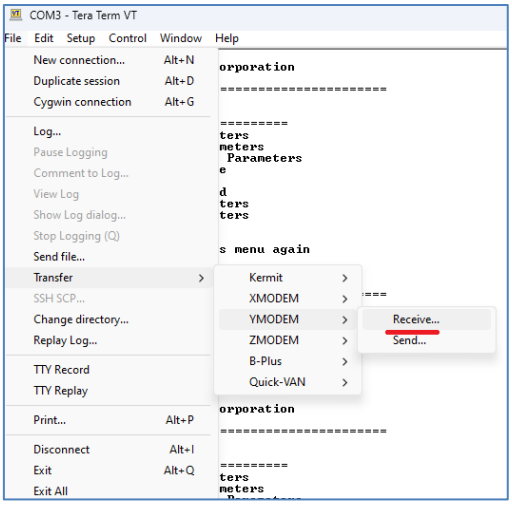


Figure 42. Activating YMODEM for Downloading Configuration File in TeraTerm

9.1.8 Load Configuration Parameters

The user can load the device configuration parameters from a configuration file by activating this option. TeraTerm instructions will be provided on the screen, see Figure 43.

```
? 1
Load Configuration Parameters using YMODEM protocol.
In TeraTerm, select: File->Transfer->YMODEM->Send... and a configuration file.


File: AX141570.cfg (size: 1562) has been uploaded.

All 17 configuration parameters have been updated.
The new configuration parameters will be applied after reboot.


?
```

Figure 43. Loading Device Configuration Parameters. Successful Result

The device uses YMODEM protocol to upload the configuration file from the user's PC to the device. The user will be prompted to activate the YMODEM sending mode and then select a configuration file to start the upload process. In TeraTerm, in the main menu, go to *File, Transfer, YMODEM, Send*, and then select a configuration file, see Figure 44.

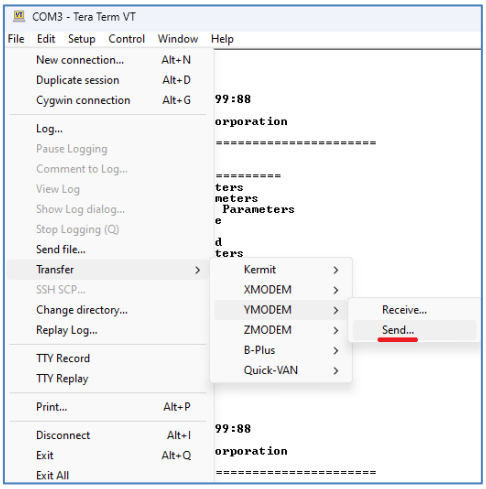


Figure 44. Activating YMODEM for Uploading Configuration File in TeraTerm

There is normally a small delay in starting the upload process, which can take up to 10 seconds to start.

The device will report the result of the file upload operation similarly to the web interface, see *Loading System Configuration* subsection of this document. In case of an error, the same detailed description of the error will be provided.

For example, if the *SwitchPort2Mode* configuration parameter has an incorrect value of "Master1" instead of "Master", the following error message will be shown, see Figure 45.

```
? 1
Load Configuration Parameters using YMODEM protocol.
In TeraTerm, select: File->Transfer->YMODEM->Send... and a configuration file.


File: AX141570.cfg (size: 1563) has been uploaded.

Configuration Parameter Error: 0x05 on line 25. Data Error.
Line 25: SwitchPort2Mode          = Master1


?
```

Figure 45. Loading Device Configuration Parameters.
Error in Configuration Parameter Value

9.1.9 Virtual Cable Tester

This option will activate the device virtual cable tester. It will bring a cable test menu with two options, see Figure 46.

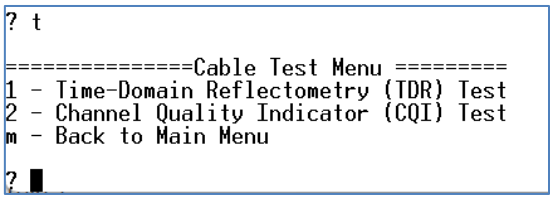


Figure 46. Virtual Cable Test Menu

All cable tests are performed by PHY chips on the Ethernet ports. The normal Ethernet communication will be disrupted during these tests.

9.1.9.1 TDR Cable Test

The time-domain reflectometry (TDR) test will check the cable integrity and calculate the expected distance to the fault in case an open or short circuit is detected, see Figure 47.

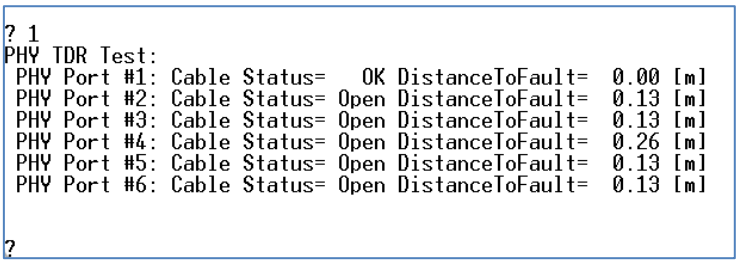


Figure 47. TDR Cable Test

9.1.9.2 CQI Cable Test

The channel quality indicator (CQI) test measures the cable insertion and return losses on the active Ethernet ports, see Figure 48.

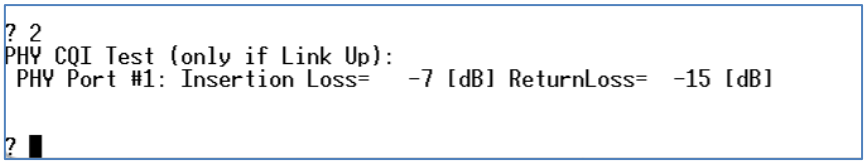


Figure 48. CQI Cable Test

9.2 Bootloader Activation

The user can activate the device bootloader using this option. The bootloader will be activated after an immediate device reboot, see Figure 49.

```
? b
Rebooting the device. Bootloader will be activated after reboot.

?
Bootloader has been activated.

=====================================================
 Project       : 6PORT-AUTOENET-GB-SWITCH Bootloader
 Version       : 1.01
 Release Date  : September 2024

 (c) Axiomatic Technologies Corporation
 www.axiomatic.com
=====================================================
==================== Menu ===========================
1 - Load New Application Firmware
2 - Show Application Firmware Information Record
3 - Check Flash Memory Chip
4 - Reboot Device
    Press any key to show this menu again

? 
```

Figure 49. Activating Bootloader Menu

This activation is not permanent. Next reboot will return the device to the normal operation.

9.2.1 Load New Firmware

The user can load a new application firmware by activating this bootloader menu option. The file uploading instructions for TeraTerm will appear on the screen, see Figure 50.

```
? 1

Load Application Firmware File.
Use Menu: File->Send File... with XON/XOFF control and "Binary File" options.
```

Figure 50. Load Application Firmware File Prompt

The user should pick the firmware file and start the uploading process by pressing the *Open* button, see Figure 51.

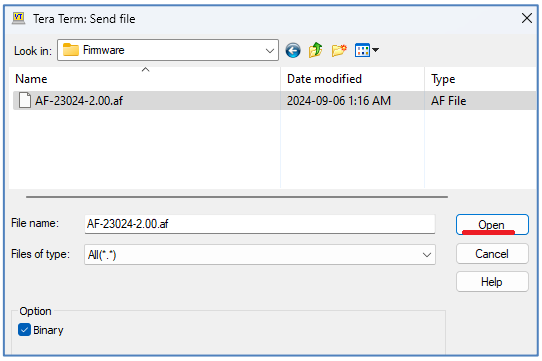


Figure 51. Selecting New Firmware

The firmware file is provided by Axiomatic in a proprietary binary format with extension: `.af`. The file name should have the following format: `AF-23024-X.XX.af`, where the `<X.XX>` field wildcard reflects the firmware version number[1].

[1] `AF-23024-2.00.af` file will be used for illustration of the firmware update process in this manual.

Once uploading of the new firmware is done, it is checked and programmed into the microcontroller and the device is restarted.

The uploading and programming processes are animated on the terminal screen. At the end of the firmware update, if no errors are encountered, the user will see the main menu of the new uploaded firmware, see Figure 52.

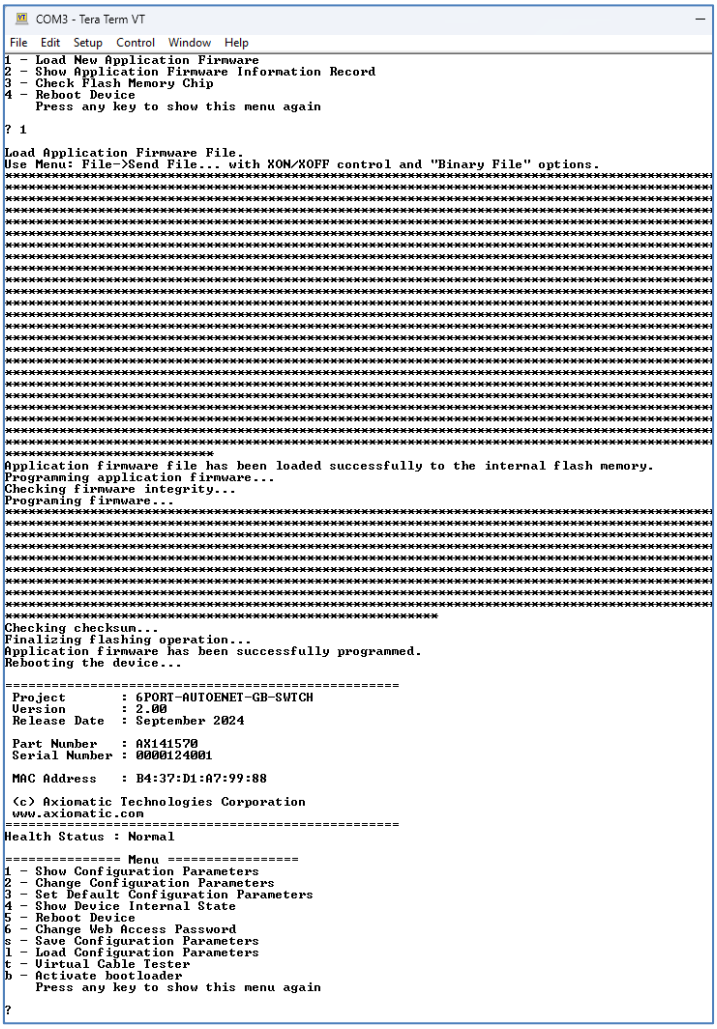


Figure 52. Uploading New Firmware

If something goes wrong, an error message will be displayed, and the whole process will be terminated.

9.2.2 Show Application Firmware Information Record

This menu option is intended to show the user a description of the application firmware programmed into the microcontroller during the last firmware update, see Figure 53.

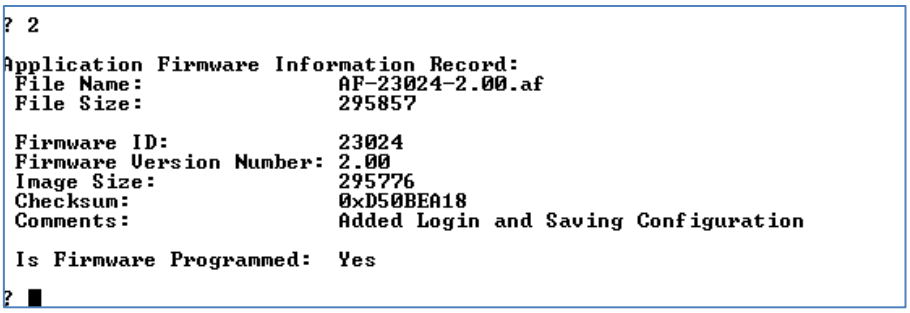


Figure 53. Application Firmware Information Record

The application firmware file name is only available when the firmware was updated through the web interface.

9.2.3 Check Flash Memory Chip

This auxiliary menu option shows information of the flash memory chip installed in the device.

9.2.4 Reboot Device

The user will leave the bootloader by choosing this option and rebooting the device. The device main menu will be displayed after reboot.

10 TECHNICAL SPECIFICATIONS

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. Users should satisfy themselves that the product is suitable for use in the intended application.

All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Limitations & Return Materials Process as described on https://www.axiomatic.com/service/.

All specifications are typical at nominal input voltage and 25°C unless otherwise specified.

10.1 Power Supply

Table 5. Power Supply Input

Parameter	Value	Remarks
Supply Voltage	9 to 36 VDC	12 V, 24 V – nominal
Supply Current[1]	400 mA	12 V – typical
	200 mA	24 V – typical
Quiescent Current[2]	0.1 mA	12 V – typical
	0.2 mA	24 V – typical
Power Enable Input (PWREN)	On, if V_{PWREN} > 6 V	Can be connected to BATT+
	Off, if V_{PWREN} < 0.5 V	Can be left open or connected to BATT-
	R_{PWREN} >> 10 kOhm	High impedance input
LED Indicator	Power ON	Green LED
Protection	Overvoltage, Reverse Polarity, Transients/Surge	

[1]All Ethernet ports and RS-232 port are disconnected.
[2]Power supply is disabled. PWREN input is left open.

10.2 Ethernet Switch

Table 6. Ethernet Switch Parameters

Parameter	Value	Remarks
Number of Ports	6	Individually configurable
Switch Type	Unmanaged	Based on Marvell 88Q6113, with individually configurable PHYs, based on Marvell 88Q2112
Switching Capacity	12 Gbps	
Forwarding Rate	8.93 Mpps	
MAC Address Table	16 K Entries	16384 address database entries
Packet Buffer Memory	2 Mbit	
Jumbo Frame	10236/10240 bit	Tagged/Untagged frames
QoS	8 Priority Queues	
	802.1p/DSCP QoS	
Port Type	1000BASE-T1	IEEE 802.3bp-2016
	100BASE-T1	IEEE 802.3bw-2015
Port Speed	1 Gbps / 100 Mbps	Individually configurable per port
Port Mode	Master/Slave	Individually configurable per port
Port LED Indicators	Yellow - Link/Activity	One set per port
	Green - Speed	
Virtual Cable Tester	Provided	Uses Marvell 88Q2112 PHYs
Communication Protocols	Ethernet IEEE 802.3, IP, ICMP, ARP, UDP, TCP, DHCP, HTTP, Proprietary[1]	For internal web server and proprietary discovery protocol on Port #1
Web server	On Port #1 only	Used for the switch configuration, diagnostics, and flashing application firmware. Configuration file support[3]. Password protected[3]. Web server can be disabled through the RS-232 port.
Internal Diagnostics	Health Status	Available from the web server or RS-232 port user interface
RS-232 Port	3-wire	Local alternative to the web server. Menu based text user interface[2]. YMODEM for upload/ download configuration files[3]

[1] Proprietary discovery protocol is supported by Axiomatic `AxioDisc.exe` Windows console application and *CAN-ENET Software Support Package* (SSP), P/N AX140910, v3.0.0+.
[2] Use any terminal emulation software, TeraTerm is preferred (free download from: https://teratermproject.github.io/index-en.html).
[3]Added in V2.00 firmware.

10.2.1 LED Indicators

Table 7. Link/Activity (LINK/ACT) LED

LED	Description
Off	No Link
Yellow	Link On
Blinking Yellow	Link On. Transmit or Receive Activity on the Link

Table 8. Speed (1G/100M) LED

LED	Description
Off	Link On at 100 Mbps or No Link
Green	Link On at 1 Gbps

10.2.2 RS-232 Port

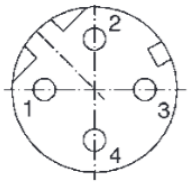
Table 9. RS-232 Port Settings

Parameter	Value	Remarks
Bit Rate	115200 bps	
Data	8-bit	
Parity	None	
Stop	1 bit	
Flow Control	Xon/Xoff	For flashing new application firmware only

10.3 Ethernet Connector

M12 socket, 4-pin, D-coded, female connector, BINDER, P/N: 99-3732-201-04.
Use D-coded mating connectors compliant with IEC 61076-2-101:2012.
A mating cable is available from Axiomatic under P/N: AX070168 (Cable 2 m (6.5 ft.), 4-pin M12 D-coded, Unterminated Leads)

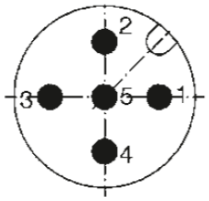
Table 10. Ethernet Connector Pinout

PIN #	Description	
1	TRD+	
2	N/C	
3	TRD-	
4	N/C	

10.4 Power Connector

M12 socket, 5-pin, A coded, male connector, BINDER, P/N: 09-3441-126-05.
Use A-coded mating connectors compliant with IEC 61076-2-101:2012.
A mating cable is available from Axiomatic under P/N: AX070169 (Cable 5 m (16.4 ft.), 5-pin M12 A-coded, Unterminated Leads)

Table 11. Power Connector

PIN #	Description	
1	PWREN[1]	
2	BATT+	
3	BATT- (RS-232_GND[2])	
4	RS-232_TX	
5	RS-232_RX	

[1] Connect to BATT+, if not used.
[2] RS-232 Ground is connected to BATT-.

10.5 General Specifications

Table 12. General Specifications

Parameter	Value	Remarks
Operating Temperature	-40 to +75 °C (-40 to 167 °F)	
Storage Temperature	-40 to +85 °C (-40 to 185 °F)	
Environmental Protection	IP67	IEC 60529. With mated connectors
Size	7.25 in x 3.75 in x 1.58 in (184.2 mm x 95.3 mm x 40.0 mm)	L x W x H excluding connectors. See dimensional drawing
Weight	1.41 lbs (0.64 kg)	
Compliance	RoHS Directive	

10.6 Housing

Cast aluminum, anodized enclosure. Lexan overlay. For dimensional drawing, see Figure 54.

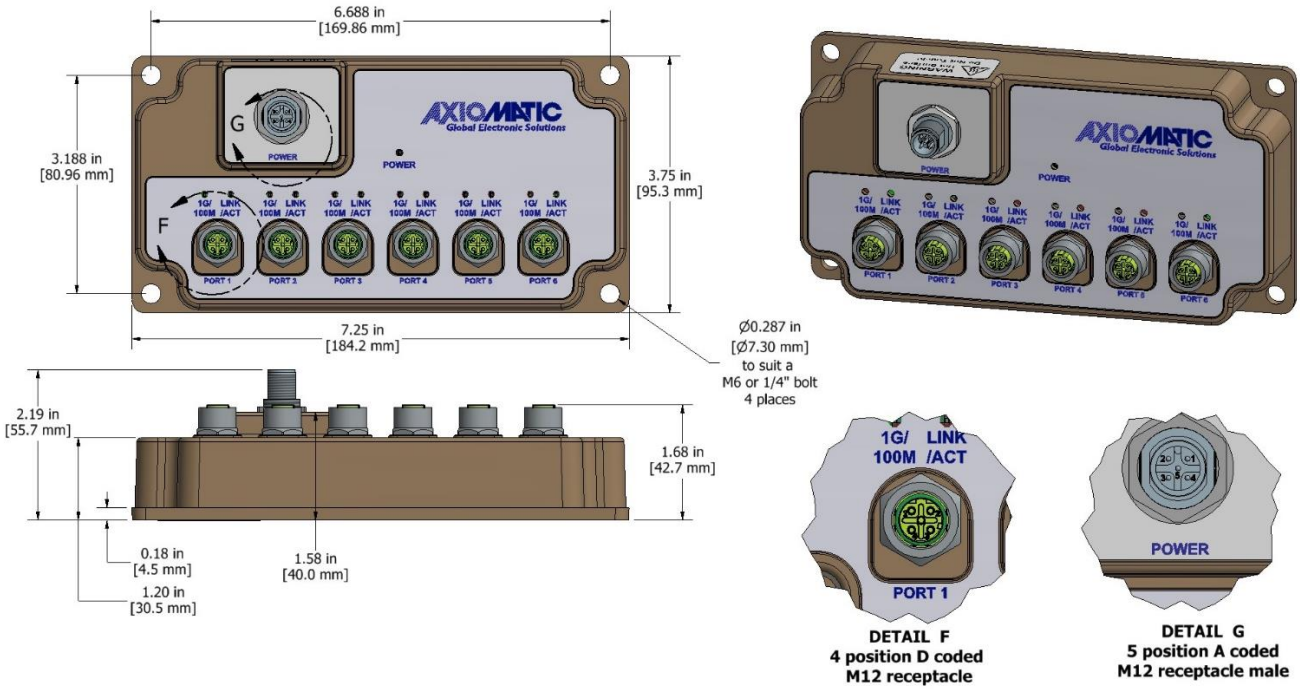


Figure 54. Dimensional Drawing of AX141570

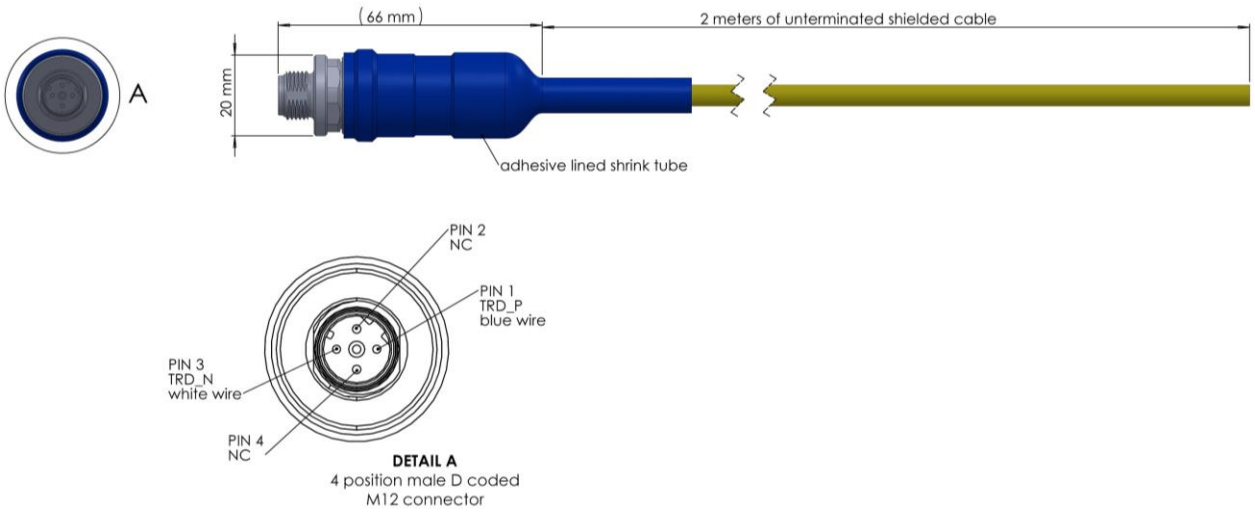


Figure 55. Dimensional Drawing of AX070168

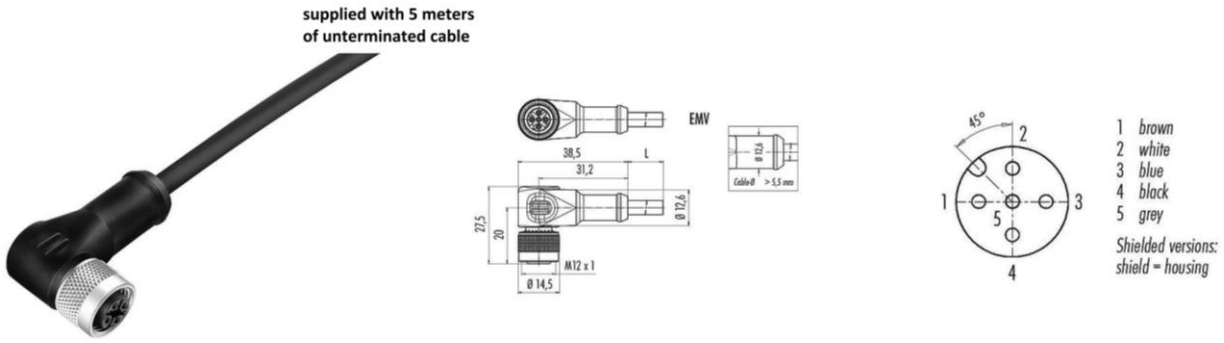


Figure 56. Dimensional Drawing of AX070169

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Third party software version numbers are shown for application firmware 2.00. Higher version numbers can be used in subsequent releases.

12 VERSION HISTORY

User Manual Version	Firmware version	Date	Author	Modifications
2A	2.xx	November 26, 2024	M Ejaz	• Added accessory cables and their drawings. • Marketing review
2	2.xx	September 16, 2024	Olek Bogush	• Added password protection on the web interface. Added subsections: o *Connecting to the Device* in *Device Configuration* section. o *Device Homepage* in *Device Configuration* section. o *Password Change* in *Device Configuration* section. o *Change Web Access Password* in *RS-232 Interface* section. Updated other sections accordingly. • Added support for configuration file operations. Added subsections: o *Text User Interface* in *RS-232 Interface, Device Organization, Device Description* section. o *YMODEM* in *RS-232 Interface, Device Organization, Device Description* section. o *Configuration File* in *Device Configuration* section. o *Save Configuration Parameters* in *RS-232 Interface* section. o *Load Configuration Parameters* in *RS-232 Interface* section. Updated other sections accordingly. • Updated *Dimensional Drawing* in *Housing, Technical Specifications* section. Corrected device *Size* and added device *Weight* in *General Specifications*, *Technical Specifications* section. • Small corrections and updates throughout the document.
1A	1.xx	June 26, 2024	Olek Bogush	• Updated *Dimensional Drawing* in *Technical Specifications* section.
1	1.xx	June 20, 2024	Olek Bogush	• Initial release.

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We have an ISO9001:2015 registered design/manufacturing facility in Canada.

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- Runtime hours, description of problem
- Wiring set up diagram, application and other comments as needed

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