User Manual UMAX140940
Version 1.2
Firmware 1.xx

USER MANUAL

CAN to Modbus TCP/IP Converter

P/N: AX140940

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VERSION HISTORY

Version	Date	Author	Modification
1.0	September 30, 2021	Meera Patel	Initial Draft for Rev 1 hardware
1.1	March 8, 2022	Meera Patel	Solved the Bug of CAN RX message ON/OFF Added Standard ID CAN Messages for CAN Rx. Added CAN Shared PGN support for CAN Tx.
1.2	September 13, 2023	Kiril Mojsov	Performed Legacy Updates

ACRONYMS

A	Ampere
ACK	Positive Acknowledgement (from SAE J1939 standard)
ARP	Address Resolution Protocol
°C	Celsius (degree)
CAN	Controller Area Network
CE	Conformité Européenne (European Conformity)
CM	Conversion Method
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code (from SAE J1939 standard)
EA	The Axiomatic Electronic Assistant PC Application Software
ECU	Electronic Control Unit (from SAE J1939 standard)
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FCC	Federal Communications Commission
FMI	Failure Mode Identifier
G	Acceleration in Gravity Units
GPL	General Public License
hr	hour
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
ID	Identifier
IEC	International Electrotechnical Commission
IP	Internet Protocol or Ingress Protection (for housing)
ISO	International Organization for Standardization
OC	Occurrence Count
L	Length (for size)
LAN	Local Area Network
LED	Light-Emitting Diode
m	meters
MAC	Media Access Control (address)
MDIX	Medium Dependent Interface Crossover (MDI-X)
Ms	Millisecond
NAK	Negative Acknowledgement (from SAE J1939 standard)
PA	Polyamide
PDU1	A format for messages that are to be sent to a destination address, either specific or global (from SAE J1939 standard)
PDU2	A format used to send information that has been labeled using the Group Extension technique and does not contain a destination address.
PHY	Physical Layer Transceiver (Ethernet chip)
P/N	Part Number
PoE	Power Over Ethernet
RoHS	Restriction of Hazardous Substances

RTOS	Real-Time Operating System
SP	Service Pack
SPN	Suspect Parameter Number (SAE J1939)
SW	Software
TCP	Transmission Control Protocol
UDP/IP	User Datagram Protocol / Internet Protocol
UL	Underwriters Laboratories (safety organization)
USB	Universal Serial Bus
V	Volt
VDC	Volt Direct Current
W	Watt or Width (for size)
WAN	Wide Area Network

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1. CONVERTER DESCRIPTION

The CAN to Modbus TCP/IP Converter is a simple device converting CAN frames into MODBUS TCP/IP datagrams and sending them over the Ethernet network. The device can also convert Modbus TCP/IP datagrams into CAN frames.

The converter has one CAN and one Ethernet port. It supports a high-speed CAN with baud rate up to 1Mbit/s and a fast 100Mbit/s Ethernet. All standard and extended CAN frames, including data and remote frames, are supported.

The power can be passed to the successive device through the Pout Pin. Protection is provided.

The converter contains a web server to setup configuration parameters and monitor the internal state of the converter using a web browser. The user can also update the converter firmware using the web browser.

To ensure low latency in processing CAN and Ethernet messages, the converter software runs under control of a real-time operating system.

The converter is designed to work on off-road machinery or in a harsh industrial environment with power transients, high humidity, and vibrations.

1.1 Hardware Block Diagram

The converter hardware block diagram is presented in Figure 1.

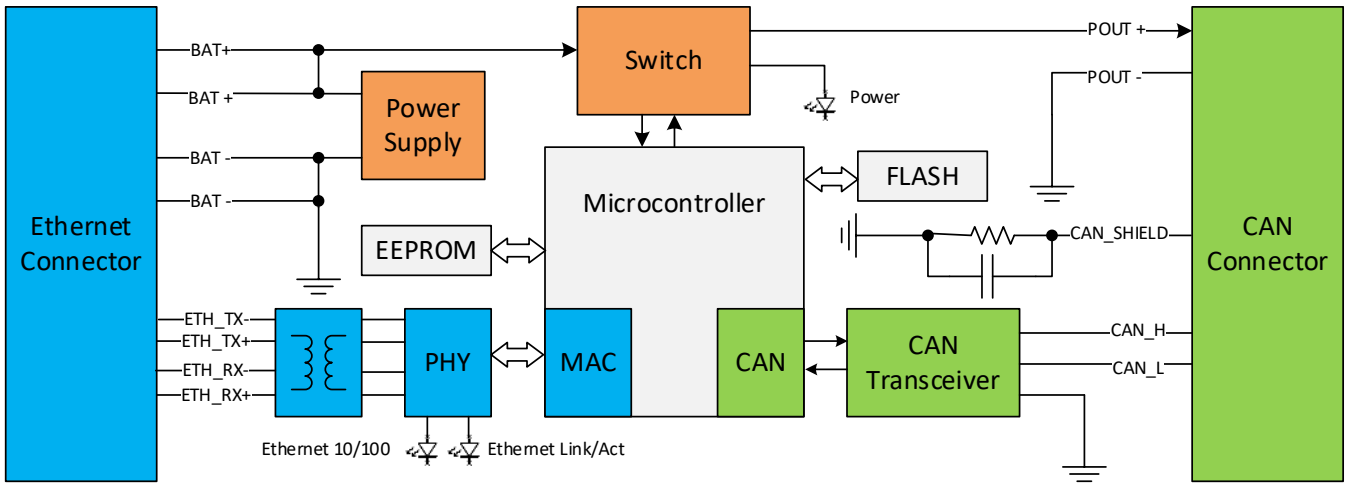


Figure 1. The Converter Hardware Block Diagram

The converter is powered from the Ethernet connector using dedicated power lines. The power from the Ethernet connector can be delivered to the CAN connector through a switch controlled by a microcontroller.

The Ethernet transformers with PHY, together with the CAN transceiver, provide Ethernet and CAN physical interfaces.

A powerful ARM Cortex-M4 microcontroller runs IP protocol stack and all Ethernet to CAN conversion logic.

1.2 LED Indicators

There are three LED indicators on the front panel of the converter. A bi-color “Power” indicator shows whether the unit is powered. It turns red when there is an error on the CAN power output.

The two Ethernet LED indicators are hardwired to the PHY chip and show the transmission speed “Ethernet 10/100” and the link/activity status “Ethernet Link/Act”, see Table 1:

Table 1. Converter LED Indicators

Name	Color	Description	
Power	Green/Red	Off	The converter is not powered.
		Green	The converter is powered. CAN Power Output is in normal condition.
		Red	CAN Power Output is in a fault condition.
Ethernet 10/100	Green	On	Ethernet speed is 100 Mbit/s
		Off	Ethernet speed is 10 Mbit/s
Ethernet Link/Act	Green	On	Ethernet link is up
		Off	Ethernet link is down
		Blinking	Ethernet link is up and active

1.3 Firmware Organization

The Ethernet to CAN Converter firmware contains two independent parts: the *Communication Device* and the *Web Server*, see Figure 2:

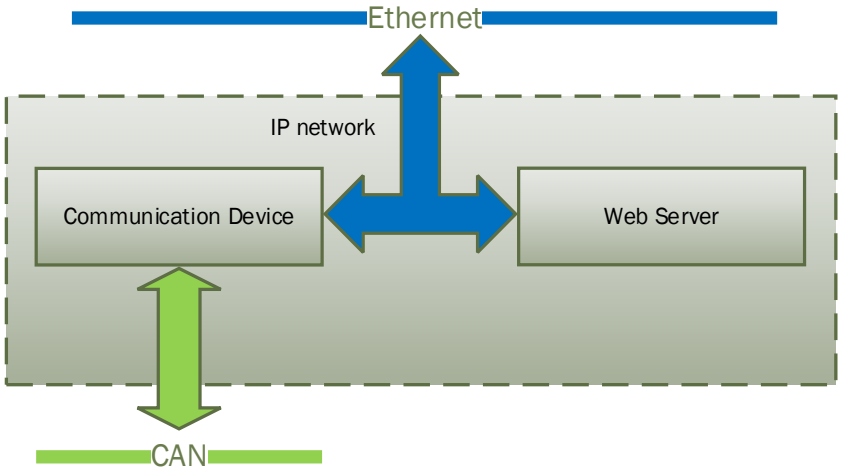


Figure 2. Converter Firmware Architecture

The *Communication Device* is responsible for the protocol conversion between CAN and Ethernet networks and the *Web Server* provides the converter user interface.

Both the *Communication Device* and the *Web Server* use the same IP network interface. The IP address resolution is provided by the ARP protocol.

1.3.1 Communication Device

The *Communication Device* supports a master/slave communication model to communicate CAN messages and other auxiliary information over the Ethernet. In this model, the *Communication Device* has a primary slave role, allowing external clients to establish independent connections with the device.

In addition to the slave role, the device can also act as a master, if the *Ethernet Master Enabled* configuration parameter is set to *YES*. In this case, the device will try to establish a connection with a customer specified slave device.

The *Communication Device* uses Modbus TCP/IP protocol, The value of the *Device Port* for Modbus TCP/IP will be always 502, as it is reserved for Modbus TCP/IP Communication.

1.3.1.1 TCP/IP Protocol

Modbus TCP/IP provides Master (Client) -Slave (Server) communication over Ethernet.

The server side opens a listening socket for incoming connections. Once a connection is accepted, a new data socket is created to handle input/output communication with the remote node. There are no restrictions on the IP address for the incoming connections.

On the client side, if "*Ethernet Master Enabled*" is set to *YES*, a data socket is created for connection with the Slave (Server) node. The port number is assigned to the socket which is 502. If the connection drops, the device will try to automatically reconnect with the node to maintain the client connection, if a hardware reset is provided to the device and if the device is working as a Server (Slave), then a webserver refresh is needed to connect again.

1.3.2 Web Server

The *Web Server* provides a user front-end interface with the converter. It runs a dynamic website that shows: the converter general information, configuration parameters, and the converter real-time diagnostics.

The user can also change configuration parameters and upload the new firmware through this website.

The web browser should support JavaScript.

1.3.3 Firmware Updates

The firmware can be remotely updated through the web server.

2 CONVERTER CONFIGURATION

The converter supports configuration over the internal website running on the device embedded web server. The default "*Device IP Address"* is *192.168.1.25* and the default *Web Server Port* is *80*. Please, make sure that there are no other devices on this IP address when connecting the converter for the first time to your LAN for configuration.

To connect to the device, run any web browser and point it to the "*Device IP Address"*. It is not necessary to specify the "*Web Server Port"* if the web server uses a standard port *80*.

After a successful connection, you will see the device home page, see: Figure 3. Converter Home Page3.

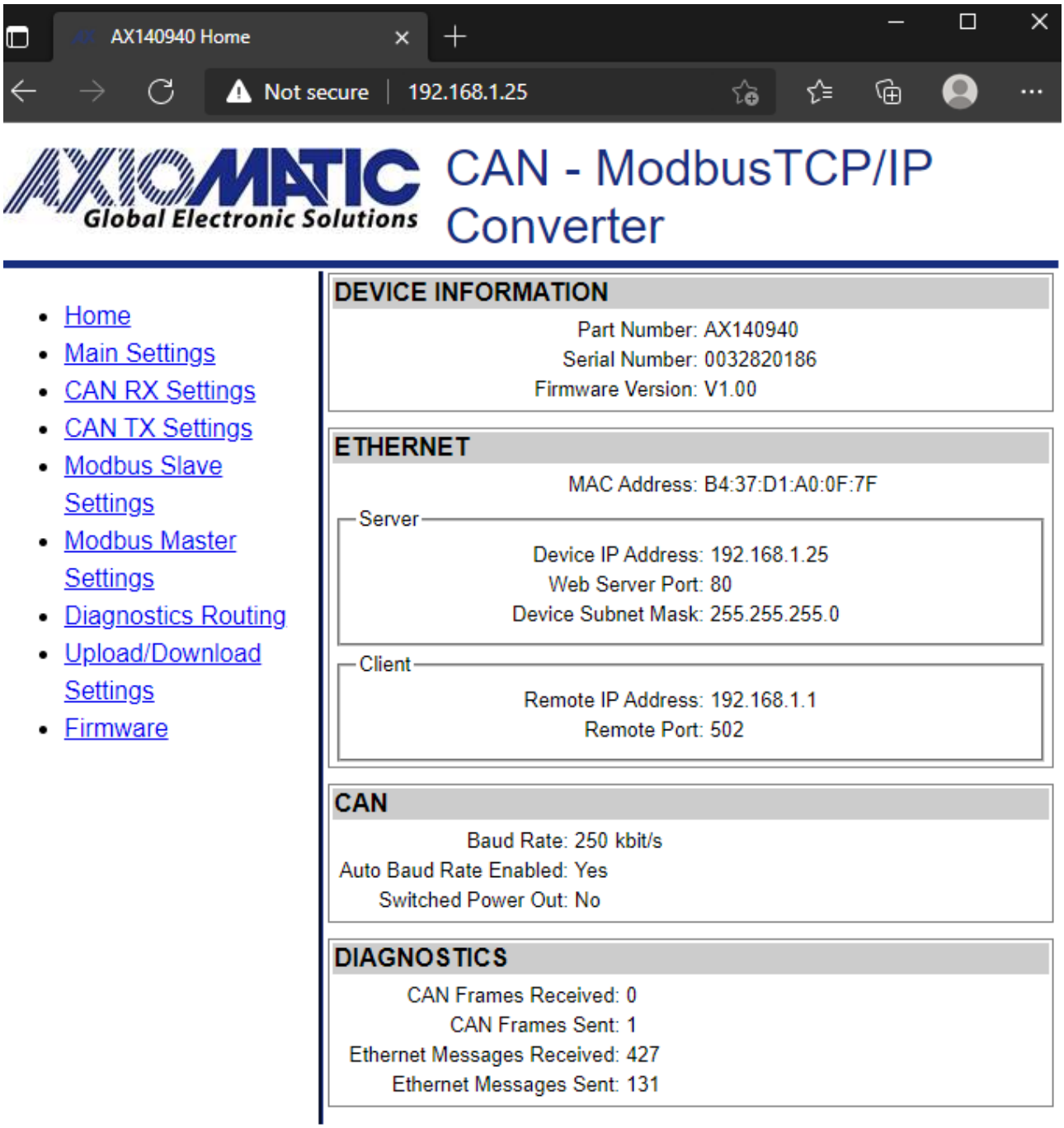


Figure 3. Converter Home Page

The home page shows the device information, including the converter part number, serial number, and firmware version. It also shows *Ethernet* and *CAN* main configuration parameters including some communication statistics (number of messages for each interface).

You will need to allow the site to run JavaScript (this setting is default in most 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. Enable JavaScript Prompt.

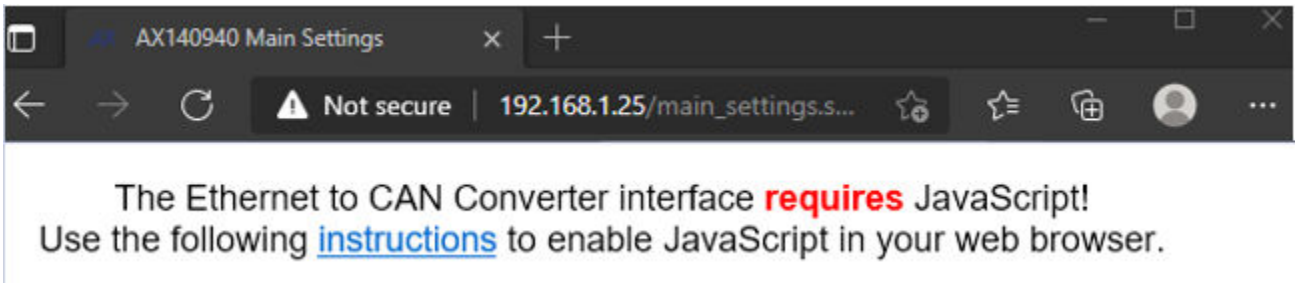


Figure 4. Enable JavaScript Prompt

The *Ethernet* configuration parameters are combined into Slave (*Server)* and Master (*Client)* groups for convenience.

The *Ethernet* and *CAN* configuration parameters have tooltips clarifying their meaning, see Figure 55.

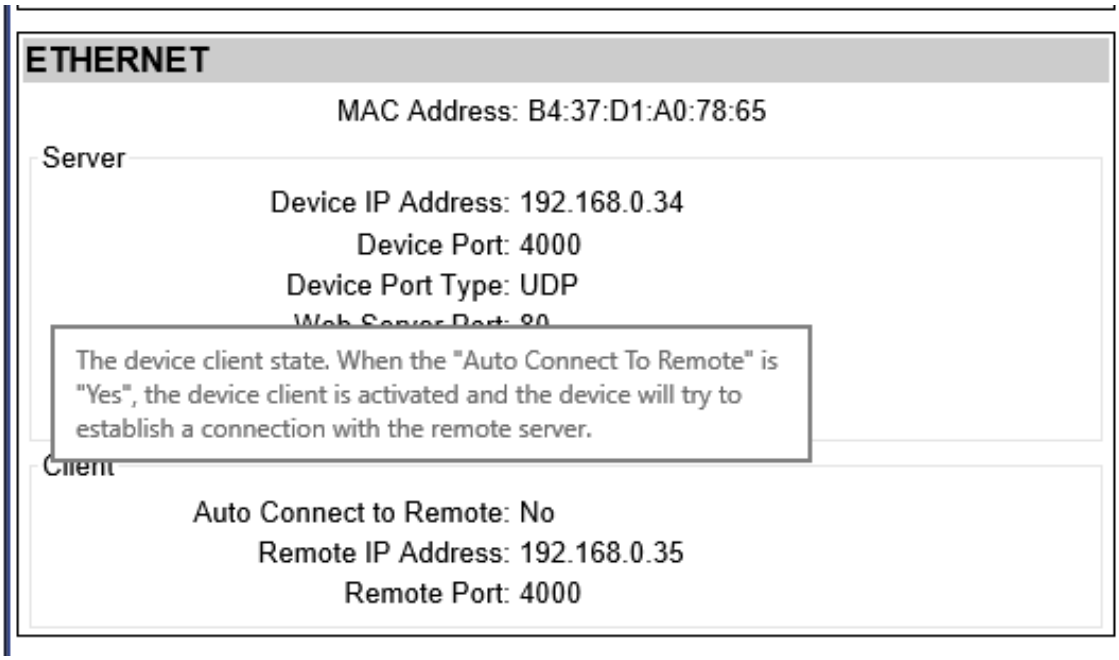


Figure 5. A Tooltip for the "Auto Connect to Remote" Configuration Parameter

2.1 Changing Configuration Parameters

All configuration parameters except the Modbus TCP/IP Master/Slave and CAN RX/TX settings can be changed through the *Main Settings* web page. The Modbus TCP/IP Master/Slave and CAN RX/TX configurations have their own configuration pages: For *CAN RX/TX configuration*, see Figure 6.

The configuration pages can be reached by clicking on their links on the left side of the website. Each configuration web page has fields to enter values of the configuration parameters and three buttons: "*Save Settings"*, "*Discard Settings"* and "*Set Defaults"*.

The "*Save Settings"* button will save configuration parameters to non-volatile memory and apply the new settings. The appropriate converter subsystems will be restarted without rebooting of the whole converter except for Modbus TCP/IP Master/Slave enable/disable.

The "*Discharge Settings"* button will bring back the original converter settings before editing, and the "*Set Defaults"* button will load the default values of the configuration parameters into the data fields on the page.

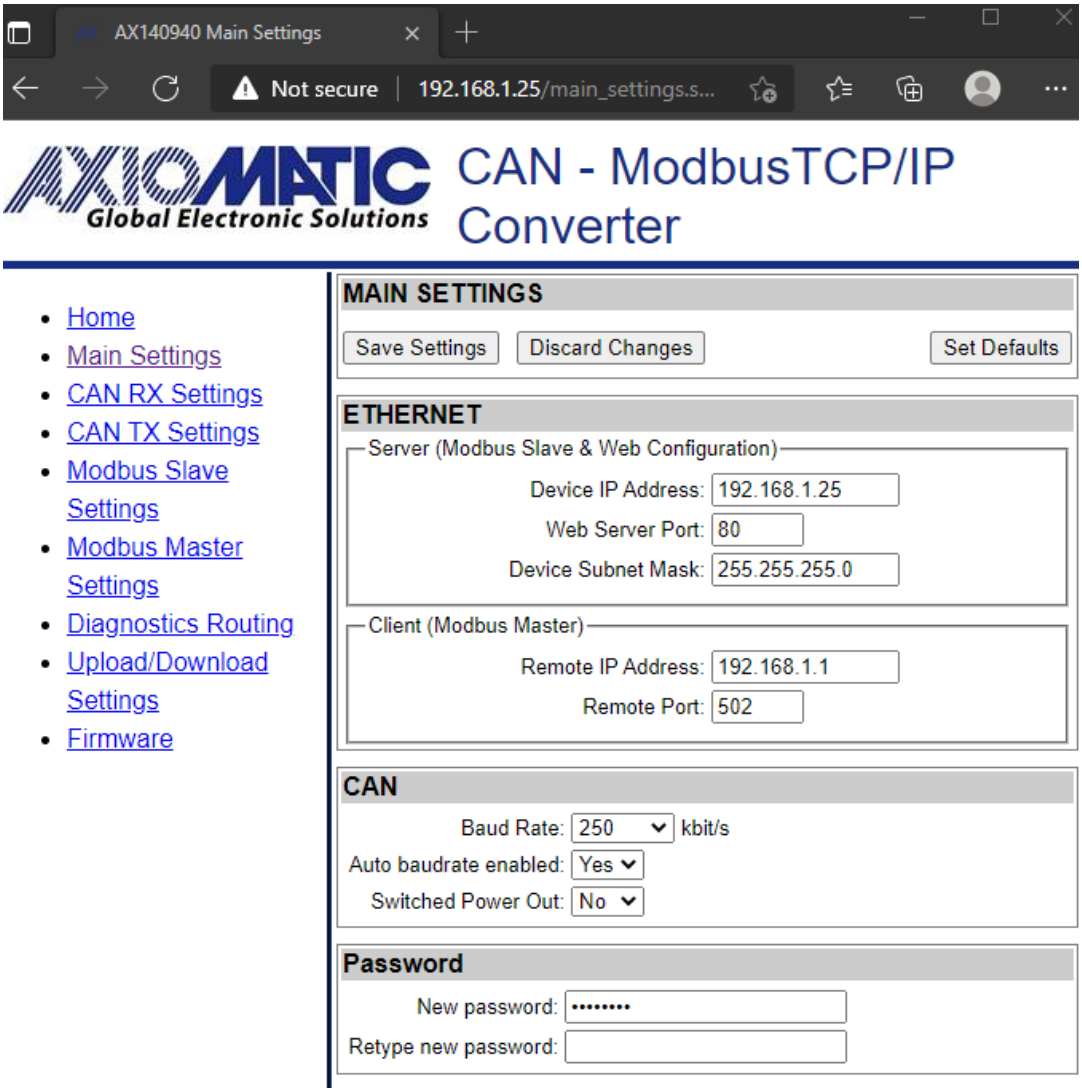


Figure 6. Converter Main Settings Page

The configuration parameters have tooltips for the user convenience. The *"Remote IP Address"* and "*Remote Port"* are set to 192.168.1.1 and 502 respectively. 502 is reserved for Modbus TCP/IP Communication. When connecting to another unit that uses same IP address, or to make a master-slave chain, do not use the same Remote IP address or same Device IP address. Needs to change the IP Address accordingly.

After pressing the "*Save Settings"* button and saving the configuration parameters, the converter replies with a confirmation message showing a result of the saving operation. For example, if the user has successfully changed the *CAN RX* settings, the following message will appear:

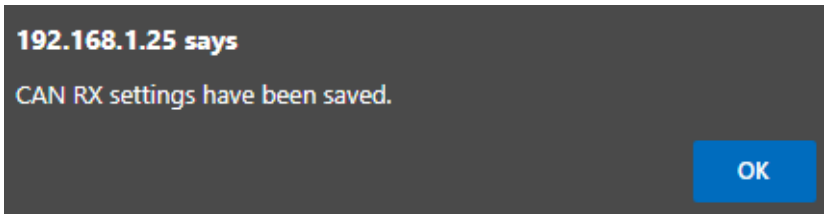


Figure 7. Settings Alert. "Configuration Parameters" settings have been saved.

If no configuration is changed and the last configuration is updated again without any change, the following message will appear:

Figure 8. Settings Alert. No changes to save!

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

In case the user leaves the page without saving, all changes will be discarded. The user can also discard changes by pressing the "*Discard Changes"* button.

2.2 Ethernet Configuration

All *Ethernet* configuration parameters can be changed through the "*Main Settings"* web page, except the "*MAC Address"* and *"Modbus TCP/IP Configuration",* which is programmed at the factory. The user-changeable configuration parameters are presented in Table 2.

Table 2. Ethernet Configuration Parameters

Configuration Parameter	Default Value	Range	Description
Device IP Address	192.168.0.34	Any IP address	The device IP address. The embedded web server uses the same IP address.
Web Server Port	80	Any port value except the *Remote Port*	The communication port of the embedded web server.
Remote IP Address	192.168.0.35	Any IP address	The remote server IP address. Used by the device client when the *Auto Connect to Remote* is *YES*.
Remote Port	502	Port value – 502 Modbus TCP/IP Port	The remote server ports. Used by the device client when the *Modbus TCP/IP Master is Enabled*

2.3 CAN Configuration

The CAN configuration parameters can be changed through the "*Main Settings"*, "*CAN Rx Settings",* and "*CAN Tx Settings"* web pages.

The main CAN configuration parameters are available through the "*Main Settings"* web page, see Table 3.

Table 3. Main CAN Configuration Parameters

Configuration Parameter	Default Value	Range	Description
Baud Rate	250 kbit/s	{1000, 666.6(6), 500, 250, 125, 100, 50, 20, 10}[1]	The CAN baud rate.
Auto Baud Rate	On	{Off, On}	Auto baud rate detect state.
Switched Power Out	Off	{Off, On}	State of the switch delivering power to the CAN connector.

[1] *666.6(6) kbit/s are set as 667.*

The CAN filters have their own web pages for setting configuration parameters.

2.3.1 CAN Rx Configuration / can_rx_settings.html

The CAN receive message parameter settings display one message at a time. CAN Message Select section provides '*Next*' and '*Previous*' buttons to go to the required message. The '*Jump to*' button selects the specified message directly. Settings should be saved before selecting another CAN receive message to be configured, otherwise the modified settings will be lost.

The *'SID: Standard ID'* checkbox allows the device to accept the CAN messages with Standard 11-bit IDs ranging from 0x0 to 0x7FF. When SID is unchecked, the device can be configured to receive CAN messages having a specific PGN.

The '*Discrete*' data type reads in the CAN data as a number (or bit field data), using the range specified by the configured number of bits (Data width). With discrete data types, the resolution, offset, minimum and maximum are not used.

The '*Continuous*' data type uses the J1939 data formatting with *resolution, offset, minimum* and *maximum values*. With continuous data, the data range is limited for reserving the upper range for J1939 special and error codes.

The '*Data destination'* and '*Data destination number'* settings specify the target interface for the received data. The received data is always stored to a local variable assigned for each CAN receive message, but the Data destination needs to be configured for forwarding the data to the Modbus TCP/IP slave interfaces.

The *Data Destination* configured as default allows us to configure the destination of CAN messages from "*CAN TX Settings"* or *"Modbus TCP/IP Master Settings"*. CAN input data will be

directed accordingly. To make an internal CAN loop by configuring '*CAN RX message'* as data destination for CAN RX.

The '*Timeout'* value specifies the amount of time for which CAN data will be stored in the input buffer after receiving the data. Setting '*Timeout' to* 0 will allow us to use the last CAN input data continuously until we receive a new message. Setting '*Timeout'* to any other value will expire the current CAN input buffer after the configured timeout.

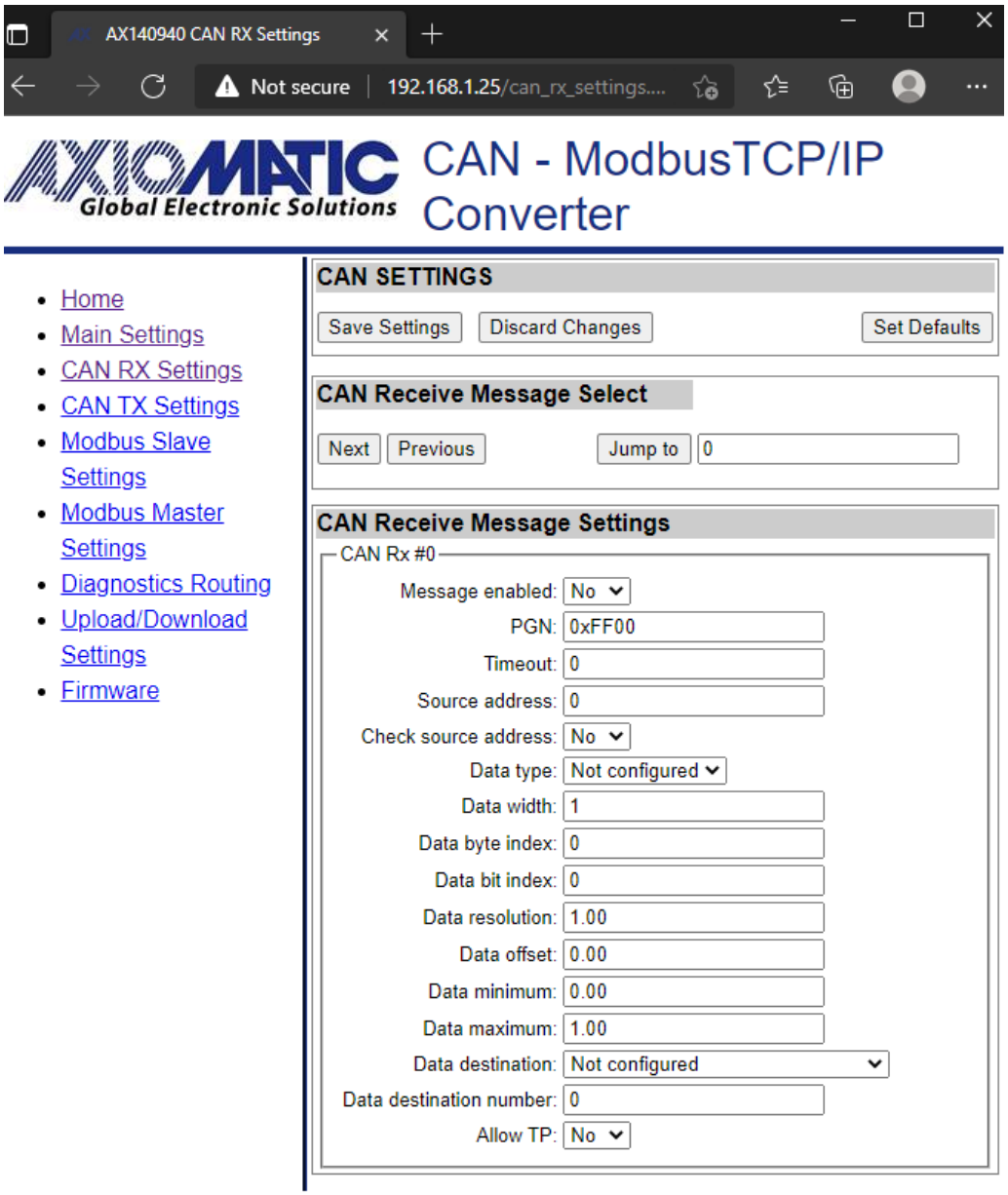


Figure 9. Converter CAN Rx Default Configuration Page

The *'Data Maximum'* specifies the maximum value received on CAN input. i.e., setting *'Data Maximum'* to 65535, specify any value more than 0xFFFF will be filtered out.

If '*Check Source Address'* is disabled, all input CAN messages from the same PGN will be output on the '*Data Destination'*.

The user can independently configure *'CAN RX Message'* Settings for each CAN Message, through '*CAN Receive Message Select' – 'Next', 'Previous'* or *'Jump to'.*

"CAN RX Settings" for each message run in parallel. It is sufficient to satisfy requirements of any active filter to pass the CAN message to the Ethernet network.

If '*Message Enabled'* is set to NO, it is considered that the CAN Rx settings for that message are disabled, and do not participate in the message filtering process.

2.3.2 CAN Tx Configuration / can_tx_settings.html

Each of the 16 CAN transmit messages support up to 16 signals for sending out received data. The transmit messages support the same *'Discrete'* and *'Continuous'* data types with same characteristics than CAN receive messages do.

Settings should be saved before selecting a new transmit message or transmit signal. In case the values are not saved, the modifications are lost when a new message or signal is selected.

The '*TX interval'* specifies time difference between two successive received CAN frames in milli-seconds.

The '*Allow TP'* configured as *YES*, allows converter to receive more than 4 bytes continuously. This is useful in the event when more than 2 Modbus registers need to be read at a time.

There are independent *"CAN TX Settings"* configuration for each CAN message.

Once the message is activated by checking the *YES/NO* box, the CAN messages will be available from configured data source. Source can be Modbus TCP/IP registers, Modbus TCP/IP master or CAN_RX, depending on *TX Interval*. If TX interval is set to zero, CAN port will never receive any data from the source, as *TX Interval* should be more than zero except direct CAN message is used.

Transmit Messages configured with the same PGNs will be combined as a single message if they have a similar *'TX Interval'*. If the shared messages have overlap in Byte or bit indexing, then the indexing configured in the higher CAN transmit message will be used. For example, if CAN transmit messages second and third have the same PGNs and overlapping in the 5th Byte, then the 5th Byte will contain the data of the third transmit message.

Direct CAN message from Modbus TCP/IP Master can be received as CAN frames even if *TX Interval* is set to zero, as *Direct CAN Message* from Modbus Master will not consider *"CAN TX settings".*

All *"CAN Message settings"* run in parallel. It is sufficient to satisfy requirements of any active message to send the CAN message to the Ethernet network.

If '*Message Enabled'* is set to NO, it is considered that the CAN Tx settings for that message are disabled, and do not participate in the message filtering process.

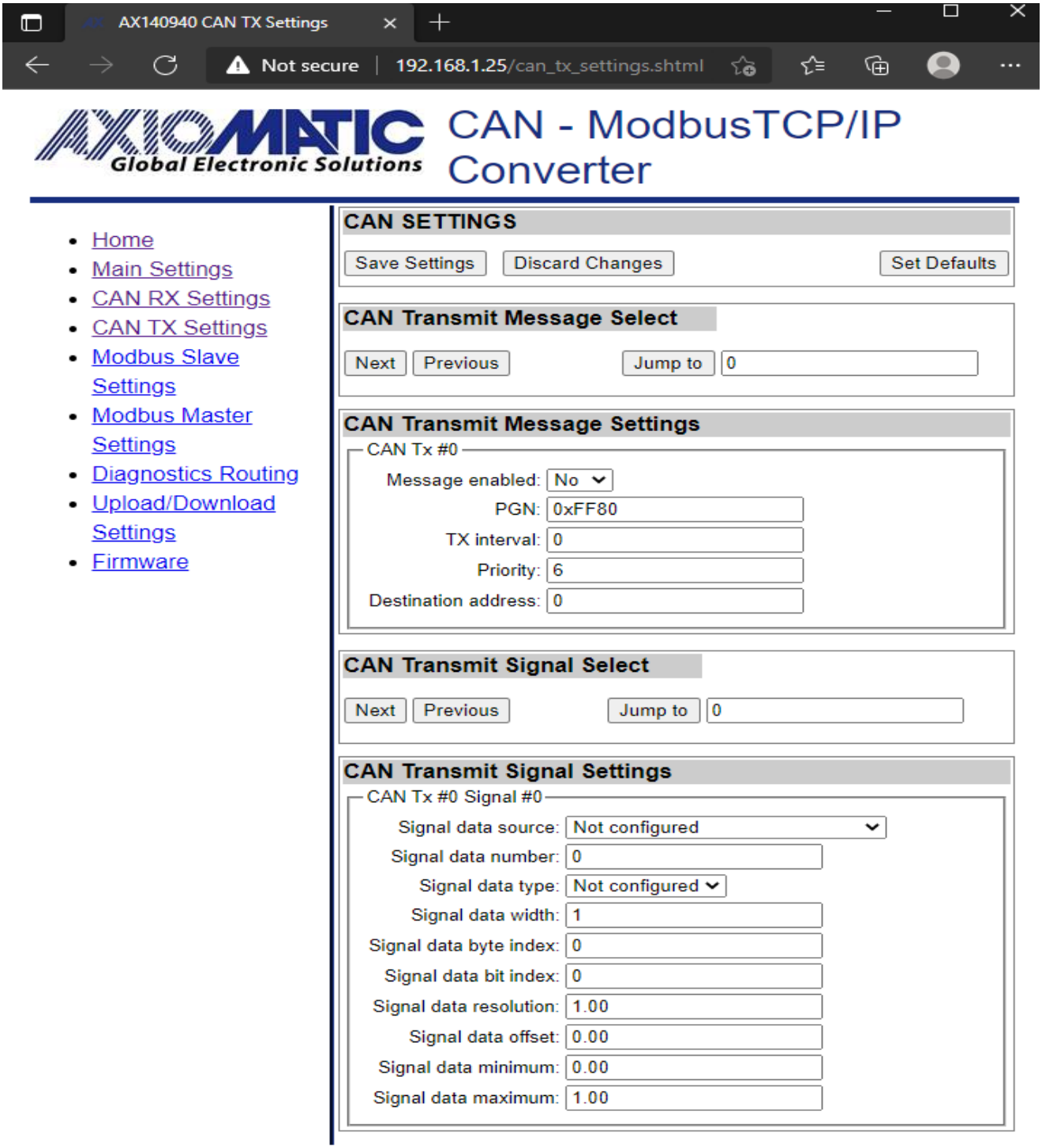


Figure 10. Converter CAN ID Mask Filters Page

3 Modbus TCP/IP Settings

The CAN to Modbus TCP/IP Converter supports Modbus TCP/IP slaves running on Ethernet port. The number and start address for each of the Modbus TCP/IP slave's inputs, coils and registers can be specified, see Figure 11.

Please note that the slave interface is enabled only if the Modbus TCP/IP master implementation is not running on that interface.

The number of inputs, coils and registers have an upper limit, and the web server will not accept values beyond the built-in maximum limit.

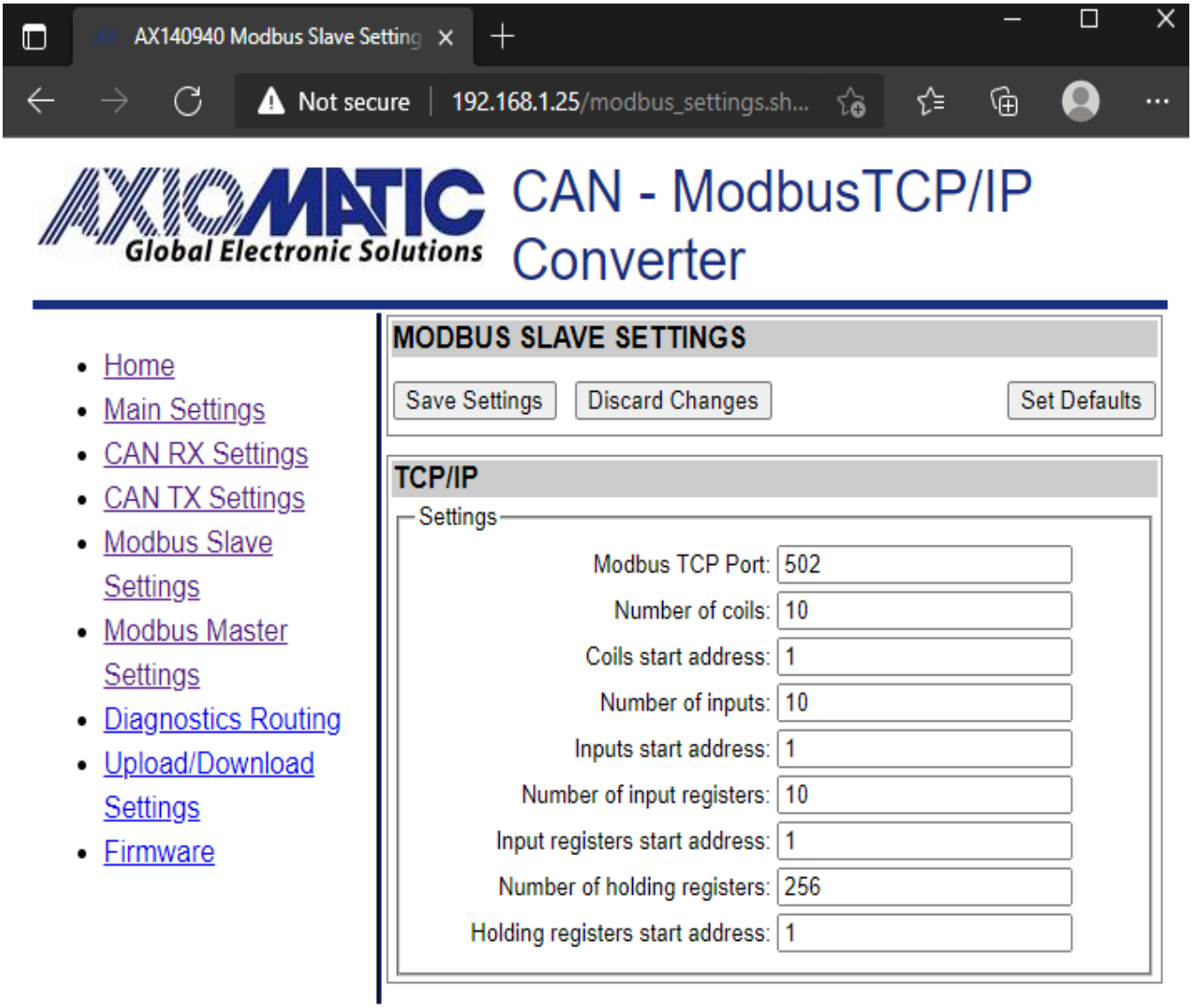


Figure 11. Converter Slave Settings

3.1 Modbus TCP/IP Master Settings

The CAN to Modbus TCP/IP Converter supports Modbus TCP/IP master running on its Ethernet port. The *'Ethernet Master Enable*' options need to be set to *YES* for enabling the Modbus TCP/IP master, see Figure 12.

Please note that enabling the Modbus TCP/IP master will disable the Modbus TCP/IP slave for that device. As at a time one device can either work as Master or as Slave.

The Default target and Default source data routing options are the built-in variables for each Modbus TCP/IP master message definition. The CAN receive message data target configuration can access these variables directly if configured to do so on the CAN receive message configuration page.

The received Modbus TCP/IP data can be also sent directly to CAN bus by selecting the '*Direct CAN TX'* option for the Forward received data to setpoint. In this case, the Received data number specifies the J1939 PGN to use (the priority will default to 6 and the CAN to Modbus TCP/IP Converter's J1939 address will be used as the source address for the direct transmit messages).

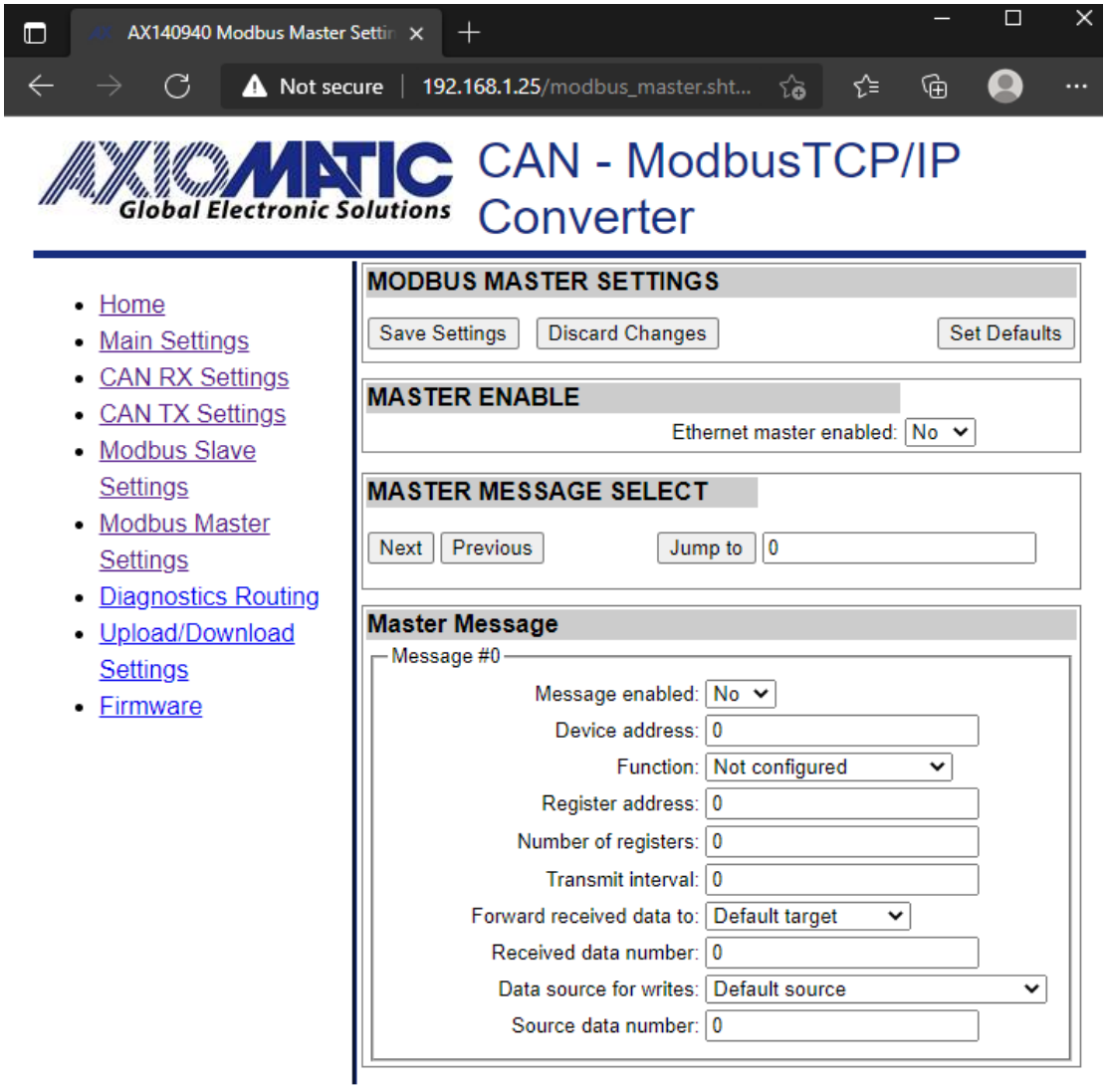


Figure 12. Modbus TCP/IP Master Settings

3.2 Diagnostics Routing

J1939 DM1 configurable diagnostics frames can be routed to Modbus TCP/IP slave interfaces using the Diagnostics routing configuration. There are 16 configurable diagnostics messages.

The routing options include routing all received diagnostics to Modbus TCP/IP or only routing the specified ones. It can be configured through *Diagnostics routing enabled,* which has three options in the drop list, ‘No diagnostics routing’, ‘Route specified SPN/FMI/SA’ and ‘Route all’.

In case specified diagnostics routing is configured, the SPN (Suspect Parameter Number (from SAE J1939 standard)) is the most important parameter to configure. The diagnostics are filtered mainly using the SPN. In case needed, the FMI and SA values can be used for more detailed filtering of the received DM1 frames. The FMI and SA can be set to “don’t care” values (32 for FMI and 255 for SA) for accepting a wider range of SPNs.

SPN and FMI are sent by the source on a diagnostic message. The ECU is compliant with the standard SAE J1939. It is user’s responsibility to select SPN that will not violate J1939 standard. For Diagnostics, DM1 – Active Diagnostic Trouble Codes supports PGN 65227 (0x00FECB).

The received DM1 data is forwarded to Modbus TCP/IP slave holding registers using the following data layout.

	Holding register	
	<15:8>	<7:0>
<MB diag. start addr.>		SPN (MSBs)
<MB diag. start addr. + 1>	SPN (16 LSBs)	
<MB diag. start addr. + 2>	Lamp	FMI
<MB diag. start addr. + 3>	SA	OC

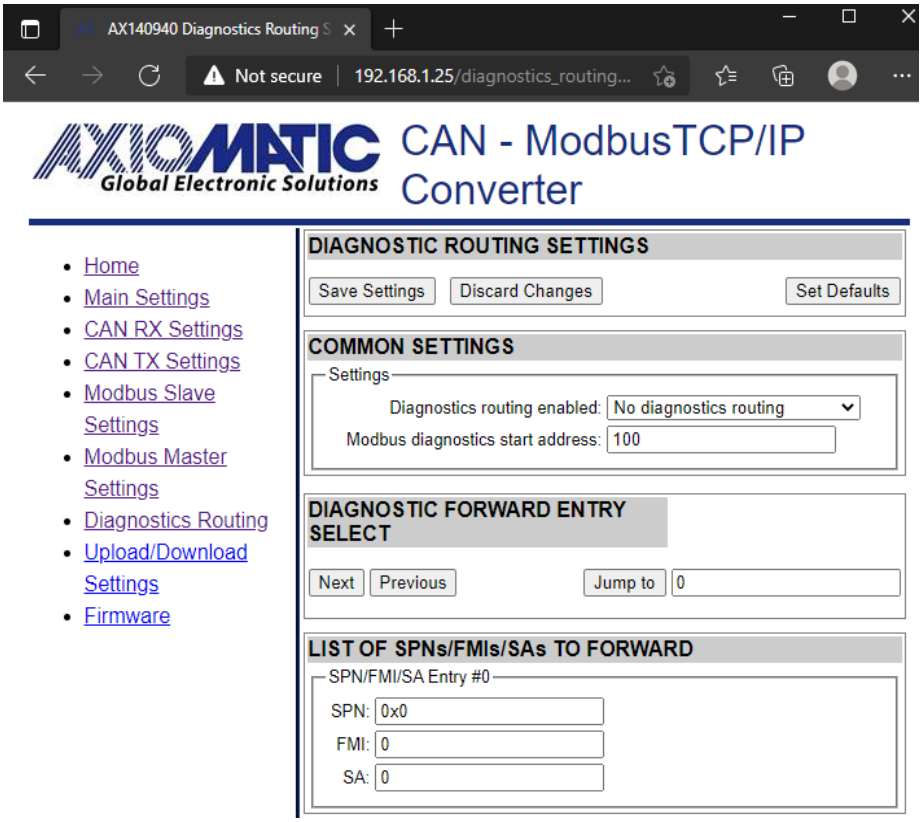


Figure 13. Health Status Message on CAN Error

3.3 Upload/Download Settings

The settings can be downloaded from the CAN to Modbus TCP/IP Converter as a binary file. When a settings file is uploaded to the CAN to Modbus TCP/IP Converter, the settings are checked using a CRC32 checksum. In case the checksum is not correct, the uploaded settings will not be stored to non-volatile memory.

The firmware v1.x requires a power cycle for applying the uploaded settings.

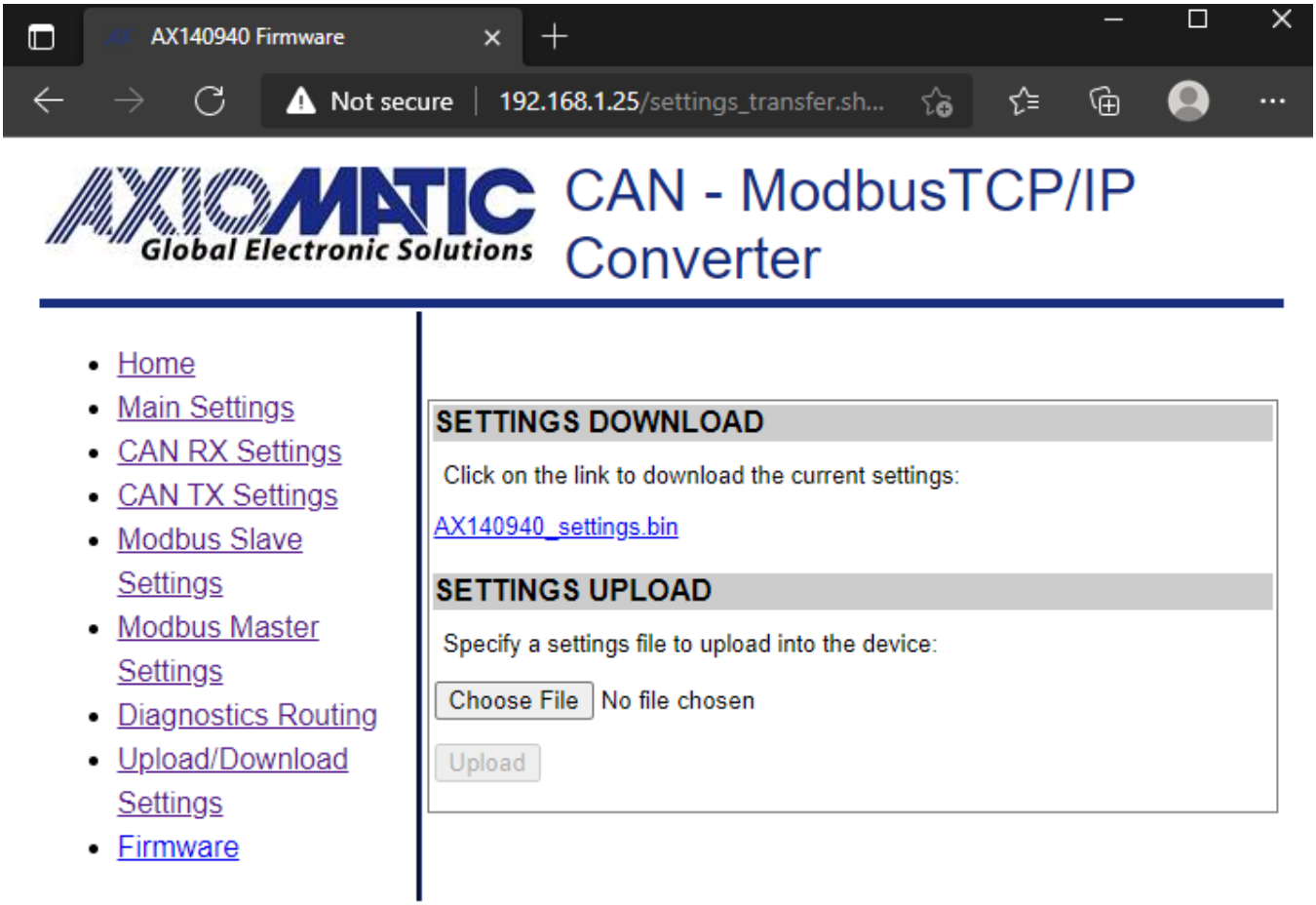


Figure 14. Health Status Message on CAN Error

4 FIRMWARE UPDATE

The converter firmware can be updated through the website.

The firmware update procedure is performed in two stages:

First, the application firmware is uploaded into the converter internal flash. During this stage, the converter checks the firmware checksum and whether it can be programmed into the unit.

Second, upon the user confirmation, the firmware is programmed into the microcontroller and the unit is restarted. At the end of this process, the user should see the new firmware version number on the converter home page in the browser.

The details of the firmware update are provided below.

4.1 Uploading the New Firmware

To upload the new firmware, the user should activate the *Firmware Uploading* page, Figure 155, by clicking on the "*Firmware"* link on the left side of the web page.

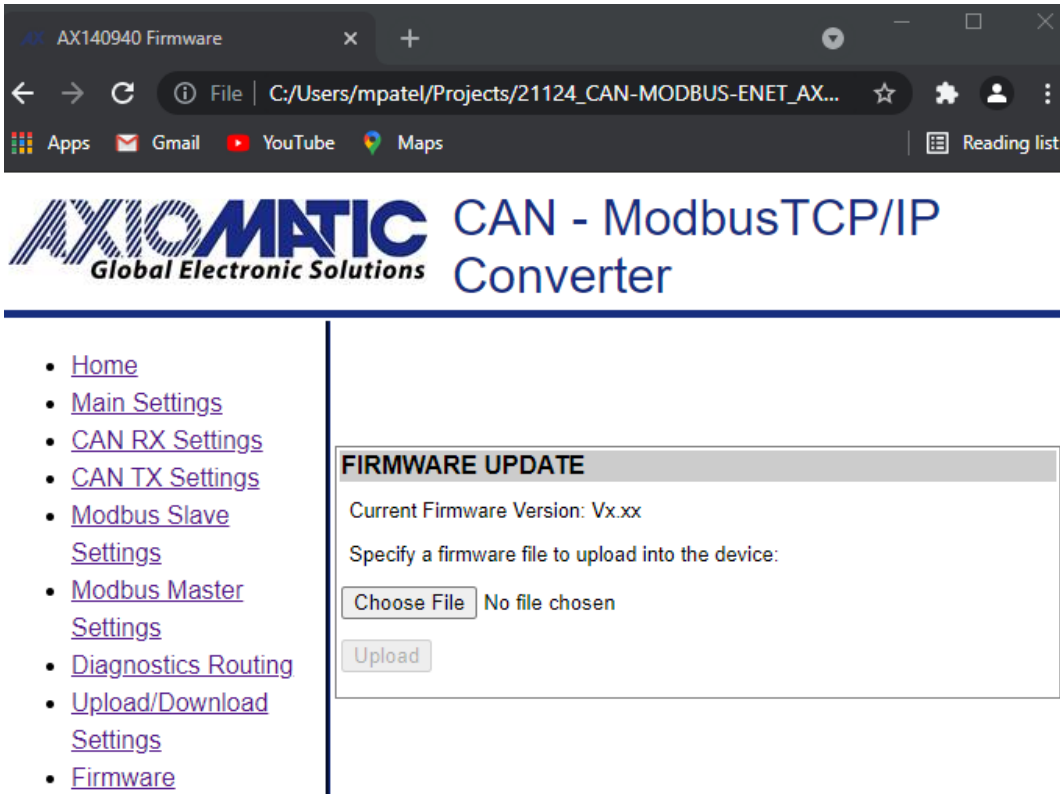


Figure 15. Firmware Uploading Page

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-21124-X.XX.af`, where the `<X.XX>` field wildcard reflects the firmware version number. We will use `AF-21124-1.00.af` file 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.

4.2 Applying the New Firmware

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

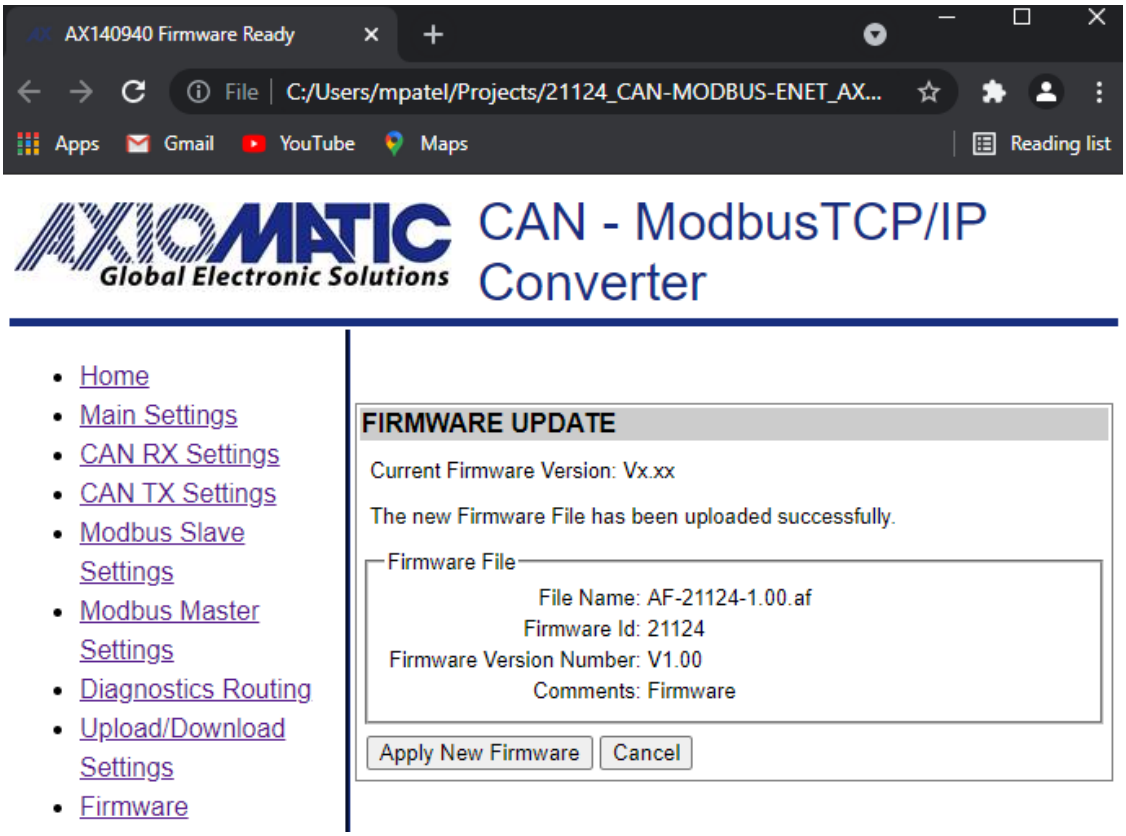


Figure 16. Firmware Update Page

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 the countdown timer.

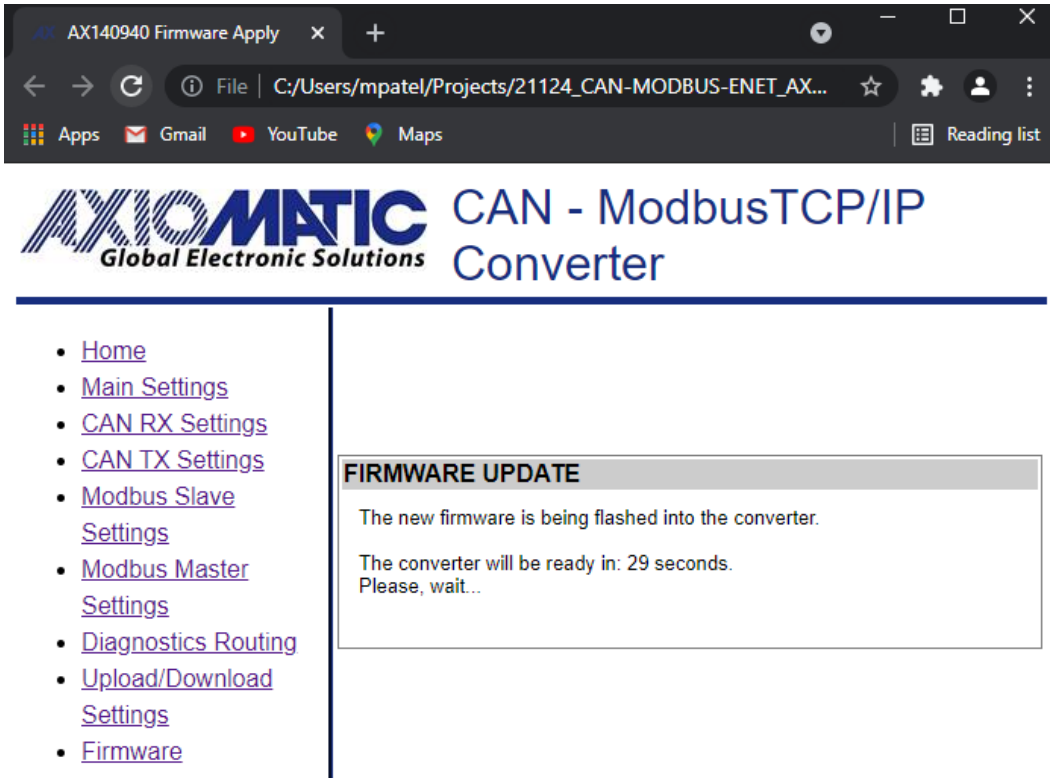


Figure 17. Firmware Update Countdown has been Started.

The countdown timer is set for 30 seconds necessary to complete the flashing process and reboot the unit, after which the converter home page will be displayed. The user will see the new application firmware version number in the *Device Information* section on the converter home page.

5 CONVERTER DEPLOYMENT

There are two major approaches in using the CAN to Modbus TCP/IP Converter. One is to use the converter on its own as a CAN extender or a baud rate converter.

For example, a pair of coupled converters can synchronize two CAN networks. This example can be extended to several CAN networks running at different baud rate in various remote locations, connected using the CAN to Modbus TCP/IP Converter.

The majority of Axiomatic PC software tools support the Ethernet to CAN converter. They can connect to the CAN bus using the Ethernet to CAN converter the same way as they connect to the bus using the USB to CAN converter. The Axiomatic Electronic Assistant (EA) can communicate with the converter starting from version 5.11.82.0, and the CAN Assistant – Scope and CAN Assistant – Visual support the converter starting from version 3.0.0.

The use of the Ethernet to CAN converters for synchronizing CAN networks with or without baud rate conversion is described below. There is no need for custom software for this type of the converter deployment.

5.1 CAN Network Synchronization

To synchronize two remote CAN networks, the user can simply connect an Ethernet to CAN converter to each of the CAN network and configure the converters the way that they will talk with each other.

5.1.1 Hardware Setup

The converters should be connected through a local or global IP network, see: Figure 18 and Figure 19.

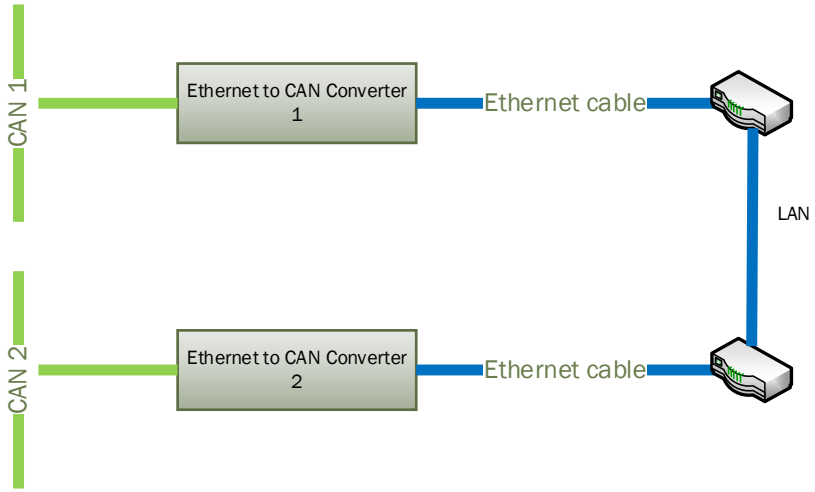


Figure 18. Local Connection through the LAN

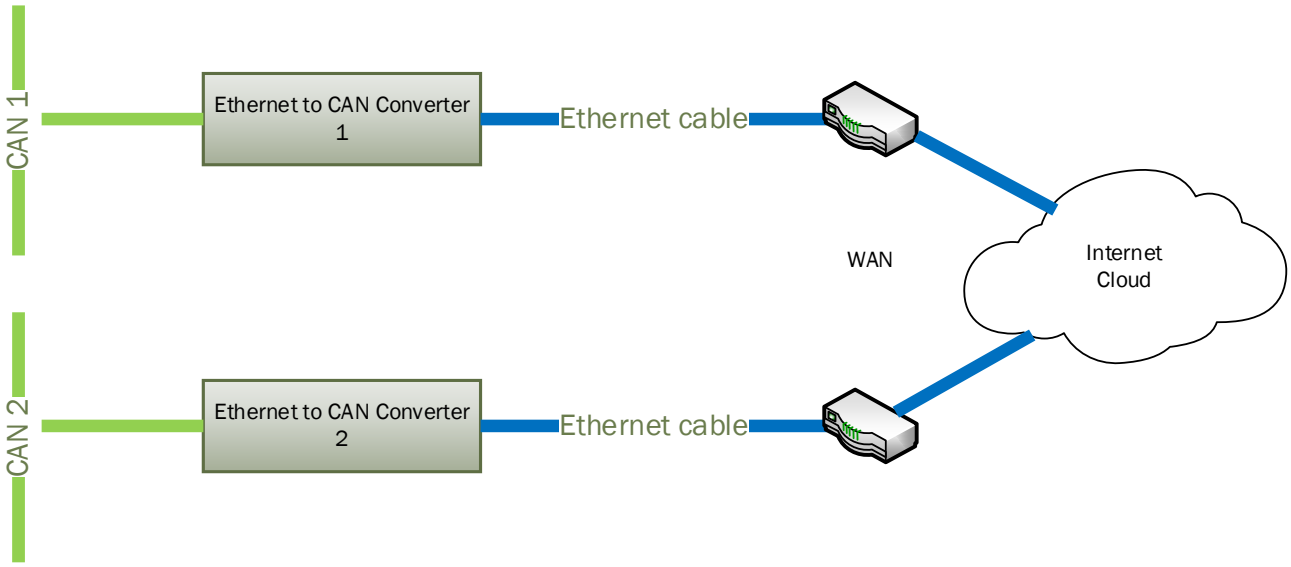


Figure 19. Global Internet Connection through the WAN

In the simplest scenario, two pre-configured converters can be connected by an Ethernet cable, see: Figure 20. Due to the Auto-MDIX feature, both: the straight and crossover cables can be used.

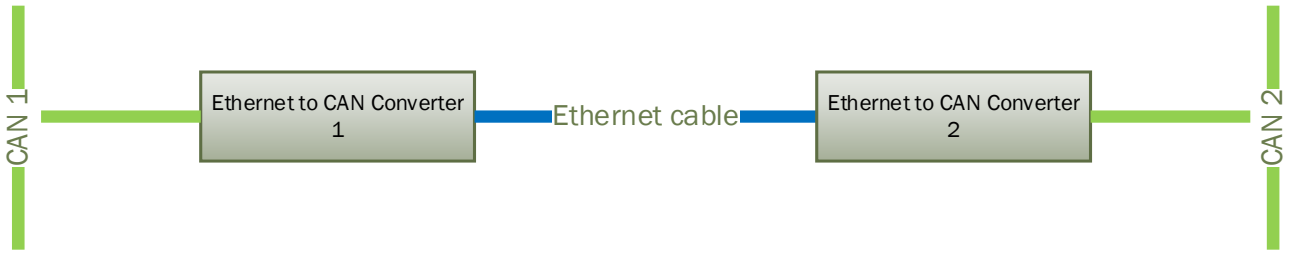


Figure 20. Simple Local Connection

The user can synchronize more than two CAN networks on LAN or WAN. There are practically no limits on the number of synchronized CAN networks, see daisy-chain connection in the Client Configuration section in Figure 23.

5.1.2 Converter Configuration

After the physical connection is established, the converters should be configured to exchange messages between each other. Since the converters support client/server communication model, one of the converters should be a server and the other one – a client.

5.1.2.1 Server Configuration

To configure the converter as a server (slave), first set: '*Device IP Address'* to the appropriate values received from your network administrator.

Set '*Modbus TCP/IP Master Enable'* to *No* to disable the client (master) side of the converter. Set the *Remote IP Address* to the appropriate value other than 192.168.1.1, as for client-server configuration, this will work as default gateway.
'Remote Port' can be left untouched since they are not used by the converter when the client mode is disabled. They are grayed on the '*Settings page*' in this mode.

For the CAN network, configure the necessary '*Baud Rate'* and Set '*Auto baud rate enable'* to *YES.*

An example of the converter configuration as a server is presented in Figure 21.

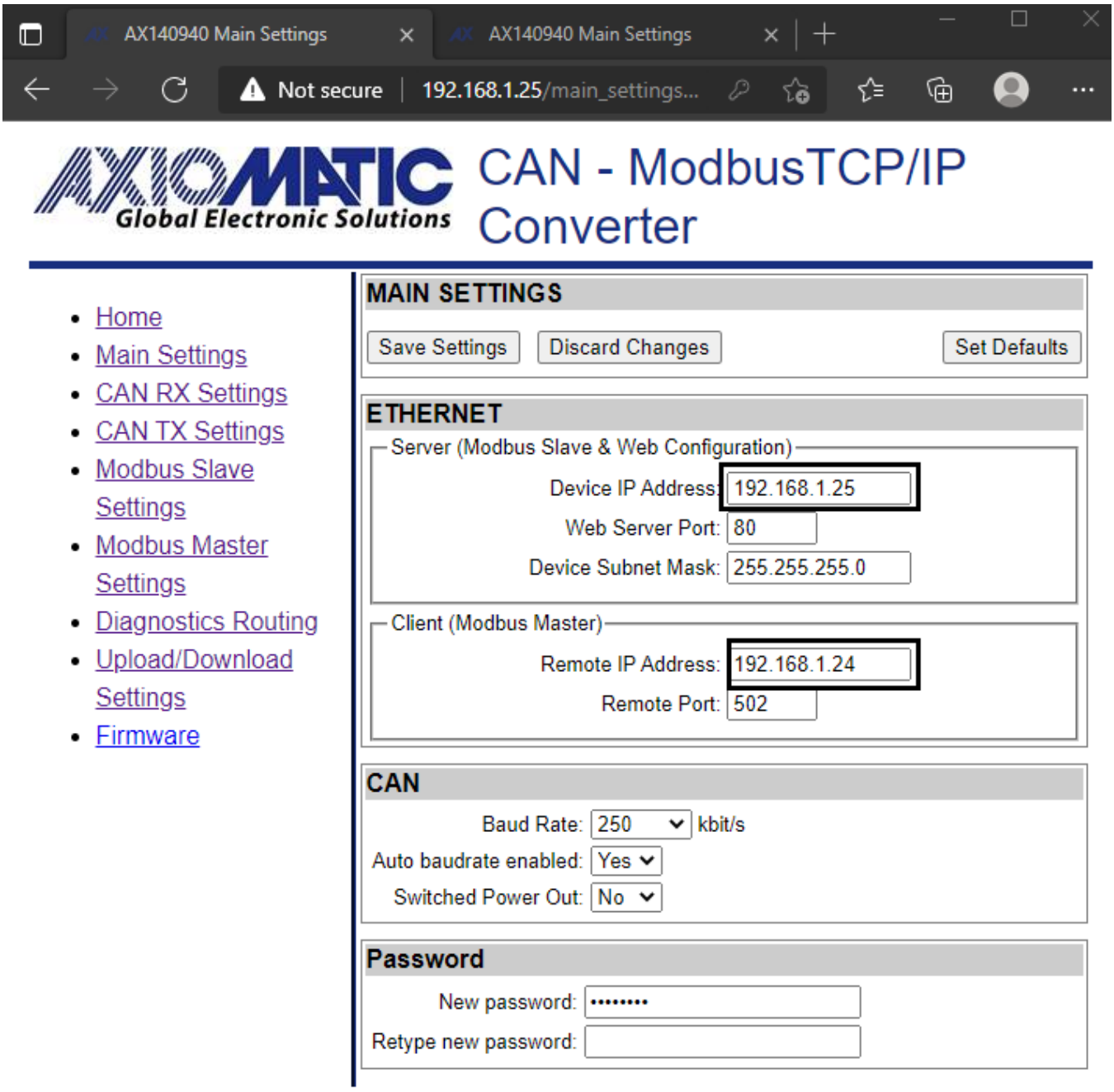


Figure 21. The Converter Server Configuration Example

5.1.2.2 Client Configuration

In the client configuration, the user should set '*Device IP Address'* the same way as with the server configuration. Remote *IP Address* and *Remote Port* to match the settings of the converter

in the server mode and activate the client mode by setting the '*Modbus TCP/IP Master Enable*' to *YES*.

The CAN network setup is done similarly to the server mode; the '*Baud Rate'* is set to the desired baud rate (not necessarily the same as on the server).

An example of the converter configuration in a client mode is presented in Figure 22.

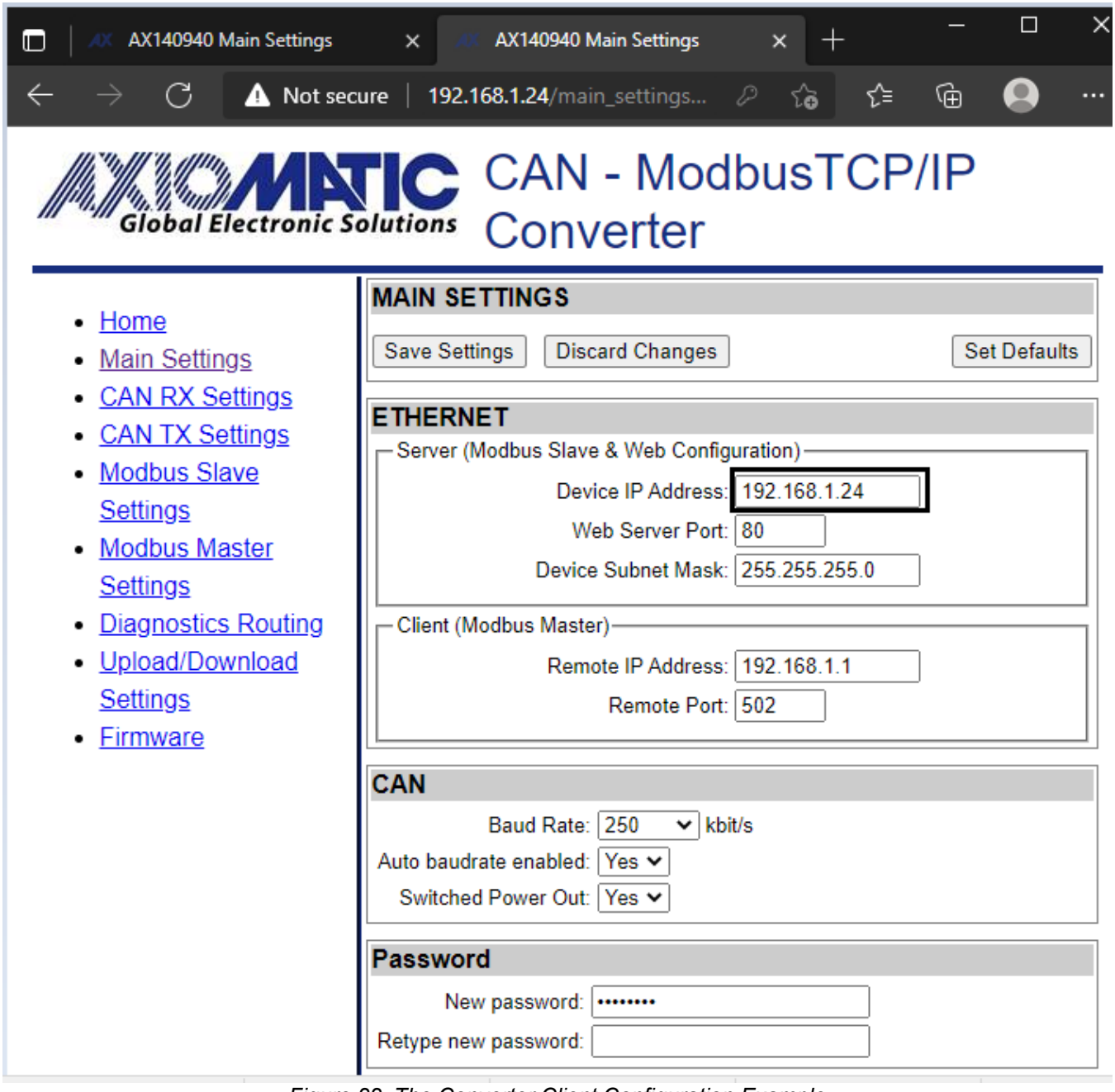


Figure 22. The Converter Client Configuration Example

The values of the *Device Port Type, Remote IP Address* and *Remote Port* of the client on Figure 22 are the same as the *Device Port Type*, *Device IP Address* and *Device Port* of the server in Figure 23.

Please note, that if the converters are connected over the internet, the '*Remote IP Address'* of the client will be a public IP address of the server, not the internal server IP address presented as the '*Device IP Address'* on Figure 21. The network administrator on the server side will be required to configure port forwarding to open internet access to the converter in the server mode.

When the converter is configured as a client, it will still act as a server accepting connections on the *Device Port* from other clients. This adds versatility to the converter configurations since the same converter can be used together with both: client and server communication nodes. As an example, the user can establish an unlimited number of daisy-chain client-server connections, see: Figure 23.

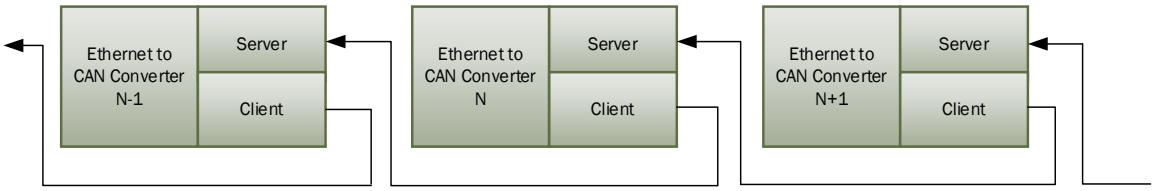


Figure 23. Daisy-Chain Converter Connection

6 TECHNICAL SPECIFICATIONS

6.1 Power Supply

6.1.1 Input

Power supply input is located on the Ethernet connector. The power supply uses automotive battery power. It is not compatible with the PoE (Power over Ethernet) IEEE 802.3 standard.

Table 4. Power Supply Input

Parameter	Value	Remarks
Supply Voltage	9…36 VDC	12V, 24V – nominal
Power Consumption	2W	Maximum at 12V
Protection	Under Voltage Shutdown Over Voltage Shutdown Reverse Polarity Transients	< 6 V > 37V 12V Load Dump

6.1.2 Output

Power supply output is located on the CAN connector.

Table 5. Power Supply Output

Parameter	Value	Remarks
Voltage Output	9…36 VDC	Pass-through power from the power supply input.
Current Output	0.7A	Maximum pass-through current.
Voltage Drop	1V	Maximum
Protection	Overcurrent Short to Battery Short to Ground	> 1A

6.2 Ethernet

Table 6. Ethernet Parameters

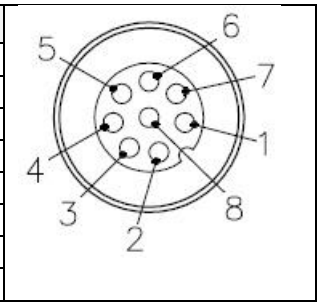
Parameter	Value	Remarks
Number of Ports	1	
Port Type	10BASE-T, 100BASE-TX	Auto-configuration and full-duplex supported.
MDIX	Auto-MDIX	Auto-crossover to eliminate cabling mismatch.
LED Indicators	Speed/Activity	
Protocols	Ethernet IEEE 802.3, IP, ICMP, ARP, UDP, TCP, HTTP	The internal web server uses HTTP protocol.
Modbus Slave Mode	Up to 32 bi-directional simultaneous connections	Only if the *Modbus Master Mode* is Enabled
Modbus Master Mode	1 remote bi-directional connection	Auto-connect to a remote server if connection is dropped or temporary unavailable. Client mode can be disabled.
Web server	Provided	Always enabled for converter configuration and diagnostics.
Internal Diagnostics	Health Status	Internal health status of the converter is transmitted in heartbeat messages. It is also available from the web server.

6.2.1 Ethernet Connector

M12 socket, 8-pin, A-coded, female connector, Phoenix Contact, P/N: 1441817.

Table 7. Ethernet Connector Pinout

PIN #	Description
1	BAT + (9-36V)
2	BAT – (GND)
3	BAT – (GND)
4	ETH_TX –
5	ETH_RX +
6	ETH_TX +
7	BAT + (9-36V)
8	ETH_RX –



Use A-coded mating connectors compliant with IEC 61076-2-101:2012.

The AX070531 Ethernet and Power Cable - 1.7m (5.5 ft.), 8-pin M12 A-coded, Unterminated Leads, Ethernet Jack, can be used for experimenting. The cable is rated -40…+75 °C.

6.3 CAN

Table 8. CAN Parameters

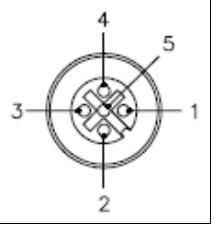
Parameter	Value	Remarks
Number of Ports	1	
Port Type	High Speed, ISO 11898-2 compatible	Twisted pair, up to 1 Mbit/s. Shield connection is provided if shielded cable is used.
Baud Rate	1000, 666.6(6), 500, 250, 125, 100, 83.3(3), 50, 20, 10[1]	[kbit/s]. Programmable through web interface.
Protocol	CAN Bosch 2.0A and B	Data Frames and Remote Frames with Standard and Extended IDs are supported. CAN ID range and mask filtering is provided.

CAN port does not contain 120 Ohm termination resistor.

6.3.1 CAN Connector

M12 socket, 5-pin, A-coded, female connector, Phoenix Contact, P/N: 1441778.

PIN #	Description
1	CAN_SHIELD
2	POUT + (Switch Output)
3	POUT – (GND)
4	CAN_H
5	CAN_L



Use mating A-coded connectors compliant with IEC 61076-2-101:2012.

The AX070532 CAN Cable - 1.5 m (5 ft.), 5-pin M12 A-coded, Unterminated Leads, can be used for experimenting. The cable is rated -40…+105 °C.

6.4 General Specifications

Table 9. General Specifications

Parameter	Value	Remarks
Operating Temperature	-40…+85 °C	Industrial temperature range
Storage Temperature	-40…+85 °C	
Environmental Protection	IP67	IEC 60529
Vibration	Sine sweep, 5-200 Hz, 8.9G peak, 2.5 hr (15 sweeps), each axis. Random, 10-1014 Hz, 6.86 Grms, 5.0 hr, each axis.	Custom profile
Shock	50G peak, 5 shocks, each axis	Custom profile
Size	4.19in x1.82in x1.32in (107mm x 47mm x 34 mm)	See dimensional drawing
Weight	0.15 lb (0.068 kg)	
Compliance	RoHS Directive	

Table 10. Electromagnetic Compatibility (EMC)

Standard	Description
EN 13309: 2010	Construction Machinery- Electromagnetic Compatibility of Machines with Internal Electrical Power Supply.
EN61000-6-4:2005	Emission Standard for Industrial Environments
EN61000-6-2:2007	Generic Standards – Immunity for Industrial Environments

6.5 Accessories

Table 11. Accessories

Axiomatic P/N	Description
AX070531	AX070531 Ethernet and Power Cable - 1.7m (5.5 ft.), 8-pin M12 A-coded, Unterminated Leads, Ethernet Jack.
AX070532	CAN Cable - 1.5 m (5 ft.), 5-pin M12 A-coded, Unterminated Leads.
AX140940K	Service tool kit, contains: • AX140940 CAN to Modbus TCP/IP Converter: • AX070531 Ethernet and Power Cable - 1.7m (5.5 ft.), 8-pin M12 A-coded, Unterminated Leads, Ethernet Jack; • AX070532 CAN Cable - 1.5 m (5 ft.), 5-pin M12 A-coded, Unterminated Leads.

6.6 Housing

Injection molded enclosure and cover. Material: PA66, 30% glass fiber reinforced, flame retardant UL 94 V-0. Ultrasonically welded. For dimensional drawing, see Figure 24.

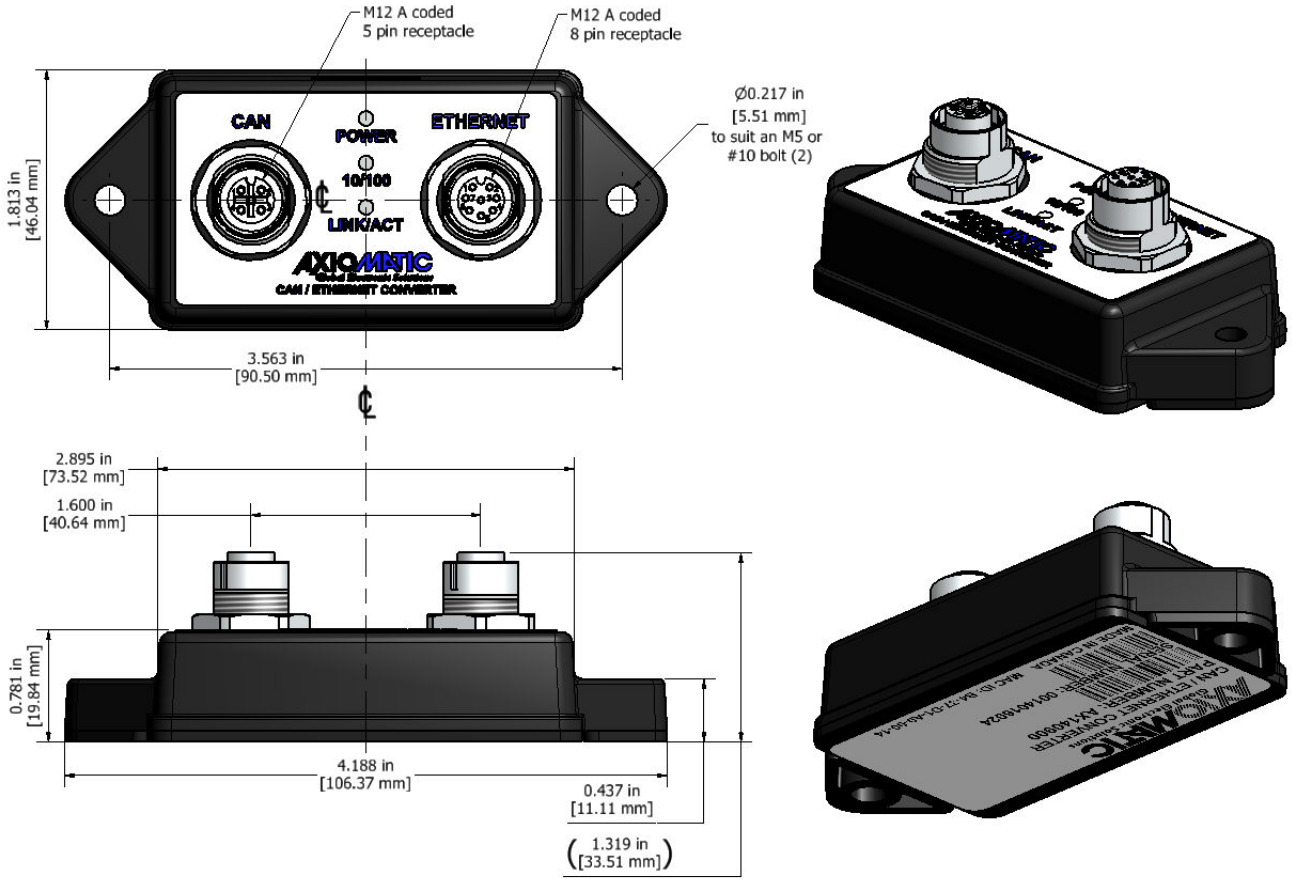


Figure 24. Dimensional Drawing

Note:
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