Gigabit Automotive Ethernet / Gigabit Ethernet Converter

<u>USER MANUAL</u>

P/N: AX141550

TABLE OF CONTENT

1. GENERAL INFORMATION

1.1 Introduction

The Ethernet to Automotive Ethernet Gigabit Converter, AX141550, has both Ethernet and Automotive Ethernet Physical Layer transceivers (1000BASE-T and 1000BASE-T1 PHYs) that are used to achieve bi-directional communication. The converter supports configuration via RS232 to update the speed (100/1000Mbps) as well as to set the Automotive Ethernet PHY to Master/Slave mode. The AX141550 does not store any packets and does not modify or filter any packets.

By default, both PHYs (Ethernet and the Automotive Ethernet) communicate at a speed of 1000Mbps, and the Automotive Ethernet is configured to work in Slave mode. Status LEDs provide information on *Power*, *Connection Link*, and *Activity*.

Power LED will be ON as soon as power is supplied to the converter. The *Power* LED is used to verify whether power is supplied to the converter. If the proper power supply level is connected to the converter, the *Power* LED will be ON; indicating the converter is ON. The AX141550 is continuously monitoring the status of Link and Activity by reading the registers of Ethernet PHYs and will show the real-time update of Ethernet and Automotive Ethernet Link and Activity on *Link* and *Activity* LEDs, respectively.

The screen shots of Tera Term in this user manual are intended for reference purposes only.
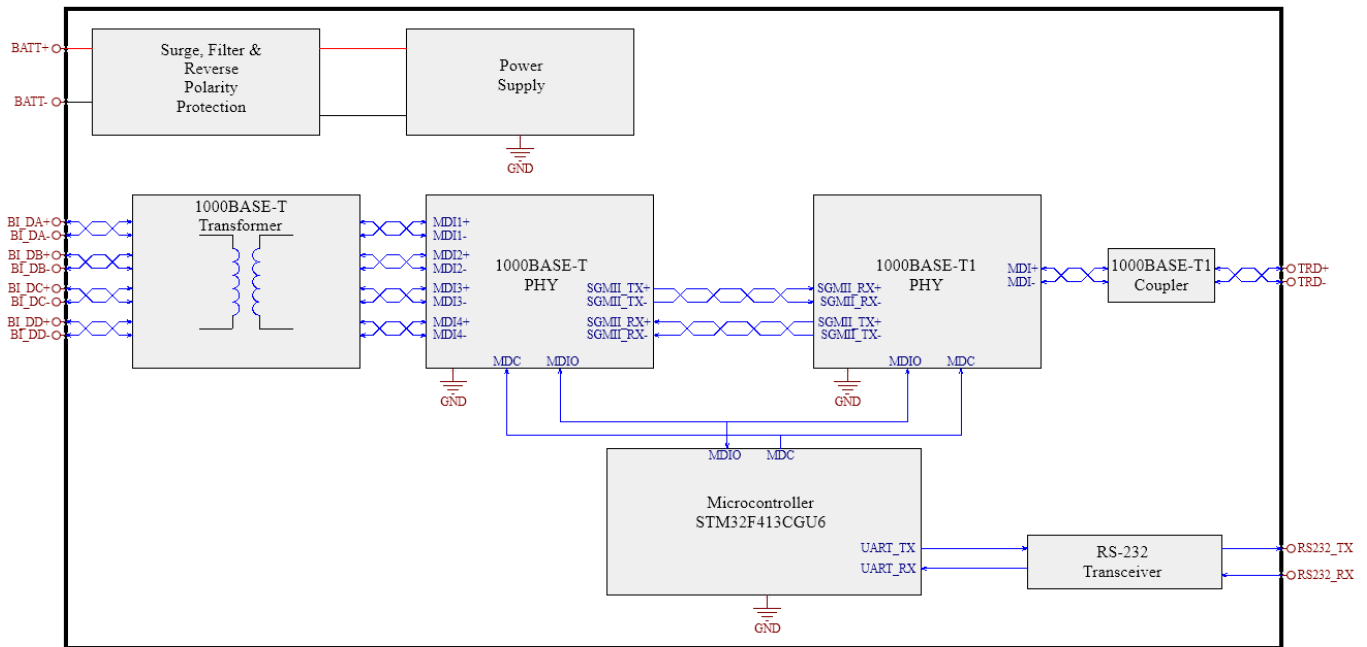
1.2 Functional Block Diagram of the Converter

Figure 1 Functional Block Diagram
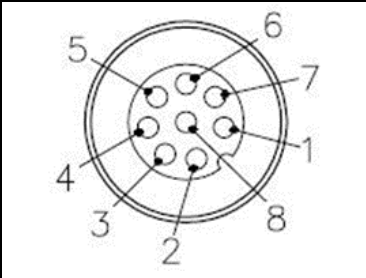
2. CONNECTORS

The converter has two connectors.

2.1 M12 8-pin (P/N: 1441817)
The M12 8-pin connector is used for the Ethernet 1000BASE-T connection. The mating harness P/N is: AX070535.

Table 1 M12 8-pin connector (P/N:141817)

PIN#	Description	
1	BI_DC_P	
2	BI_DD_P	
3	BI_DD_N	
4	BI_DA_N	
5	BI_DB_P	
6	BI_DA_P	
7	BI_DC_N	
8	BI_DB_N	
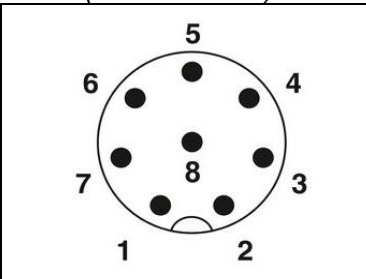
2.2 M12 8-pin (P/N: 1441804)
The M12 8-pin connector is used for power supply, RS-232, CAN, and Automotive Ethernet. 1 Phoenix Contact M12 8-pin connector (A-coded). The mating harness PN is: AX070537

Table 2 M12 8-pin connector (P/N:1441804)

PIN#	Description	
1	BATT-	
2	BATT+	
3	TRD_P	
4	TRD_N	
5	RS-232_GND	
6	RS-232 RX	
7	RS-232 TX	
8	GND	

3. CONFIGURATION USING RS-232

RS-232 configuration is password-protected and can be accessed through Tera Term or other serial terminals. Tera Term Serial Port setup is shown below.
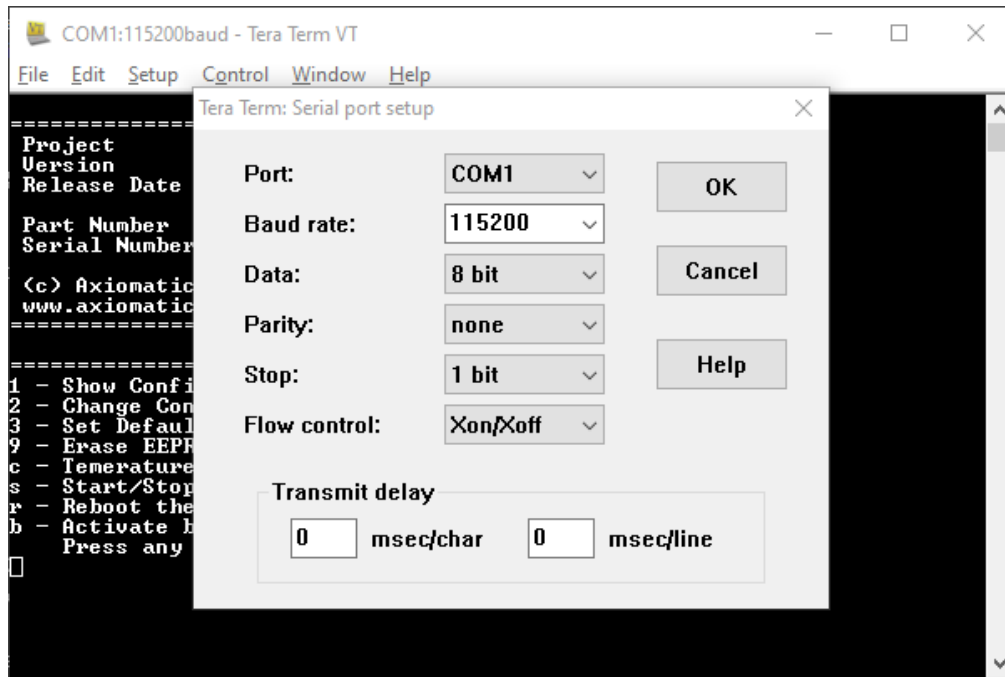

Figure 2 Tera Term: Serial port setup

Default configuration menu includes Project details like Project Name, Version number, Release Date, Part Number, and Serial Number. The menu has 8 options as attached in the picture below. To access any of the 8 options the one-time password is "AX141550".
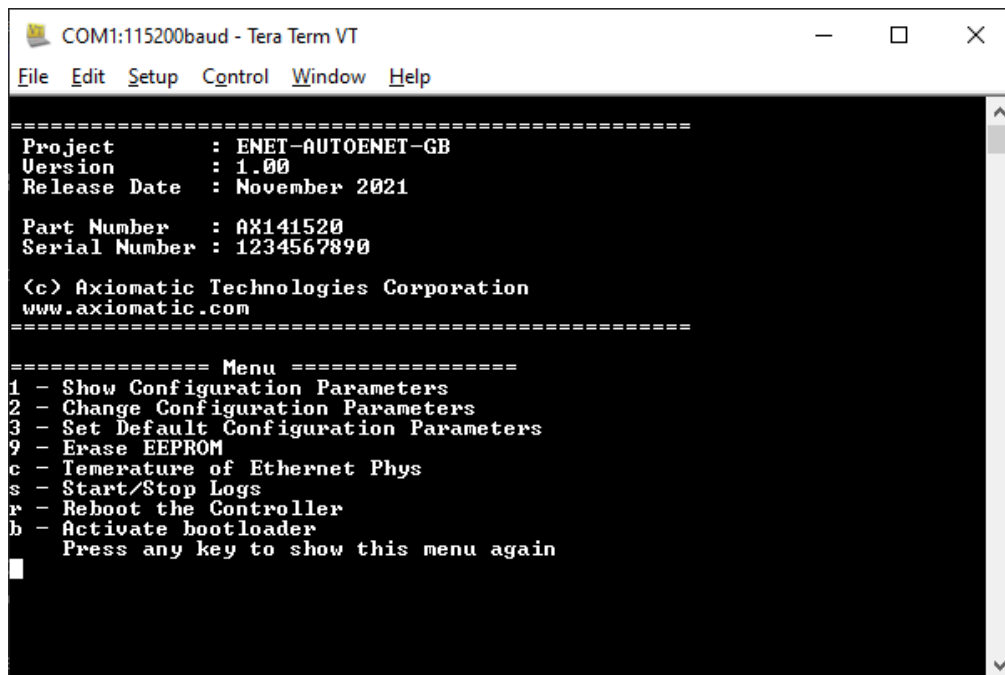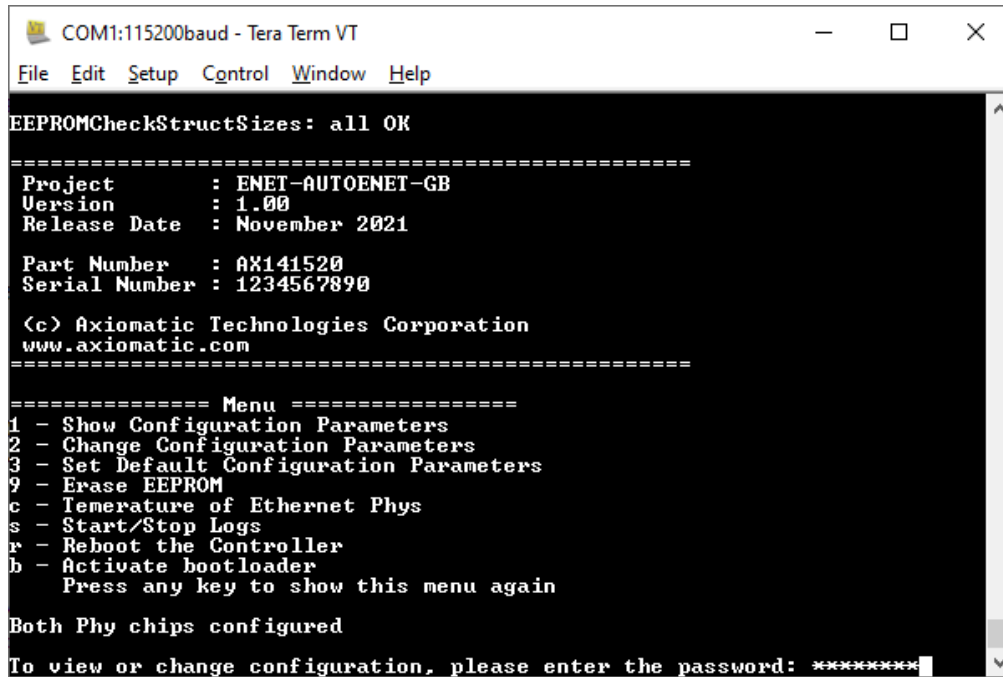

Figure 3 Default Tera Term Menu

To view or change the configuration, please enter the password: "AX141550".


```
COM1:115200baud - Tera Term VT                          —   □   ✕

File  Edit  Setup  Control  Window  Help

EEPROMCheckStructSizes: all OK

=================================================
 Project       : ENET-AUTOENET-GB
 Version       : 1.00
 Release Date  : November 2021

 Part Number   : AX141520
 Serial Number : 1234567890

 (c) Axiomatic Technologies Corporation
 www.axiomatic.com
=================================================

============== Menu =================
1 - Show Configuration Parameters
2 - Change Configuration Parameters
3 - Set Default Configuration Parameters
9 - Erase EEPROM
c - Temerature of Ethernet Phys
s - Start/Stop Logs
r - Reboot the Controller
b - Activate bootloader
    Press any key to show this menu again

Both Phy chips configured

To view or change configuration, please enter the password: ********
```
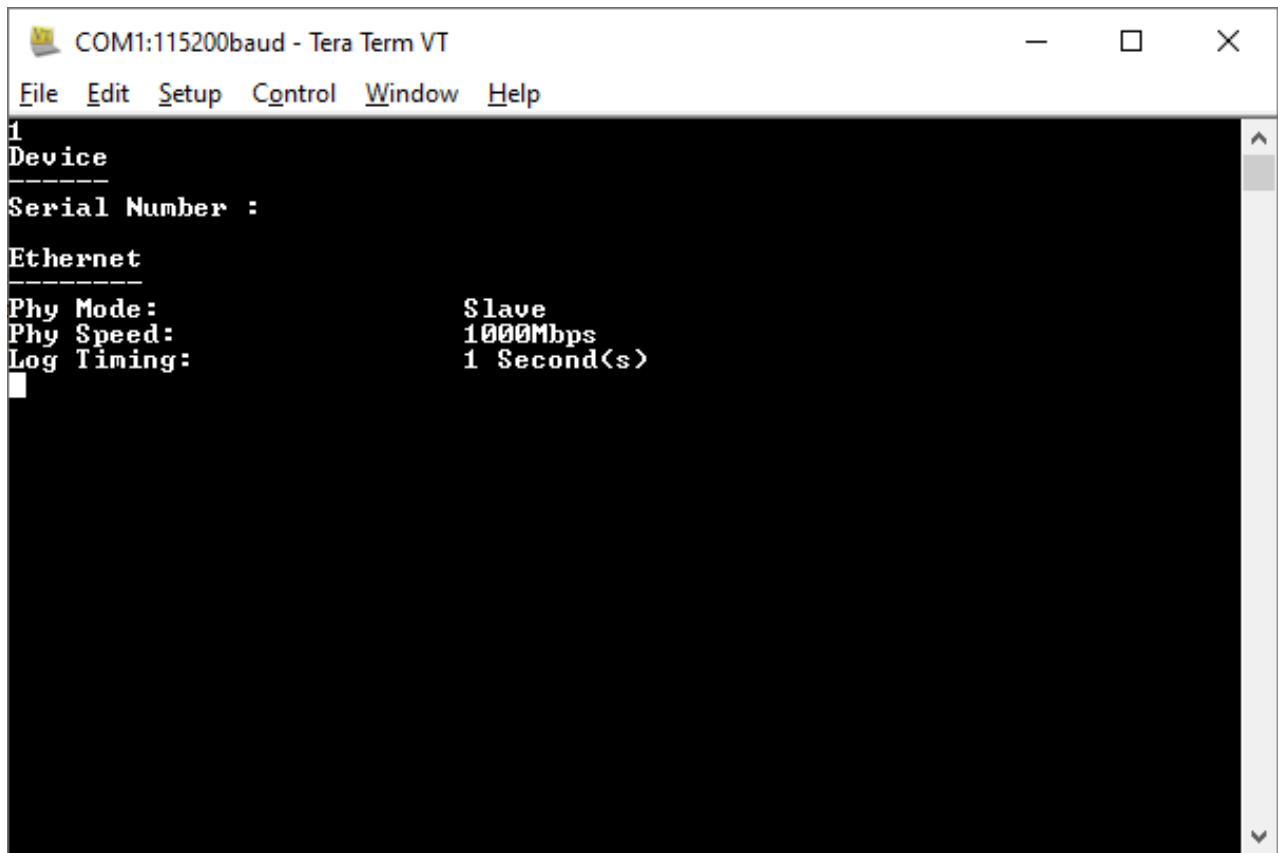
Figure 4 One-time password to access the Menu

3.1 Show Configuration Parameter

Press '1' to see the Configuration parameters. This option will show Serial Number, Converter Mode, Converter Speed, and Log Timing.

If the converter Mode is "Master", it shows that Automotive Ethernet PHY is configured to work as Master. If the converter Mode is "Slave", it shows that Automotive Ethernet PHY is configured to work as Slave. Speed shows the speed of both PHYs.

Log Timing is used to see the Power and (Ethernet and Automotive Ethernet) Link logs over RS-232. Logs are used for debugging and testing purposes. Log Timing does not affect the Converter's working and Master-Slave or Speed configuration of PHYs.

Figure 5 Show Configuration Parameter

3.2 Change Configuration Parameters

Press '2' to change the configuration parameters. This option gives the choice to change Serial Number, Mode, Speed, and Log Timing. Enter the name of the parameter that needs to be changed other than Serial Number. The option to change the Serial Number is not available for field updates.
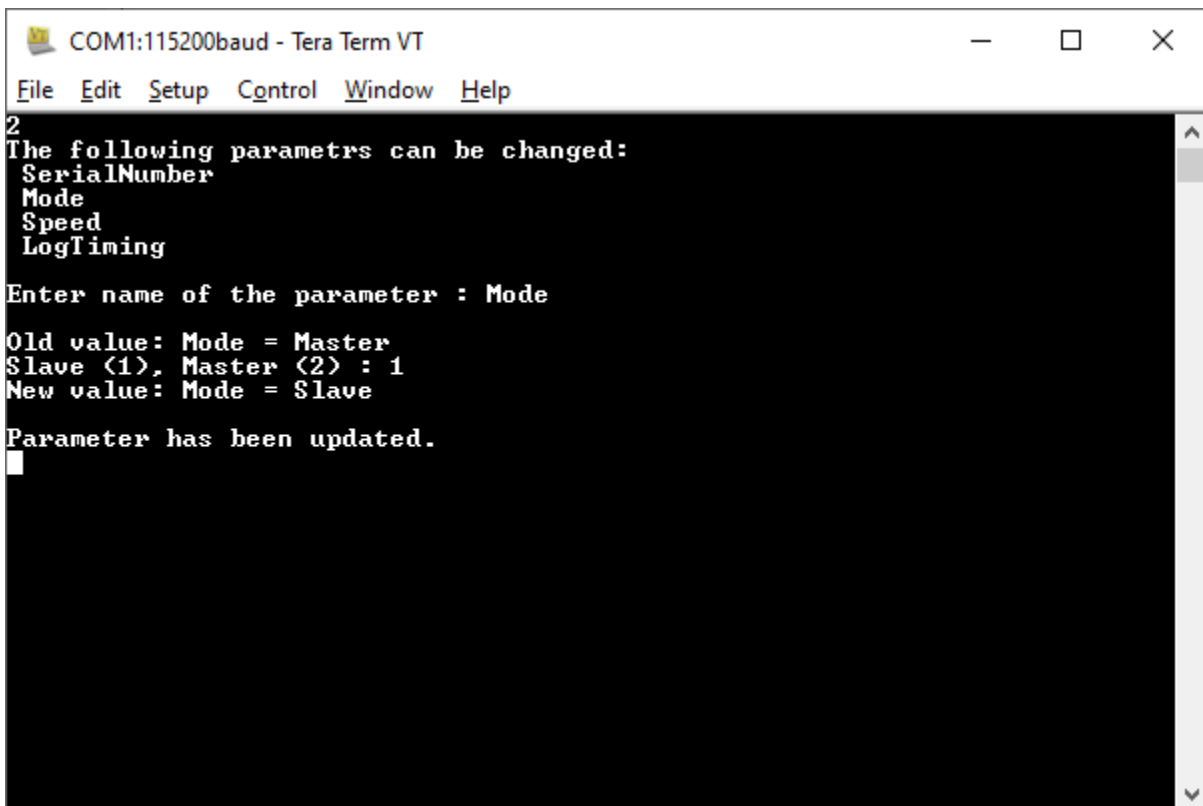
Enter the name from the list given on the Tera term window. i.e., "Mode", "Speed", or "LogTiming". Any string entered other than given on the Tera Term window will be discarded by the Converter, as the string is case sensitive. i.e., to change Speed, typing "speed" will have no effect as the converter is expecting for the string "Speed". Changing the Speed will change the Speed of both Ethernet and Automotive Ethernet PHYs.

Type "Mode" to change the mode. Press '1' to configure the Automotive Ethernet PHY in Slave mode or '2' for Master mode. Changing the Mode will change the Mode of Automotive Ethernet PHY only, as normal Ethernet PHY has Auto-negotiation enabled to negotiate the Mode.

Log Timing could be configured to have a value between 1 Second to 10 Seconds.

The Master/Slave and Speed settings will be saved. So, after reset or power cycle, the converter will have the last configured Speed, Mode, and Log Timing.

Enter the name of the parameter: "Enter string Mode to change Mode". To change the Speed or Log Timing Follow the same method. As shown in the picture below.

Figure 6 Change Parameters "Master to Slave"

3.3 Set Default Configuration Parameters

Press '3' to set the default configuration parameters. This option will set the Mode and Speed to Slave and 1000Mbps respectively, as the default mode is Slave mode and default speed is 1000 Mbps.

The log timing will be also changed to the default value, which is 1 Second.

The configuration settings will be saved. So, after reset or power cycle, the converter will have the last configured Speed, Mode, and Log Timing.
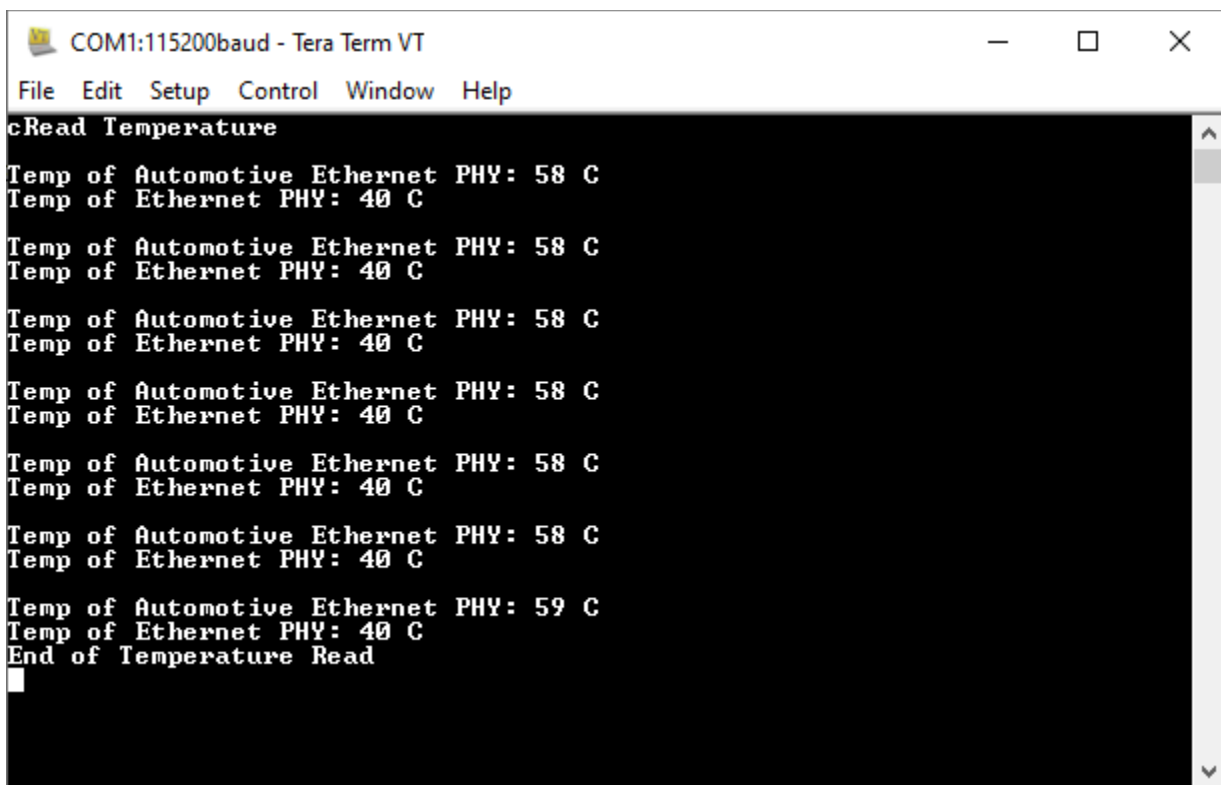
3.4 Erase EEPROM

Press '9' to Erase EEPROM. Erasing the EEPROM will erase the Firmware Flags and Firmware Configurations (Mode/Slave and Log Timing) stored in EEPROM. So, in the next power cycle, the firmware will store default Configuration parameters and Firmware Flags.

This is useful while doing the Firmware Version update, to erase the old version number stored in EEPROM and save the new version number.

3.5 Temperature of Ethernet PHYs

Press 'c'.to read the internal temperature of both the PHYs in Celsius.

Figure 7 Temperature of PHYs in Fahrenheit

3.6 Start/Stop Logs

Press 's' to start or stop the debug logs. Starting the debug logs will print the supplied voltage to the Unit and Ethernet and Automotive Ethernet Link status on Tera Term, as per the Log Timing configuration. i.e., If Log Timing is 1 Second, the converter will print the debug logs every second. Pressing 's' again will stop the logs.
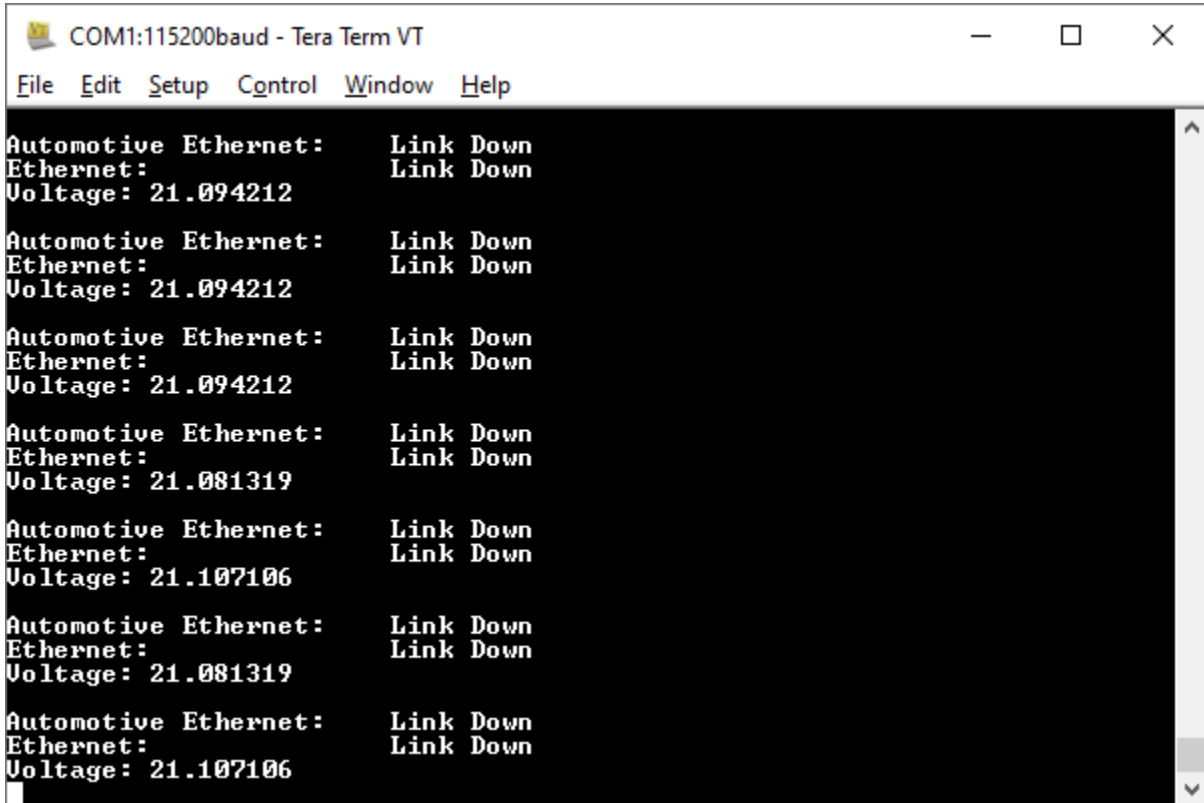
Figure 8 Status Log

3.7 Reboot the Controller

Press 'r' to reboot the converter. This will simply restart the converter. Rebooting the converter will not change the Mode or Speed of the converter. This option is useful to restart the converter through Tera Term.

3.8 Activate bootloader

Press 'b' to activate the bootloader. To activate the bootloader please enter the password: "StartBL".

As shown in the picture below, it will Reboot the convert and the Bootloader will be started. The bootloader ID will be printed, and the bootloader will be activated. Bootloader Menu will give options to load a new Firmware file, to read the current Firmware file, or to reboot the convert to close the bootloader and start the Firmware again.

Figure 9 Bootloader Menu

3.8.1 Load New Application Firmware

Press '1' to upload new Firmware. The firmware will be erased. Type 'Yes' only if a valid firmware file is received from Axiomatic Technologies to reflash. Bootloader flags will be erased. Which shows that firmware is erased.

Ready to flash new firmware? Yes/No: "Enter Yes or No and press enter."

Use Menu: **File->Send File**... with **XON/XOFF control**. Select the Firmware File (AF-22018-xx.yy.af) and select the **"Binary File" options**, where xx.yy represents the major and minor version of the firmware, respectively.
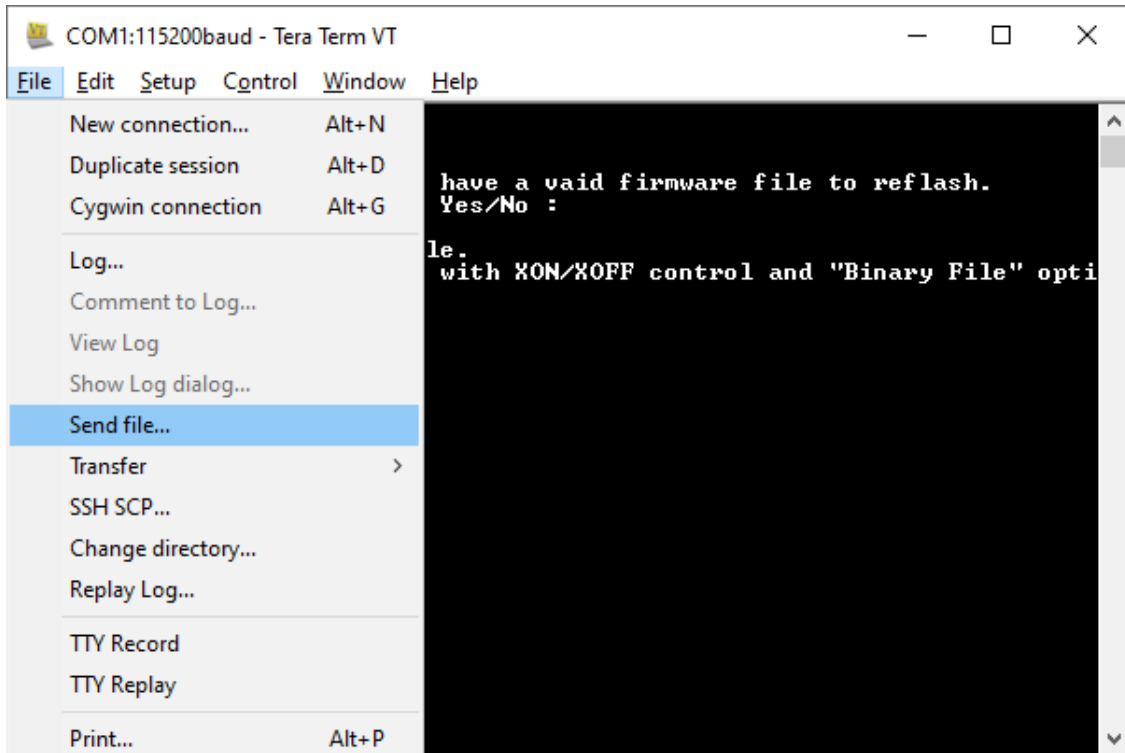
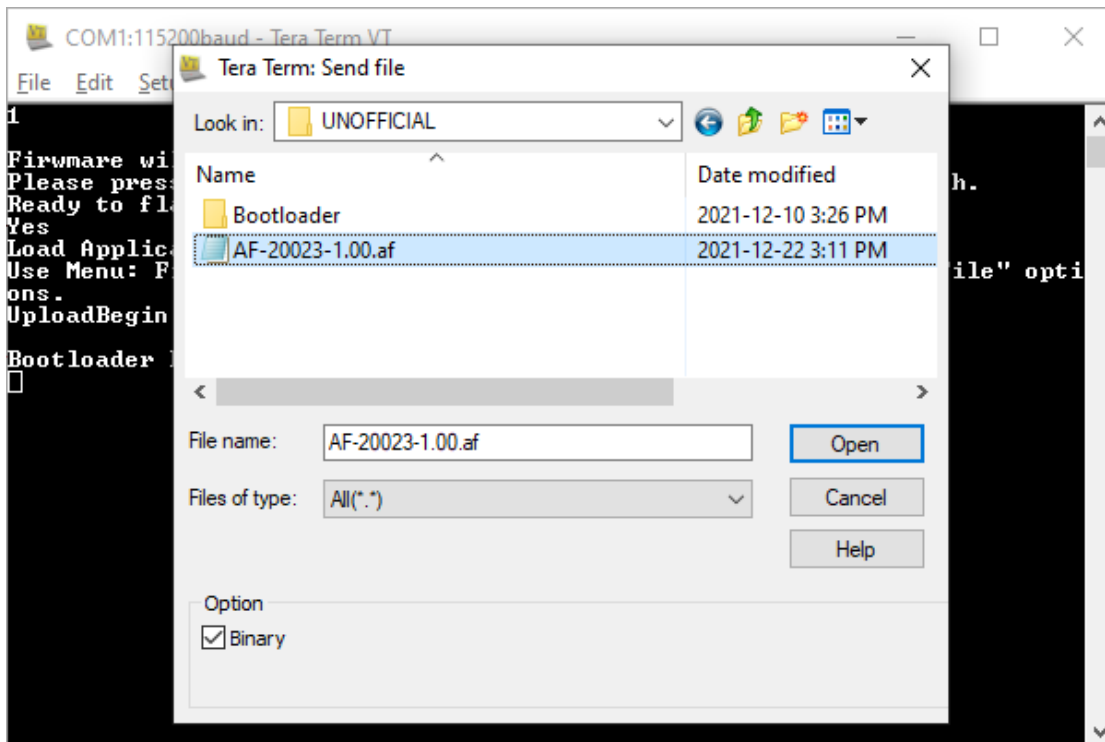*Figure 10 Step 1: File->Send File*

Figure 11 Select "Binary" and Select the Firmware File (Screenshot shown is illustrative only. The firmware loaded will be AF-22018-xx.yy for the AX141550.)

4. 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 Approvals/Limitations and Return Materials Process as described on https://www.axiomatic.com/service/.

4.1 Power Supply Input

Power Supply Input - Nominal	12 Vdc, 24 Vdc nominal (9 Vdc to 36 Vdc power supply range)
Protections	Surge protection is provided. Reverse polarity protection up to -36 V is provided. Input overvoltage (42 V) and input undervoltage (4 V) protection are provided.

4.2 Automotive Ethernet

Port Type	1 port 1000BASE-T1 (IEEE 802.3 ab compliant) Automatic Polarity Correction (for 1000 Mbps mode) Note: For 100 Mbps mode, polarity correction is not functional. Default configuration: Slave (Master mode is configurable via RS-232 interface)
PHY	Marvell 88Q2112 (100BASE-T1/1000BASE-T1)
Protection	ESD protection for signal lines
Protocol	Automotive Ethernet Ethernet IEEE 802.3bw for 100BASE-T1 (previously known as BroadR-Reach) Ethernet IEEE 802.3bp for 1000BASE-T1

4.3 Ethernet

Port Type	1 port 1000BASE-T (IEEE 802.3 bp compliant) Auto-Negotiation Automatic Polarity Correction
MDIX	Auto-MDI/MDIX (crossover)
PHY	Marvell 88EA1512 (100BASE-TX, 1000BASE-T)
Protocol	Ethernet IEEE 802.3
Protection	ESD protection for signal lines

4.4 Interfaces

User Interface for Reflashing	RS-232
RS-232	1 3-wire RS-232 port Configuration Baud Rate: 115200 kbit/s ESD and EFT protection for signal lines
RS-232 User Interface	Any terminal emulator that supports serial communication.

4.5 General Specifications

Functionality	Can be configured to acts as a master or a slave			
Microcontroller	STM32F413CGU6			
Quiescent Current Draw	100 mA @ 12 Vdc; 50 mA @ 24 Vdc			
LEDs	3 GREEN LEDs			
	LED	**ON**	**BLINK**	**OFF**
	Power	Power On		Power Off or Overvoltage/ Undervoltage Condition
	Link	Ethernet Link Up	Ethernet Activity	Ethernet Link Down
	ACT	Automotive Ethernet Link Up	Automotive Ethernet Activity	Automotive Ethernet Link Down

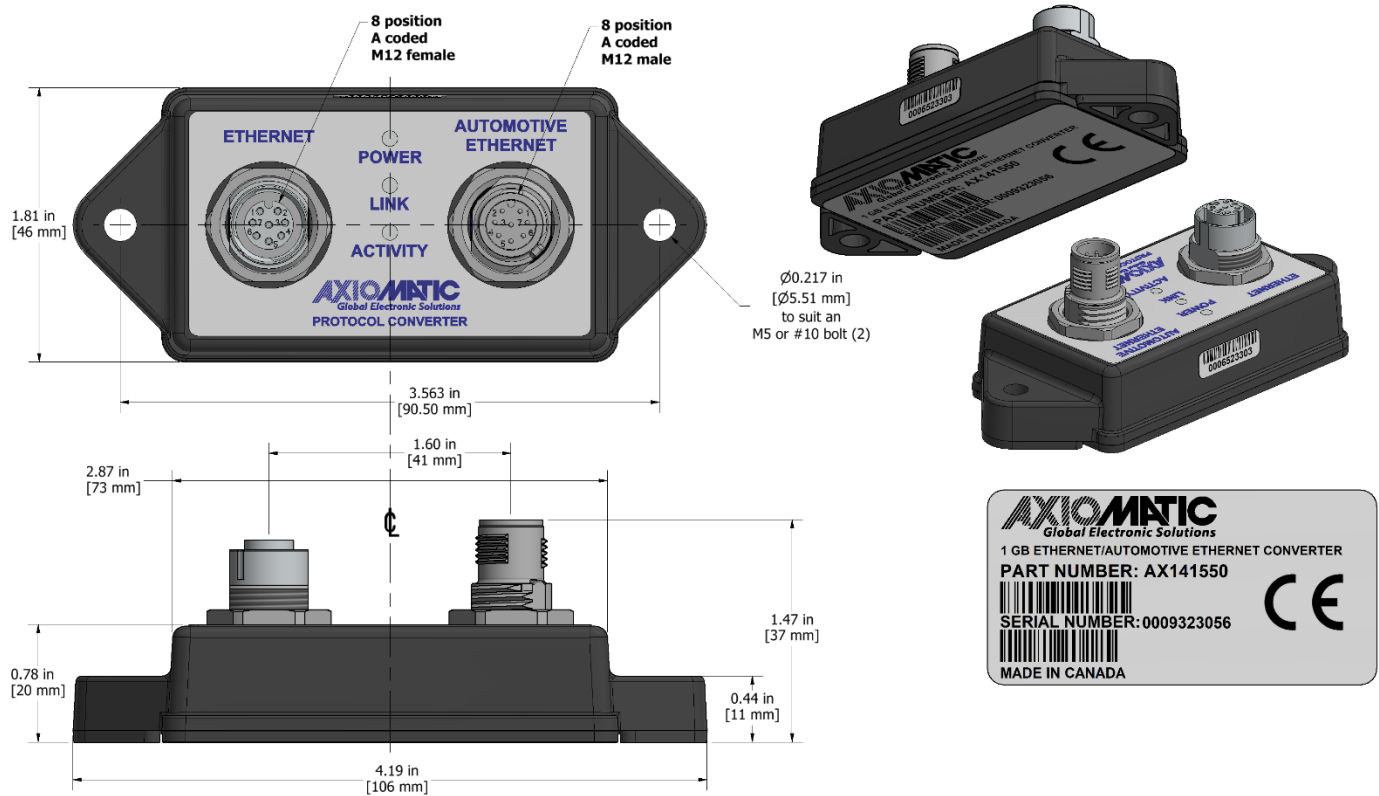| Compliance	CE / UKCA marking ISO 13766-1:2018 RoHS
Vibration	MIL-STD-202H, method 214A, test condition I/B Random Component: 7.56 Grms (8 hr/axis) MIL-STD-202H, method 204D, test condition C Sinusoidal Component: 10 g peak (8 hr/axis)
Shock	MIL-STD-202H, method 213B, test condition A Shock Component: 50 g peak
Operating Conditions	-40°C to 80°C (-40°F to 176°F) Please see temperature ratings of cables under Mating Wire Harnesses.
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Protection	IP67
Weight	0.15 lb. (0.068 kg)
Installation	The typical maximum wire harness length for Automotive Ethernet cabling is 15 m.
Enclosure and Dimensions	See dimensional drawing Figure 2.0. Nylon 6/6, 30% glass fill, Encapsulation UL 94V-0 Ultrasonically welded

4.6 Housing

Figure 12 Dimensional Drawing

4.7 Electrical Connectors

Mating Connectors	Mating connectors should meet the following standard for M12 Connectors, IEC 61076-2-101:2012. They should be A-coded.
Mating Wire Harnesses	The following part numbers are available from Axiomatic. **AX070535:** Ethernet Cable 2 m (6.5 ft.), 8-pin M12 A-coded, Ethernet Jack Note: Cable supplier is Phoenix Contact Network cable NBC-M12MR/2,0-94B/R4AC US – 1406112. The M12 connector on the harness assembly is rated for -20°C to 85°C and the RJ45 ethernet jack is rated as -20°C to 60°C. **AX070537:** Cable 1.5 m (5 ft.), 8-pin M12 A-coded, Unterminated Leads (Details preliminary)

DETAIL A

0.528 in
[13.40 mm]

Circuit diagram contact
assignment of the M12
and RJ45 plug

8 7 6 5 4 3 2 1

Schematic diagram
connector pin assignment
RJ45 plug

Schematic diagram pin assignment
M12 plug, 8-positions, A-coded

2 m

Ambient temperature (operation): -25°C ... 85°C (M12 connector)
-25°C ... 60°C (RJ45 connector)

Degree of protection: IP65 (M12 connector), IP67 (M12 connector
when plugged), IP20 (RJ45 connector)

M12x1

A

1.758 in
[44.65 mm]

Figure 13 AX070535 Mating Cable

Figure 14 AX070537 Mating Cable - Pending

5. VERSION HISTORY

Version	Date	Author	Modifications
1.0	October 16th, 2023	Weixin Kong	Initial Draft
1B	October 23, 2023	A.Wilkins	Added CE marking, ISO 13766-1:2018
1C	October 24, 2023	Weixin Kong	Revise the Technical Data
1D	October 24, 2023	A.Wilkins	Added mating cable p/n AX070537
1E	January 15, 2024	M Ejaz	Added shock test results
-	January 23, 2024	M Ejaz	Updated dimensional drawing

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Automotive Ethernet Interfaces

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DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

Axiomatic provides electronic machine control components to the off-highway, commercial vehicle, electric vehicle, power generator set, material handling, renewable energy and industrial OEM markets. *We innovate with engineered and off-the-shelf machine controls that add value for our customers.*

QUALITY DESIGN AND MANUFACTURING
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COMPLIANCE
Product compliance details can be found in the product literature and/or on axiomatic.com. Any inquiries should be sent to sales@axiomatic.com.

SAFE USE
All products should be serviced by Axiomatic. Do not open the product and perform the service yourself.

⚠️ This product can expose you to chemicals which are known in the State of California, USA to cause cancer and reproductive harm. For more information go to www.P65Warnings.ca.gov.

SERVICE
All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#) from rma@axiomatic.com. Please provide the following information when requesting an RMA number:
- Serial number, part number
- Runtime hours, description of problem
- Wiring set up diagram, application and other comments as needed

DISPOSAL
Axiomatic products are electronic waste. Please follow your local environmental waste and recycling laws, regulations and policies for safe disposal or recycling of electronic waste.

CONTACTS

Axiomatic Technologies Corporation
1445 Courtneypark Drive E.
Mississauga, ON
CANADA L5T 2E3
TEL: +1 905 602 9270
FAX: +1 905 602 9279
www.axiomatic.com
sales@axiomatic.com

Axiomatic Technologies Oy
Höytämöntie 6
33880 Lempäälä
FINLAND
TEL: +358 103 375 750

www.axiomatic.com
salesfinland@axiomatic.com