

# **USER MANUAL**

## **6-Port Automotive Gigabit Ethernet Switch**

**P/N: AX141572**

## ACRONYMS

|        |                                                       |
|--------|-------------------------------------------------------|
| AX     | Axiomatic                                             |
| ASCT   | Automotive Switch Configuration Tool                  |
| ATU    | Address Translation Unit                              |
| AVB    | Audio Video Bridging                                  |
| BATT   | Battery                                               |
| bps    | Bit per second                                        |
| °C     | Celsius (degree)                                      |
| CDS    | Certification Test Subgroup                           |
| CPU    | Central Processing Unit                               |
| dB     | Decibel                                               |
| DSCP   | Differentiated Services Code Point                    |
| EEPROM | Electrically Erasable Programmable Read-Only Memory   |
| IEEE   | Institute of Electrical and Electronics Engineers     |
| °F     | Fahrenheit (degree)                                   |
| Gbps   | Gigabit per second                                    |
| GND    | Ground                                                |
| gPTP   | Generalized Precision Time Protocol                   |
| H      | Height (for size)                                     |
| ID     | Identifier                                            |
| IEC    | International Electrotechnical Commission             |
| in     | inch                                                  |
| IP     | Internet Protocol or Ingress Protection (for housing) |
| IRL    | Ingress Rate Limiting                                 |
| ISO    | International Organization for Standardization        |
| 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                                   |
| Mpps   | Mega packets per second                               |
| mm     | millimetres                                           |
| N/A    | Not Applicable or Not Assigned                        |
| NDA    | Non-Disclosure Agreement                              |
| PC     | Personal Computer                                     |
| PHY    | Physical Layer Transceiver (Ethernet chip)            |
| P/N    | Part Number                                           |
| PTP    | Precision Time Protocol                               |
| PWR    | Power                                                 |
| PWREN  | Power Enable                                          |

|      |                                     |
|------|-------------------------------------|
| QoS  | Quality of service                  |
| RoHS | Restriction of Hazardous Substances |
| STP  | Shielded Twisted Pair               |
| TBD  | To be Determined                    |
| TCAM | Ternary Content-Addressable Memory  |
| TR   | Technical Report                    |
| TRD  | Transmit/Receive Differential       |
| TSN  | Time-Sensitive Networking           |
| UTP  | Unshielded Twisted Pair             |
| V    | Volt                                |
| VDC  | Volt Direct Current                 |
| VLAN | Virtual Local Area Network          |
| W    | Width (for size)                    |

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## **1 INTRODUCTION**

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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 version number reflects major changes to the user manual. Minor updates are done by adding letters: A, B, ..., Z to the version number.

## 2 DEVICE DESCRIPTION

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

In the default configuration, the device operates as an unmanaged switch with six 1000BASE-T1 ports in Master mode.

For managed switch operations, the device can be configured using a proprietary Automotive Switch Configuration Tool (ASCT) that can be acquired through NDA with Infineon. Windows and Linux versions are available.

The device configuration supports standard VLAN settings and advanced AVB/TSN features, including 802.1AS-2020 (gPTP) and AutoCDS 1.6 PTP profiles with credit based 802.1Qav and time aware 802.1Qbv shaping.

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.

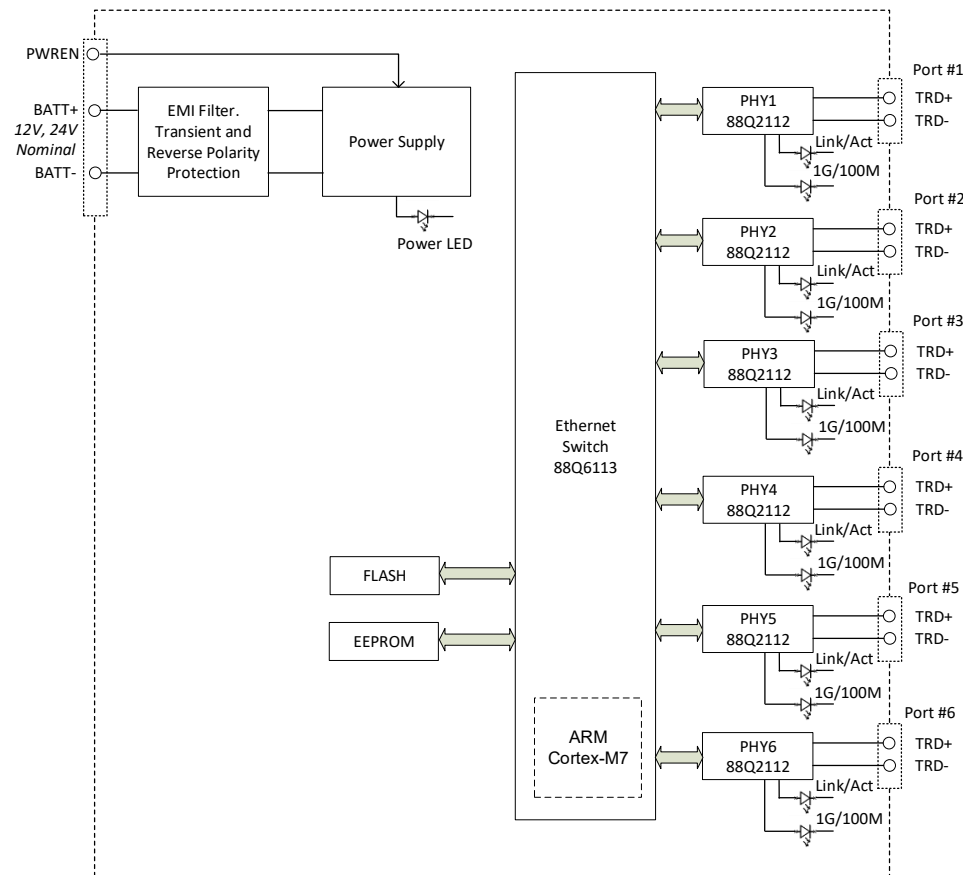


Figure 1. Device Hardware Block Diagram

The device contains six independent Gigabit Automotive Ethernet ports: Port #1...#6, 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 Infineon automotive Ethernet switch 88Q6113 paired with six Infineon PHY transceivers 88Q2112. Each PHY transceiver has its own Link/Activity (Link/Act) and Speed (1G/100M) LED indicators hardwired to the PHY chip.

The device is controlled by Infineon 88Q6113 switch firmware running on internal ARM Cortex M7 CPU. The Flash and EEPROM are used to store the firmware and configuration parameters of the switch.

### 3 DEVICE CONFIGURATION

For advanced managed options, the device can be configured using a proprietary Automotive Switch Configuration Tool (ASCT) from Infineon. Windows and Linux versions are available, please contact Infineon for further details.

A PC running the tool can be connected to any port of the switch, unless the port is disabled by the current switch configuration.

#### 3.1 Port PHY Configuration

The ASCT allows users to configure the device port speed (1Gbit/s or 100Mbit/s) and mode (Master or Slave) for each port individually using the runtime operation settings.

Use the following commands to configure the device PHYs to the necessary port settings, see Table 1.

Table 1. PHY Configuration Commands

| Port Number | PHY Configuration Command                                                 |
|-------------|---------------------------------------------------------------------------|
| 1           | WriteClause45, 1, 1, 1, 0x0834, 0xc001, Port #1 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 1, 1, 1, 0x0834, 0x8001, Port #1 1Gbps Slave               |
|             | WriteClause45, 1, 1, 1, 0x0834, 0xc000, Port #1 100Mbps Master            |
|             | WriteClause45, 1, 1, 1, 0x0834, 0x8000, Port #1 100Mbps Slave             |
| 2           | WriteClause45, 2, 1, 1, 0x0834, 0xc001, Port #2 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 2, 1, 1, 0x0834, 0x8001, Port #2 1Gbps Slave               |
|             | WriteClause45, 2, 1, 1, 0x0834, 0xc000, Port #2 100Mbps Master            |
|             | WriteClause45, 2, 1, 1, 0x0834, 0x8000, Port #2 100Mbps Slave             |
| 3           | WriteClause45, 3, 1, 1, 0x0834, 0xc001, Port #3 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 3, 1, 1, 0x0834, 0x8001, Port #3 1Gbps Slave               |
|             | WriteClause45, 3, 1, 1, 0x0834, 0xc000, Port #3 100Mbps Master            |
|             | WriteClause45, 3, 1, 1, 0x0834, 0x8000, Port #3 100Mbps Slave             |
| 4           | WriteClause45, 4, 1, 1, 0x0834, 0xc001, Port #4 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 4, 1, 1, 0x0834, 0x8001, Port #4 1Gbps Slave               |
|             | WriteClause45, 4, 1, 1, 0x0834, 0xc000, Port #4 100Mbps Master            |
|             | WriteClause45, 4, 1, 1, 0x0834, 0x8000, Port #4 100Mbps Slave             |
| 5           | WriteClause45, 5, 1, 1, 0x0834, 0xc001, Port #5 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 5, 1, 1, 0x0834, 0x8001, Port #5 1Gbps Slave               |
|             | WriteClause45, 5, 1, 1, 0x0834, 0xc000, Port #5 100Mbps Master            |
|             | WriteClause45, 5, 1, 1, 0x0834, 0x8000, Port #5 100Mbps Slave             |
| 6           | WriteClause45, 6, 1, 1, 0x0834, 0xc001, Port #6 1Gbps Master <sup>1</sup> |
|             | WriteClause45, 6, 1, 1, 0x0834, 0x8001, Port #6 1Gbps Slave               |
|             | WriteClause45, 6, 1, 1, 0x0834, 0xc000, Port #6 100Mbps Master            |
|             | WriteClause45, 6, 1, 1, 0x0834, 0x8000, Port #6 100Mbps Slave             |

<sup>1</sup>Default port configuration. Command can be omitted; it is included for completeness only.

## 4 TECHNICAL SPECIFICATIONS

### 4.1 Power Supply

Table 2. Power Supply Input

| Parameter                            | Value                                           | Remarks                                |
|--------------------------------------|-------------------------------------------------|----------------------------------------|
| Supply Voltage                       | 9 to 36 VDC                                     | 12 V, 24 V – nominal                   |
| Standby Supply Current <sup>1</sup>  | TBD                                             | 12 V – typical <sup>4</sup>            |
|                                      | TBD                                             | 24 V – typical <sup>4</sup>            |
| Maximum Supply Current <sup>2</sup>  | TBD                                             | 12 V – typical <sup>4</sup>            |
|                                      | TBD                                             | 24 V – typical <sup>4</sup>            |
| Shutdown Supply Current <sup>3</sup> | 0.1 mA                                          | 12 V – typical <sup>4</sup>            |
|                                      | 0.2 mA                                          | 24 V – typical <sup>4</sup>            |
| Power Enable Input (PWREN)           | On, if $V_{PWREN} > 6\text{ V}$                 | Can be connected to BATT+              |
|                                      | Off, if $V_{PWREN} < 0.5\text{ V}$              | Can be left open or connected to BATT- |
|                                      | $R_{PWREN} \gg 10\text{ k}\Omega$               | High impedance input                   |
| LED Indicator                        | Power ON                                        | Green LED                              |
| Protection                           | Overvoltage, Reverse Polarity, Transients/Surge |                                        |

<sup>1</sup>All Ethernet ports are set at maximum speed and disconnected.

<sup>2</sup>All Ethernet ports are set at maximum speed and connected.

<sup>3</sup>Power supply is disabled. PWREN input is left open.

<sup>4</sup>At room temperature (25 °C).

### 4.2 Ethernet Switch

Table 3. Ethernet Switch Parameters

| Parameter                          | Value                          | Remarks                                                |
|------------------------------------|--------------------------------|--------------------------------------------------------|
| Number of Ports                    | 6                              | Individually configurable                              |
| Switch Type                        | Unmanaged/Managed <sup>1</sup> | Managed if configuration software is used <sup>1</sup> |
| 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              | Per port                                               |
|                                    | 802.1p/DSCP QoS                |                                                        |
| Port Type                          | 1000BASE-T1                    | IEEE 802.3bp-2016. Default setting                     |
|                                    | 100BASE-T1                     | IEEE 802.3bw-2015                                      |
| Port Speed                         | 1 Gbps/100 Mbps <sup>2</sup>   | 1 Gbps default                                         |
| Port Mode                          | Master/Slave <sup>2</sup>      | Master default                                         |
| Port LED Indicators                | Yellow - Link/Activity         | One set per port                                       |
|                                    | Green - Speed                  |                                                        |
| Software Configurable <sup>1</sup> |                                |                                                        |
| Packet Forwarding                  | Static ATU Entries             | Static MAC address translation                         |
| VLAN                               | Port-based VLANs               |                                                        |
|                                    | 802.1Q Tag VLANs               | 4K VLAN IDs                                            |
|                                    | Port Mirroring                 |                                                        |
| Ingress Rate Limiting              | 8 IRL Resources                | Per port                                               |
| AVB/TSN                            | 802.1AS-2020                   | gPTP                                                   |

| Parameter              | Value                     | Remarks                                                                 |
|------------------------|---------------------------|-------------------------------------------------------------------------|
|                        | AutoCDS 1.6               | Avnu Alliance                                                           |
|                        | 802.1Qav                  | Forwarding and Queuing for Time-Sensitive Streams. Credit Based Shaping |
|                        | 802.1Qbv                  | Enhancements for Scheduled Traffic. Time Aware Shaping                  |
|                        | Static Stream Reservation | 62 streams                                                              |
| Deep Packet Inspection | 48-byte and 96-byte Depth | TCAM-based, 256 rules                                                   |

<sup>1</sup> Automotive Switch Configuration Tool v4. Proprietary software from Infineon. NDA is required.

<sup>2</sup> Configurable by Automotive Switch Configuration Tool using runtime operation settings.

#### 4.2.1 LED Indicators

Table 4. Link/Activity (LINK/ACT) LED

| LED             | Description           |
|-----------------|-----------------------|
| Off             | No Link               |
| Yellow          | Link is up            |
| Blinking Yellow | Link is up and active |

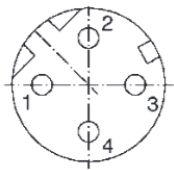
Table 5. Speed (1G/100M) LED

| LED   | Description                       |
|-------|-----------------------------------|
| Off   | Link is up at 100 Mbps or no link |
| Green | Link is up at 1 Gbps              |

#### 4.3 Ethernet Connector

M12 socket, 4-pin, D-coded, shielded female connector, BINDER, P/N: 99-3732-201-04. Use D-coded mating connectors compliant with IEC 61076-2-101:2012 or AX070168 accessory cable, see Table 9. For Ethernet connector pinout, see Table 6.

Table 6. Ethernet Connector Pinout

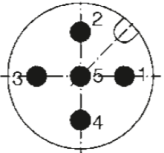
| PIN # | Description |  |
|-------|-------------|-------------------------------------------------------------------------------------|
| 1     | TRD+        |                                                                                     |
| 2     | N/C         |                              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

For Automotive Ethernet cable requirements see Appendix A.

#### 4.4 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 or AX070169 accessory cable, see Table 9. For Power connector pinout, see Table 7.

Table 7. Power Connector

| PIN # | Description        |  |
|-------|--------------------|-------------------------------------------------------------------------------------|
| 1     | PWREN <sup>1</sup> |                                                                                     |
| 2     | BATT+              |                                                                                     |
| 3     | BATT-              |                                                                                     |

|     |                             |  |
|-----|-----------------------------|--|
| 4,5 | Not used. Keep disconnected |  |
|-----|-----------------------------|--|

<sup>1</sup> Connect to BATT+, if not used.

## 4.5 General Specifications

Table 8. 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<br>(184.2 mm x 95.3 mm x 40.0 mm) | L x W x H excluding connectors.<br>See dimensional drawing |
| Weight                   | 1.41 lbs (0.64 kg)                                            |                                                            |
| Compliance               | RoHS Directive                                                |                                                            |

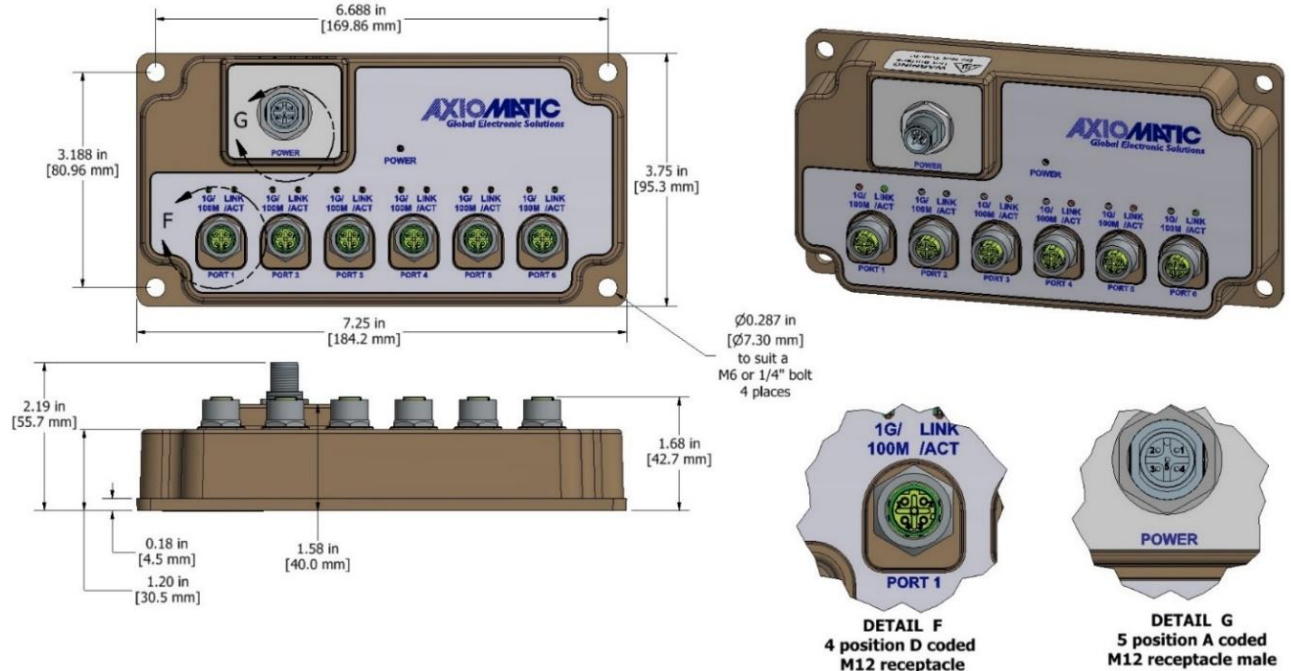
## 4.1 Accessories

Table 9. Accessories

| Axiomatic P/N | Description                                                                     |
|---------------|---------------------------------------------------------------------------------|
| AX070168      | Automotive Ethernet Cable, 4-pin M12 D-coded, 2 m (6.5 ft.), Underminated Leads |
| AX070169      | Power Cable, 5-pin M12 A-coded, 5 m (16.4 ft.), Underminated Leads              |

## 4.2 Housing

Cast aluminum, anodized enclosure. Lexan overlay. For dimensional drawing, see Figure 2.



## 5 APPENDIX A. Ethernet Cable Requirements

Automotive Ethernet utilizes a single balanced twisted pair with 100 Ohm characteristic impedance. The cable characteristics should meet or exceed the appropriate automotive Ethernet standard, see Table A1.

Table A1. Cable Requirements

| Port Speed | Cable Type | Segment Type           | Frequency Range | Maximum Cable Insertion Loss <sup>1</sup> | Maximum Distance | Ethernet Standard |
|------------|------------|------------------------|-----------------|-------------------------------------------|------------------|-------------------|
| 1 Gbps     | UTP, STP   | B (Optional Segment)   | 1-600 MHz       | 8.5 dB @ 100MHz                           | 40m              | IEEE 802.3bp-2016 |
|            |            |                        |                 | 13.8 dB @ 250 MHz                         |                  |                   |
|            |            |                        |                 | 22.3 dB @ 600 MHz                         |                  |                   |
|            | UTP        | A (Automotive Segment) | 1-600 MHz       | 6.1 dB @ 100 MHz                          | 15m              |                   |
|            |            |                        |                 | 9.9 dB @ 250 MHz                          |                  |                   |
|            |            |                        |                 | 15.9 dB @ 600 MHz                         |                  |                   |
| 100 Mbps   | UTP        | -                      | 1-66 MHz        | 2.6 dB @ 10 MHz                           | 15m              | IEEE 802.3bw-2015 |
|            |            |                        |                 | 4.9 dB @ 33 MHz                           |                  |                   |
|            |            |                        |                 | 7.2 dB @ 66 MHz                           |                  |                   |

<sup>1</sup> At maximum cable length. For other cable characteristics see the appropriate Ethernet standard.

Depending on the application, the following cable standards can be used for selecting the Ethernet cable, see Table A2.

Table A2. Cable Standards

| Application               | Cable Standard                                                                                                                                                                                                               |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Automotive                | OPEN Alliance TC9, Channel and Components Requirements for 1000BASE-T1 Link Segment Type A (STP).<br>OPEN Alliance TC9, Channel and Components Requirements for 1000BASE-T1 Link Segment Type A (UTP).                       |
| Commercial and Industrial | ISO/IEC TR 11801-9906 (T1-B cable type or better for 100BASE-T1, 1000BASE-T1 Type A, B)<br>IEC 61156-11 (Horizontal floor wiring. T1-B cable type parameters)<br>IEC 61156-12 (Work area wiring. T1-B cable type parameters) |

## 6 APPENDIX B. Third Party Software License Notices

This section contains Third Party Software License Notices and/or Additional Terms and Conditions for licensed third-party software components included in the switch firmware.

Table 3. Third Party Software License Notices

| Third Party Software      | License Notice/Terms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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## 7 VERSION HISTORY

| User Manual Version | Date          | Author      | Modifications                                                    |
|---------------------|---------------|-------------|------------------------------------------------------------------|
| 1                   | April 7, 2026 | Olek Bogush | <ul style="list-style-type: none"><li>Initial release.</li></ul> |

## OUR PRODUCTS

AC/DC Power Supplies  
Actuator Controls/Interfaces  
Automotive Ethernet Switches  
Battery Chargers  
CAN Controls, Routers, Repeaters  
CAN/WiFi  
CAN/Bluetooth (Classic, BLE)  
CAN bus Routers  
CANopen I/O Modules  
Current/Voltage/PWM Converters  
DC/DC Power Converters  
Engine Temperature Scanners  
Ethernet/CAN Converters, Gateways  
Ethernet Switches  
Fan Drive Controllers  
Gateways, CAN/Modbus, RS-232  
Gyroscopes, Inclinometers  
Hydraulic Valve Controllers  
Inclinometers, Triaxial  
I/O Controls  
LVDT Signal Converters  
Machine Controls  
Media Converters  
Modbus, RS-422, RS-485 Controls  
Motor Controls, Inverters  
Power Supplies, DC/DC, AC/DC  
PWM Signal Converters/Isolators  
Resolver Signal Conditioners  
SAE J1939 I/O Modules  
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

We have an ISO9001 registered R&D, electronics design and manufacturing facility in Canada.

Sales offices are in Canada, USA, Australia and Finland.

## COMPLIANCE

Product compliance details can be found in the product literature and/or on [axiomatic.com](http://axiomatic.com). Any inquiries should be sent to [sales@axiomatic.com](mailto: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](http://www.P65Warnings.ca.gov).

## TECHNICAL SUPPORT

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- Wiring set up diagram, application and other comments as needed

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