

## BLDC Motor Drive

Drives a 12V, 24V or 48VDC BLDC motor

Bidirectional, up to 25A

Smooth and precise speed control using Hall Sensors

CAN (SAE J1939)

with Electronic Assistant® 

### Features:

- Speed control of one BLDC motor (12/24/48V, up to 25A)
- User configurable to suit various motor requirements
- Can interface with integral Hall Effect Commutation Sensors
- Regenerative braking supported
- Power or current limiting mode for heat protection
- Motor enable input (digital input)
- Digital input for motor direction
- Accepts 1 0-5V or 0-10V or 0-20mA or 4-20mA input for speed command (user configurable)
- Option: 2<sup>nd</sup> analog input
- CAN (SAE J1939) can alternatively provide all command inputs.
- Bridge-type driver uses Pulse Width Modulation
- 1 digital output acts as Hall output for reading or monitoring RPM
- Robust 8...60VDC power supply interface with transient surge and reverse polarity protection
- Thermal overload, under-voltage, short circuit and over-current protection provided
- 1+5V reference (+12V optional)
- 1 RS-232 port, 1 CAN port (SAE J1939) (CANopen® on request)
- Rugged IP67 rated packaging with watertight plug-in connections
- Operational from -40 to 85°C (-40 to 185°F)
- Suitable for moist, high shock and vibration environments
- **Electronic Assistant®**  runs on a *Windows* operating system for user configuration. An Axiomatic USB-CAN converter links the PC to the CAN bus.
- Alternatively, PC-based user setup and configuration can be performed with Tera Term data terminal via RS-232



**Applications:** The Axiomatic motor drive controls a variety of low power, low voltage brushless (BLDC) motors. It can be used in applications, such as:

- Transportation power plants
- Mobile equipment (off-highway)
- Fuel cells
- Material handling equipment, electric vehicles
- Industrial automation

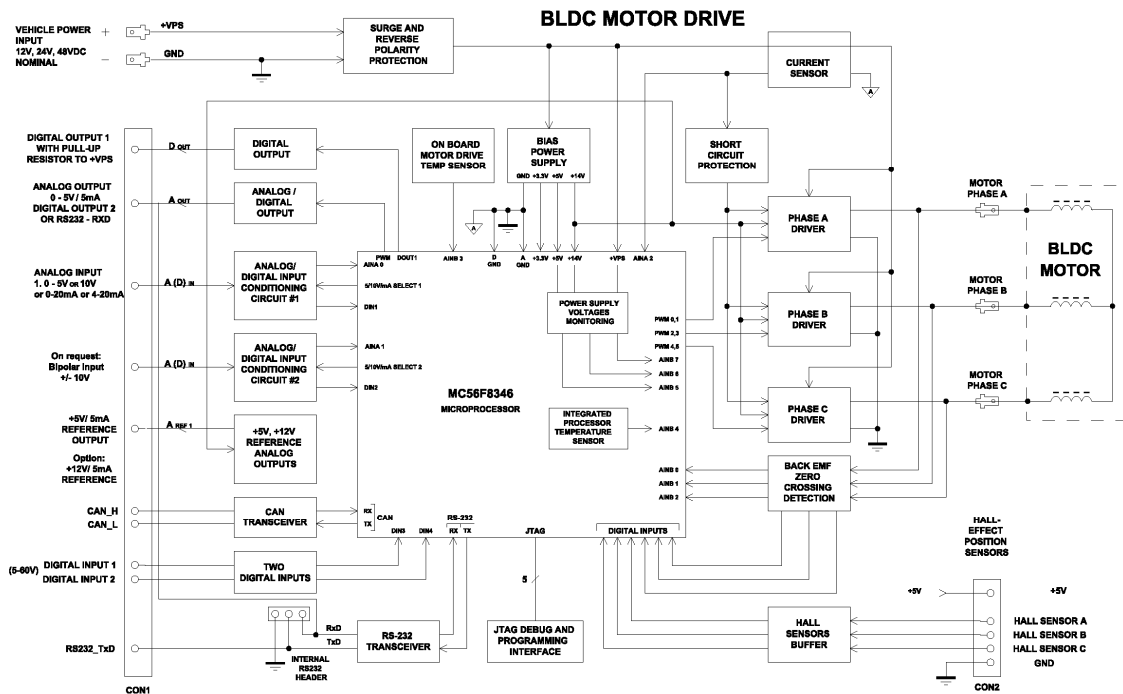
<p><b>Ordering Part Numbers:</b></p> <p><b>Motor Controller P/N: AX100200</b> <i>For options to be implemented, contact Axiomatic.</i></p> <p><b>Accessories:</b></p> <p><b>Mating Connector KIT P/N: AX070400</b> (ITT Cannon connectors: CB6E16-11P, CB6E16-10P, CB6E14S-5P, CB6E20-11P)</p>	<p><b>AX070502 Configuration KIT</b> includes the following.</p> <p>USB-CAN Converter P/N: AX070501 1 ft. (0.3 m) USB Cable P/N: CBL-USB-AB-MM-1.5 12 in. (30 cm) CAN Cable with female DB-9 P/N: CAB-AX070501 AX070502IN CD P/N: CD-AX070502, includes: <b>Electronic Assistant®</b> software; EA &amp; USB-CAN User Manual UMAX07050X; USB-CAN drivers &amp; documentation; CAN Assistant (Scope and Visual) software &amp; documentation; and the SDK Software Development Kit.</p> <p><b>NOTE: To order this kit, you need only to specify P/N: AX070502.</b></p>
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## Configuration:

The controller is user configurable by either setting up different parameters. Pre-programmed motor profiles are available on request. A PC-based data terminal such as Tera Term is used to configure the controller via RS-232 serial communications. Alternatively, the controller can be remotely configured via the Electronic Assistant® on a SAE J1939 network. The following is a list of configurable parameters when using the Electronic Assistant®.

- Number of poles
- Rated motor RPM
- Rated motor current
- Acceleration time
- Deceleration time
- Heat protection mode
- Power/current limit
- Speed control mode: open loop (default) or closed loop
- Speed open loop gain
- Speed PID gains

## Block Diagram



## Technical Specifications:

### Input Specifications

Power Supply Input - Nominal	12V, 24V or 48V nominal power supply (8..60V range) Transient surge protection is provided. Inrush current limiting is provided. Regenerative energy absorbing is provided.
Reverse Polarity Protection	Provided
Discrete Control Inputs	1 analog input (0-5V, 0-10V, 0-20mA or 4-20mA) for speed command User configurable Option: 2 <sup>nd</sup> analog input (Contact Axiomatic.)  2 digital inputs for enable and direction control at battery voltage level normally and with 5-60V operating range (Factory default is both active high.)
Position Feedback with Sensor	Interfaces to 3 Hall Effect Position Sensors integrated into the motor.

### Output Specifications

Drive Output	Outputs to one BLDC motor (12V/24/48V, up to 25A) High Frequency PWM output 37.5A @ 24VDC nominal for 2 minutes 30A @ 24VDC nominal for 5 minutes 25A @ 24VDC nominal for 1 hour
PWM Frequency	10-15 kHz
Digital Output	1 Pulse Frequency Modulation (PFM) output (at battery voltage level) for reading and monitoring RPM (Active low with pull-up) User configurable as controlled from software or acting as a buffered Hall position sensing signal for external speed reading (Default: Hall output)
Protection	Overcurrent, Short circuit protection provided Driver over-temperature protection provided
Reference Voltage	+5 Volts, 5 mA (Option: +12V)

### Operating Mode

Basic Operation	Open loop or closed loop speed control (user configurable)
Regenerative Braking	Inherent operating mode
Power/Current Limiting	Power or current limiting operating mode (user configurable) allows the drive to safely operate when it exceeds the preset power/current limit. The default is current limiting. This mode is only useful in open loop speed control operation mode and is primarily for heat protection.

## General Specifications

Microprocessor	Motorola MC56F83546 128 Kbytes program flash 8 Kbytes data flash 8 Kbytes data RAM 8 Kbytes boot flash Clock 60 MHz
Control Logic	Standard embedded software is provided.
RS-232 Interface	RS232 serial communication is available for interface to a serial port (i.e. COM1) on a PC (19200 Baud Rate, N81) Tera Term or Microsoft HyperTerminal™ or an equivalent data terminal A wire harness with a built-in RS-232 connector must be used with the following pinout. Controller Connector, RS-232 TXD -> female DB-9 Pin 2 Controller Connector, RS-232 RXD -> female DB-9 Pin 3 Controller Connector, RS-232 GND -> female DB-9 Pin 5
CAN port	SAE J1939 (CANopen® on request)
CAN User Interface	Electronic Assistant® for <i>Windows</i> operating systems It comes with a royalty-free license for use.  The Electronic Assistant® requires an USB-CAN converter to link the device's CAN port to a <i>Windows</i> -based PC for initial configuration. An Axiomatic USB-CAN Converter AX070501 is available. Order the EA and USB-CAN as a kit (P/N AX070502), which includes all interconnecting cables.

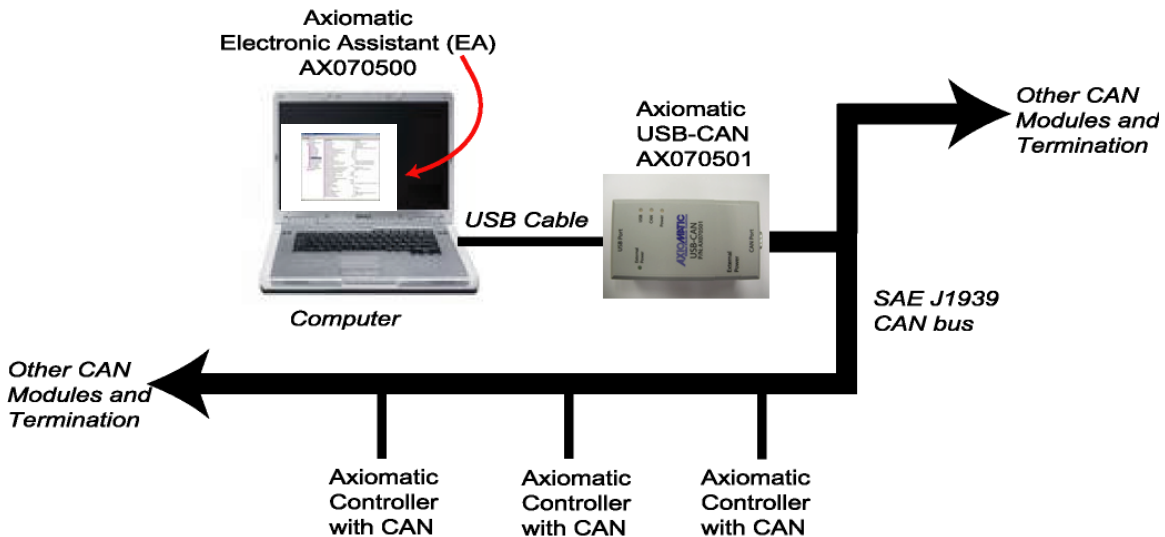


Figure 1 - User Configuration Using Electronic Assistant® (EA)

**Table 1 - Electronic Assistant® and USB-CAN Converter**

**AX070502**, Configuration KIT includes the following.  
 USB-CAN Converter P/N: AX070501  
 1 ft. (0.3 m) USB Cable P/N: CBL-USB-AB-MM-1.5  
 12 in. (30 cm)CAN Cable with female DB-9 P/N: CAB-AX070501  
 AX070502IN CD P/N: CD-AX070502, includes: Electronic Assistant® software AX070500; EA & USB-CAN User Manual UMAX07050X; USB-CAN drivers & documentation; CAN Assistant (Scope and Visual) software & documentation; and the Software Development Kit.  
**NOTE: To order this kit, you need only to specify P/N: AX070502.**

**Electronic Assistant®** 

The Electronic Assistant® (EA) runs on any modern PC with the Microsoft Windows® 2000 operating system or higher. It comes with a royalty-free license for use.

**System Requirements:**

- Operating System: *Windows* 2000 or higher including 64-bit editions
- Port: USB 1.1 or 2.0 full speed
- Display: VGA (XGA or better with 1024 x 768 recommended)
- Setup and Configuration: Refer to the User Manual UMAX07050X.

**To order the EA software at the time of initial purchase, order the KIT AX070502 (see above) which includes the USB-CAN converter.** For additional EA and USB-CAN software ONLY CD's, use ordering P/N: CD-AX070502.

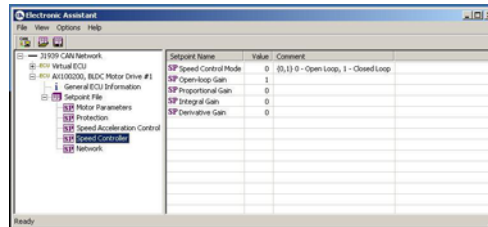
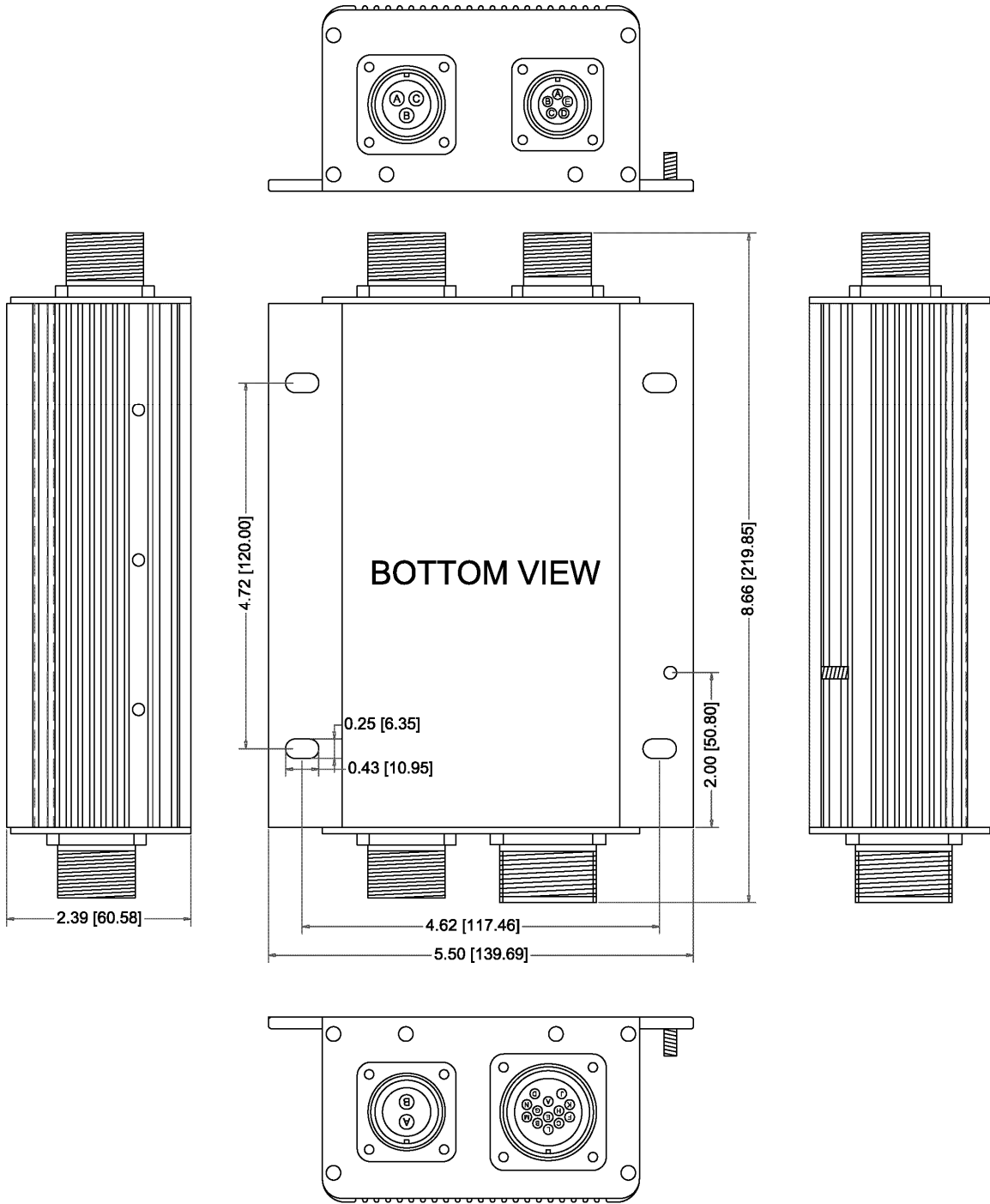


Figure 7.0 Configuration screen from the Electronic Assistant®

The Electronic Assistant® (EA) is a *Windows*-based software configuration tool that runs on a PC connected to a J1939 bus via a USB to CAN converter, AX070501. Upon being connected to the bus, the EA will find all the Electronic Control Units (ECU) on the bus, and recognized those manufactured by Axiomatic. Using this tool, a user can quickly configure an Axiomatic ECU for the desired performance over a wide variety of applications.

Electrical Connections	<p><b>Power input connector (C1):</b> ITT Cannon P/N CT2R16-11S (Mating connector: ITT Cannon CT6E16-11P) A: Batt+ B: Batt-</p> <p><b>Motor output connector (C2):</b> ITT Cannon P/N CT2R16-10S (Mating connector: ITT Cannon CT6E16-10P) A: Phase A B: Phase B C: Phase C</p> <p><b>Hall sensor connector (C3):</b> ITT Cannon P/N CT2R14S-5S (Mating connector: ITT Cannon CT6E14S-5P) A: Hall Sensor A B: Hall Sensor B C: Hall Sensor C D: +5V E: GND</p> <p><b>Signal connector (C4):</b> ITT Cannon P/N CT2R20-11S (Mating connector: ITT Cannon CT6E20-11P) A: +5V Reference B: GND C: Digital In 1 (Enable) D. Analog In 1 (Speed Command) E. OPTION: Analog Input 2 F. Digital Input 2 (Direction) G. GND Analog H. CAN_H J. CAN_L K. CAN_GND L. Digital Out M. RS-232 TXD N. RS-232 RXD Note: 1 – Either GND or CAN-GND can be used as RS-232 GND.</p> <p>Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s).</p>
Mounting	<p>The motor controller should be mounted as close to the battery and/or the motor as possible. Install the unit with appropriate space available for servicing and for adequate wire harness access and strain relief.</p> <p>Mounting ledges include holes sized for M6 or ¼ inch bolts. The bolt length will be determined by the end-user's mounting plate thickness. Typically 20 mm (3/4 inch) is adequate.</p>
Packaging and Dimensions	<p>Encapsulated Packaged in an aluminum extrusion with stainless steel end plates 5.50 x 6.77 x 2.39 inches (W x L x H excluding connectors) 139.7 x 172.0 x 60.6 mm Refer to the dimensional drawing.</p>
Weight	4.20 lbs. (1.90 kg)
Operating Conditions	Operating: -40 to 85°C (-40 to 185°F)
Protection Rating	IP67



### Dimensional Drawing (inches [mm])

Note: CANopen® is a registered community trade mark of CAN in Automation e.V.

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 [www.axiomatic.com/service.html](http://www.axiomatic.com/service.html).

Form: TDAX100200-06/12/09