25A DC MOTOR CONTROLLER

Variable Speed Control, Onboard I/O
CAN SAE J1939, Rugged Packaging
with Axiomatic Electronic Assistant

P/N: AX100100

Features:

- Unidirectional or bi-directional DC motor control (up to 25A)
- Flexible control
  - ➤ open loop speed control;
  - ➤ closed loop speed control (on request);
  - ➤ external feedback control (application-specific and on request).
- 2 inputs are user configurable from the following: 0-5V; 0-10V; 0-20 mA; 4-20 mA; or digital.
- Map the control input to either of the 2 command inputs or messages from a CAN bus.
- Enable function can be mapped to 2 inputs or CAN
- 4 configurable and independent ramps smooth motor rotation, protecting the controller and the system
- Additional 2 current outputs (2A proportional or hotshot digital) drive accessories such as hydraulic valves or relays for machine control or safety interlock.
- 1 0-5V output provides a configurable multi-functional feedback signal for monitoring purposes
- Outputs can be coded as feedback messages sent to the CAN bus
- A reference voltage is provided to power an external sensor or potentiometer.
- Highly efficient and robust design with isolation for drive and processing circuits
- Operational from 9 to 36VDC (12 or 24VDC nominal)
- CAN (SAE J1939) is provided (CANopen® on request)
- **Axiomatic Electronic Assistant** for setpoint configuration
- Compact size for easy mounting on a vehicle
- Suitable for moist, high shock and vibration environments
- Rugged IP67 corrosion resistant aluminum housing
- Operational from -40 to 85°C (-40 to 185°F)

Applications: Motor variable speed, position and/or flow control in Lift Equipment, Electric Vehicles for Material Handling, Cranes and Hoists, Hydraulic Tail Lifts and Winches, Golf Carts, Military Equipment, Mobile Pumps and Hydraulic Powerpacks

Ordering Part Numbers:
Motor Controller P/N: **AX100100**   **Accessories:**   Axiomatic Electronic Assistant Configuration KIT, P/Ns: **AX070502,** or **AX070506K**   **Wire Harness KIT** P/N: **AX070100**   *Or you can order them individually.*   CAN and I/O wire harness assembly, 2m   - P/N: **AX070102**   Power and Motor Control wire harness assembly, 2m - P/N: **AX070103**   RS-232 wire harness – P/N: **AX070101**   *(Note: The AX070101 is not required if the Axiomatic EA is used for configuration.)*

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/.
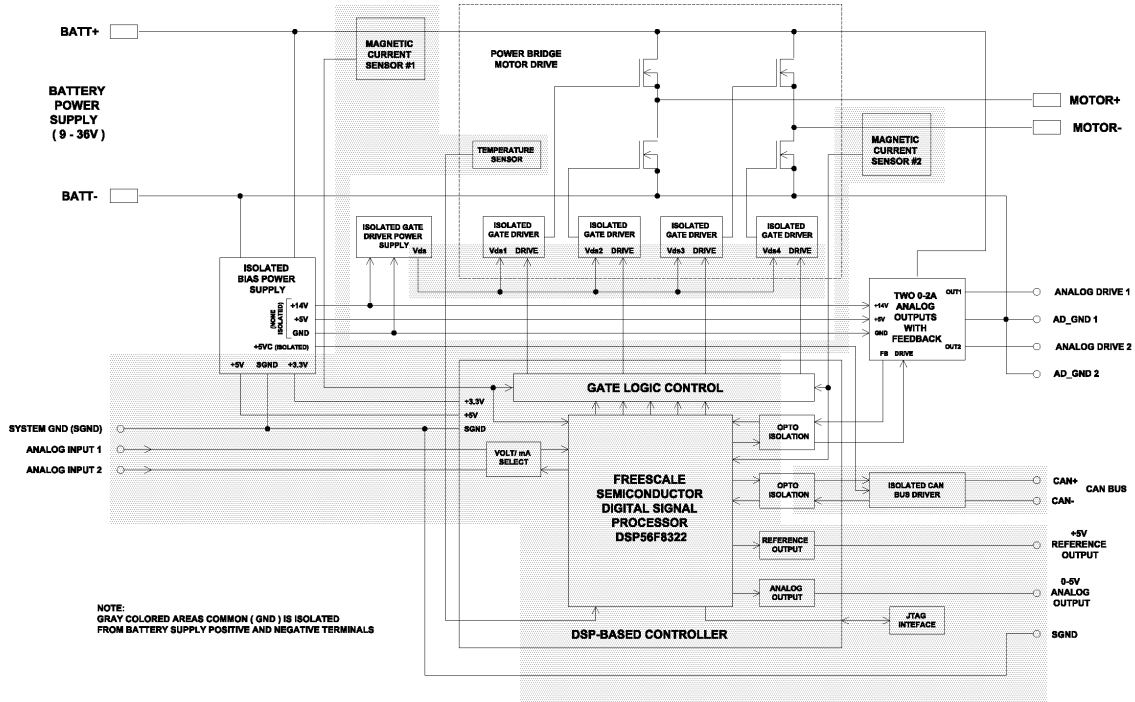

Figure 1 - Block Diagram

Input Specifications

Power Supply Input - Nominal	12 or 24VDC nominal; 9…36 VDC
Surge Protection	Provided
Under-voltage Protection	Built-in
Isolation	All inputs are isolated from the power supply driving the motor and current outputs.
Command Inputs	2 signal inputs (0-5V, 0-10V, 0-20 mA, 4-20 mA or digital) Input properties are user configurable. Refer to the block diagram and Table 1.0. Any input on the controller can be coded into a Proprietary B message that can be sent to the CAN network.
Analog Ground	2 Provided NB. Do not connect Analog GND to BATTERY GND.

Table 1.0 Inputs to AX100100 (Up to 2 user selectable inputs)	
Input Type	Description
Universal Analog Inputs	Up to 2 analog inputs are available. 0…5VDC or 0…10VDC The offset is in millivolts and the resolution is mV/bit, when sending a CAN message. Input measurement setpoints are interpreted in volts. 4…20mA or 0…20mA The offset is in microamps and the resolution is µA/bit, when sending a CAN message. Input measurement setpoints are interpreted in milliamps.
Digital Inputs	Up to 2 digital inputs are available. These inputs can be used as an enable or direction command for the controller. The input accepted is active high (switch is connected to a +V signal when ON).

Output Specifications

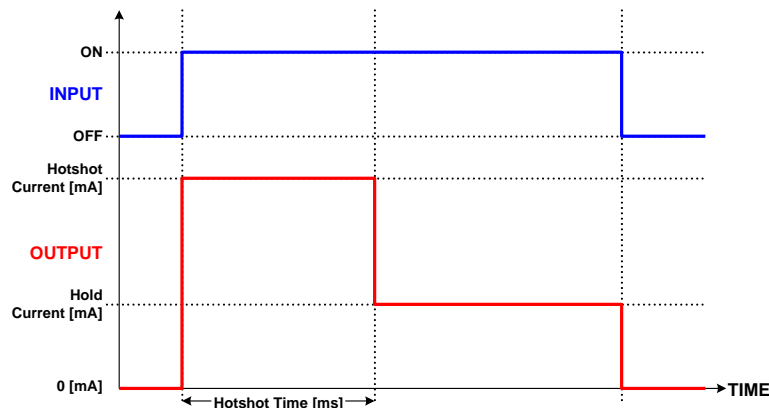|	
Output to Motor	H-bridge 50A @ 24VDC nominal for 2 minutes at room temperature 37.5 @ 24VDC nominal for 30 minutes at room temperature 25A @ 24VDC nominal for 1 hour minimum Overcurrent protection is provided. Short circuit protection is provided. The maximum rated speed and motor rated current are configurable to suit individual motor specifications.
Motor Stop	Shut off with or without ramping
Motor Direction	Motor direction command can be mapped to any input or come from the CAN bus.

Motor Control Mode	Flexible control is provided by user configurable parameters for
	    • open loop speed control;
	    • closed loop speed control (on request); or
	    • external feedback control (on request).
	The control input to drive the motor can be mapped to either of the 2 universal inputs or the controller can respond to messages from a CAN bus.

Thermal Protection	Thermal protection is built-in and configurable.
Current Outputs	2 proportional (0…2A) or hotshot digital (2A) Ramp and dither setpoints are configurable. **Hot Shot Coil Saver Outputs** (Refer to Figure 2.): The outputs are on/off with a hotshot current which keeps the load ON with a holding current. This is used as an energy saving method of load control. Each output is configurable to send a feedback message to the CAN bus. The feedback is always sent as a word with a resolution of 1 mA/bit, and 0 mA offset.
Signal Output	1 0-5V signal provides feedback of the duty cycle being applied to the motor or of another selected variable. The analog output is isolated from the power supply section of the circuit. This voltage output is configurable whether to send a feedback message to the CAN bus. The feedback is always sent as a word with a resolution of 1 mV/bit, and 0 mV offset.
Reference Voltage	+5V, 10 mA is available to power a sensor or potentiometer.

HOTSHOT DIGITAL

Figure 2 – Proportional Output Hotshot Digital Profile

General Specifications

Microcontroller	DSP56F8346
Motor Control	Standard embedded software is provided. The following parameters are user configurable. Motor Direction: Unidirectional or bi-directional control from an input or the CAN bus. The direction is also configurable. Enable: A universal input can be configured to enable the motor when on. A CAN message can also be used as an enable input. Control Mode: Open loop speed or closed loop speed control (on request) or external feedback control (on request) CAN: CAN bus messages control the motor and/or auxiliary outputs instead of the analog or digital inputs

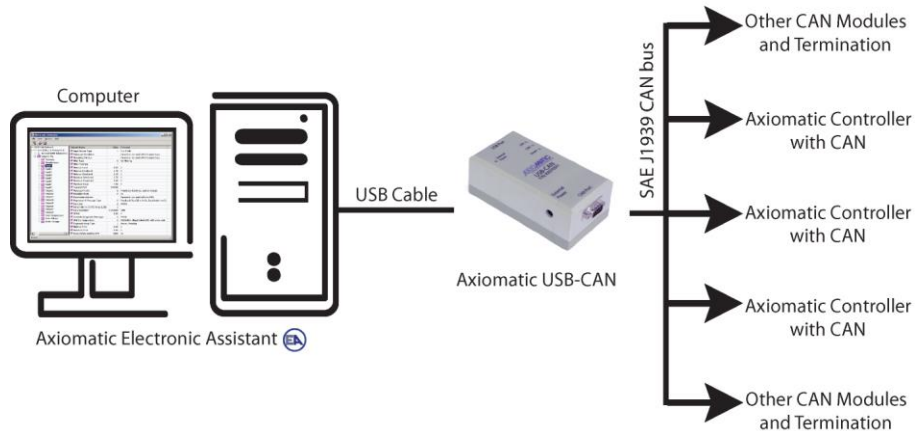|	
User Interface	The Axiomatic Electronic Assistant for *Windows* operating systems. It comes with a royalty-free license for use. The Axiomatic Electronic Assistant requires a USB-CAN converter to link the device's CAN port to a *Windows*-based PC for initial configuration. Order the Axiomatic EA and Axiomatic USB-CAN as a kit (P/N AX070502, or AX070506K), which includes all interconnecting cables. Refer to Figure 3 and Table 3 for details.

Figure 3 - User Configuration Using the Axiomatic Electronic Assistant (EA)

Table 3 – The Axiomatic Electronic Assistant and USB-CAN Converter

Axiomatic Electronic Assistant	
The Axiomatic 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.	 *Figure 7.0 Configuration screen from the Axiomatic Electronic Assistant*

CAN Interface	1 CAN port (SAE J1939) (CANopen® on request.) The software was designed to provide flexibility and provides the following. • Configurable ECU Instance in the NAME (for multiple ECU's on the network) • Configurable Motor Control Parameters • Configurable Motor PID Parameters • Configurable Input Parameters • Configurable Output Parameters • Configurable PGN and Data Parameters *Note: Configurable parameters are also called setpoints.* The motor controller is compliant with Bosch CAN protocol specification, Rev.2.0, Part B, and the following J1939 standards. *Table 2: J1939 Compliance* **See J1939 Compliance table below**

Table 2: J1939 Compliance

OSI Network Model Layer	J1939 Standard
Physical	J1939/11 – Physical Layer, 250K bit/s, Twisted Shielded Pair. J1939/15 - Reduced Physical Layer, 250K bits/sec, Un-Shielded Twisted Pair (UTP).
Data Link	J1939/21 – Data Link Layer
Data Link	Request (PGN 59904) Acknowledgement (PGN 59392) Transport Protocol – Connection Management (PGN 60416) Transport Protocol – Data Transfer Message (PGN 60160) Proprietary A (PGN 61184) Proprietary B (PGN's 65280 to 65535) NB. The user can also configure an input channel to send messages to another node using the Proprietary A PGN 61184.
Network Layer	J1939/81 – Network Management J1939, Appendix B – Address and Identity Assignments
Network Layer	Arbitrary Address Capable ECU - It can dynamically change its network address in real time. The controller supports: Address Claimed Messages (PGN 60928) and Commanded Address Messages (PGN 65240).
Application Layer	J1939/71 – Vehicle Application Layer
Application Layer	None of the application layer PGN's are supported as part of the default configurations. However, the controller could be configured such that any of the input messages to be sent will use a PGN from this section, or for the outputs to respond to the data in a message with a PGN from this section. The data size, index, resolution and offset can all be configured for the appropriate SPN associated with the PGN. *It is the user's responsibility to configure the controller such that it will not violate the J1939 standard.*
Application Layer	J1939/73 – Application Layer – Diagnostics
Application Layer	DM – Diagnostic messaging (on request)

Electrical Connections	Refer to Table 4. Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s).
Mounting	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. 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.
Shielding & Grounding	Refer to the User Manual.
Enclosure and Dimensions	Encapsulated in an aluminum extrusion with stainless steel end plates 5.50 x 6.93 x 2.38 inches 139.7 x 176.02 x 60.6 mm (W x L x H including connectors, excluding mating connectors) *Refer to Figure 4.0.*
Weight	3.25 lbs. (1.47 kg)
Operating Conditions	Operating: -40 to 85°C (-40 to 185°F)
Protection Rating	IP67

Table 4 - Electrical Pin Out Chart
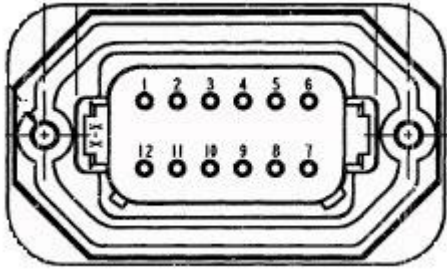
CAN and I/O Connector:
12-pin (equivalent TE Deutsch P/N: DT13-12PA)
Pin 1: CAN_Lo
Pin 2: CAN_High
Pin 3: CAN_Shield
Pin 4: Analog Input 2
Pin 5: Analog_GND 2
Pin 6: Current Output 2
(connected externally to BATT GND)
Pin 7: Current Output 1
(connected externally to BATT GND)
Pin 8: Analog_GND 1
Pin 9: Analog Input 1
Pin 10: +5V ref.
Pin 11: Analog GND (for Vout)
Pin 12: Voltage Output

A mating wire harness including 2 meters of unterminated wires and the mating connector assembly (which is equivalent to the TE Deutsch P/Ns: DT06-12SA, W12S wedgelock and sockets 0462-201-16141) is available. Ordering P/N: **AX070102**

Pin#	Colour	Function
1	Blue	CAN_L
2	Orange	CAN_H
3	Empty	(CAN Shield)
4	Yellow	AIN2
5	Black	GND2
8	Black	GND1
9	White	AIN1
10	Red	+5Vref
6	Purple	SOL2
7	Gray	SOL1
11	Black	VGND
12	Green	VOUT

RS-232 port:
 4 pin M8 P/N: NAN-T-3MR-M8

Mating Connector:
AX070101 (NAN-T-3FP-2M and a DB-9 connector)
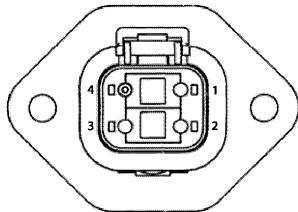
Power and Motor Control:
4-pin (equivalent TE Deutsch P/N: DTP04-4P-L012)
Pin 1: Battery +
Pin 2: Battery -
Pin 3: Motor -
Pin 4: Motor +

A mating wire harness is available and includes 2 meters (6.5 ft.) of unterminated 12 AWG wires as well as the mating connector assembly (which is equivalent to the TE Deutsch P/N: DTP06-4S, WP4S and four contact sockets 0462-203-12141).
Ordering P/N: **AX070103**

Pin#	Colour	Function
1	Red	Batt+
2	Black	Batt-
3	White/Black	Fwd-/Rev+
4	White Red	Fwd+/Rev-

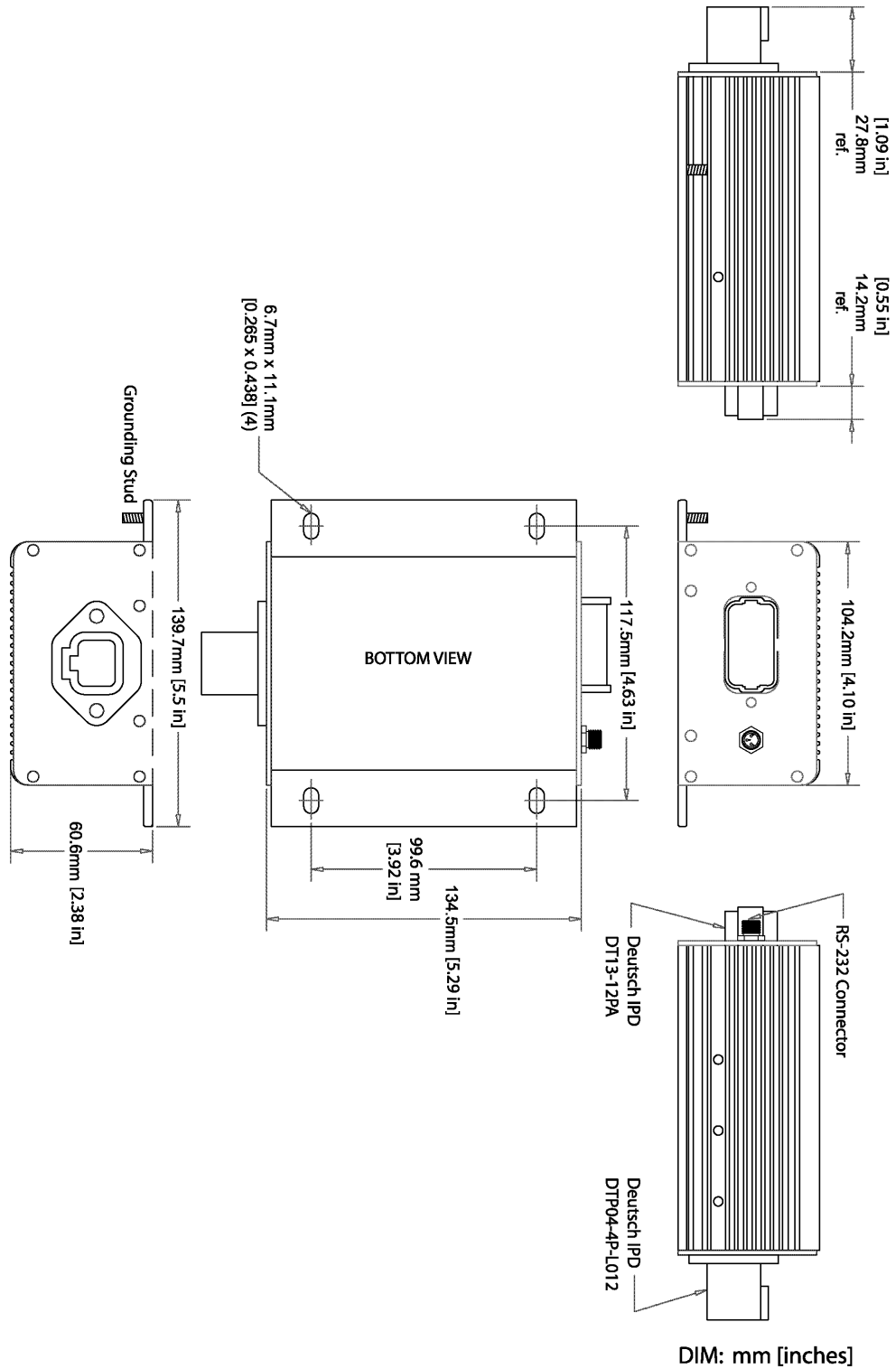*Figure 4 - Dimensional Drawing*

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