TECHNICAL DATASHEET #TDAX102100-P2.0

40 A DC MOTOR CONTROLLER, SAE J1939

Variable Speed Control
Onboard I/O
Overcurrent Protection (up to ±50 A)
Rugged Packaging
Configurable with Axiomatic Electronic Assistant

P/N: AX102100 (Rev P2.0)

Features

- Unidirectional or bi-directional DC motor control (up to 40 A)
- Flexible control
  - open or closed loop speed control; command inputs or CAN messages.
  - open or closed loop current control; constant user configurable maximum command.
- Configurable and independent ramps smooth motor rotation, protecting the controller and the system
- 2 isolated digital inputs
- 1 isolated STO (Safe Torque Off) or E-Brake safety interlock input
- 2 isolated universal signal inputs user configurable as 0-20 mA, 4-20 mA, 0-5 V, 0-10 V, PWM, or digital
- Map the control input to any of the command inputs or messages from a CAN bus.
- 2 current outputs (selectable as Proportional Current 0-2.5 A, Proportional Voltage, PWM Duty Cycle,
- 2.5 A On/Off Digital, or 2.5 A Hotshot Digital) drive accessories such as hydraulic valves or relays for machine control or safety interlock.
- Overcurrent protection provided up to ±50 A for each output leg
- Outputs can be coded as feedback messages sent to the CAN bus.
- 1 voltage reference (5 V) to power sensor inputs
- Highly efficient and robust design with isolation for drive and processing circuits
- 12, 24, or 48 VDC nominal
- CAN (SAE J1939 with auto-baud-rate detection)
- **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, Material Handling, Cranes and Hoists, Hydraulic Tail Lifts and Winches, Golf Carts, Military Equipment, Mobile Pumps, and Hydraulic Powerpacks

Ordering Part Numbers

40A DC Motor Controller, SAE J1939 with Auto-Baud-Rate Detection
- P/N: **AX102100** (Rev P2.0)

Accessories:
Mating Plug KIT - P/N: **PL-DTM06-12SA**
2m Wire Harness for Power and Motor Connector - P/N: **AX070137**
(For details, please refer to the General Specifications below.)
Axiomatic Electronic Assistant Configuration KIT - P/N: **AX070502** or **AX070506K**

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Block Diagram

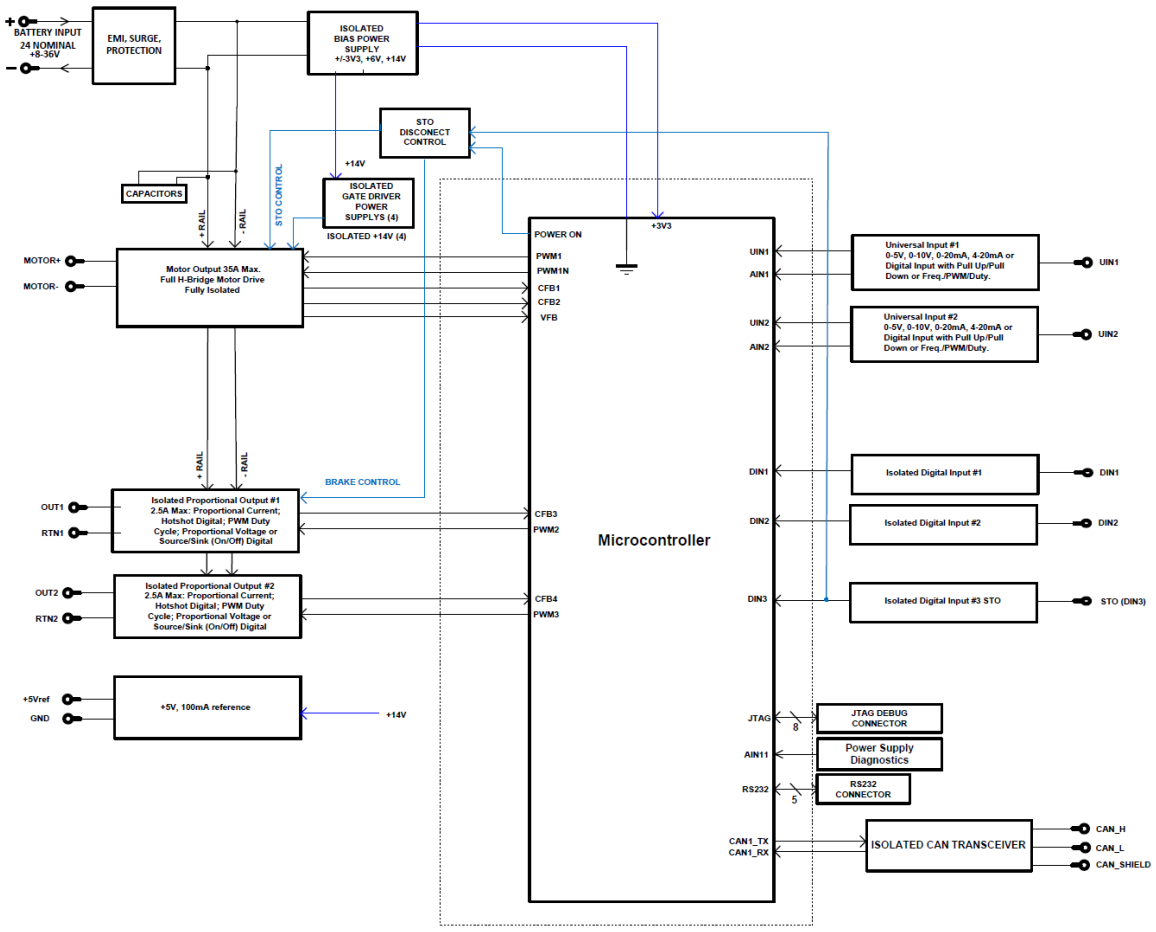

Figure 1 - Block Diagram

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 Limitations & Return Materials Process as described on https://www.axiomatic.com/service/.

All specifications are typical at nominal input voltage and 25 degrees C unless otherwise specified.

Power Supply

Power Supply Input	12, 24, or 48 VDC nominal 8 to 60 VDC power supply range
Quiescent Current	155 mA @ 12 VDC; 78 mA @ 24 VDC (typical)
Surge Protection	Provided
Reverse Polarity Protection	Provided
Undervoltage Protection	Provided. Hardware shutdown at 3.56 V.

Inputs

Command Inputs	5 isolated user selectable signal inputs (2 universal signal, 3 digital signal) Any input on the controller can be coded into a Proprietary B message that can be sent to the CAN network. Refer to Table 1.0.
Voltage Reference	One 5 V ±2 % (100 mA)
Ground	1 input ground is provided
Isolation	All inputs are isolated from the power supply driving the motor and current outputs.

Table 1.0 - User Programmable Universal Inputs

Universal Signal Inputs	Up to 2 universal signal inputs 12-bit Analog to Digital Protected against shorts to Ground or +Vsupply User selectable as: Current, Voltage, PWM, or Digital types <u>Current</u> Range: 4-20 or 0-20 mA Resolution: 1 µA Accuracy: ±1 % error Current Sense Resistor: 124 Ω (Voltage must not exceed 12 V) <u>Voltage</u> Range: 0-5 or 0-10 V Resolution: 1 mV Accuracy: ±1 % error <u>PWM</u> Signal Frequency Range: 1 Hz to 20 kHz Duty Cycle: 0 to 100 % Resolution: 0.01 % Accuracy: ±1 % error (Voltage must not exceed 43 V) <u>Digital</u> Active High to Vsupply or Active Low to Ground Amplitude: 3.3 V to +Vsupply (Voltage must not exceed 43 V)
Digital Inputs	2 digital inputs 1 STO (Safe Torque Off) or E-Brake safety interlock input If the cable to this input is disconnected, the MOTOR remains OFF (for safety reasons). These inputs can be used as an enable or direction command for the controller. The only acceptable signal for these 3 inputs is Active Low (i.e., connection to Battery -). Maximum Current: 8 mA Maximum Voltage: 43 V

Outputs

Output to Motor	1 output for a DC motor Full H-bridge for forward and reverse motor or brake operation 50 A @ 24 VDC nominal for 2 minutes at room temperature 40 A @ 24 VDC nominal for 1 hour minimum Short circuit protection is provided. Current measurement is provided. Overcurrent protection is provided up to ±50 A for each output leg in AX102100 Revision P2.0. Supply voltage measurement 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 the following. • open or closed loop speed control; variable target command • open or closed loop current control; constant maximum command The control input to drive the motor can be mapped to either of the 6 inputs or the controller can respond to messages from a CAN bus.
Thermal Protection	Thermal protection is built-in and configurable.
Universal Outputs	2 outputs user configurable as Proportional Current, Proportional Voltage, PWM Duty Cycle, On/Off Digital, or Hotshot Digital. High side sourcing up to 2.5 A High frequency drive Overcurrent protection up to 4 A Short circuit protection Ramp and dither setpoints are configurable. <u>Proportional Current</u> Resolution: 1 mA Accuracy: ±1 % <u>Proportional Voltage</u> Resolution: 0.1 V Accuracy: ±5 % <u>PWM</u> Resolution: 0.1 % Accuracy: ±0.1 % <u>Digital</u> Sourcing from power supply or output off Load at supply voltage must not draw more than 2.5 A. <u>Hot Shot Digital (Coil Saver)</u> Refer to Figure 2. The outputs are turned 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.

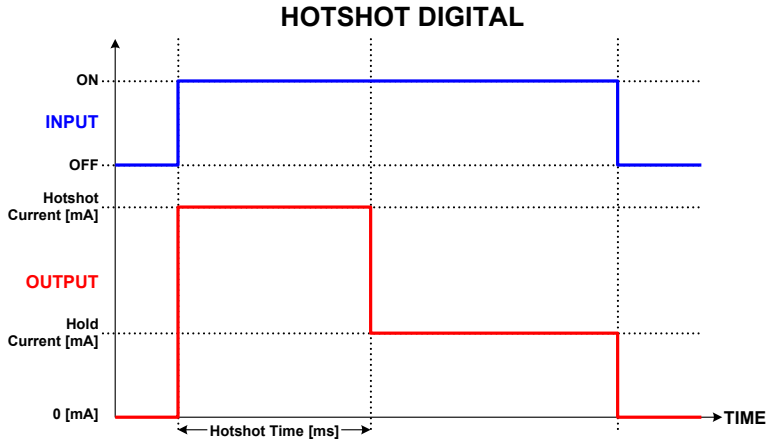

Figure 2 – Proportional Output Hotshot Digital Profile

General Specifications

Microcontroller	STM32F405RGT7
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 with externally commanded motor RPM control from an input or CAN message. Open loop current/ torque or closed loop current/torque with constant user settable maximum value. CAN: CAN bus messages control the motor and/or auxiliary outputs instead of the analog or digital inputs.
CAN Port	1 port (SAE J1939) Supported baud rates: 250 kbit/s (default), 500 kbit/s, 667 kbit/s, and 1 Mbit/s with auto-baud-rate detection
User Interface	Axiomatic Electronic Assistant (EA) – P/N: **AX070502** or **AX070506K**
Enclosure and Dimensions	Encapsulated in an anodized cast aluminum enclosure with lid gasket 8.95 in. x 6.67 in. x 2.88 in. (227 mm x 169 mm x 73 mm) L x W x H including connectors, excluding mating connectors Refer to Figure 3.0.
Weight	3.7 lbs. (1.68 kg)
Operating Temperature	-40 to 85 °C (-40 to 185 °F)
Storage Temperature	-50 to 120 °C (-40 to 248 °F)
Compliance	RoHS
Protection Rating	IP67
Vibration	MIL-STD-202H, method 204, test condition C 10 g peak (Sine) MIL-STD-202H, method 214A, test condition I/B 7.56 Grms peak (Random)
Shock	MIL-STD-202H, method 213B, test condition A 50 g peak
Electrical Connections	Refer to Table 2.0.
Shielding & Grounding	Refer to the User Manual.
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ω, 0.25 W minimum, metal film or similar type. They should be placed between CAN High and CAN Low terminals at both ends of the network.
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 in. bolts. The bolt length will be determined by the end-user's mounting plate thickness. Typically, 20 mm (3/4 in.) is adequate.

Table 2.0 - Electrical Pin Out

Input, Output & CAN Connector

12-pin receptacle (TE Deutsch P/N: DTM13-12PA)

Pin	Description
1	Universal Output 1 (Brake Output)
2	CAN High
3	CAN Low
4	Digital Input 1
5	5 V Reference
6	Universal Input 2
7	Universal Input 1
8	Signal Ground
9	STO / E-Brake Safety Interlock Input (Active Low)
10	Digital Input 2
11	Battery -
12	Universal Output 2

Power & Motor Connector

4-pin receptacle (Molex P/N: 19436-0411)

Pin	Description
1	Battery +
2	Battery -
3	Motor +
4	Motor -

Mating Connectors

Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s).

Input, Output & CAN Mating Connector

Available from Axiomatic as P/N PL-DTM06-12SA. It comprises the following TE Deutsch parts: 1x plug (DTM06-12SA); 1x wedgelock (WM12S); 12x contacts (0462-201-20141) and 6x sealing plugs (0413-204-2005).

Power & Motor Mating Connector

A mating wire harness is available with P/N **AX070137**. It comprises 2 meters (6.5 ft.) of unterminated 12 AWG wires as well as the mating connector Molex 19432-0001.

Pin	Color	Description
1	Red	Battery +
2	Black	Battery -
3	White / Red	Forward - / Reverse +
4	White / Black	Forward + / Reverse -

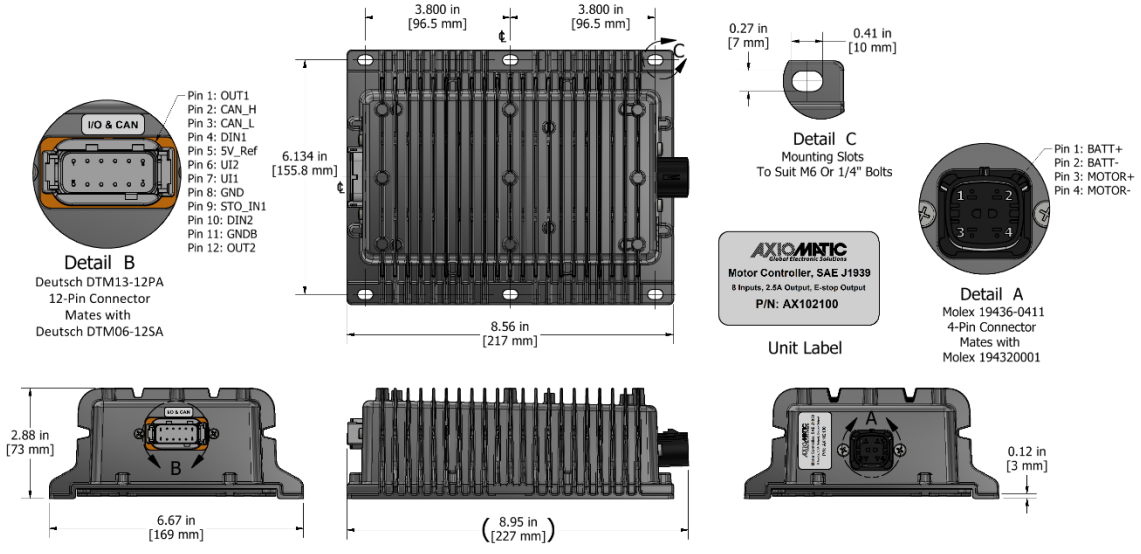

Figure 3 - Dimensional Drawing

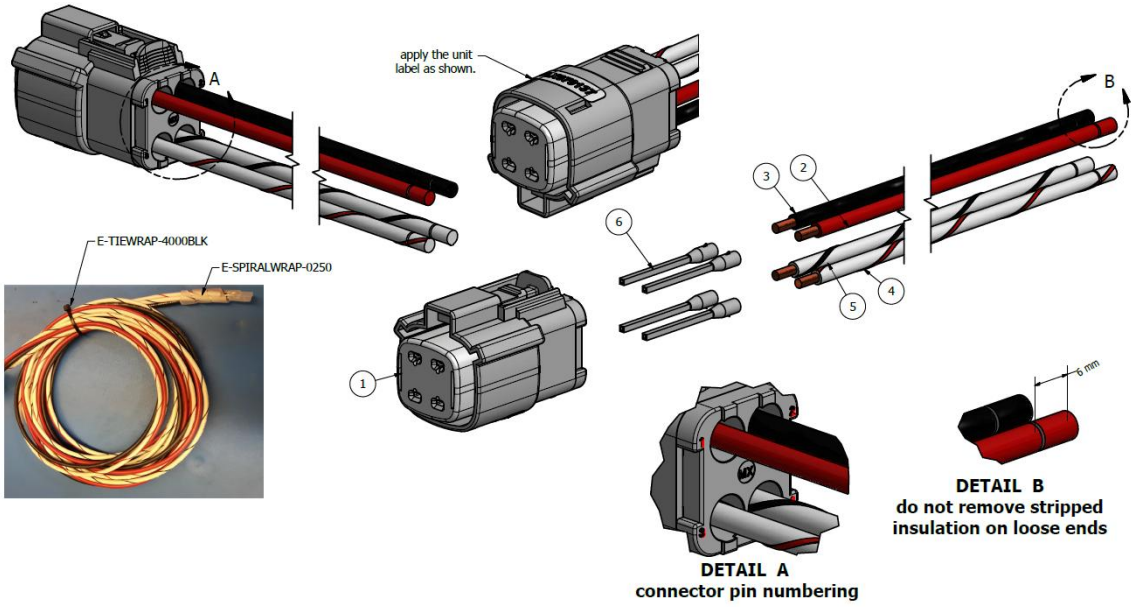

Figure 4 – Wire Harness Drawing

Form: TDAX102100-P2.0-09/02/2025