TECHNICAL DATASHEET #TDAX105000

150A DC MOTOR CONTROLLER

Speed, torque or PID control
Drives brushed DC motors up to 150 A (200 A overcurrent limit)
Onboard I/O controls accessories (valves and relays)
CAN SAE J1939
High efficiency, Rugged
***with the* Axiomatic Electronic Assistant**

P/N: AX105000

Features:

- Unidirectional or bi-directional brushed DC motor control
- Up to 150 A continuous output current to the motor
- Overcurrent protection is provided in software and is user configurable up to 300 A.
- Flexible control provided by a variety of user configurable options, including:
  - Open loop speed; Closed loop speed; Setpoint speed; Torque control (setpoint or closed loop); or PID control (linear or setpoint).
- Highly efficient and robust design with isolation between drive and processing circuits
- Motor can be disabled by a variety of methods for safety including software overcurrent shutdown
- 12 Vdc or 24 Vdc nominal
- 4 isolated universal signal inputs are user configurable from the following: voltage; current; PWM; or digital types.
- 4 isolated digital inputs with 2 inputs reserved for STO inputs
- The control input to drive the motor can be mapped to any of the inputs and/or the controller can respond to messages from a CAN bus.
- Configurable and independent ramps soften changes in motor voltage and current.
- Additional 2 relay outputs (Form C)
- 2 universal signal outputs (up to 2.5 A) are configurable as proportional current, hotshot digital, PWM, proportional voltage or on/off digital types.
- Outputs are configurable to send a feedback message to the bus.
- A +5 V reference voltage is provided to power an external sensor or potentiometer.
- Aluminum PCB substrate provides optimal thermal management
- CAN (SAE J1939) is provided (CANopen® on request)
- The Axiomatic Electronic Assistant runs on a *Windows* operating system for user configuration during set-up. An Axiomatic USB-CAN converter links the PC to the CAN bus.
- Easy mounting on a vehicle
- Rugged IP67 rating with corrosion resistant aluminum housing
- Suitable for harsh environments
- Operational from -40°C to 85°C (-40°F to 185°F)

Applications:

- Mobile Equipment
- Electric Vehicles for Material Handling
- Lift Platforms

Ordering Part Numbers:

150 A DC Motor Controller with CAN SAE J1939 (250 kbps): **AX105000**
150 A DC Motor Controller with CAN SAE J1939 (500 kbps): **AX105000-01**
150 A DC Motor Controller with CAN SAE J1939 (1 Mbps): **AX105000-02**

Accessories:
Axiomatic Electronic Assistant Configuration KIT, P/Ns: **AX070502, AX070505K** or **AX070506K**

Mating Connector KIT P/N: **PL-DTM06-12SA-12SB** (includes DTM06-12SA, DTM06-12SB, 2 WM12S, 24 Contacts, and Sealing Plugs)

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Description:

The motor controller can be operated as either a self-contained control system, driving the motor directly from the on-board inputs, or it can be integrated into a SAE J1939 network of controllers. It has four universal signal inputs and 4 digital inputs that can be used to drive the motor or extra outputs. Two of the digital inputs are reserved for safety interlock functionality.

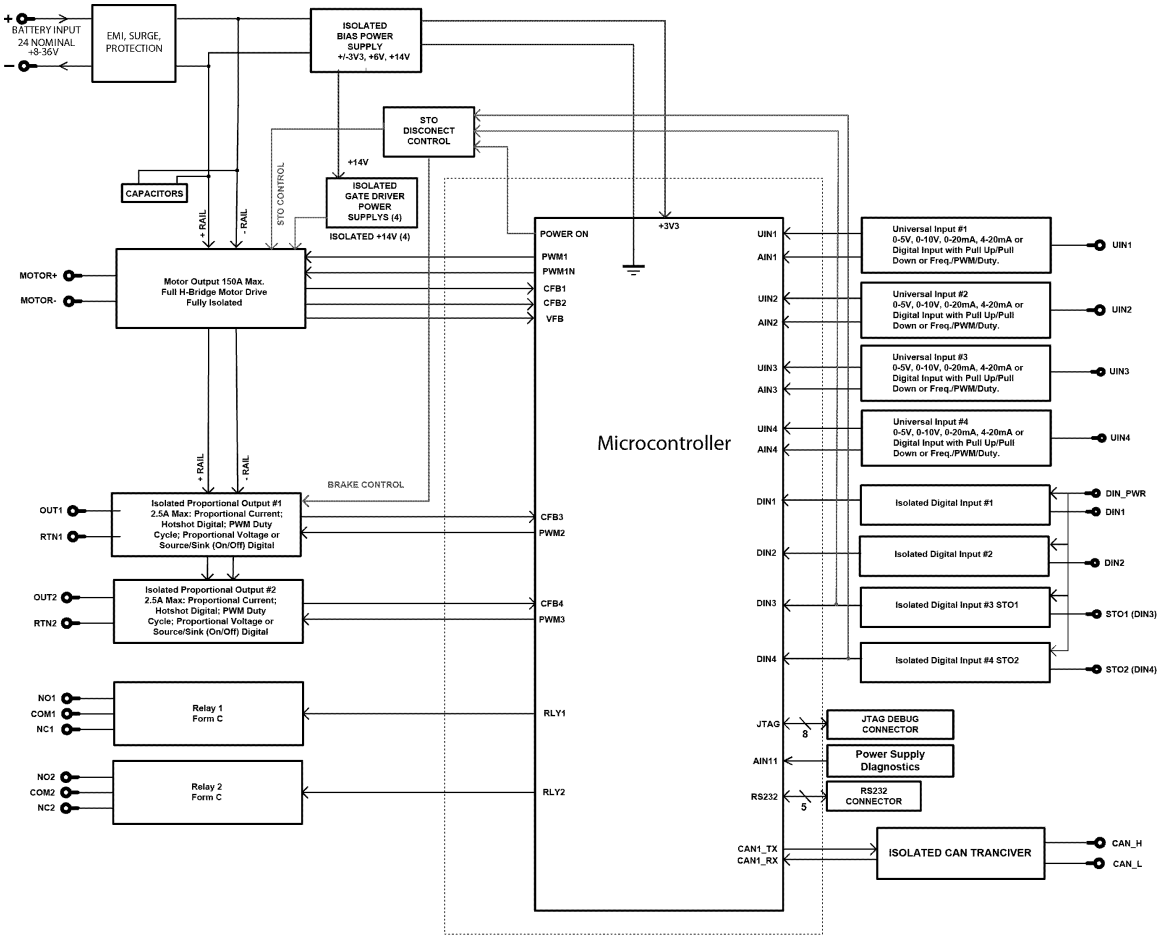
In addition to the powerful DC motor drive, the motor controller has two outputs to drive two hydraulic proportional coils up to 2.5 A each, and two relay outputs. This allows the motor controller to be a fully integrated control platform for small machines using a combination of hydraulic actuators and a motor drive system.

It uses full isolation to separate the inputs and the processor section of the controller from the motor power and output.

The motor controller has a number of built-in protections that can shut off the motor in adverse conditions. These features include hardware shutoffs to protect the circuits from being damaged as well as software shutdown features that can be enabled in safety critical systems.

A rugged enclosure and connections provide reliability in machine environments.

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

Input Specifications

Power Supply Input	12 Vdc or 24 Vdc nominal (8 Vdc to 36 Vdc)
Quiescent Current	100 mA @ 24 V typical; 150 mA @ 12 V typical
Surge Protection	Provided
Under-voltage Protection	Provided
Over-voltage Protection	Provided
Over-current Protection	Provided, hardware shutdown @ +/- 300 A
Isolation	All inputs are isolated from the power supply driving the motor and current outputs.
Universal Inputs	4 Universal Signal Inputs. Inputs are isolated from the power supply. User selectable as: Voltage; Current; PWM or Digital types. 12-bit Analog to Digital (voltage, current) Protected against shorts to GND or +Vsupply Voltage Types: 1 mV resolution, accuracy +/- 1% error 0-5 V or 0-10 V. Current Types: 1 uA resolution, accuracy +/- 1% error 0-20 mA or 4-20 mA Current sense resistor 124 Ω PWM Signal Frequency: 1 – 20,000 Hz PWM Duty Cycle: 0 to 100% PWM Input: 0.01% resolution, accuracy +/- 1% error Digital Input: Active High to Vsupply or Active Low to GND Amplitude: 3.3 V to +Vsupply Inputs are sampled every 1 msec. Refer to the block diagram and the user manual for details.
Ground	1 Provided Note: Do not connect SIGNAL INPUT GND to BATTERY GND.
Input Impedances	0-5 V @ 1MΩ 0-20 mA @ 250 Ω Frequency @ 10 kΩ pullup
Digital Inputs	4 fully isolated 2 inputs are dedicated as STO (Safe Torque Off) and E-Brake safety interlocks inputs Opto-isolated input, normally not active for safety. A power connection is provided which will accept 9 to 36 Vdc from an external power supply or from the battery. If this cable is disconnected, the MOTOR remains OFF. Amplitude: min. 9 Vdc to max. 36 Vdc Input current max. 8 mA The input accepted is active low (input is connected to digital input supply GND when ON).
Digital Common	Provided for connection to the digital input power supply.

Output Specifications

Output to Motor	1 output for brushed DC motors Full H-bridge for forward and reverse motor or brake operation Hz is programmable 150 A @ 24 Vdc nominal for 5 hours 100 A @ 24 Vdc nominal continuous Overcurrent protection is provided in software. It is user configurable up to +/-300 A at each output leg.

	Safety interlock provided with 2 dedicated STO inputs that independently shut off the top and bottom side of the H-bridge output. Current measurement is provided. Supply voltage measurement is provided. User configurable, independent ramps soften changes in motor voltage and current, in either forward or reverse directions. The maximum rated speed is configurable to suit individual motor specifications.
Motor Direction	Refer to the user manual for details.
Thermal Protection	Thermal protection is built in. Overtemperature shutdown is set at 125°C. (default) It is user configurable up to 150°C.
Universal Outputs	Two outputs selectable as: Proportional Current; Hotshot Digital; PWM Duty Cycle; Proportional Voltage; or On/Off Digital Output #1 has dedicated E-Stop Brake hardware protection function Half-bridge output, current sensing, grounded load. High side sourcing up to 2.5 A Overcurrent protection Short circuit protection in hardware Current Outputs: 1 mA resolution, accuracy +/- 1% error Voltage Outputs: 0.1 V resolution, accuracy +/- 5% error High frequency drive PWM Outputs: 0.1% resolution, accuracy +/- 0.1% error Digital On/Off: Sourcing from power supply or output off Load at supply voltage must not draw more than 2.5 A.
Relay Outputs	2 Form C relay outputs Maximum 2 A @ 250 Vac or 30 Vdc
Reference Voltage	+5 V, 100 mA is available to power a sensor or potentiometer and is referenced to Frequency GND

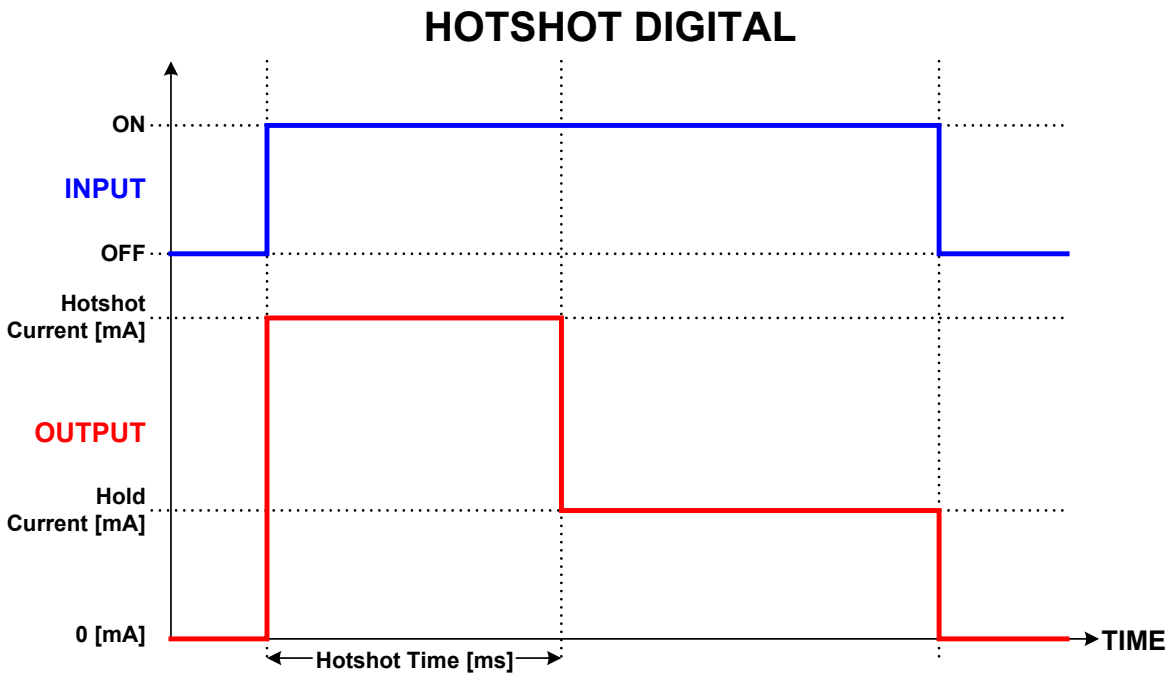


Figure 1 – Proportional Output Hotshot Digital Profile

General Specifications

Microcontroller	STM32F407VG
Efficiency	>95%
Motor Control Logic	Standard embedded software is provided. The motor controller is a highly programmable controller, allowing the user to configure it for their application. Its sophisticated control algorithms allow for open or closed loop drive of the motor and proportional outputs. All I/O on the unit are inherently independent from one another but can be programmed to interact in a large number of ways. All configurable parameters are user selectable using the Axiomatic Electronic Assistant. Refer to the user manual for details.
Diagnostics	Each input and output channel can be configured to send diagnostic messages to the CAN network if the I/O goes out of range. Diagnostic data is stored in a non-volatile log. Refer to the user manual for details.
Additional Fault Feedback	There are several types of faults that the controller will detect and provide a response: unit over temperature; power supply undervoltage and overvoltage; hardware shutdown and lost communication.
CAN User Interface	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 Electronic Assistant and Axiomatic USB-CAN as a kit (P/N: AX070502 or AX070505K), which includes all interconnecting cables. Refer to Figure 2 for details.

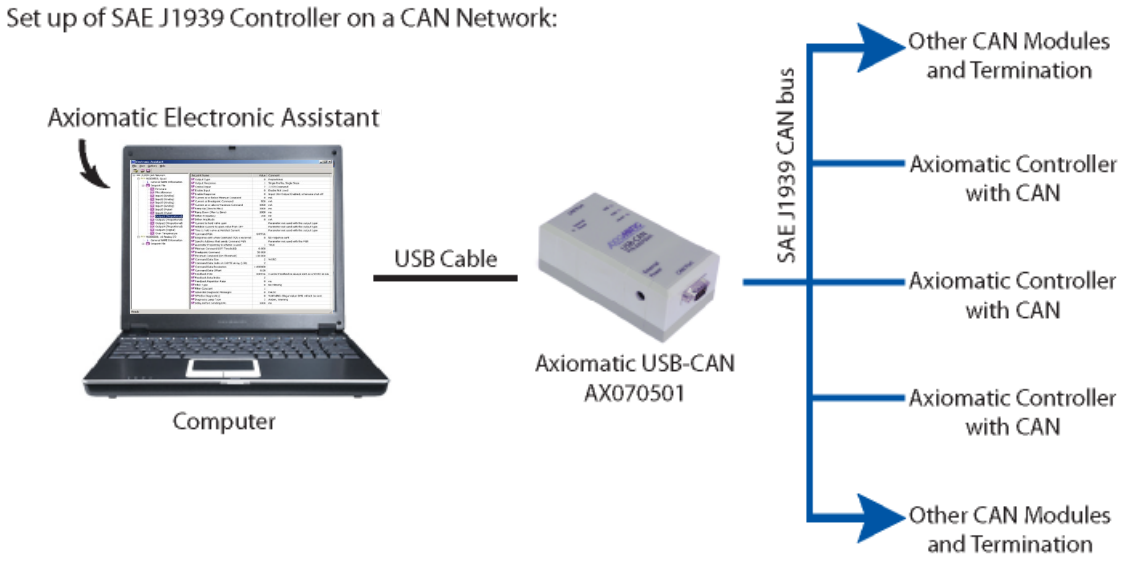


Figure 2 - User Configuration Using Axiomatic Electronic Assistant

Communications	1 SAE J1939 port (CANopen® is available on request.) Model AX105000: 250 kbps baud rate Model AX105000-01: 500 kbps Model AX105000-02: 1 Mbps
Electrical Connections	Refer to Table 1. Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s).
Mounting	The controller has 4 mounting holes. The holes are sized for 5/16 inch or M8 bolts. The bolt length will be determined by the end-user's mounting plate thickness. Typically, 20 mm (3/4 inch) is adequate. To ground the device to the machine, connect the grounding strap via the 4 x M8 or 5/16 inch mounting bolts. The use of a star washer on one or more of the bolts along with the grounding strap will ensure a solid ground connection.
Enclosure and Dimensions	Hard anodized die cast aluminum, molded EPDM gasket Refer to Figure 3.
Weight	9.45 lb. (4.286 kg)
Operating Conditions	Operating: -40°C to 85°C (-40°F to 185°F)
Protection Rating	IP67

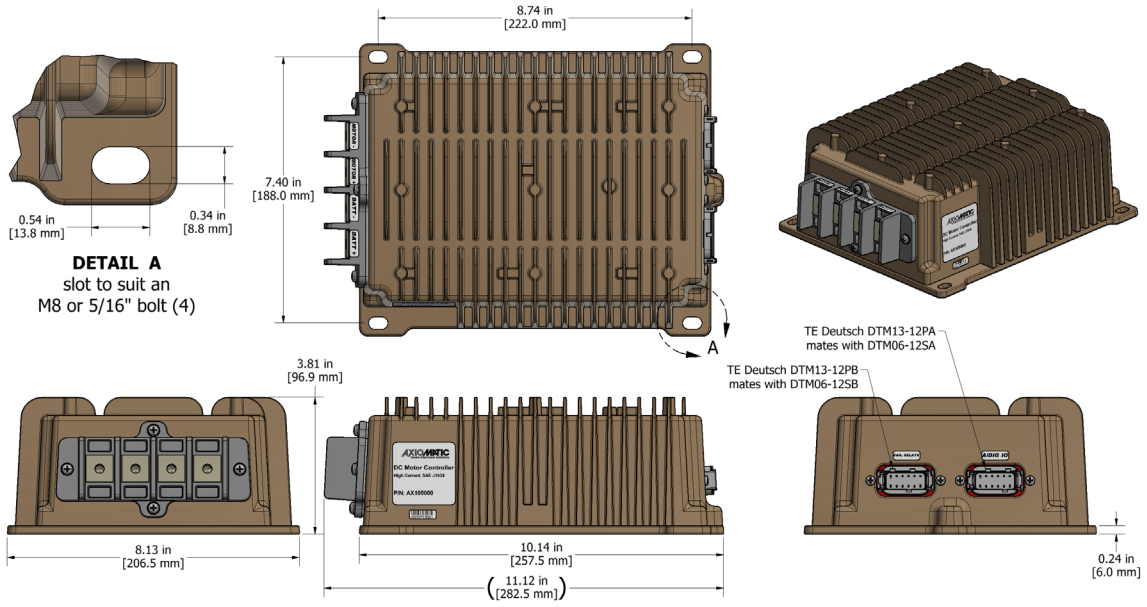


Figure 3 – Dimensions

Table 1 - Electrical Pin Out Chart

I/O **CONNECTOR** 12-pin connector (equivalent TE Deutsch P/N: DTM13-12PA) Pin 1: DIG IN POWER Pin 2: DIG IN 1 Pin 3: STO IN 2 Pin 4: UNIVERSAL SIGNAL IN 2 Pin 5: UNIVERSAL SIGNAL IN 3 Pin 6: +5 V REF Pin 7: SIGNAL INPUT GND Pin 8: SIGNAL INPUT GND Pin 9: UNIVERSAL SIGNAL IN 4 Pin 10: UNIVERSAL SIGNAL IN 1 Pin 11: DIG IN 2 Pin 12: STO IN 1 **CAN & RELAY CONNECTOR** 12 pin connector (equivalent TE Deutsch P/N: DTM13-12PB) Pin 1: CAN_H Pin 2: Output 1+ Pin 3: Output 1 Return Pin 4: NC_2 Pin 5: NO_2 Pin 6: COM_2 Pin 7: COM_1 Pin 8: NO_1 Pin 9: NC_1 Pin 10: Output 2 Return Pin 11: Output 2+ Pin 12: CAN_L	**Power and Motor Control:** 4 Aluminum power pass-through blocks accessible via M8 tapped holes in enclosure. Wire lugs should be attached to these. Refer to Figure 3 for orientation of holes to access Aluminum power pass through blocks. Motor - Motor + Battery - Battery + **WARNING: Wiring the motor in upside down (i.e. all connections backwards) will result in the motor running in full forward with NO control from the processor!**
Mating Plug Kit	**PL-DTM06-12SA-12SB** (includes 1 DTM06-12SA, 1 DTM06-12SB, 2 WM12S, 24 Contacts, and Sealing Plugs)

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Form: TDAX105000-06/26/23