

Preliminary  
**TECHNICAL DATASHEET #TDAX105000**  
**150A DC MOTOR CONTROLLER**

*Speed, torque or PID control*  
*Drives brushed DC motors up to 150A (200A overcurrent limit)*  
*Onboard I/O controls accessories (valves and relays)*  
**CAN SAE J1939**  
*High efficiency, Rugged*  
*with Electronic Assistant*  
**P/N: AX105000**

**Features:**

- Unidirectional or bi-directional brushed DC motor control
- Up to 150A continuous output current to the motor
- Overcurrent protection is provided in software and is user configurable up to 300A.
- 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
- 12V or 24Vdc nominal
- 4 universal signal inputs are user configurable from the following: voltage; current; PWM; or digital types.
- 4 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 2.5A) 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 +5V 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)
- **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 to 85°C (-40 to 185°F)



**Applications:** Mobile Equipment, Electric Vehicles for Material Handling, Lift Platforms

**Ordering Part Numbers:**

**150A DC Motor Controller with CAN: AX105000**

**Accessories:**

**Electronic Assistant KIT, AX070502**

Mating Connector KITS available from Axiomatic:

<b>AX070105</b>	Mating Plug Kit for 12-pin Connector for I/O (DT06-12SA, W12S, 0462-201-16141, 114017)
<b>AX070111</b>	Mating Plug Kit for 12-pin Connector for CAN & Relays (DT06-12SB, W12S, 0462-201-16141, 114017)

## 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 CAN 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.

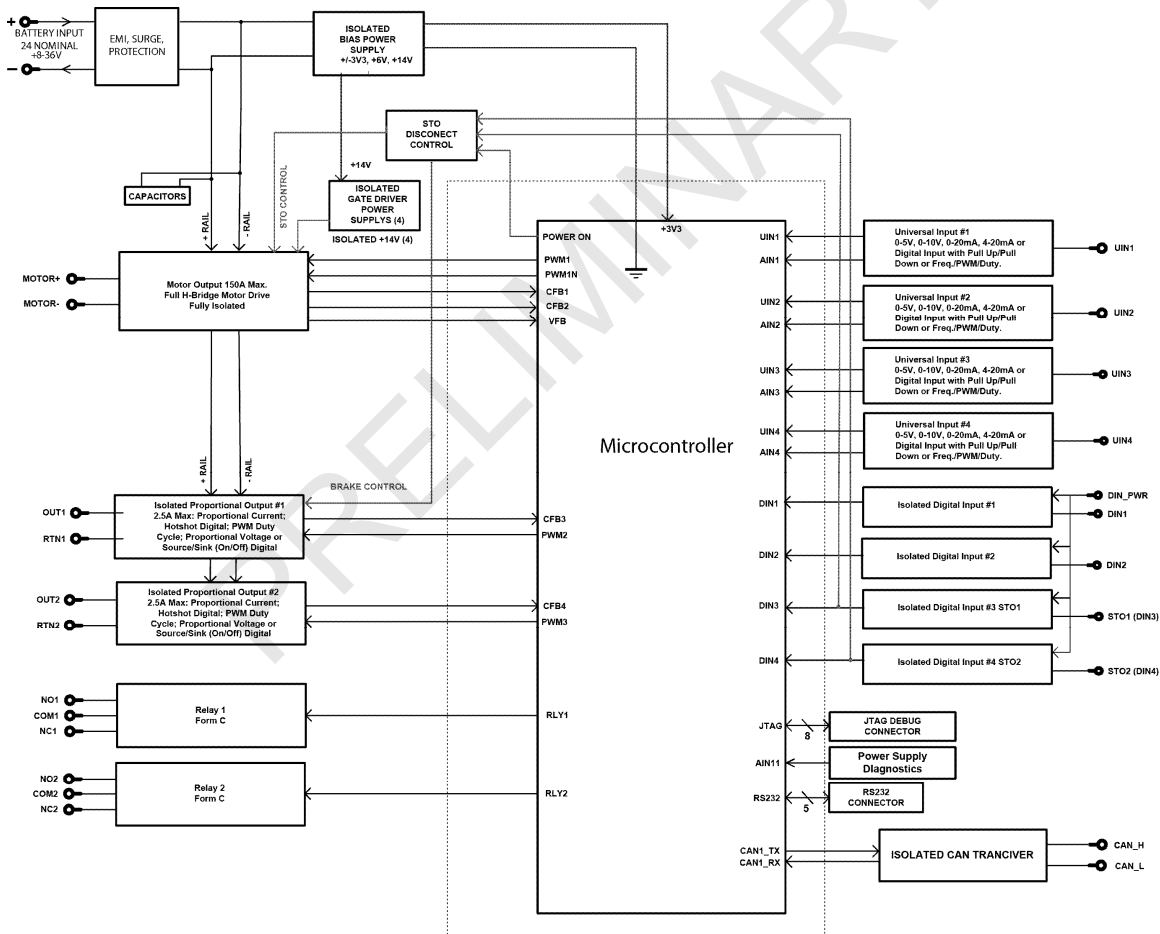
In addition to the powerful DC motor drive, the motor controller has two outputs to drive two hydraulic proportional coils up to 2.5A each, and two relay outputs. This allows the motor controller to be a fully integrated control platform for small machines using a combination of hydraulic actuators and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

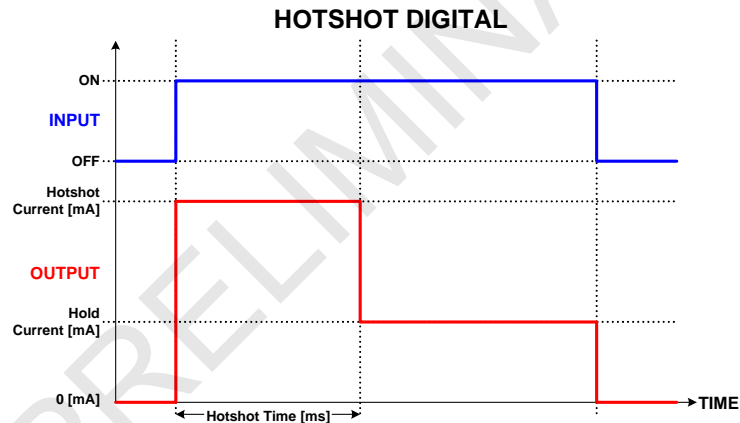
### Input Specifications

Power Supply Input - Nominal	24Vdc nominal 8...36 VDC
Surge Protection	Provided
Under-voltage Protection	Provided
Over-voltage Protection	Provided
Over-current Protection	Provided, hardware shutdown @ +/- 300A
Isolation	All inputs are isolated from the power supply driving the motor and current outputs.
Universal Inputs	<p>4 Universal Signal Inputs User selectable as: Voltage; Current; PWM or Digital types. 12-bit Analog to Digital (voltage, current) Protected against shorts to GND or +Vsupply</p> <p>Voltage Types: 1mV resolution, accuracy +/- 1% error 0-5V or 0-10V.</p> <p>Current Types: 1uA resolution, accuracy +/- 1% error 0-20mA or 4-20mA Current sense resistor 124Ω</p> <p>PWM Signal Frequency: 1 – 20,000 Hz PWM Duty Cycle: 0 to 100% PWM Input: 0.01% resolution, accuracy +/- 1% error</p> <p>Digital Input: Active High to Vsupply or Active Low to GND Amplitude: 3.3V to +Vsupply</p> <p>Inputs are sampled every 1 msec.</p> <p>Refer to the block diagram and the user manual for details.</p>
Ground	1 Provided NB. Do not connect GND to BATTERY GND.
Input Impedances	0-5V @ 1MΩ 0-20 mA @ 250 Ohms Frequency @ 10 KΩ pullup
Digital Inputs	<p>4 fully isolated Two (2) inputs are dedicated as STO (Safe Torque Off) and E-Brake safety interlocks inputs Opto-isolated input, normally not active for safety. Amplitude: min. 8Vdc to max. 36Vdc Input current max. 8 mA</p>
Digital Common	Provided for connection to the digital input power supply.

### Output Specifications

Output to Motor	<p>One output for brushed DC motors</p> <p>Full H-bridge for forward and reverse motor or brake operation Hz is programmable</p> <p>150A @ 24VDC nominal for &gt;5 hours 100A @ 24VDC nominal continuous</p> <p>Overcurrent protection is provided in software. It is user configurable up to +/- 300A at each output leg.</p> <p>Safety interlock provided with 2 dedicated STO inputs that independently shut off the top and bottom side of the H-bridge output.</p> <p>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.</p> <p>The maximum rated speed is configurable to suit individual motor specifications.</p>
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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 fully isolated 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 2.5A Overcurrent protection Short circuit protection in hardware  Current Outputs: 1mA resolution, accuracy +/- 1% error  Voltage Outputs: 0.1V 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 2.5A.
Relay Outputs	2 Form C relay outputs Maximum 2A @ 250Vac or 30Vdc
Reference Voltage	+5V, 10 mA is available to power a sensor or potentiometer and is referenced to Frequency GND

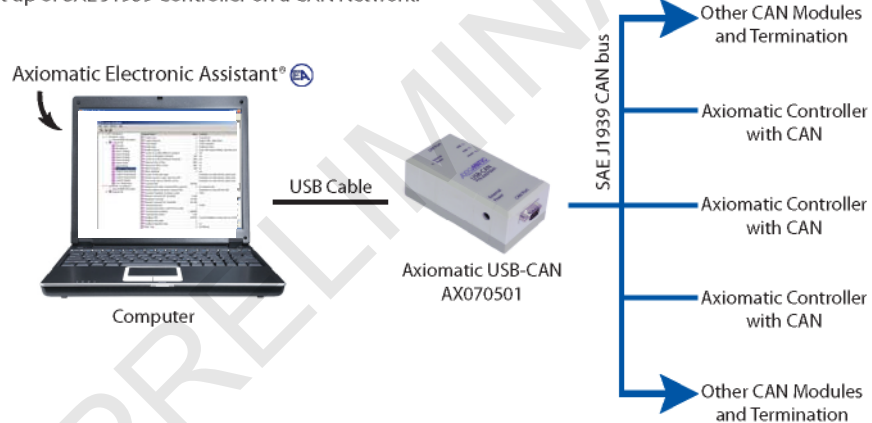


**Figure 1 – Proportional Output Hotshot Digital Profile**

## General Specifications

Microprocessor	STM32F407VG
Efficiency	>95%
Motor Control Logic	<p>Standard embedded software is provided.</p> <p>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.</p> <p>All configurable parameters are user selectable using the Electronic Assistant®. Refer to the user manual for details.</p>
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	<p>Electronic Assistant® for <i>Windows</i> operating systems It comes with a royalty-free license for use.</p> <p>The Axiomatic Electronic Assistant requires a USB-CAN converter to link the device's CAN port to a <i>Windows</i>-based PC for initial configuration. Order the EA and Axiomatic USB-CAN as a kit (P/N AX070502), which includes all interconnecting cables. Refer to Figure 2 and Table 1 for details.</p>

Set up of SAE J1939 Controller on a CAN Network:



**Figure 2 - User Configuration Using Electronic Assistant® (EA)**

Communications	1 SAE J1939 port (CANopen is available on request.)
Electrical Connections	Refer to Table 2. 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 4.
Weight	6.50 lb. (2.95 kg)
Operating Conditions	Operating: -40 to 85°C (-40 to 185°F)
Protection Rating	IP67
Regulatory Approvals	CE marking pending

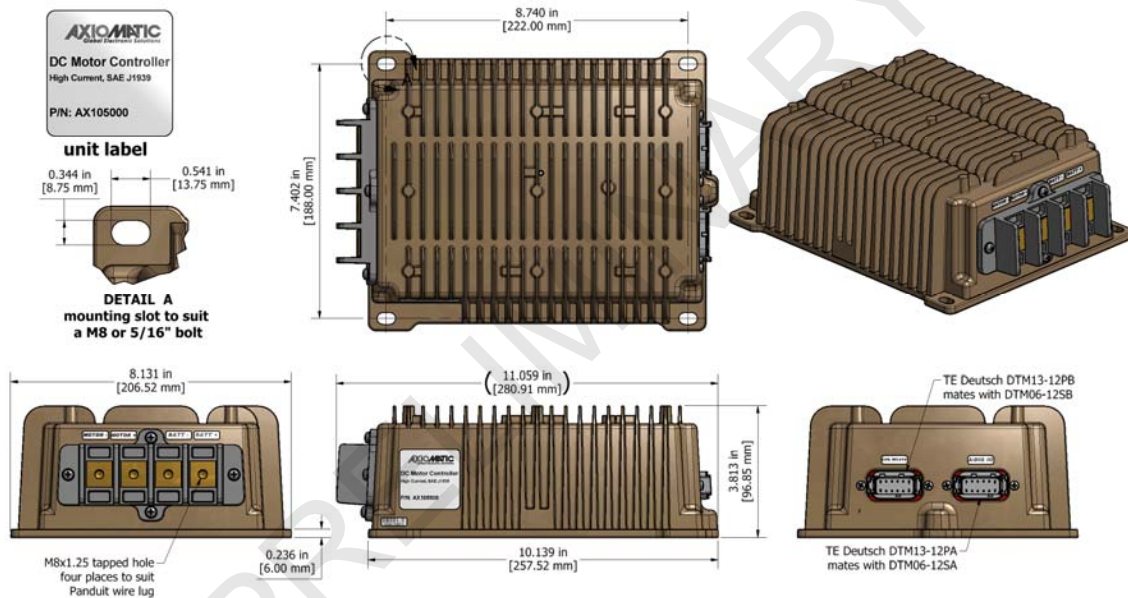


Figure 4 – Dimensions

**Table 2 - Electrical Pin Out Chart**

<p><b>I/O CONNECTOR</b>                  12 pin 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: +5V 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</p>	<p><b>Power and Motor Control:</b>                  4 Aluminum power pass through blocks accessible via M8 tapped holes in enclosure. Wire lugs should be attached to these.</p> <p>Refer to Figure 4 for orientation of holes to access Aluminum power pass through blocks.</p> <p>Motor -                  Motor +                  Battery -                  Battery +</p>			
<p>Mating Connector KITS are available from Axiomatic.</p> <table border="1"> <tr> <td data-bbox="250 625 386 709"><b>AX070105</b></td> <td data-bbox="386 625 782 709">Mating Plug Kit for 12-pin Connector (J26) (DT06-12SA, W12S, 0462-201-16141, 114017)</td> </tr> </table>	<b>AX070105</b>	Mating Plug Kit for 12-pin Connector (J26) (DT06-12SA, W12S, 0462-201-16141, 114017)	<table border="1"> <tr> <td data-bbox="799 541 1386 646"> <p><b>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!</b></p> </td> </tr> </table>	<p><b>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!</b></p>
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<p><b>CAN &amp; RELAY CONNECTOR</b>                  12 pin 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</p>				
<p>Mating Connector KITS are available from Axiomatic.</p> <table border="1"> <tr> <td data-bbox="250 1108 386 1192"><b>AX070111</b></td> <td data-bbox="386 1108 782 1192">Mating Plug Kit for 12-pin Connector (J25) (DT06-12SB, W12S, 0462-201-16141, 114017)</td> </tr> </table>	<b>AX070111</b>	Mating Plug Kit for 12-pin Connector (J25) (DT06-12SB, W12S, 0462-201-16141, 114017)		
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*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: TDAX105000-06/21/19