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:

<table>
<thead>
<tr>
<th>150A DC Motor Controller with CAN: AX105000</th>
</tr>
</thead>
</table>

Accessories:
Electronic Assistant KIT, AX070502

Mating Connector KITS available from Axiomatic:

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

In Europe:
Axiomatic Technologies Oy
Höytämönkatu 6
33880 LEMPÄÄLÄ - Finland
Tel. +358 103 378 750
Fax. +358 3 3595 660
www.axiomatic.fi

In North America:
Axiomatic Technologies Corporation
5916 Wallace Street
Mississauga, ON Canada L4Z 1Z8
Tel. 1 905 602 9270
Fax. 1 905 602 9279
www.axiomatic.com
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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Input - Nominal</td>
<td>24Vdc nominal 8...36 VDC</td>
</tr>
<tr>
<td>Surge Protection</td>
<td>Provided</td>
</tr>
<tr>
<td>Under-voltage Protection</td>
<td>Provided</td>
</tr>
<tr>
<td>Over-voltage Protection</td>
<td>Provided</td>
</tr>
<tr>
<td>Over-current Protection</td>
<td>Provided, hardware shutdown @ +/- 300A</td>
</tr>
<tr>
<td>Isolation</td>
<td>All inputs are isolated from the power supply driving the motor and current outputs.</td>
</tr>
</tbody>
</table>

#### Universal Inputs

- **4 Universal Signal Inputs**
  - User selectable as: Voltage; Current; PWM or Digital types.
  - Protected against shorts to GND or +Vsupply
  - Voltage Types: 1mV resolution, accuracy +/- 1% error 0-5V or 0-10V.
  - Current Types: 1uA resolution, accuracy +/- 1% error 0-20mA or 4-20mA
  - Current sense resistor 124Ω
  - 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: 3.3V to +Vsupply
  - Inputs are sampled every 1 msec.
  - Refer to the block diagram and the user manual for details.

#### Ground

- 1 Provided
- NB: Do not connect GND to BATTERY GND.

#### Input Impedances

- 0-5V @ 1Mohm
- 0-20 mA @ 250 Ohms
- Frequency @ 10 KOhm pullup

#### Digital Inputs

- 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

#### Digital Common

- Provided for connection to the digital input power supply.

### Output Specifications

#### Output to Motor

- One output for brushed DC motors
  - Full H-bridge for forward and reverse motor or brake operation Hz is programmable
  - 150A @ 24VDC nominal for >5 hours
  - 100A @ 24VDC nominal continuous
  - Overcurrent protection is provided in software. It is user configurable up to +/- 300A 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.
<table>
<thead>
<tr>
<th>Motor Direction</th>
<th>Refer to the user manual for details.</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Microprocessor</th>
<th>STM32F407VG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>&gt;95%</td>
</tr>
</tbody>
</table>

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 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

Electronic Assistant® for Windows operating systems. It comes with a royalty-free license for use.

The Axiomatic Electronic Assistant requires an USB-CAN converter to link the device’s CAN port to a Windows-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.

Set up of SAE J1939 Controller on a CAN Network:

![Set up of SAE J1939 Controller on a CAN Network](image)

**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

<table>
<thead>
<tr>
<th>I/O CONNECTOR</th>
<th>Power and Motor Control:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 pin Deutsch P/N: DTM13-12PA</td>
<td>4 Aluminum power pass through blocks accessible via M8 tapped holes in enclosure. Wire lugs should be attached to these.</td>
</tr>
<tr>
<td>Pin 1: DIG IN POWER</td>
<td>Refer to Figure 4 for orientation of holes to access Aluminum power pass through blocks.</td>
</tr>
<tr>
<td>Pin 2: DIG IN 1</td>
<td>Motor -</td>
</tr>
<tr>
<td>Pin 3: STO IN 2</td>
<td>Motor +</td>
</tr>
<tr>
<td>Pin 4: UNIVERSAL SIGNAL IN 2</td>
<td>Battery -</td>
</tr>
<tr>
<td>Pin 5: UNIVERSAL SIGNAL IN 3</td>
<td>Battery +</td>
</tr>
<tr>
<td>Pin 6: +5V REF</td>
<td></td>
</tr>
<tr>
<td>Pin 7: SIGNAL INPUT GND</td>
<td></td>
</tr>
<tr>
<td>Pin 8: SIGNAL INPUT GND</td>
<td></td>
</tr>
<tr>
<td>Pin 9: UNIVERSAL SIGNAL IN 4</td>
<td></td>
</tr>
<tr>
<td>Pin 10: UNIVERSAL SIGNAL IN 1</td>
<td></td>
</tr>
<tr>
<td>Pin 11: DIG IN 2</td>
<td></td>
</tr>
<tr>
<td>Pin 12: STO IN 1</td>
<td></td>
</tr>
</tbody>
</table>

Mating Connector KITS are available from Axiomatic.

| AX070105 | Mating Plug Kit for 12-pin Connector (J26) (DT06-12SA, W12S, 0462-201-16141, 114017) |

<table>
<thead>
<tr>
<th>CAN &amp; RELAY CONNECTOR</th>
<th>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!</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 pin Deutsch P/N: DTM13-12PB</td>
<td>Power and Motor Control:</td>
</tr>
<tr>
<td>Pin 1: CAN_H</td>
<td>4 Aluminum power pass through blocks accessible via M8 tapped holes in enclosure. Wire lugs should be attached to these.</td>
</tr>
<tr>
<td>Pin 2: Output 1+</td>
<td>Refer to Figure 4 for orientation of holes to access Aluminum power pass through blocks.</td>
</tr>
<tr>
<td>Pin 3: Output 1 Return</td>
<td>Motor -</td>
</tr>
<tr>
<td>Pin 4: NC_2</td>
<td>Motor +</td>
</tr>
<tr>
<td>Pin 5: NO_2</td>
<td>Battery -</td>
</tr>
<tr>
<td>Pin 6: COM_2</td>
<td>Battery +</td>
</tr>
<tr>
<td>Pin 7: COM_1</td>
<td></td>
</tr>
<tr>
<td>Pin 8: NO_1</td>
<td></td>
</tr>
<tr>
<td>Pin 9: NC_1</td>
<td></td>
</tr>
<tr>
<td>Pin 10: Output 2 Return</td>
<td></td>
</tr>
<tr>
<td>Pin 11: Output 2+</td>
<td></td>
</tr>
<tr>
<td>Pin 12: CAN_L</td>
<td></td>
</tr>
</tbody>
</table>

Mating Connector KITS are available from Axiomatic.

| AX070111 | Mating Plug Kit for 12-pin Connector (J25) (DT06-12SB, W12S, 0462-201-16141, 114017) |

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.

Form: TDAX105000-06/21/19