

**TECHNICAL DATASHEET #TDAX100100**  
**25A DC MOTOR CONTROLLER**  
**P/N: AX100100**

*Variable Speed Control, Onboard I/O*  
*CAN SAE J1939, Rugged Packaging*

with Electronic Assistant® 

**Features:**

- Unidirectional or bi-directional DC motor control
- Up to 25A continuous output current to the motor
- 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.
- The control input to drive the motor can be mapped to either of the 2 command inputs or the controller can respond to messages from a CAN bus.
- User configurable enable function can be mapped to any of the 2 inputs or a CAN message
- 4 configurable and independent ramps smooth motor rotation, protecting the controller and the system being driven
- Additional 2 current outputs (2A proportional or hotshot digital) are available to 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)
- **Electronic Assistant®**  runs on a *Windows* operating system for simple user configuration. An Axiomatic USB-CAN converter links the PC to the CAN bus.
- Compact size for easy mounting on a vehicle
- Suitable for moist, high shock and vibration environments
- Fully sealed with a rugged IP67 corrosion resistant aluminum housing
- Operational from -40 to 85°C (-40 to 185°F)



**Applications:** Lift Equipment, Electric Vehicles for Material Handling, Cranes and Hoists, Hydraulic Tail Lifts and Winches, Golf Carts, Military Equipment, Mobile Pumps and Hydraulic Powerpacks

<b>Ordering Part Numbers:</b>	
<p><b>Motor Controller P/N: AX100100</b></p> <p><b>Accessories:</b></p> <p><b>Wire Harness KIT P/N: AX070100</b></p> <p><i>Or you can order them individually.</i></p> <p>CAN and I/O wire harness assembly, 2m            - P/N: <b>AX070102</b></p> <p>Power and Motor Control wire harness assembly, 2m            - P/N: <b>AX070103</b></p> <p>RS-232 wire harness – P/N: <b>AX070101</b>  <i>(Note: The AX070101 is not required if the AX070500 EA is used for configuration.)</i></p>	<p><b>AX070502 Configuration KIT</b> includes the following.</p> <p>USB-CAN Converter P/N: AX070501</p> <p>1 ft. (0.3 m) USB Cable P/N: CBL-USB-AB-MM-1.5</p> <p>12 in. (30 cm) CAN Cable with female DB-9 P/N: CAB-AX070501</p> <p>AX070502IN CD P/N: CD-AX070502, includes: <b>Electronic Assistant®</b> AX070500 software; EA &amp; USB-CAN User Manual UMAX07050X; USB-CAN drivers &amp; documentation; CAN Assistant (Scope and Visual) software &amp; documentation; and the SDK Software Development Kit.</p> <p><b>NOTE: To order this kit, you need only to specify P/N: AX070502.</b></p>

# Technical Specifications:

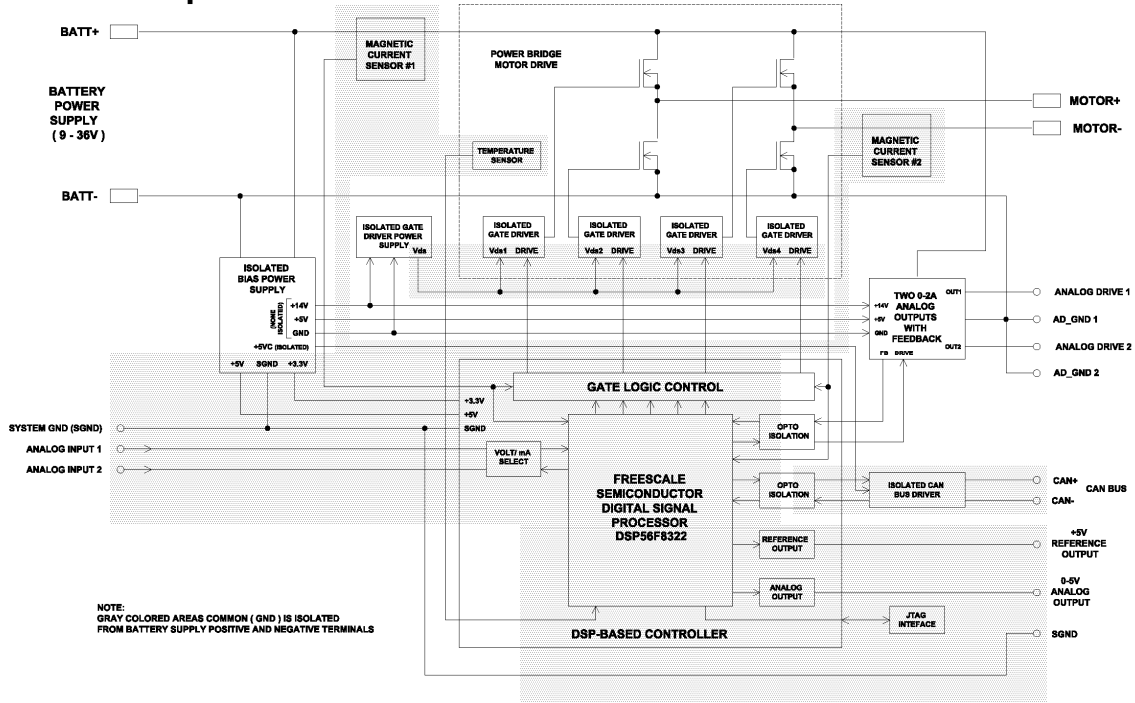


Figure 1 - Block Diagram

## 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 universal 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.

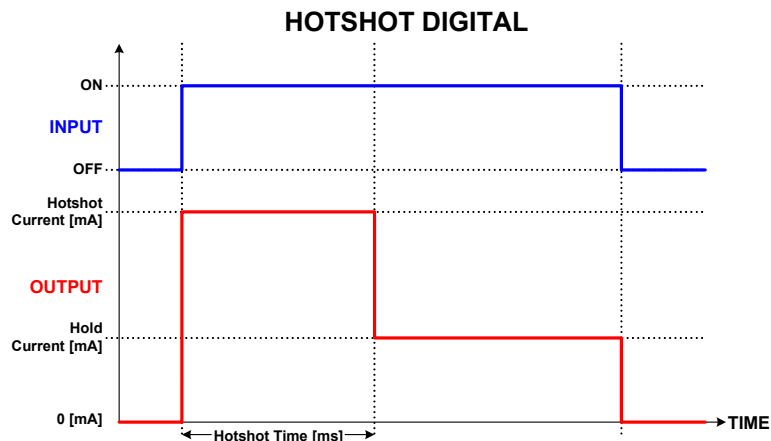
Table 1.0 Inputs to AX100100 (Up to 2 user selectable inputs)

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 $\mu$ A/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.
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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 <ul style="list-style-type: none"> <li>➤ open loop speed control;</li> <li>➤ closed loop speed control (on request); or</li> <li>➤ external feedback control (on request).</li> </ul> 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. <b>Hot Shot Coil Saver Outputs</b> (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.



**Figure 2 – Proportional Output Hotshot Digital Profile**

### General Specifications

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

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 an USB-CAN converter to link the device's CAN port to a <i>Windows</i>-based PC for initial configuration. An Axiomatic USB-CAN Converter AX070501 is available. Order the EA and USB-CAN as a kit (P/N AX070502), which includes all interconnecting cables. Refer to Figure 3 and Table 3 for details.</p>
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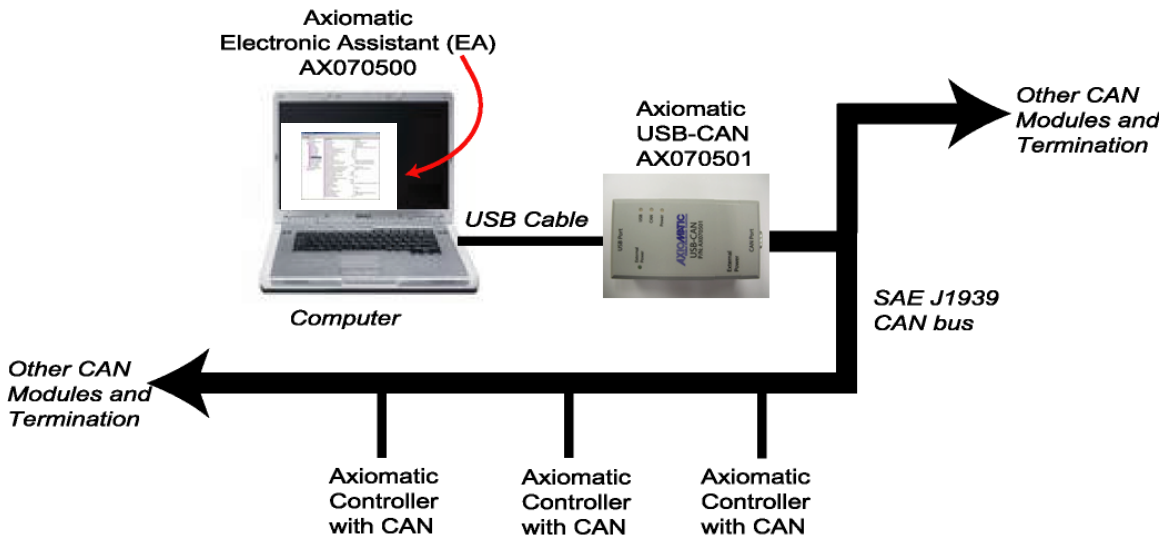


Figure 3 - User Configuration Using Electronic Assistant (EA)

Table 3 - Electronic Assistant® and USB-CAN Converter

**AX070502**, Configuration KIT includes the following.  
 USB-CAN Converter P/N: AX070501  
 1 ft. (0.3 m) USB Cable P/N: CBL-USB-AB-MM-1.5  
 12 in. (30 cm)CAN Cable with female DB-9  
 P/N: CAB-AX070501  
 AX070502IN CD P/N: CD-AX070502, includes: Electronic Assistant® software AX070500; EA & USB-CAN User Manual UMAX07050X; USB-CAN drivers & documentation; CAN Assistant (Scope and Visual) software & documentation; and the Software Development Kit.  
 NOTE: To order this kit, you need only to specify P/N: AX070502.

**Electronic Assistant®**   
 The 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.

**To order the EA software at the time of initial purchase, order the KIT AX070502 (see above) which includes the USB-CAN converter.** For additional EA and USB-CAN software ONLY CD's, use ordering P/N: CD-AX070502.

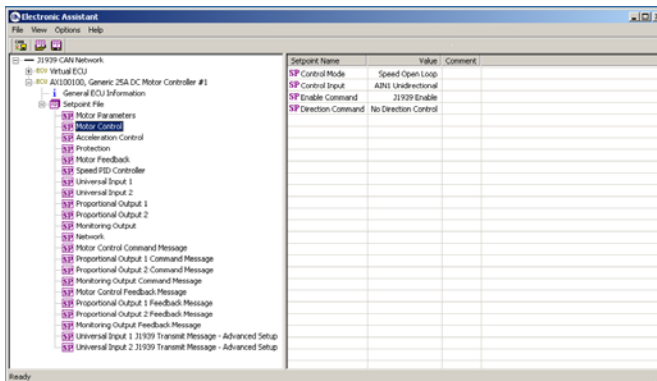
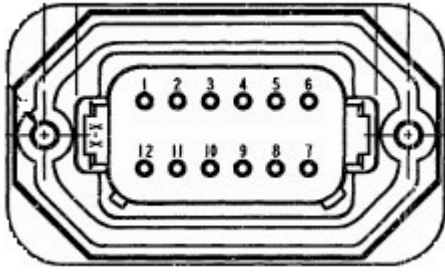


Figure 7.0 Configuration screen from the Electronic Assistant

The Electronic Assistant® (EA) is a *Windows*-based software configuration tool that runs on a PC connected to a J1939 bus via a USB to CAN converter, AX070501. Upon being connected to the bus, the EA will find all the Electronic Control Units (ECU) on the bus, and recognized those manufactured by Axiomatic. Using this tool, a user can quickly configure an Axiomatic ECU for the desired performance over a wide variety of applications.

CAN Interface	<p>1 CAN port (SAE J1939) (CANopen on request.)</p> <p>The software was designed to provide flexibility and provides the following.</p> <ul style="list-style-type: none"> <li>• Configurable ECU Instance in the NAME (for multiple ECU's on the network)</li> <li>• Configurable Motor Control Parameters</li> <li>• Configurable Motor PID Parameters</li> <li>• Configurable Input Parameters</li> <li>• Configurable Output Parameters</li> <li>• Configurable PGN and Data Parameters</li> </ul> <p><i>Note: Configurable parameters are also called setpoints.</i></p> <p>The motor controller is compliant with Bosch CAN protocol specification, Rev.2.0, Part B, and the following J1939 standards.</p> <table border="1" data-bbox="613 531 1385 1402"> <thead> <tr> <th colspan="2" data-bbox="613 531 1385 569"><i>Table 2: J1939 Compliance</i></th> </tr> <tr> <th data-bbox="613 569 841 621">OSI Network Model Layer</th> <th data-bbox="841 569 1385 621">J1939 Standard</th> </tr> </thead> <tbody> <tr> <td data-bbox="613 621 841 695">Physical</td> <td data-bbox="841 621 1385 695">J1939/11 – Physical Layer, 250K bit/s, Twisted Shielded Pair. J1939/15 - Reduced Physical Layer, 250K bits/sec, Un-Shielded Twisted Pair (UTP).</td> </tr> <tr> <td data-bbox="613 695 841 915" rowspan="2">Data Link</td> <td data-bbox="841 695 1385 737">J1939/21 – Data Link Layer</td> </tr> <tr> <td data-bbox="841 737 1385 915">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.</td> </tr> <tr> <td data-bbox="613 915 841 1073" rowspan="2">Network Layer</td> <td data-bbox="841 915 1385 978">J1939/81 – Network Management J1939, Appendix B – Address and Identity Assignments</td> </tr> <tr> <td data-bbox="841 978 1385 1073">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).</td> </tr> <tr> <td data-bbox="613 1073 841 1402" rowspan="3">Application Layer</td> <td data-bbox="841 1073 1385 1104">J1939/71 – Vehicle Application Layer</td> </tr> <tr> <td data-bbox="841 1104 1385 1314">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. <i>It is the user's responsibility to configure the controller such that it will not violate the J1939 standard.</i></td> </tr> <tr> <td data-bbox="841 1314 1385 1346">J1939/73 – Application Layer – Diagnostics</td> </tr> <tr> <td data-bbox="841 1346 1385 1402">DM – Diagnostic messaging (on request)</td> <td data-bbox="841 1346 1385 1402"></td> </tr> </tbody> </table>	<i>Table 2: J1939 Compliance</i>		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	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	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	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. <i>It is the user's responsibility to configure the controller such that it will not violate the J1939 standard.</i>	J1939/73 – Application Layer – Diagnostics	DM – Diagnostic messaging (on request)	
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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.																		
Packaging 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) <i>Refer to Figure 4.0.</i>																		
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**



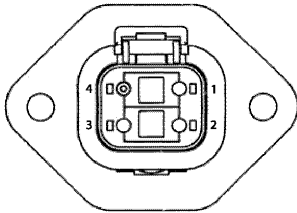
CAN and I/O Connector:

12 pin 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 Deutsch IPD mating connector assembly (P/N: 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



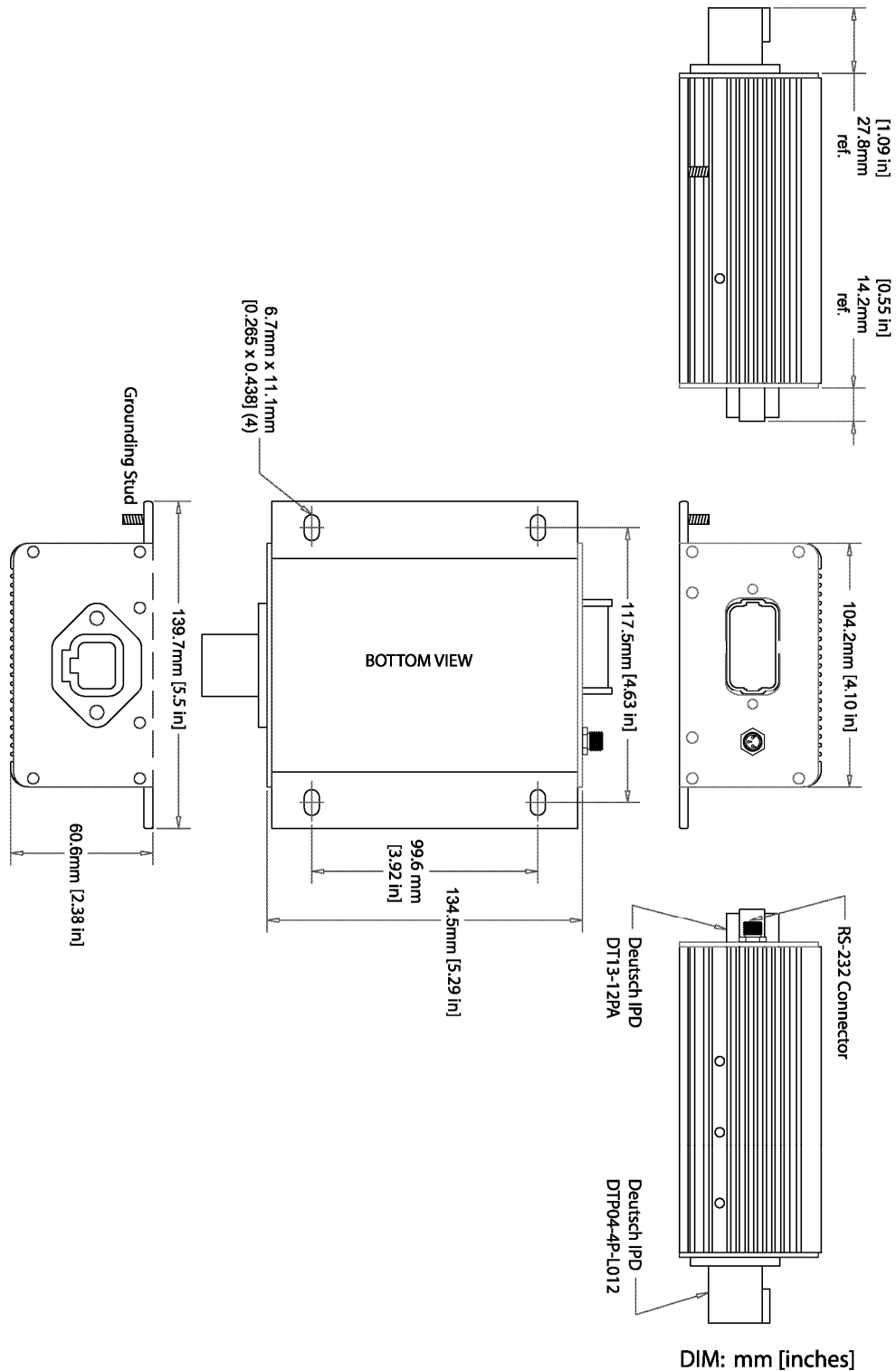
Power and Motor Control:

4 pin Deutsch IPD 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 Deutsch IPD mating connector assembly (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**

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: TDAX100100-07/14/09