

2 Universal Inputs, Dual Valve Controller

2 Universal Signal Inputs
2-3A Outputs Drive Hydraulic Valves
CAN (SAE J1939)

Programmable with Electronic Assistant®
Simulink®

P/N: AX022410
and AX022410S

Features:

- 2 universal signal inputs configurable as:
 - Voltage
 - Current
 - Resistive
 - PWM
 - Frequency/RPM
 - or Digital
- 2 outputs to drive valves (0-3A)
- Outputs are user configurable as:
 - Proportional Current
 - Proportional Voltage
 - Hotshot Digital
 - PWM Duty Cycle (1 Hz to 25 kHz)
 - or On/Off Digital
- 1 +5V Reference
- Fully protected outputs
- 12V, 24V or 48VDC nominal
- 1 CAN (SAE J1939) port (CANopen® on request)
- Rugged aluminum packaging and Deutsch IPD 12-pin connector
- IP67
- Flexible user programming for application-specific control logic via the CAN based **Electronic Assistant®** in Model AX022410
- Simulink® block library is available in Model AX022410S



The controller is designed to meet the rugged demands of mobile equipment and heavy duty industrial machine control applications. These applications include, but are not limited to:

- **Proportional Fan Drive Control**
- PID Closed Loop Valve Control
- Hydraulic Valve Control
- Signal Conversion

Ordering Part Numbers:

SAE J1939 version Controller interfacing with Electronic Assistant®: **AX022410**

SAE J1939 Controller with Simulink®: **AX022410S**

Hardware Interface Library for Simulink® Files and User Manual: **CD-AX022410S**

Accessories:

Mating Plug Kit (DTM06-12SA, WM12S, 12 0462-201-20141, 3 plugs): **PL-DTM06-12SA**

Electronic Assistant®: **AX070502**

Description: The Dual Input, Dual Output Valve Controller is designed for extremely versatile control of up to two proportional outputs to directly drive hydraulic valve coils or other loads. Its flexible circuit design gives the user a wide range of configurable input or output types. The sophisticated control algorithms allow the user to program the controller for a wide range of applications without the need for custom software.

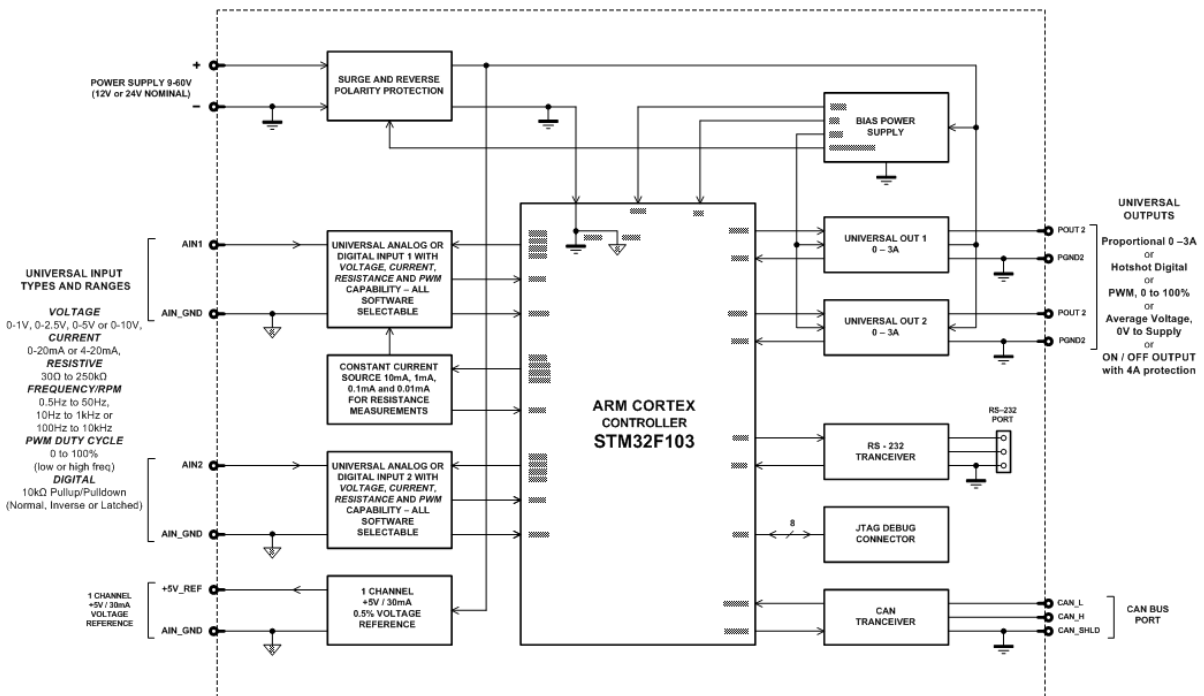
The controller has two fully programmable universal inputs that can be setup to read: voltage, current, resistive, PWM, frequency/RPM, or digital input signals. There are also two universal outputs that can be setup to drive: proportional current (up to 3A each); hotshot digital current; proportional voltage (up to supply); proportional PWM; or straight on/off digital loads. All I/O ports on the unit are independent from one another.

It 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 proportional outputs. It can be operated as either a self-contained control system, driving the outputs directly from the on-board inputs, and/or it can be integrated into a CAN J1939 network of controllers. All I/O and logical function blocks on the unit are inherently independent from one another, but can be programmed to interact in a large number of ways. While the Block Diagram shows the hardware features, Figure 1 shows the logical function blocks (software) available in Model AX022410.

There are a number of built-in protection features that can shut off the outputs in adverse conditions. They include hardware shutoffs to protect the circuits from being damaged as well as software shutdown features that can be enabled in safety critical systems.

All setpoints are user configurable using the Electronic Assistant® in model AX022410. The model P/N: AX022410S operates with Simulink® for easy graphical programming in a model based simulation and development environment. The Axiomatic Hardware Interface Library (HWIL) is provided for this purpose. For simulating models using Axiomatic HWIL, licenses for Simulink and Stateflow are required. Code generation requires the Simulink Coder license in addition. Refer to Figure 2.0.

BLOCK DIAGRAM



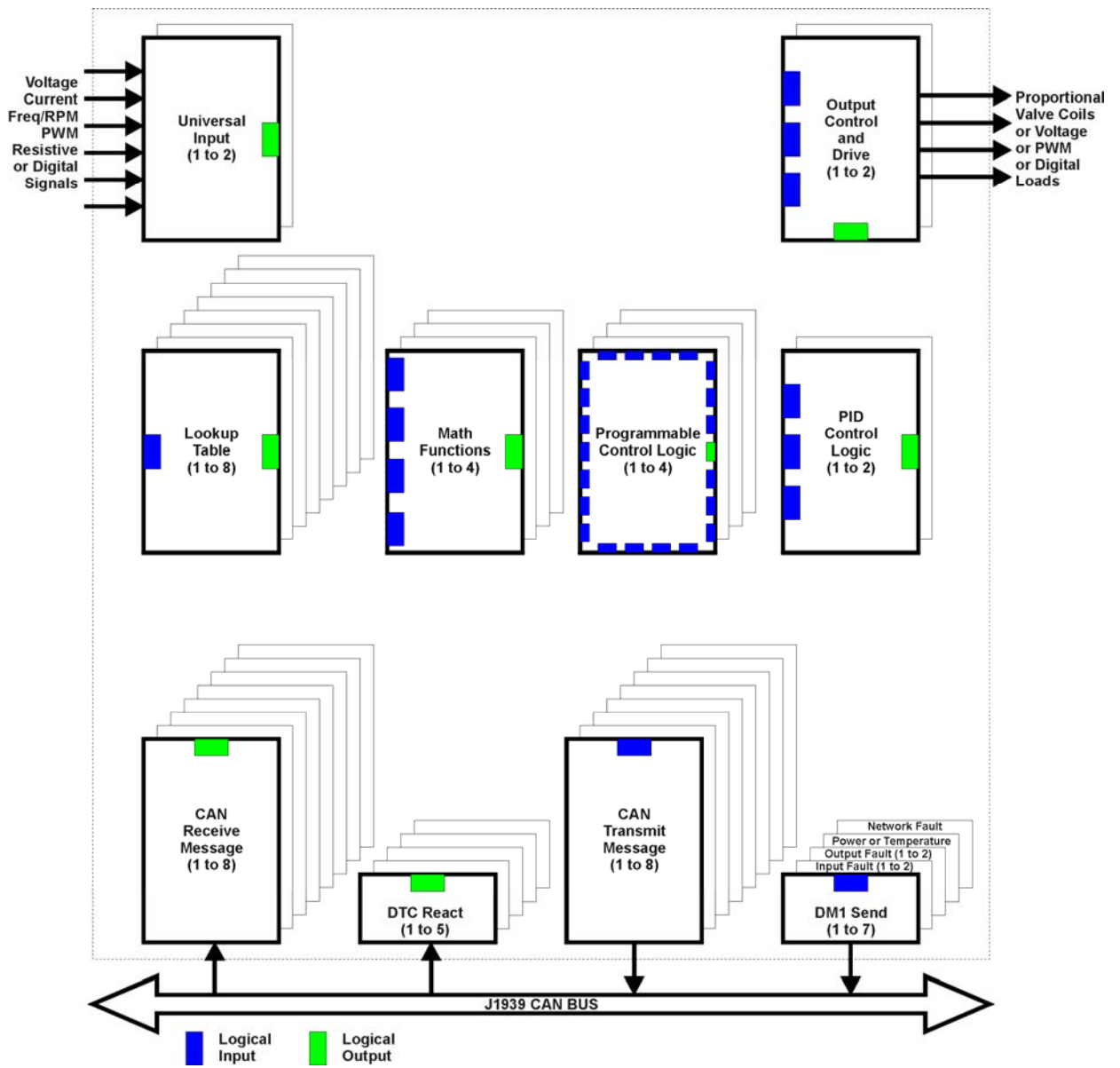


Figure 1B –Logical Functional Block Diagram

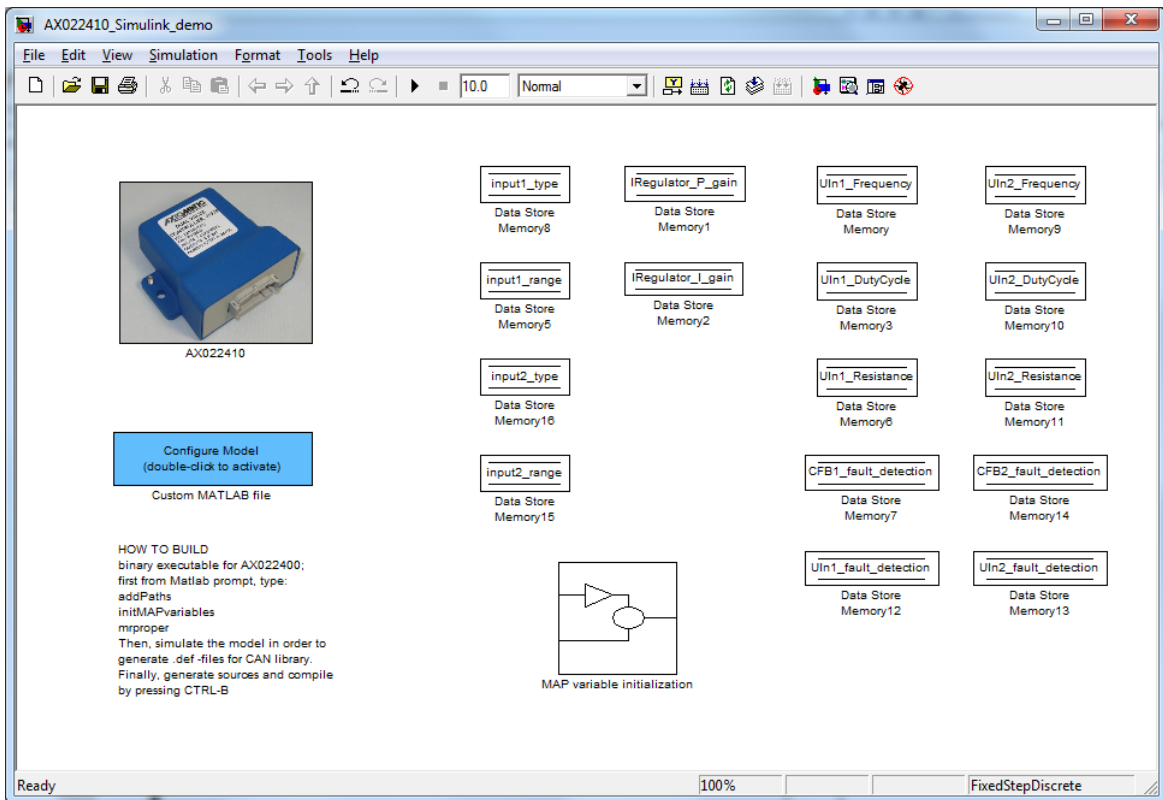


Figure 2 – Axiomatic’s Simulink Library Browser

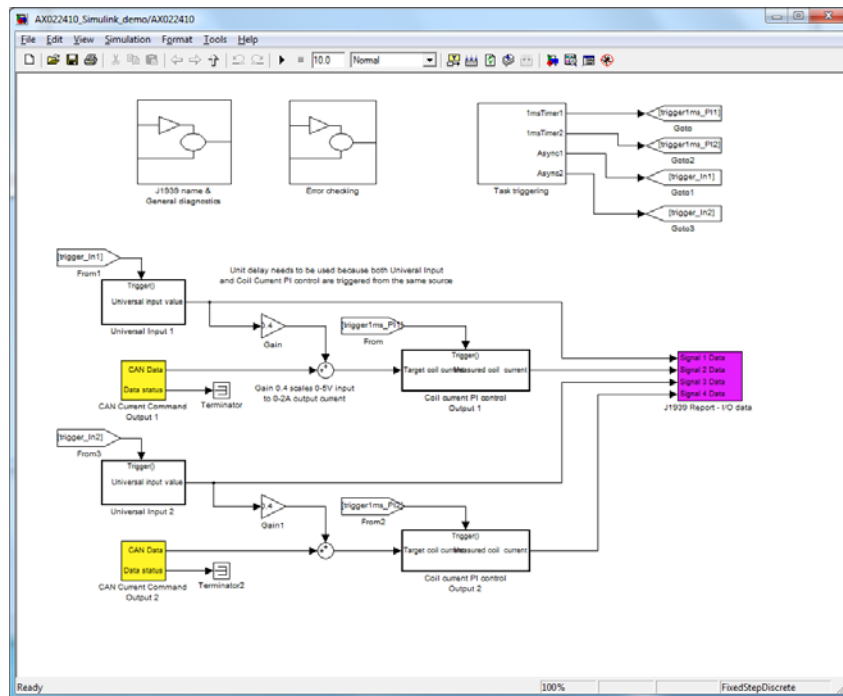


Figure 3 – AX022410S with Simulink

Technical Specifications:

Inputs

Power Supply Input - Nominal	12, 24, 48VDC nominal (9...60 VDC power supply range)
Protection	Reverse polarity protection is provided. Surge protection up to 65V is provided. Overvoltage shutdown of the output load is provided. Undervoltage protection (hardware and software shutdown at 7.5V) is provided.
CAN	SAE J1939 Commands CANopen® is available in P/N: AX022411 and AX022411S.
Voltage Reference	One provided 5V +/- 0.2% error Can source up to 50mA without derating
Analog GND Reference	One provided
Universal Signal Inputs	2 fully independent universal inputs are provided. Refer to Table 1.0 All inputs are user selectable as Voltage, Current, Resistive, Frequency, RPM, PWM or Digital input types. Inputs are sampled multiple times per millisecond. Protected against shorts to GND or +Vps (up to 60 Vdc) All input channels can handle negative voltage inputs down to -2VDC due to voltage spikes or noise. Response time to change at the input 2 mSec +/- 1 mSec (without software filtering) unless otherwise noted.

Table 1.0 – Input – User Selectable Options	
Analog Input Functions	Voltage Input, Current Input or Resistive Input 12-bit Analog to Digital
Voltage Input	0-1V (Impedance 1 MΩ) 0-2.5V (Impedance 1 MΩ) 0-5V (Impedance 135 kΩ) 0-10V (Impedance 127 kΩ) 1mV resolution, accuracy +/- 1% error
Current Input	0-20 mA (Current Sense Resistor 249 Ω) 4-20 mA (Current Sense Resistor 249 Ω) 1uA resolution, accuracy +/- 2% error
Resistive Input	Self-calibrating for range of 30 Ω to 250 kΩ 1Ω resolution, accuracy +/- 1% error Slower response time is due to the auto-calibration feature. It could take up to ~2 Sec. for the input reading to stabilize after a large change (i.e. 50Ω to 200kΩ) at the input, or to detect an open circuit. <i>It is recommended to use software filtering type Moving Average with Filter Constant 100 for this input type.</i>
Digital Input Functions	Discrete Input, PWM Input, Frequency Input, RPM Input 15-bit timer (PWM, Frequency, RPM)
Digital Input Level	5V CMOS, +Vps (12V, 24V)
PWM Input	0 to 100% Low Frequency (<1kHz) or High Frequency (>100 Hz) 0.01% resolution, accuracy +/- 1% error 1MΩ Impedance, or 10kΩ Pullup/Pulldown <i>Response time is dependent on input frequency.</i>
Frequency/RPM Input	0.5 to 50Hz Range: 0.01Hz resolution 10Hz to 1kHz Range: 0.1Hz resolution 100 Hz to 10kHz Range: 1Hz resolution Accuracy +/- 1% error 1 MΩ Impedance, or 10 kΩ Pullup/Pulldown <i>Response time is dependent on input frequency.</i>
Digital Input	Active High or Active Low Normal, Inverse or Latched (pushbutton) Configurable 10kΩ pullup or pulldown resistor (to GND) resistor which can also be disabled (floating input) Rising edge ON threshold 3.7V +/- 0.1V Falling edge OFF threshold 2.9V +/- 0.1V Input debouncing selectable, will slow response time

Outputs

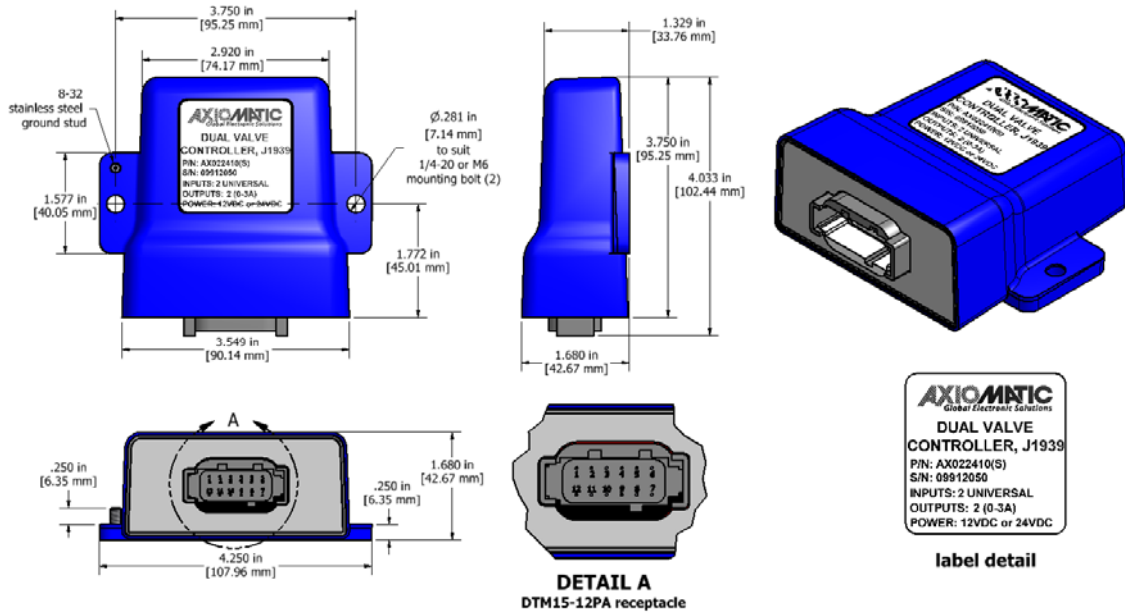
CAN	SAE J1939 Messages																		
Universal Outputs	<p>Two independent software controlled outputs selectable as: Proportional Current; Hotshot Digital; PWM Duty Cycle; Proportional Voltage; or On/Off Digital types</p> <p>Half-bridge outputs, current sensing, grounded load. High side sourcing up to 3A</p> <p>All output types have configurable minimum and maximum output levels within the range for the type selected.</p> <p>Current Outputs: 1mA resolution, accuracy +/- 2% error Software controlled PID current Range 0 to 3000 mA Fully configurable dither superimposed on top of output current Configurable from 50 to 400Hz amplitude High frequency output drive at 25kHz <i>Note: Both outputs use the same dither and drive frequencies.</i></p> <p>Voltage Outputs: 0.1V resolution, accuracy +/- 3% error Average voltage output based on unit power supply High frequency drive at 25kHz Additional external filtering is required to create a DC voltage</p> <p>PWM Outputs: 0.1% resolution, accuracy +/- 1% error Range 0 to 100% Output Frequency: 1 Hz to 25 kHz Configurable frequency ONLY if no current output types are used, otherwise default 25kHz is used Outputs can be linked in this mode to provide mirrored output signals. (Note: This is not a true half H-bridge; no deadband is provided.)</p> <p>Digital On/Off: Load at supply voltage must not draw more than 3A.</p>																		
Response Time	<p>All responses were tested using 0-5V input, full input step change commanding a full output range step change, with no ramps on the output.</p> <p>Response times accurate to +/- 10ms</p> <table border="1"> <thead> <tr> <th>Type</th> <th>Rising Edge</th> <th>Falling Edge</th> </tr> </thead> <tbody> <tr> <td>Current *</td> <td>150 ms</td> <td>170 ms</td> </tr> <tr> <td>Hotshot Digital *</td> <td>160 ms</td> <td>160 ms</td> </tr> <tr> <td>PWM</td> <td>30 ms</td> <td>30 ms</td> </tr> <tr> <td>Voltage</td> <td>30 ms</td> <td>30 ms</td> </tr> <tr> <td>On/Off Digital</td> <td><2ms</td> <td><2ms</td> </tr> </tbody> </table> <p><i>*Current response tested with 12V HydraForce coil 6507212. Response times will vary depending on the load inductance.</i></p>	Type	Rising Edge	Falling Edge	Current *	150 ms	170 ms	Hotshot Digital *	160 ms	160 ms	PWM	30 ms	30 ms	Voltage	30 ms	30 ms	On/Off Digital	<2ms	<2ms
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Protection	<p>Fully protected against short circuit to ground or +Vps Grounded short circuit protection will engage at 4.5A +/- 0.5A. Unit will fail safe in the case of a short-circuit condition, and is self-recovering when the short is removed.</p>																		
Power GND Reference	One Provided																		

General Specifications

Quiescent Current	70 mA at 12 V Typical 40 mA at 24 V Typical 27 mA at 48 V Typical
Microprocessor	ARM 7 processor STM32103CB 32-bit, 128 Kbyte flash program memory
Diagnostics	Each input and output channel can be configured to send diagnostic messages to the J1939 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 power supply undervoltage and overvoltage, microprocessor over temperature and lost communication. They can be sent to the J1939 CAN bus.
Control Logic	User programmable functionality using Electronic Assistant® service tool Refer to the User Manual for details.

Communications	Compliant to SAE CAN J1939 Standard 1 CAN port (SAE J1939) CANopen® is available on request.
CAN User Interface	Compliant to SAE CAN J1939 Standard Model AX022410 interfaces with the Electronic Assistant®, P/N: AX070502 , for <i>Windows</i> operating systems. It comes with a royalty-free license for use. To use the Electronic Assistant, an USB-CAN converter links the device's CAN port to a <i>Windows</i> -based PC. Model AX022410S includes a Simulink® block library. Simulink® is a model-based design tool from Mathworks®. Using Simulink®, the OEM machine designer may simulate their control system with the AX022410S module included. This permits fine tuning of the design parameters and testing of functionality prior to machine prototype installation. The CD-AX022410S includes the Hardware Interface Library for Simulink® Files and the controller's User Manual.
CAN Response Time	Per the J1939 standard, the maximum recommended transmit rate for any message is 10ms. Response time of feedback on the CAN to changes at the I/O will be a combination of the I/O type's response time and the configurable software filtering, ramps, delays, etc. that were selected in the application.
Reflashing Software over CAN	Reflash software over the CAN bus per the SAE J1939 standard using the Electronic Assistant®.
Packaging	Aluminum enclosure, integral Deutsch IPD connector P/N: DTM15-12PA 4.03 x 4.25 x 1.68 inches 102.44 x 107.96 x 42.67 mm L x W x H including integral connector
Protection	IP67
Weight	0.65 lbs. (0.295 kg) without encapsulation
Temperature Rating	Operating: -40 to 85°C (-40 to 185°F) Storage: -50 to 105°C (-58 to 221°F)
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.
Installation	Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.25 inches (6.35 mm) thick. If the module is mounted without an enclosure, it should be mounted to reduce the likelihood of moisture entry. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm). Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s). 16AWG or 18AWG wiring is recommended for this connector. The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose. All field wiring should be suitable for the operating temperature range of the module. All chassis grounding should go to a single ground point designated for the machine and all related equipment.

Dimensional Drawing



DETAIL A
DTM15-12PA receptacle

Mating plug is Deutsch IPD P/N: DTM06-12SA with 2 wedgelocks (W12S) and 12 contacts (0462-201-20141). All field wiring should be suitable for the operating temperature range.

Dimensions: inches [mm]

Electrical Connections	12 pin Deutsch IPD connector P/N: DTM15-12PA A mating plug kit is available as Axiomatic P/N: PL-DTM06-12SA . It is comprised of Deutsch IPD P/N's 1 DTM06-12SA, 1 WM12S, 12 0462-201-20141 and 3 plugs for any unused pins.																												
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Notes:

CANopen® is a registered community trade mark of CAN in Automation e.V.
Electronic Assistant® is a registered U.S. trade mark of Axiomatic Technologies Corporation.
Simulink® is a registered trademark of The Mathworks, Inc.

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: TDAX022410-06/06/13