Stepper Motor Drive

**1 Analog Input, 1 Frequency/PWM Input
Motor Output (2A), Digital Output (5A)
12V or 24VDC
+5V Reference
1 CAN (SAE J1939)**

with **Electronic Assistant®** (EA)

P/N: AX100700

Rugged and Programmable Motor Drive for 2-Phase Stepper Motors

Features:

- Simple and accurate control of the levels, waveforms, timing and phase-shifts of the current for a two phase stepper motor via SAE J1939 command messages
- 1 analog input for voltage or current (user selectable) can act as a command source for a run-time parameter, feedback in a PID control loop or as an E-stop command
- +5V reference voltage to power a sensor or potentiometer
- 1 Frequency or PWM input for inductive or active sensors (user selectable)
- 12V/24VDC input power (nominal)
- Surge protection, over and under voltage protection
- Motor output is 2A per phase for a Stepper Motor.
- Motor direction is selectable
- 1 sinking digital output (up to 5A) for a relay, brake or other load
- 1 CAN (SAE J1939)
- CANopen® module available on request
- Open or closed loop motor drive control logic (user selectable)
- Highly programmable to meet various application-specific requirements
- **Electronic Assistant®** (EA) runs on a *Windows* operating system for user configuration and programming. An Axiomatic USB-CAN converter links the PC to the CAN bus.
- Fault detection over CAN bus
- Rugged packaging and connectors

Applications:

- Construction Equipment, Mobile Equipment, Material Transport Vehicles, On-road Vehicles (Bus)

Ordering Part Numbers:

SAE J1939 Stepper Motor Drive: **AX100700**

Accessories:
Mating Plug Kit: **PL-DTM06-12SA-12SB**
(The KIT is comprised of: DTM06-12S, DTM06-12SB, 2 W12S and 24 contacts. The Axiomatic stock # is FG-IOCTRL-19.)

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; EA & USB-CAN User Manual UMAX07050X; USB-CAN drivers & documentation; CAN Assistant (Scope and Visual) software & documentation; and the SDK Software Development Kit.
NOTE: To order this kit, you need only to specify P/N: AX070502.

Block Diagram
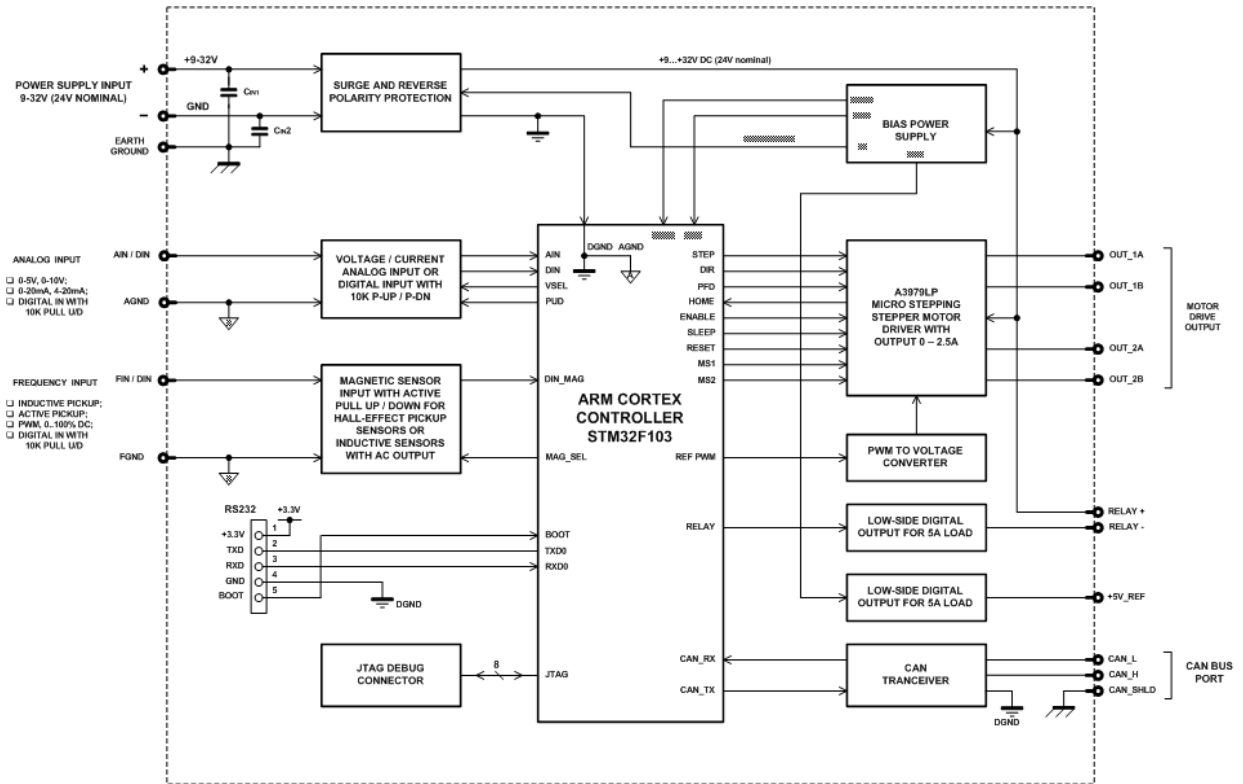
Set up of SAE J1939 Controller on a CAN Network:
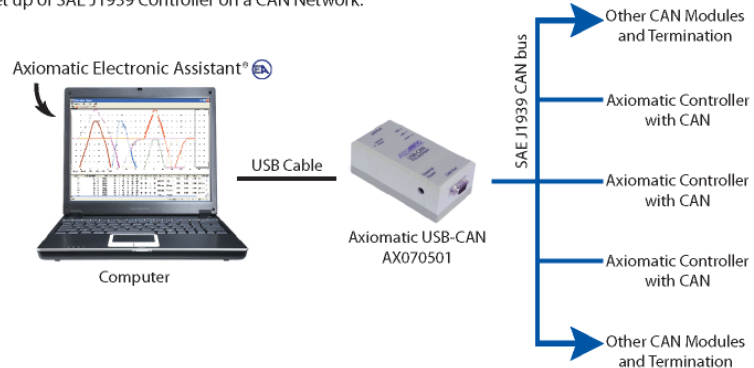
The controller belongs to a family of Axiomatic smart controllers with programmable internal architecture. This provides users with flexibility, allowing them to build their own custom controller with a required functionality from a set of predefined internal functional blocks using the PC-based Axiomatic Electronic Assistant® software tool. Application programming is performed through the CAN interface, without disconnecting the controller from the user's system.

Technical Specifications:
Input Specifications

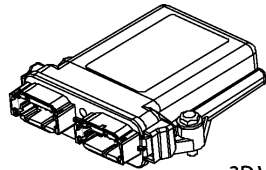|	
Power Supply Input - Nominal	12V or 24VDC nominal (9…32 VDC power supply range)
Reverse Polarity Protection	Provided
Surge Protection	Provided
Under-voltage Protection	Provided, software reaction
Over-voltage Protection	Provided, software reaction
Analog/Digital Input	1 Analog/Digital input, user configurable • Voltage • Current • Digital (active high or active low) Inputs are sampled every 1 msec. Protected against shorts to GND or +Vcc Accuracy: +/- 1% over range Resolution: 1mV or 1uA, depending on type
Frequency Input	1 Frequency or PWM, for inductive or active sensors User configurable for sampling range: 0.5 Hz to 50Hz; 10Hz to 1kHz; or 100Hz to 10 kHz Can be configured as active high or low digital input Inputs are sampled every 1 msec. Protected against shorts to GND or +Vcc Accuracy: +/- 1% over range Resolution: 0.01 Hz or 0.1 Hz or 1Hz, depending on measuring range. 0.1% for PWM input
Signal Grounds	2 Analog GND (Input and +5Vref) 1 Frequency GND
Input Impedance	0-5V @ 1MOhm 0-20 mA @ 130 Ohms Frequency/PWM @ 10 KOhm pullup or pulldown

Output Specifications

Output to Motor	Allegro DMOS Microstepping Driver, A3979 Maximum 2A per phase for a Stepper Motor Some overcurrent protection is provided by the drive chip up to 2.5A. User has full access to all the chip's features via CAN messages.
Motor Disable	Motor can be disabled in a variety of ways, including "Motor Mode", and "E-Stop" input, or when an error is detected.
Motor Direction	Motor Direction can be user selected for Clockwise or Counter-Clockwise Drive. Refer to the User Manual for details.
Thermal Protection	Thermal protection is built-in to driver chip.
Digital Output	1 sinking (switched to GND) output for up to a 5A load (relay, brake or other load)
Reference Voltage	+5V, 10 mA is available to power a sensor or potentiometer and is referenced to Analog GND

General Specifications

Microprocessor	STM32F103, 32-bit at 72MHz
Motor Drive Logic	Standard embedded software is provided. The stepper drive 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. 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®. There are 2 types of function blocks associated with the stepper motor logic and drive. Stepper Drive Values: Default run-time values, ranges for linear controls Stepper Drive Controls: Selection of control sources for all the run-time variables associated with the stepper and output drive Up to 15 independent CAN Receive messages can be read from a J1939 network to control the various run-time variables associated with the stepper drive. Up to 10 independent CAN Transmit messages can be sent to a J1939 network for system diagnostics and feedback.
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.

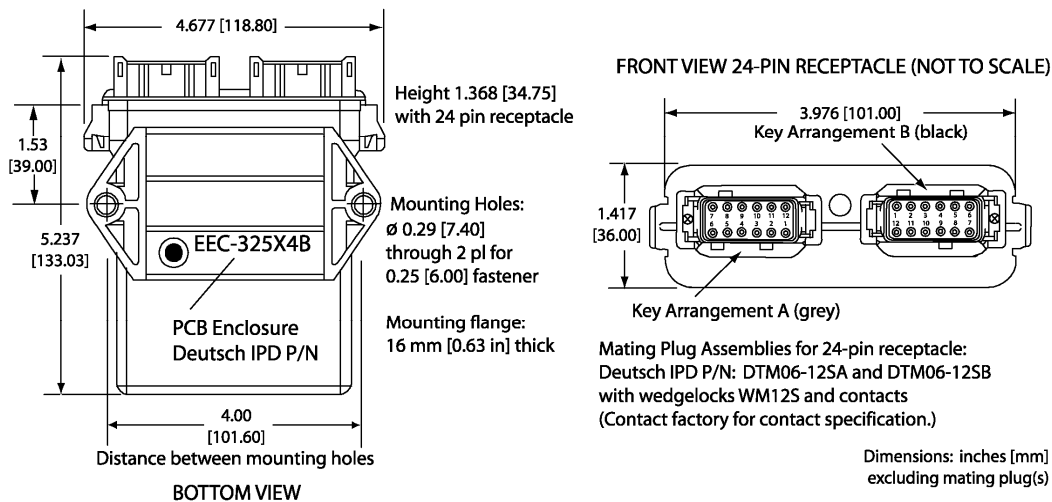|	
Additional Fault Feedback	There are several types of faults that the controller will detect and provide a response: phase current winding problems; power supply undervoltage and overvoltage; and lost communication. They can be sent to the CAN bus.
CAN User Interface	The Electronic Assistant® for *Windows* operating systems comes with a royalty-free license for use on multiple computers. It requires an USB-CAN converter to link the device's CAN port to a *Windows*-based PC. An Axiomatic USB-CAN Converter AX070501 is available as part of the Axiomatic Configuration KIT. **P/N: AX070502**, the Axiomatic 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; EA & USB-CAN User Manual UMAX07050X; USB-CAN drivers & documentation; CAN Assistant (Scope and Visual) software & documentation; and the SDK Software Development Kit.
Quiescent Current Draw	32.88 mA @ 12Vdc
Weight	0.55 lbs. (0.25 kg)
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Storage Temperature	-55 to 125 °C (-67 to 257°F)
Protection	IP67, Unit is conformal coated in the housing.
Packaging and Dimensions	High Temperature Nylon housing - Deutsch IPD PCB Enclosure (EEC-325X4B) 4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm (W x L x H excluding mating plugs)

Dimensional Drawing

HOUSING DIMENSIONS
Housing Material: High Temperature Nylon (Black)

3D VIEW
Housing with 24 Pin Receptacle

4.677 [118.80]

Height 1.368 [34.75] with 24 pin receptacle

1.53 [39.00]

5.237 [133.03]

EEC-325X4B

PCB Enclosure Deutsch IPD P/N

Mounting Holes: Ø 0.29 [7.40] through 2 pl for 0.25 [6.00] fastener

Mounting flange: 16 mm [0.63 in] thick

4.00 [101.60]
Distance between mounting holes
BOTTOM VIEW

FRONT VIEW 24-PIN RECEPTACLE (NOT TO SCALE)

3.976 [101.00]
Key Arrangement B (black)

1.417 [36.00]

Key Arrangement A (grey)

Mating Plug Assemblies for 24-pin receptacle:
Deutsch IPD P/N: DTM06-12SA and DTM06-12SB
with wedgelocks WM12S and contacts
(Contact factory for contact specification.)

Dimensions: inches [mm]
excluding mating plug(s)

Mounting	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 0.63 inches (16 mm) thick.
	If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry.
	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. No wire or cable harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters. All field wiring should be suitable for the operating temperature range. 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).
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.
Electrical Connections	Deutsch DTM series 24 pin receptacle (DTM13-12PA-12PB-R008) Mating plug: Deutsch DTM06-12SA and DTM06-12SB with 2 wedgelocks (WM12S) and 24 contacts (0462-201-20141). 20 AWG wire is recommended for use with contacts 0462-201-20141. **Use dielectric grease on the pins when installing the controller.**

Typical Connections

Key Arrangement B (black)

Key Arrangement A (grey)
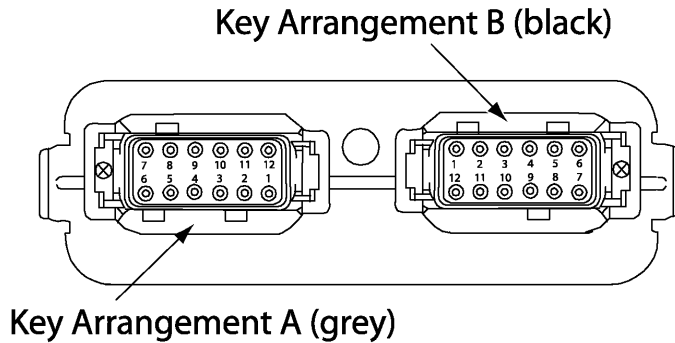
FRONT VIEW 24 PIN RECEPTACLE

Grey Connector		Black Connector	
Pin #	Function	Pin #	Function
1	No Connection	1	Phase 1, A+
2	CAN Shield	2	Phase 2, B+
3	No Connection	3	Digital Output + (+Vcc)
4	Frequency GND	4	Frame GND (external connection)
5	+5V Reference GND (AGND)	5	Battery -
6	Analog GND (AGND)	6	Battery +
7	Analog Input (Voltage/Current 1 or Din1)	7	Battery +
8	+5V Reference (up to 10mA)	8	Battery -
9	Frequency Input (Frequency/PWM 1 or Din2)	9	Frame GND (external connection)
10	No Connection	10	Digital Output – (up to 5A)
11	CAN Low	11	Phase 2, B-
12	CAN High	12	Phase 1, A-

Control Logic

The Stepper Motor Drive is designed to give the user full access to the 2A drive control chip A3979 via J1939 command messages. It allows for simple and accurate control of the levels, waveforms, timing, and phase-shifts of the current for a two phase stepper motor.

The drive allows the user to set the default values for the stepper motor using the Axiomatic Electronic Assistant ® . It also allows the user to set the default targets and ranges for the run-time variables such as the step rate the motor is to run at, or the number of steps the motor is to take before holding.

A unique feature of the drive is that not only are the run-time variables accessible through EA, but they can also be independently controlled by J1939 messages received while the unit is operational. This means that while the EA tool is used for initial setup and configuration, all the drive values can be changed as needed without it.

The default configuration for the drive is to be a purely reactive control based on the command data received from J1939 messages. However, it does have more sophisticated logic supported for more complex controls. Contact Axiomatic for application-specific programming.

The "off-the-shelf" logic blocks supported by the drive, and selectable by the user, are:
a) Automatic PID control of the direction and step rate when the *"Motor Mode"* is selected to be controlled by the "PID Control Function" block.
b) Diagnostic detection, reaction and feedback
c) Up to five acceleration/deceleration profiles that can be setup using EA, then selected during operation via a CAN message.
d) Automatic resetting of the "Number of Steps" command so that the controller can simply send the same CAN message again to step the same number of steps.

The drive also has two inputs that could be used as the command source for a run-time parameter, rather than a CAN message. Alternatively, the inputs could be used for feedback in a PID control, or as simple digital controls, for example to E-Stop the device. Lastly, they could independently be sent to the J1939 network as input data for another device on the CAN bus.

Lastly, the drive has a single digital output, capable of sinking up to 5A, to drive a relay, brake or other load in a system. By default, the output is controlled by a CAN message received from the J1939 network, but it too could be controlled by one of the inputs instead. The output can be setup for a simple on/off response, or to blink indicating a fault has been detected by the drive.

Note: CANopen® is a registered community trade mark of CAN in Automation e.V.

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: TDAX100700-07/16/12