

## Two Bipolar and Two Universal Signal Inputs Dual Valve Controller

*Configurable AB Encoder Input*

*Two 2.5A High Side Outputs*

*+5V Reference*

*CAN (SAE J1939)*

*with Axiomatic Electronic Assistant*

**P/N: AX022440**

### Features:

- Two (2) signal inputs are selectable as bipolar or unipolar voltage, current, digital, PWM or Frequency signal types:
  - 0-5V, 0-10V, 0 to +/- 5V, 0 to +/- 10V;
  - 4-20mA, 0-20mA;
  - PWM;
  - Frequency;
  - or Digital.
- Two (2) universal signal inputs are configurable as:
  - Voltage
  - Current
  - Resistive
  - PWM
  - Frequency/RPM
  - Digital
  - or AB Encoder
- Two (2) independent outputs to drive valves (0-2.5A) are user configurable as:
  - Proportional Current;
  - Proportional Voltage;
  - Hotshot Digital;
  - PWM Duty Cycle (1 Hz to 25 kHz);
  - or On/Off Digital.
- SAE J1939 CAN port
- 12Vdc or 24Vdc nominal
- One reference voltage (+5V) is available to power sensors.
- Operates from -40 to 85°C (-40 to 185°F).
- One LED indicator
- IP20
- DIN rail mount
- CE marking
- Configurable via the Axiomatic Electronic Assistant



### Applications:

The controller is designed to meet the rugged demands of industrial machine and automation applications. These applications include, but are not limited to:

- PID Closed Loop Valve Control, Hydraulic Valve Control
- Signal Conversion

### Ordering Part Numbers:

Dual Bipolar Input, Dual Valve Controller, 250 kbps SAE J1939: **AX022440**  
Dual Bipolar Input, Dual Valve Controller, 500 kbps SAE J1939: **AX022440-01**  
Dual Bipolar Input, Dual Valve Controller, 1Mbps SAE J1939: **AX022440-02**

### Accessories:

Axiomatic Electronic Assistant Configuration KIT: **AX070502**, or **AX070506K**

## Description:

The Dual Valve Controller is designed for extremely versatile control of up to two proportional outputs to directly drive 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: bipolar or unipolar voltage, current, resistive, frequency, or digital input signals. There are also two universal outputs that can be setup to drive: proportional current (up to 2.5A 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.

The 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 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 many ways.

It has several built-in protections 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 Axiomatic Electronic Assistant.

A rugged power supply interface accepts 12 Vdc or 24 Vdc nominal for battery powered machine applications. An LED indicates operational status. The enclosure is DIN rail mount. It operates from -40 to 85°C (-40 to 185°F). The sophisticated control algorithms allow the user to program the controller for a wide range of applications without the need for customer software.

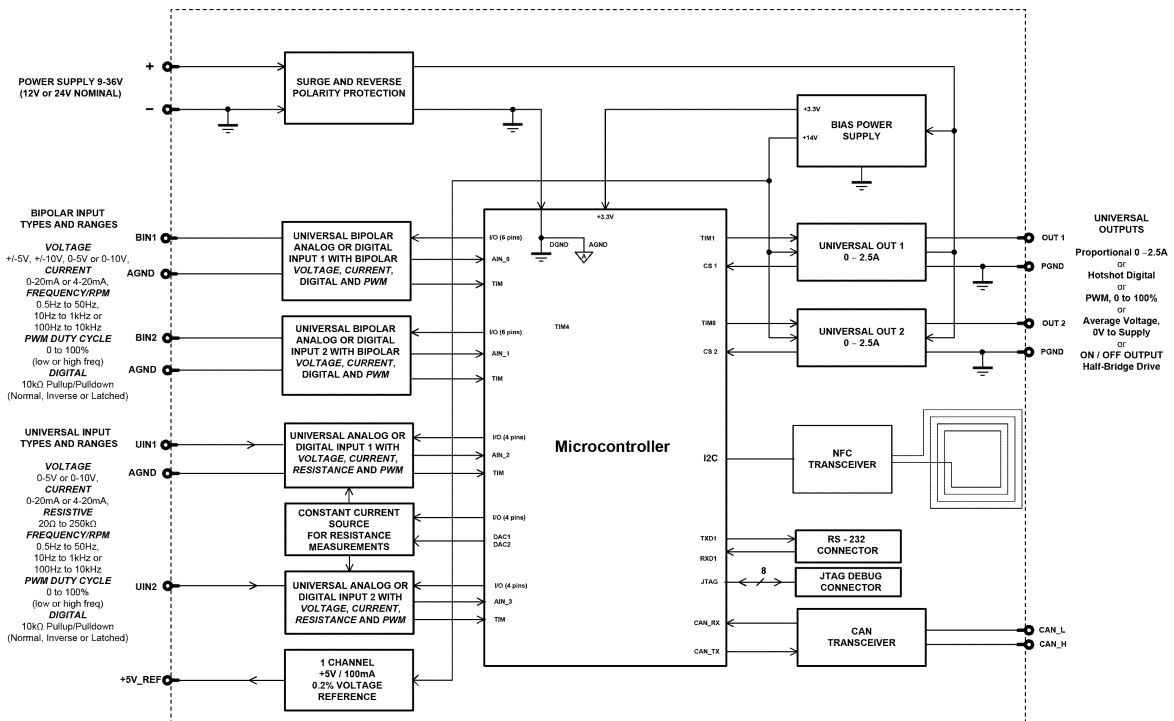


Figure 1 –Logical Functional Block Diagram (Please note NFC antenna is not used.)

## Technical Specifications:

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 <https://www.axiomatic.com/service/>.

### Power Supply

Power Supply Input	12 Vdc or 24 Vdc nominal 8...36 Vdc power supply range Shutdown voltage is 6.0 Vdc.
Protection	Reverse polarity protection is provided. Surge protection up to 150V is provided. Overvoltage shutdown of the output load is provided at 41V. Undervoltage protection (hardware and software shutdown at 6V) is provided.

### Inputs

2 Bipolar Analog or Digital Signal Inputs	User programmable as Voltage, Current, Frequency, RPM, PWM or Digital signal inputs types. Refer to Table 1.0.
---	---

**Table 1.0 –User Programmable Bipolar Voltage or Other Signal Inputs**

Analog & Digital Input Functions	Voltage Input, Current Input, Resistive Input or Digital Input
Voltage Input	0-5 V (Impedance 110 kΩ) 0-10 V (Impedance 130 kΩ) +/- 5V (Impedance 110 kΩ) +/- 10V (Impedance 130 kΩ) 1mV resolution, accuracy +/- 0.2% error 10 kΩ pull-up / pull-down option
Current Input	0-20 mA (Impedance 124 Ω) 4-20 mA (Impedance 124 Ω) 1 μA resolution, accuracy +/- 0.2% error 10 kΩ pull-up / pull-down option
Digital Input Level	Accepts 5 V TTL Accepts up to Vps Threshold: Low <1 V High >2.2 V
Digital Input	1 M Ω Impedance Active High or Active Low with 10 kΩ pull-up or pull-down
Timer Input Functions	PWM Input, Frequency Input or RPM Input
PWM Input	Low Frequency (0.50 Hz to 1 kHz) High Frequency (100 Hz to 10 kHz) 0 to 100% D.C. 0.01% resolution, accuracy +/- 0.1% error
Frequency/RPM Input	0.5 Hz to 50 Hz; 10 Hz to 1 kHz; or 100 Hz to 20 kHz 0.01% resolution, accuracy +/- 0.1% error

Maximum and Minimum Ratings

Characteristic	Min	Max	Units
Power Supply	8	36	V dc
Voltage Input	0	36	V dc
Current Input 0(4)-20 mA	0	12	Vdc
Digital Input	0	36	Vdc
PWM Duty Cycle	0	100	%
PWM Low Frequency	10	1 000	Hz
PWM High Frequency	100	10 000	Hz
PWM Voltage pk - pk	0	36	V dc
RPM Frequency	0.5	20 000	Hz

Universal Signal Inputs	2 fully independent universal signal inputs are provided. All inputs are user selectable as Voltage, Current, Resistive, Frequency, RPM, PWM or Digital input types. Refer to Table 2.0.
Encoder Input	Two of the Universal Signal Inputs can be configured as one 2 phase, phase A and B, incremental encoder input for speed and direction. Range: 0.5 Hz to 150 kHz Amplitude: up to +Vsupply

Table 2.0 – Input – User Selectable Options																																													
Analog Input Functions	Voltage Input, Current Input or Resistive Input 12-bit Analog to Digital																																												
Voltage Input	0-2.5V (Impedance 1 M $\Omega$ ) 0-5V (Impedance 200 k $\Omega$ ) 0-10V (Impedance 135 k $\Omega$ ) 1mV resolution, accuracy +/- 0.2% error 10 k $\Omega$ pull-up / pull-down option																																												
Current Input	0-20 mA (Current Sense Resistor 124 $\Omega$ ) 4-20 mA (Current Sense Resistor 124 $\Omega$ ) 1 $\mu$ A resolution, accuracy +/- 0.2% error 10 k $\Omega$ pull-up / pull-down option																																												
Resistive Input	Self-calibrating for range of 20 $\Omega$ to 250 k $\Omega$ with Auto Ranging 1 $\Omega$ resolution, accuracy +/- 1% error																																												
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 +/- 0.2% error 1M $\Omega$ impedance, or 10k $\Omega$ pull-up / pull-down <i>Response time is dependent of input frequency.</i>																																												
Frequency/RPM Input	0.1 to 50Hz Range: 0.20Hz resolution 10Hz to 1kHz Range: 2.0Hz resolution 100 Hz to 20kHz Range: 70Hz resolution Accuracy +/- 0.1% error 1 M $\Omega$ impedance, or 10 k $\Omega$ pull-up / pull-down <i>Response time is dependent of input frequency.</i>																																												
Digital Input	Configurable Active High with 10k $\Omega$ pullup or Active Low with pulldown resistor (to GND) resistor which can also be disabled (floating input) Normal, Inverse or Latched (pushbutton) Rising edge ON threshold 3.7V +/- 0.1V Falling edge OFF threshold 2.9V +/- 0.1V Input debouncing is selectable and will slow response time																																												
Maximum and Minimum Ratings	<table border="1"> <thead> <tr> <th>Characteristic</th> <th>Min</th> <th>Max</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>Power Supply</td> <td>8</td> <td>36</td> <td>V dc</td> </tr> <tr> <td>Voltage Input</td> <td>0</td> <td>36</td> <td>V dc</td> </tr> <tr> <td>Current Input 0(4)-20 mA</td> <td>0</td> <td>12</td> <td>Vdc</td> </tr> <tr> <td>Resistive Input</td> <td>20</td> <td>250 000</td> <td><math>\Omega</math></td> </tr> <tr> <td>Digital Input</td> <td>0</td> <td>36</td> <td>Vdc</td> </tr> <tr> <td>PWM Duty Cycle</td> <td>0</td> <td>100</td> <td>%</td> </tr> <tr> <td>PWM Low Frequency</td> <td>10</td> <td>1 000</td> <td>Hz</td> </tr> <tr> <td>PWM High Frequency</td> <td>100</td> <td>10 000</td> <td>Hz</td> </tr> <tr> <td>PWM Voltage pk - pk</td> <td>0</td> <td>36</td> <td>V dc</td> </tr> <tr> <td>RPM Frequency</td> <td>0.5</td> <td>20 000</td> <td>Hz</td> </tr> </tbody> </table>	Characteristic	Min	Max	Units	Power Supply	8	36	V dc	Voltage Input	0	36	V dc	Current Input 0(4)-20 mA	0	12	Vdc	Resistive Input	20	250 000	$\Omega$	Digital Input	0	36	Vdc	PWM Duty Cycle	0	100	%	PWM Low Frequency	10	1 000	Hz	PWM High Frequency	100	10 000	Hz	PWM Voltage pk - pk	0	36	V dc	RPM Frequency	0.5	20 000	Hz
Characteristic	Min	Max	Units																																										
Power Supply	8	36	V dc																																										
Voltage Input	0	36	V dc																																										
Current Input 0(4)-20 mA	0	12	Vdc																																										
Resistive Input	20	250 000	$\Omega$																																										
Digital Input	0	36	Vdc																																										
PWM Duty Cycle	0	100	%																																										
PWM Low Frequency	10	1 000	Hz																																										
PWM High Frequency	100	10 000	Hz																																										
PWM Voltage pk - pk	0	36	V dc																																										
RPM Frequency	0.5	20 000	Hz																																										
Protection	All inputs are protected against short to GND. All inputs, except current inputs, are protected against shorts to Nominal Vps (36Vdc). All input channels can handle negative voltage inputs down to -2VDC due to voltage spikes or noise.																																												
Sampling Time	Inputs are sampled multiple times per millisecond. Response time to change at the input is 2 mSec +/- 1 mSec (without software filtering) unless otherwise noted.																																												
Analog GND References	Three GND connections are provided.																																												
+5V Reference	One +5V Reference, +/- 0.5%, 100 mA																																												

## Outputs

Universal Outputs	<p>Two independent universal outputs are selectable as: proportional current; proportional voltage; hotshot; ON/OFF digital; or PWM type.</p> <p>Universal output type: Up to 2.5A sourcing (high-side)</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 +/- 1% error Software controlled PID current Range 0 to 2500 mA Fully configurable dither superimposed on top of output current Configurable amplitude and frequency range from 50 to 400Hz High frequency output drive at 25kHz (default) <i>Note: Both outputs use the same dither frequency.</i> <i>Outputs can be independently configured for high frequency output.</i></p> <p>Voltage Outputs: 0.1V resolution, accuracy +/- 5% 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.</p> <p>Digital On/Off: Sourcing from power supply, sinking from output to ground or off. Load at supply voltage must not draw more than 4A.</p>
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	Two are provided.

## General Specifications

Microprocessor	STM32F407VG, 32-bit, 1MByte flash memory
Quiescent Current	76mA @ 12V; 43 mA @ 24V Typical
LED Indicator	1 bicolour LED (Red and Green) Power, heartbeat, input fault indication and output fault indication
CAN Communications	1 CAN port (SAE J1939) (CANopen® on request) Model: AX022440 – 250 kbps baud rate Model: AX022440-01 – 500 kbps baud rate Model: AX022440-02 – 1 Mbps baud rate
Control Logic	User programmable functionality using the Axiomatic Electronic Assistant service tool. Refer to the User Manual for details.
CAN Communications	Compliant to SAE CAN J1939 Standard 1 CAN port (SAE J1939)
User Interface	Axiomatic Electronic Assistant KIT, P/N: AX070502, or AX070506K
Software Reflashing	Axiomatic Electronic Assistant KIT, P/N: AX070502, or AX070506K

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.
Compliance	CE marking
Protection	IP20
Weight	0.30 lb. (0.136 kg)
Temperature Rating	Operating: -40 to 85°C (-40 to 185°F) Storage: -50 to 105°C (-58 to 221°F)
Enclosure and Dimensions	PHO ME MAX 22.5 2-2 KMGY – 2713625 (vented) Polyamide, UL94V0, cULus recognized, China RoHS DIN rail TH 35-7.5 99 x 114.5 x 22.6 mm (L x H x D) Refer to Figure 2.0.
Electrical Connections	4 Phoenix Contact PSPT 2,5/ 4-ST KMGY spring clamp connectors Accepts 24-14 AWG wire. Refer to Table 3.0 and Figure 2.0. for pin out.
Installation	DIN rail mount, TH 35-7.5
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.

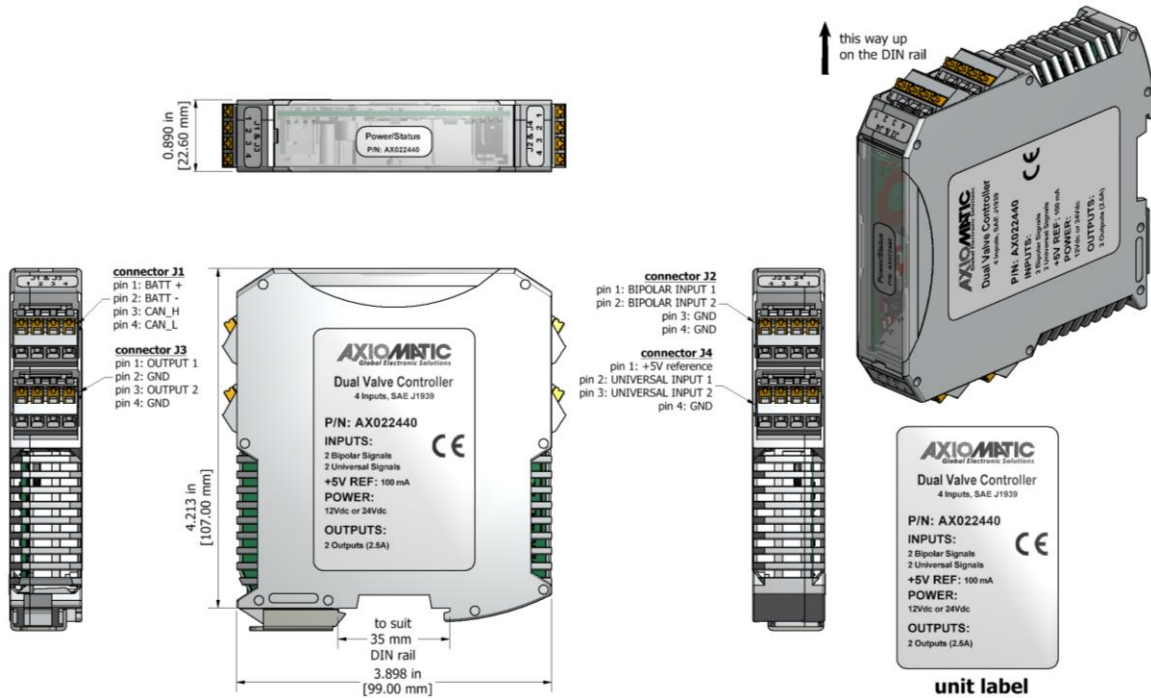


Figure 2 – Dimensional Drawing

Table 3.0 – Pin out: AX022440

Power and CAN (J1)		Outputs (J3)		Inputs (J2)		Inputs (J4)	
Pin #	Function	Pin #	Function	Pin #	Function	Pin #	Function
1	Power +	1	Output 1+	1	Bipolar Input 1	1	+5V Reference
2	Power -	2	Output 1-	2	Bipolar Input 2	2	Universal Signal Input 1
3	CAN_H	3	Output 2+	3	Analog Input GND	3	Universal Signal Input 2
4	CAN_L	4	Output 2-	4	Analog Input GND	4	Input GND

CANopen® is a registered community trademark of CAN in Automation e.V.

Form: TDAX022440-01/02/2024