

## 2 Universal Inputs, Dual Valve Controller

2 Universal Inputs

2-3A Outputs

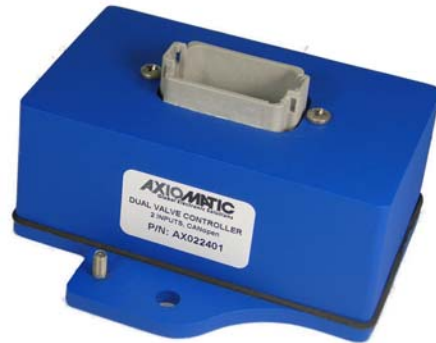
1 +5V Reference

CANopen®

P/N: AX022401

### 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 to power a potentiometer or low-power transducer
- Fully protected outputs
- 12V, 24V or 48VDC nominal
- 1 CAN port (CANopen®)
- Rugged IP67 packaging and connectors
- User programmable functionality
- .EDS provided to interface to standard CANopen® tools



### Applications:

The controller is designed to meet the rugged demands of mobile equipment, marine and heavy duty industrial machine applications.

These applications include, but are not limited to:

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

### Ordering Part Numbers:

2 Universal Inputs, Dual Valve Controller, CANopen®: **AX022401**

EDS File, User Manual: **CD-AX022401**

**Accessories: AX070105** Mating Plug Kit (DT06-12SA, W12S, 12 0462-201-16141, 3 plugs)

**Description:** The 2 Universal Inputs, Dual Output Valve Controller is designed for extremely versatile control of the 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. An EDS file is provided to interface to standard CANopen® tools. The two outputs 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. Both outputs are high-side driven (sourcing) outputs. The controller also has two fully programmable universal inputs that can be setup to read: voltage; current; resistive; frequency; or digital input signals. It also has a single +5Vref that can source up to 30mA to provide a reference for a potentiometer or low-power transducer. The 2i2o 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 CANopen® 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. Refer to Figure 1B.

# BLOCK DIAGRAMS

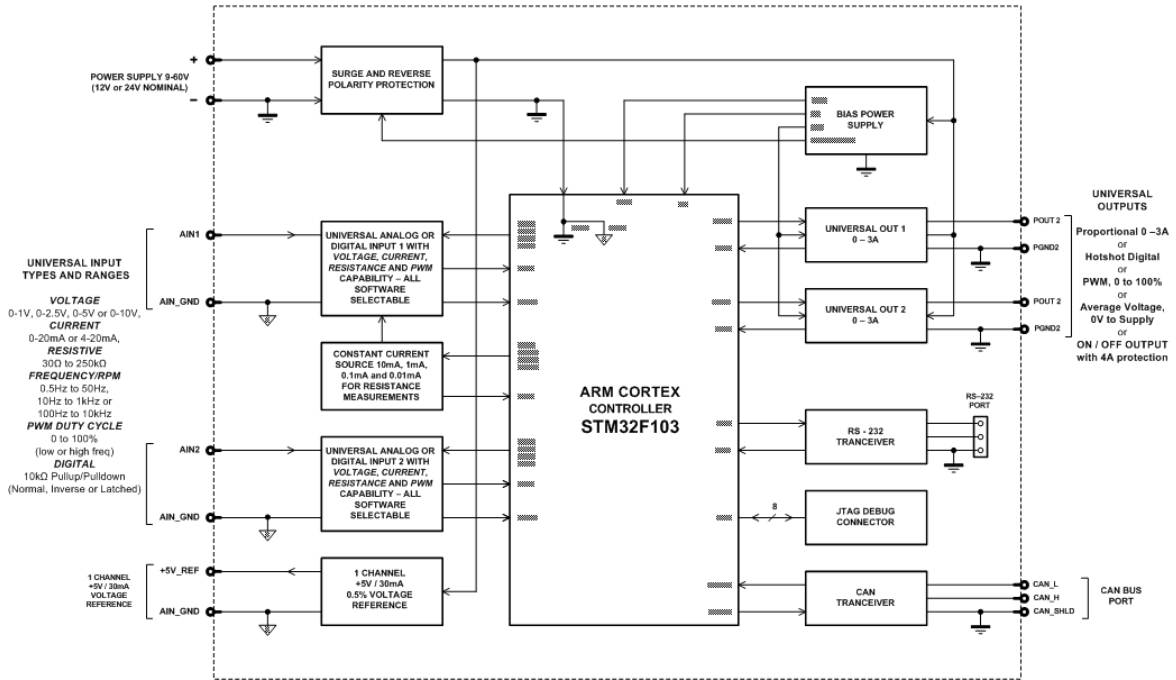


Figure 1A – Hardware Block Diagram

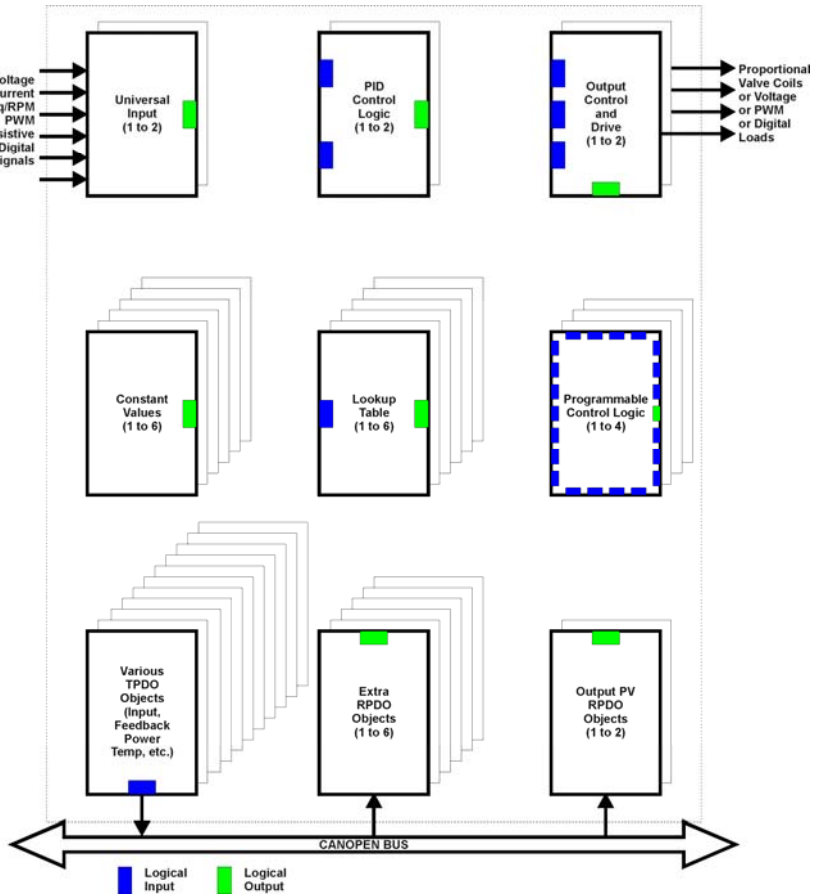


Figure 1B – Logical Functional Block Diagram

## Technical Specifications:

### Power Supply

Power Supply Input	12, 24, 48VDC nominal (8...60VDC power supply range)
Supply Current	70 mA at 12 V Typical, 40 mA at 24 V Typical, 27 mA at 48 V Typical
Protection	Reverse polarity protection is provided. Power supply input section protects against transient surges and shorts. Overvoltage protection up to 65V is provided. Undervoltage protection down to ~7.5V is provided.

### Inputs

Analog Input Functions	Voltage [V], Current [mA], Resistive [kΩ], PWM [%], Frequency [Hz], RPM
Sampling Rate	Inputs are sampled multiple times per millisecond.
Response Time	Response time to a change at the input is 2ms +/- 1ms (without software filtering) unless otherwise noted.
Protection	Protected against shorts to GND or +Vps (up to 60V)
Voltage Input	0-1V (Impedance 1 MΩ) 0-2.5V (Impedance 1 MΩ) 0-5V (Impedance ~135 KΩ) 0-10V (Impedance ~127 KΩ)
Current Input	0-20mA (Impedance 249 Ω) 4-20mA (Impedance 249 Ω)
Resistive Input	25 Ω to 250 kΩ Self-calibrating for range of 25 Ω to 250 kΩ <i>Slower response time is due to the auto-calibration feature.</i>  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>
PWM Input	0 to 100% (at 10 Hz to 1kHz or 100 Hz to 10 kHz) Selectable 10kΩ pullup to +5V or pulldown to AGND resistor (or 1MΩ) <i>Response time is dependent on input frequency.</i>
Frequency Input	0.5 Hz to 50 Hz, 10 Hz to 1 kHz, or 100 Hz to 10 kHz Selectable 10kΩ pullup to +5V or pulldown to AGND resistor (or 1MΩ) <i>Response time is dependent on input frequency.</i>
Digital Input Function	5V CMOS, Active High or Active Low Selectable 10kΩ pullup to +5V or pulldown to AGND resistor (or 1MΩ) Normal, Inverse or Latched (push-button) response Debouncing is provided.
Input Accuracy	<1% full scale error (all types)
Input Resolution	12-bit Analog to Digital (voltage, current, resistive) Voltage Type: 1mV resolution Current Type: 1uA resolution Resistive Type: 1 Ω resolution  15-bit Timer (frequency, RPM, PWM) 0.5 to 50Hz Range: 0.01Hz resolution 10Hz to 1kHz Range: 0.1Hz resolution 100 Hz to 10kHz Range: 1Hz resolution RPM Type: 0.01 RPM resolution PWM Type: 0.01% resolution
Error Detection/Reaction	Out of Range High and Low detection EMCY code generation (object 1003h) and fault reaction possible (1029h) Output(s) shutdown function can be enabled.  Frequency/PWM Input fault detection time to flag an error (i.e. open) 0.5 to 50Hz Range: ~4 seconds (<0.25Hz) 10Hz to 1kHz Range: ~0.105 seconds (<9.5Hz) 100 Hz to 10kHz Range: ~0.01 seconds (<0.95Hz)
Independence	Inputs are fully independent from one another with one exception: a) The ADC timer and Input 1 timer are shared. Therefore, if one input has to be analog, and the other a timer input, use IN2 for the timed input. Otherwise, both inputs can be setup as timer inputs.

## Outputs

Analog Output Functions	Current [mA], Voltage [V], PWM [%], Digital On/Off, Hotshot On/Off																		
Output Type	High side switch (sourcing output) up to 3A, Grounded Load Current sensing for close-loop control, current feedback on object 2370h																		
Current PID Loop	Factory calibrated. User configurable (use with caution)																		
Dithering	Fully configurable dither superimposed on top of output current configurable from 50 to 400Hz, 0 to 500mA amplitude High frequency output drive at 25kHz <i>Note: Both Outputs use the same dither and drive frequencies</i>																		
Output Resolution and Accuracy	Output Current mode 1mA resolution, +/- 2% full scale error Output PWM DC mode 0.1% resolution, +/- 1% full scale error Output Voltage* mode 0.1V resolution, +/-3% full scale error <i>* Additional external filtering is required to create a DC voltage</i>																		
Response time	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.  Response times accurate to +/- 1ms <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>&lt;2ms</td> <td>&lt;2ms</td> </tr> </tbody> </table> <i>*Current response tested with 12V HydraForce coil 6507212. Response times will vary depending on the load inductance.</i>	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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Voltage	30 ms	30 ms																	
On/Off Digital	<2ms	<2ms																	
Error Detection/Reaction	EMCY code generation (object 1003h) and fault reaction possible (1029h) when an open or short circuit is detected at the output (current mode only)																		
Independence	Outputs are fully independent from one another with the following exceptions: a) both use the same AO Dither Frequency (object 2320h sub-index 1) b) both use the same AO Output Frequency (object 2380h sub-index 1) c) PWM outputs can be linked → AO2 becomes the mirror of AO1** If either output is configured as a current output (proportional or hotshot), output drive frequency remains fixed at 25kHz for both outputs <b>** Not a true half H-bridge output, no deadband provided in mirrored PWM</b>																		

## References

Voltage Reference	Voltage Reference +5V +/- 0.2% Can source up to 50mA without derating Short circuit to GND protected Protected from connection to the power supply rail.
Analog GND Reference	One provided for inputs
Power GND Reference	One provided for outputs

## Communication

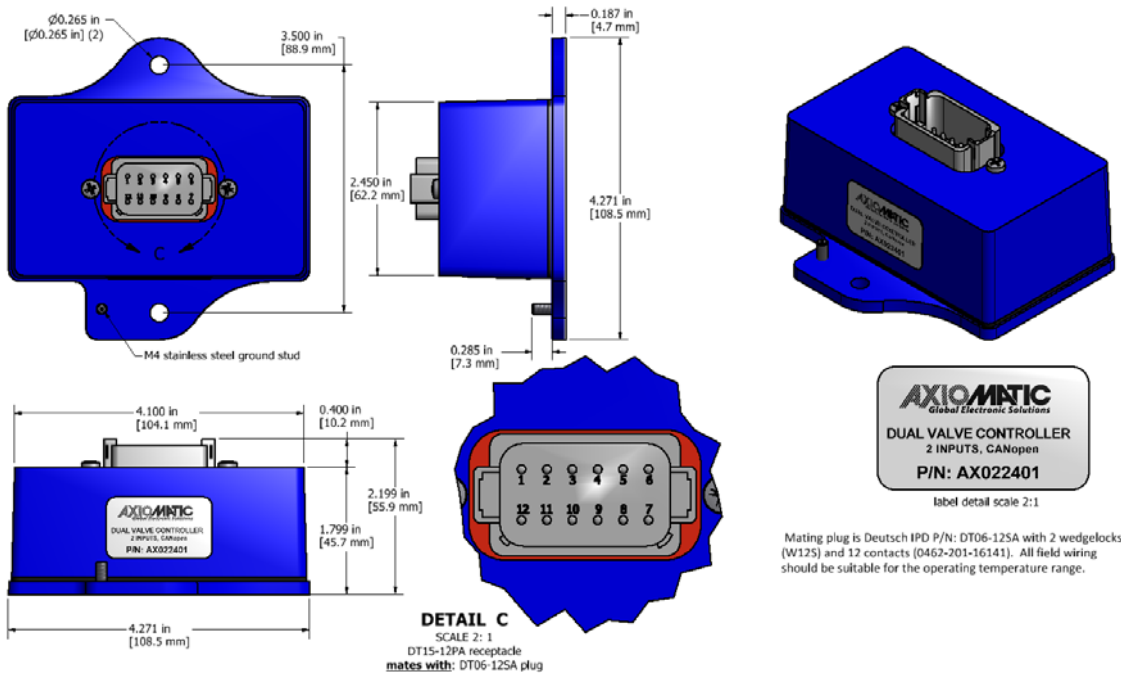
CAN	1 CAN 2.0B port, protocol CiA CANopen ® By default, the 2i2o Controller transmits measured input (FV object 7100h) and output current feedback (FV object 2370h) on TPDO1
CAN Response Time	The maximum recommended transmit rate for any TPDO is 10ms Response time of feedback on the CAN to changes at 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.
Node-ID and Baud Rate	Configurable using Layer Setting Services. Default Node-ID = 127 and Baud Rate = 125 kbps.
Network Termination	According to the CAN standard, 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.

## General Specifications

Quiescent Current	70 mA at 12 V Typical 40 mA at 24 V Typical 27 mA at 48 V Typical
Microprocessor	32-bit, 128 KByte flash program memory, ARM7 processor STM32103CB
Control Logic	User programmable functionality using SDO object access, per CiA DS-301
User Interface	.EDS provided to interface to standard CANopen® tools
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Storage	-50 to 105 °C (-58 to 221 °F)
Packaging	Rugged aluminum housing, integral Deutsch IPD connector Can be mounted directly on the valve block or remotely Suitable for moist, high shock, vibrating and non-hazardous environments Encapsulated (DOW SYLGARD SILICONE ELASTOMER 170) 4.27 x 4.27 x 2.14 inches 108.49 x 108.49 x 54.28 mm L x W x H including integral connector
Protection	IP67; Unit is conformal coated within housing.
Weight	1.3 lbs. (0.59 kg) with encapsulation in potting material
Electrical Connections	12 pin Deutsch IPD connector P/N: DT15-12PA A mating plug kit is available as Axiomatic P/N: <b>AX070105</b> .  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.

### CAN and I/O Connector

Pin #	Description (Notes)
1	Output 2 +
2	Output 1 +
3	P_GND (Out1 and Out2 GND)
4	A_GND (In1 and In2 GND)
5	CAN_L
6	CAN_H
7	CAN_Shield
8	Input 2 +
9	Input 1 +
10	+5Vref (up to 50 mA)
11	BATT -
12	BATT +



Installation	<p>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.</p> <p>The unit can be mounted on the valve directly.</p> <p>If the module is mounted without an enclosure, it should be mounted to reduce the likelihood of moisture entry.</p> <p>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).</p> <p>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.</p> <p>All field wiring should be suitable for the operating temperature range of the module.</p> <p>All chassis grounding should go to a single ground point designated for the machine and all related equipment.</p>
Network Termination	<p>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.</p>

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](http://www.axiomatic.com/service.html).*

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