Four Inputs, Two Outputs Universal Valve Controller

2 Universal Signal Inputs, Magnetic Pick Up Sensor, or Encoder Inputs
2-3A High Side, Low Side or Half-bridge Outputs
CAN (SAE J1939)

Programmable with Electronic Assistant®

P/N: AX022420

Features:

- 2 universal signal inputs configurable as:
  - Voltage
  - Current
  - Resistive
  - PWM
  - Frequency/RPM
  - or Digital
- Magnetic Pick Up Input
- Encoder Input
- 2 independent outputs to drive valves (0-3A) are user configurable as:
  - Proportional Current;
  - Proportional Voltage;
  - Hotshot Digital;
  - PWM Duty Cycle (1 Hz to 25 kHz);
  - or On/Off Digital.
- Universal output type is user selectable as high side, low side or half bridge output.
- 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).
- Two LED indicators
- IP20
- DIN rail mount
- CE marking
- Configurable via Electronic Assistant®
- The firmware was developed using Simulink®.
- A Near Field Communications Antenna is provided for configuration using an Android Smartphone:
  - Place the phone next to the antenna and configure while unpowered.
  - The E-Write NFC Android Application provides flexible user configurability for application-specific input-output relationship with slope or time response.
- Protected and secure communications

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
- Signal Conversion

Ordering Part Numbers:

<table>
<thead>
<tr>
<th>Dual Input, Two Outputs Valve Controller, 250 kbps SAE J1939:</th>
<th>AX022420</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Input, Two Outputs Valve Controller, 500 kbps SAE J1939:</td>
<td>AX022420-01</td>
</tr>
<tr>
<td>Dual Input, Two Outputs Valve Controller, 1 Mbps SAE J1939:</td>
<td>AX022420-02</td>
</tr>
</tbody>
</table>

Accessories: Electronic Assistant®: AX070502
**Description:**

The Universal Valve Controller (4i2o) 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: voltage, current, resistive, frequency, 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. The universal output type is user selectable as high side, low side or half bridge output. All I/O ports on the unit are independent from one another.

The 4i2o 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.

The 4i2o 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 Electronic Assistant®.

A rugged power supply interface accepts 12 Vdc or 24 Vdc nominal for battery powered machine applications. LED’s indicate 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.

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**Figure 1 – Logical Functional Block Diagram**

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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 www.axiomatic.com/service.html.

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.  
Overshutdown of the output load is provided at 41V.  
Undervoltage protection (hardware and software shutdown at 6V) is provided. |

Inputs

| 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 1.0.  
Inputs are sampled multiple times per millisecond.  
Protected against shorts to GND or +Vps (up to 43Vdc)  
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. |
|-----------------------|-----------------------------------------------------------------|
| Voltage Reference     | 1 +5VDC, +/- 0.5%, 100mA maximum  
Analog GND Reference   | One provided  
Magnetic Pick Up Sensor Input | Range: 0.5 Hz to 20 kHz  
Amplitude: 100 mV to 60 Vrms  
Encoder Input | One 2 phase, phase A and B, incremental encoder input.  
Range: 0.5 Hz to 150 kHz  
Amplitude: up to +Vs supply  

Table 1.0 – Input – User Selectable Options

| Analog Input Functions | Voltage Input, Current Input or Resistive Input  
12-bit Analog to Digital  
Voltage Input | 0-2.5V (Impedance 1 MΩ)  
0-5V (Impedance 200 kΩ)  
0-10V (Impedance 135 kΩ)  
1mV resolution, accuracy +/- 1% error  
Current Input | 0-20 mA (Current Sense Resistor 124 Ω)  
4-20 mA (Current Sense Resistor 124 Ω)  
1uA resolution, accuracy +/- 1% error  
Resistive Input | Self-calibrating for range of 20 Ω to 250 kΩ with Auto Ranging  
1Ω 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 +/- 1% error  
1MΩ Impedance, or 10kΩ Pullup/Pulldown  
Response time is dependent on input frequency.  
Frequency/RPM Input | 0.5 to 50Hz Range: 0.20Hz resolution  
10Hz to 1kHz Range: 2.0Hz resolution  
100 Hz to 20kHz Range: 70Hz resolution  
Accuracy +/- 1% error  
1 MΩ Impedance, or 10 kΩ Pullup/Pulldown  
Response time is dependent on input frequency.  
Digital Input | Configurable Active High with 10kΩ 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, will slow response time. |
### Outputs

<table>
<thead>
<tr>
<th><strong>Universal Outputs</strong></th>
<th>Two independent universal outputs selectable as: proportional current, proportional voltage, hotshot or ON/OFF digital or PWM type.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Universal output type is user selectable as high side, low side or half bridge output.</td>
</tr>
<tr>
<td></td>
<td>Up to 3A sourcing (high-side and half-bridge mode) or up to -3A sinking (low-side mode)</td>
</tr>
<tr>
<td></td>
<td>All output types have configurable minimum and maximum output levels within the range for the type selected.</td>
</tr>
<tr>
<td>Current Outputs</td>
<td>1mA resolution, accuracy +/- 1% error</td>
</tr>
<tr>
<td></td>
<td>Software controlled PID current</td>
</tr>
<tr>
<td></td>
<td>Range 0 to 3000 mA</td>
</tr>
<tr>
<td></td>
<td>Fully configurable dither superimposed on top of output current</td>
</tr>
<tr>
<td></td>
<td>Configurable amplitude and frequency range from 50 to 400Hz</td>
</tr>
<tr>
<td></td>
<td>High frequency output drive at 25kHz (default)</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Both outputs use the same dither frequency.</td>
</tr>
<tr>
<td></td>
<td>Outputs can be independently configured for high frequency output.</td>
</tr>
<tr>
<td><strong>Voltage Outputs</strong></td>
<td>0.1V resolution, accuracy +/- 5% error</td>
</tr>
<tr>
<td></td>
<td>Average voltage output based on unit power supply</td>
</tr>
<tr>
<td></td>
<td>High frequency drive at 25kHz</td>
</tr>
<tr>
<td></td>
<td>Additional external filtering is required to create a DC voltage</td>
</tr>
<tr>
<td><strong>PWM Outputs</strong></td>
<td>0.1% resolution, accuracy +/- 1% error</td>
</tr>
<tr>
<td></td>
<td>Range 0 to 100%</td>
</tr>
<tr>
<td></td>
<td>Output Frequency: 1 Hz to 25 kHz</td>
</tr>
<tr>
<td></td>
<td>Configurable frequency ONLY if no current output types are used, otherwise default 25kHz is used</td>
</tr>
<tr>
<td></td>
<td>Outputs can be linked in this mode to provide mirrored output signals.</td>
</tr>
<tr>
<td><strong>Digital On/Off</strong></td>
<td>Sourcing from power supply, sinking from output to ground or off.</td>
</tr>
<tr>
<td></td>
<td>Load at supply voltage must not draw more than 4A.</td>
</tr>
</tbody>
</table>

### General Specifications

<table>
<thead>
<tr>
<th><strong>Microprocessor</strong></th>
<th>STM32F205VGT7 32-bit, 1MByte flash memory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quiescent Current</strong></td>
<td>80 mA @ 12Vdc, 50 mA @ 24Vdc typical</td>
</tr>
<tr>
<td><strong>LED Indicators</strong></td>
<td>2 bicolour LED’s (Red and Green)</td>
</tr>
<tr>
<td></td>
<td>Power, heartbeat, input fault indication and output fault indication</td>
</tr>
<tr>
<td><strong>Simulink®</strong></td>
<td>Model AX022420 was developed using Simulink®.</td>
</tr>
<tr>
<td><strong>CAN Communications</strong></td>
<td>1 Isolated CAN port (SAE J1939) (CANopen® on request)</td>
</tr>
<tr>
<td></td>
<td>Models: AX022420 – 250 kbps baud rate</td>
</tr>
<tr>
<td></td>
<td>AX022420-01 – 500 kbps baud rate</td>
</tr>
<tr>
<td></td>
<td>AX022420-02 – 1 Mbps baud rate</td>
</tr>
<tr>
<td><strong>Control Logic</strong></td>
<td>User programmable functionality using Electronic Assistant® service tool</td>
</tr>
<tr>
<td></td>
<td>Refer to the User Manual for details.</td>
</tr>
<tr>
<td><strong>CAN Communications</strong></td>
<td>Compliant to SAE CAN J1939 Standard</td>
</tr>
<tr>
<td></td>
<td>1 CAN port (SAE J1939)</td>
</tr>
<tr>
<td><strong>NFC Communications</strong></td>
<td>Near Field Communication</td>
</tr>
<tr>
<td></td>
<td>Full-duplex</td>
</tr>
<tr>
<td></td>
<td>Data rate: 106 kbit/s</td>
</tr>
<tr>
<td></td>
<td>Complies with ISO1443 (RF protocol), ISO13239, and ISO7816</td>
</tr>
<tr>
<td><strong>User Interface</strong></td>
<td>Electronic Assistant® P/N: AX070502</td>
</tr>
<tr>
<td></td>
<td>E-WRITE NFC Application is available from the Google Play Store.</td>
</tr>
<tr>
<td><strong>Software Reflashing</strong></td>
<td>Electronic Assistant® P/N: AX070502</td>
</tr>
</tbody>
</table>
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

Phoenix Contact: ME MAX 22.5 G 2-2 KMGY – 2713638 or 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 22.5 x 99 mm (L x H x W 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 2.0 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.

Table 2.0 – Pin out: AX022420

<table>
<thead>
<tr>
<th>PIN #</th>
<th>Function</th>
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<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BATT +</td>
<td>1</td>
<td>Output 1-</td>
<td>1</td>
<td>Universal Input 1</td>
<td>1</td>
<td>Magnetic Pick Up Input</td>
</tr>
<tr>
<td>2</td>
<td>BATT –</td>
<td>2</td>
<td>Output 1+</td>
<td>2</td>
<td>Universal Input 2</td>
<td>2</td>
<td>Common Analog GND</td>
</tr>
<tr>
<td>3</td>
<td>CAN_H</td>
<td>3</td>
<td>Output 2-</td>
<td>3</td>
<td>Input GND</td>
<td>3</td>
<td>Encoder Input A</td>
</tr>
<tr>
<td>4</td>
<td>CAN_L</td>
<td>4</td>
<td>Output 2+</td>
<td>4</td>
<td>+5V Reference</td>
<td>4</td>
<td>Encoder Input B</td>
</tr>
</tbody>
</table>

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.

Form: TDAX022420-08/23/18