

TECHNICAL DATASHEET #TDAX021910

8 In, 5 Output Valve Controller

7 Universal Analog Inputs
 1 Magnetic Pickup Sensor Input
 4-2.5A Proportional or On/Off Outputs
 1-2.5A Digital Output
 CAN (SAE J1939)

with Axiomatic Electronic Assistant

P/N: AX021910

Features:

- Inputs:
 - 7 universal analog signal inputs (current, voltage, resistive, frequency, digital or PWM)
 - 1 magnetic pickup sensor input (RPM)
- Outputs:
 - 5 proportional or on/off valve drivers up to 2.5 A
 - Open or closed loop (PID) drive is user configurable
 - Fully protected
- Powerful H7 processor for advanced programming features
- 1 CAN (SAE J1939) port
- CANopen® module available on request
- PID control logic is user configurable
- Time delays can be programmed using the Look Up Tables.
- Flexible and user programmable functionality for diverse applications using the PC-based **Axiomatic Electronic Assistant**, together with an Axiomatic USB-CAN converter
- 12V or 24Vdc nominal
- Rugged IP67 protection for harsh environments
- Vibration compliance for mobile equipment



Applications:

The controller is designed for harsh operating environments.

Typical applications can include:

- Industrial, off-highway and marine applications - control of hydraulic proportional poppet or spool valves
- Closed loop control of hydraulic valves
- Interface with a diesel engine's electronic control module PWM signal to drive accessories
- Transmission controls
- Fan drive controls (on request)
- Vehicle traction control (on request)

Ordering Part Numbers:

SAE J1939 version

Controller: **AX021910**

Accessories:

Mating Plug Kit: **PL-DTM06-12SA-12SB**

Axiomatic Electronic Assistant Configuration KIT: **AX070502, AX070505K, or AX070506K**

Description:

The 8 Input, 5 Output Valve Controller (8i5o) is designed for versatile control of up to four 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 seven fully programmable universal inputs that can be setup to read: voltage; current; resistive; frequency; or digital input signals. For added flexibility, it also has a magnetic sensor circuit that can read AC signals and convert them into a frequency (RPM) pickup. Lastly, there is an eighth digital input that can be used for global enable/disable or overrides of one or all of the outputs.

There are four 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. For applications requiring a fifth digital output, there is also one high-side (sourcing) output for up to a 2.5A digital load.

The 8i5o valve controller is highly programmable and allows 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. Refer to the block diagram, Figure 1A, for the hardware features. Figure 1B shows the logical function blocks (software) available on the 8i5o.

The 8i5o has 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.

The various function blocks supported by the 8i5o are outlined below. All setpoints are user configurable over the CAN port using the Axiomatic Electronic Assistant and an Axiomatic USB-CAN converter.

SAE J1939 References:

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, October 2007
J1939/21	Data Link Layer, SAE, December 2006
J1939/71	Vehicle Application Layer, SAE, January 2009
J1939/73	Application Layer-Diagnostics, SAE, September 2006
J1939/81	Network Management, SAE, May 2003

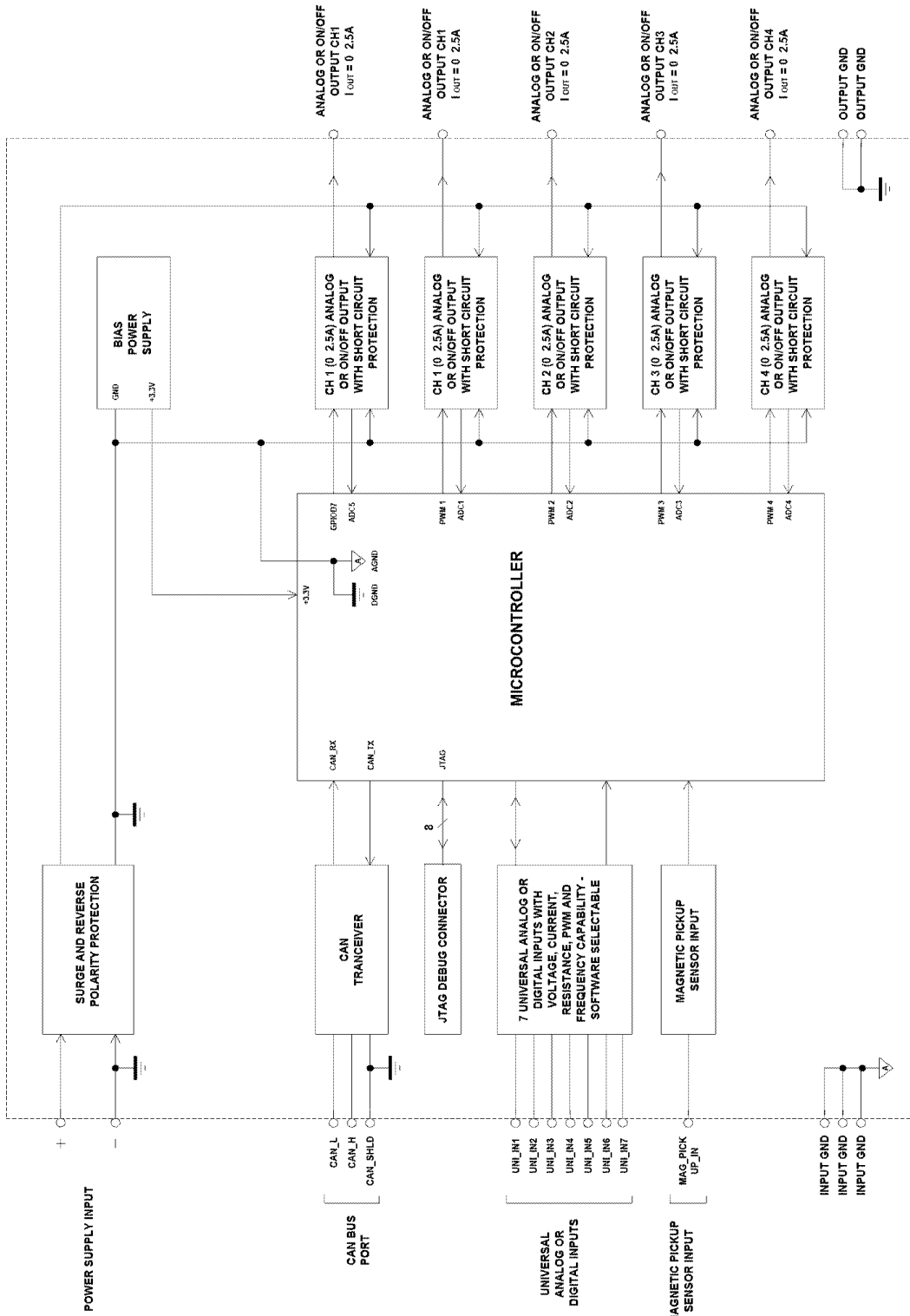


Figure 1A –Hardware Block Diagram

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/>.

Inputs

Power Supply Input - Nominal	12V or 24Vdc nominal (9...60 Vdc power supply range)
Protection	Reverse polarity protection is provided. Surge protection up to 75VDC is provided. Under-voltage shutdown protection of 7.5VDC is provided. Over-voltage shutdown protection is provided.
CAN	SAE J1939 Commands
Input Grounds	3 GND connections are provided.
RPM Input	1 Magnetic Pickup Sensor Input Range: 0.5 Hz to 10 kHz 100mV to 100V RMS
Universal Signal Inputs	7 universal inputs are provided. Refer to Table 1.0. All input types are user selectable using the Axiomatic EA as: <ul style="list-style-type: none"> • Voltage • Current • Resistive • Frequency • RPM • PWM • or Digital Inputs are sampled every 1 msec. Protected against shorts to GND or +Vcc

Table 1.0 – Universal Input – User Selectable Parameters	
Analog Input Functions	Voltage Input, Current Input or Resistive Input 12-bit Analog to Digital
Voltage Input	1 mV resolution, accuracy +/-1% error 0-1V (1 MΩ impedance) 0-2.5V (1MΩ impedance) 0-5V (150 KΩ impedance) 0-10V (133 KΩ impedance)
Current Input	1μA resolution, accuracy +/-2% error Current sense resistor 124 Ω 0-20 mA 4-20 mA
Resistive Input	1 Ω resolution, accuracy +/-1% error Self-calibrating for a range of 30Ω to 250 kΩ
Digital Input Functions	Discrete Input, PWM Input, Frequency Input 15-bit Timer
PWM Input	0.01% resolution, accuracy +/-1% error 1 M Ω impedance 0 to 100% Low frequency <1KHz High frequency >100 Hz
Frequency Input	Accuracy +/-1% error 1 MΩ impedance 0.5 Hz to 50 kHz range: 0.01 Hz resolution 10 Hz to 1kHz range: 0.1 Hz resolution 100 Hz to 10 kHz range: 1 Hz resolution
Digital Input	1 MΩ impedance Active High Debouncing provided at 1 ms resolution

Outputs

CAN	SAE J1939 Messages
Universal Outputs	<p>Five fully independent software controlled outputs selectable using the Axiomatic EA as:</p> <ul style="list-style-type: none"> • Proportional Current • Hotshot Digital (See Figure 2.) • PWM Duty Cycle • On/Off Digital <p>Half-bridge outputs, current sensing, grounded load. High side sourcing up to 2.5A</p> <p>Current Outputs: 1mA resolution, accuracy +/- 2% error Software controlled PID current, not accessible to user Fully configurable dither from 50 to 400Hz. High frequency drive at 25kHz</p> <p>Voltage Outputs: 0.1V resolution, accuracy +/- 5% error Average output based on unit power supply High frequency drive at 25kHz</p> <p>PWM Outputs: 0.1% resolution, accuracy +/- 0.1% error Configurable frequency ONLY if no voltage or current output types are used.</p> <p>Digital On/Off: Load at supply voltage must not draw more than 2.5A.</p>
Output GND	2 GND connections are provided.
Protection	Fully protected against short circuit to ground and short circuit to power supply rail. Unit will fail safe in the case of a short circuit condition, self-recovering when the short is removed.

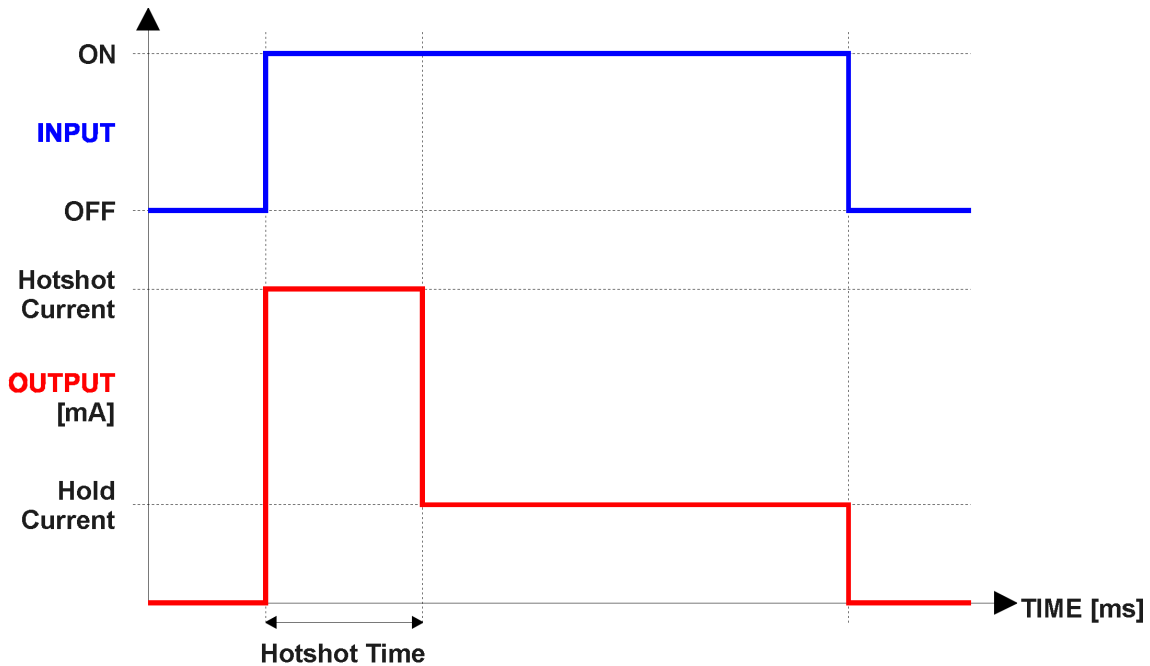


Figure 2 – Hotshot Digital Output (User selectable)

General Specifications

Microprocessor	STM32H723ZGT6 1 MB Program Space 32-bit, 1MB Flash Program Memory, 64KB EEPROM
Quiescent Current Draw	82.6mA @ 12V 58.8mA @ 24V
Control Logic	User programmable functionality using the Axiomatic Electronic Assistant Default control logic is shown in Figure 5.
Communications	1 CAN port (SAE J1939)
User Interface	The Axiomatic Electronic Assistant for <i>Windows</i> operating systems It comes with a royalty-free license for use. Refer to Figure 3. The Axiomatic Electronic Assistant requires an Axiomatic USB-CAN converter to link the device's CAN port to a <i>Windows</i> -based PC. P/N: AX070502 , an Axiomatic Assistant 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: Axiomatic Electronic Assistant software; Axiomatic EA & USB-CAN User Manual UMAX07050X; USB-CAN drivers & documentation; CAN Assistant (Scope and Visual) software & documentation; and the SDK Software Development Kit.
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: unit power supply under-voltage and over-voltage, and lost communication. They can be sent to the CAN bus.

Set up of SAE J1939 Controller on a CAN Network:

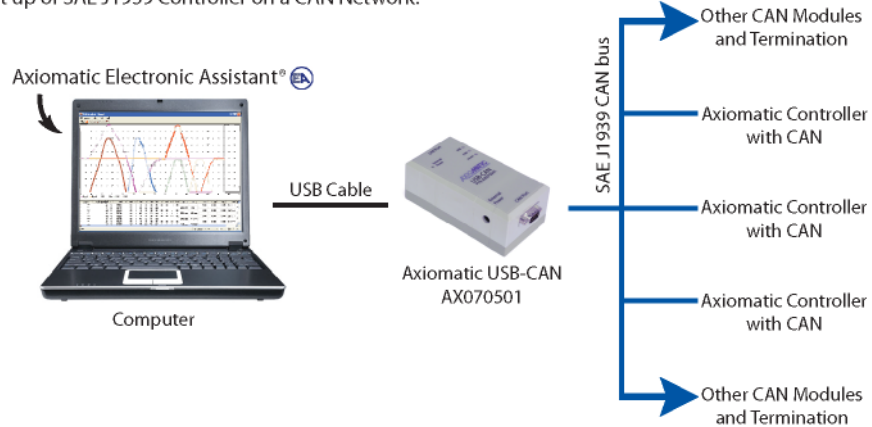
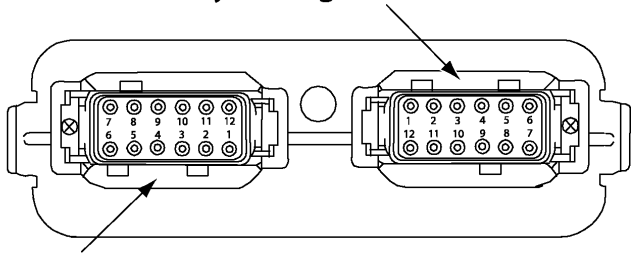


Figure 3 – Configuration using the Axiomatic EA

Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Weight	0.55 lb. (0.25 kg)
Vibration and Shock Compliance	MIL-STD-202G, Test 204D, 214A and 213B 7.68 Grms (Random) 10 g peak (Sine) 50 g (Shock)
Protection	IP67 rating for the product assembly
Electrical Connections	24-pin receptacle (equivalent TE Deutsch P/N: DTM13-12PA-12PB-R008) Mating plug – equivalent to the TE Deutsch P/Ns: 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. <div style="text-align: center;"> <p>Key Arrangement B (black)</p>  <p>Key Arrangement A (grey)</p> <p>FRONT VIEW 24 PIN RECEPTACLE</p> </div> <p>Refer to Table 2.0 for the pin out.</p>
Enclosure	High Temperature Nylon PCB Enclosure - (equivalent TE Deutsch P/N: EEC-325X4B) 5.254 x 4.68 x 1.42 inches 138.4 x 119mm x 36 mm (W x L x H excluding mating plugs) Refer to Figure 4.

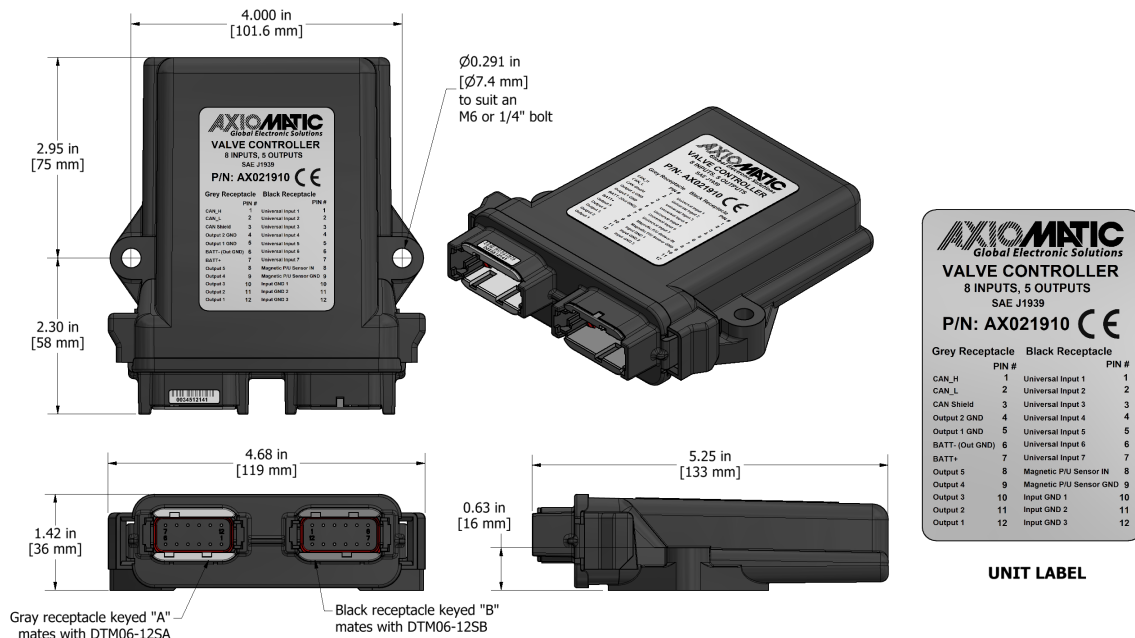


Figure 4 – Enclosure Dimensions

Table 2.0 – Pin out: AX021910

Grey Connector		Black Connector	
Pin #	Function	Pin #	Function
1	CAN H	1	Universal Input 1
2	CAN L	2	Universal Input 2
3	CAN Shield	3	Universal Input 3
4	Output 2 GND	4	Universal Input 4
5	Output 1 GND	5	Universal Input 5
6	BATT- (Out GND)	6	Universal Input 6
7	BATT +	7	Universal Input 7
8	Output 5	8	Magnetic P/U Sensor IN
9	Output 4	9	Magnetic P/U Sensor GND
10	Output 3	10	Input GND 1
11	Output 2	11	Input GND 2
12	Output 1	12	Input GND 3

Control Logic

Below is shown a simplified block diagram illustrating the default control logic programmed into the 8i5o Valve Controller.

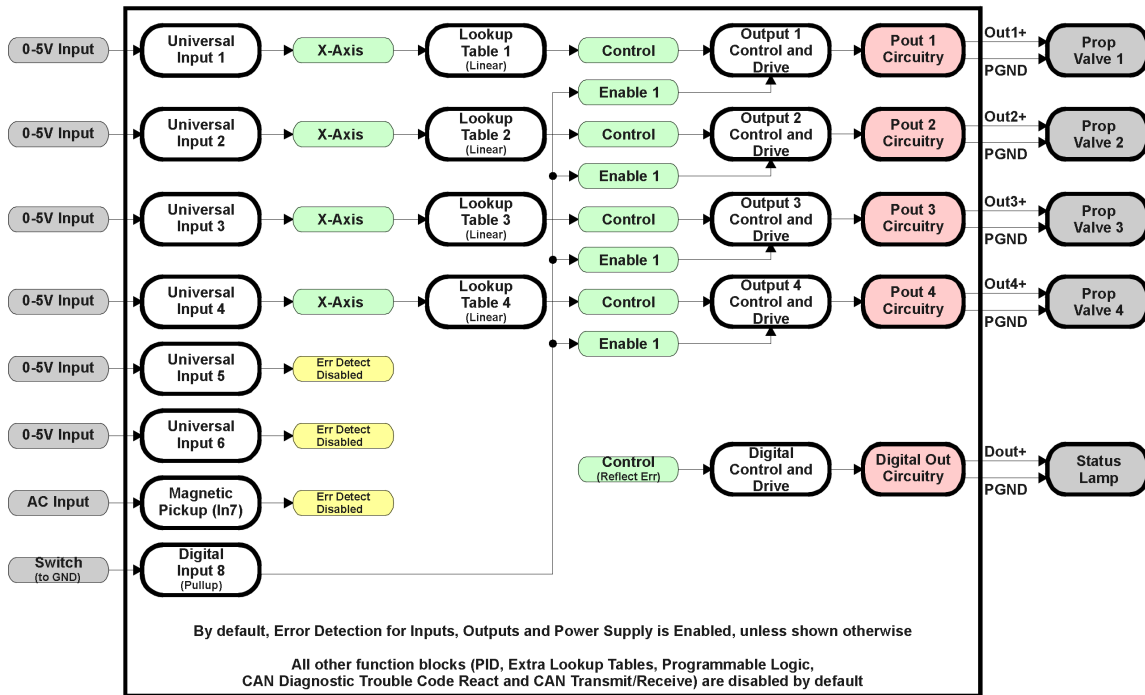


Figure 5 – Default Control Logic

By default, the controller is programmed to be fully self-contained, and does not require a connection to the CAN network to function. All other software function blocks (PID, extra lookup table, programmable logic, CAN diagnostic trouble code react and CAN transmit/receive) are disabled by default.

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

Form: TDAX021910-06/12/23