ACORN User Guide

For Revision 171025 (Aka Acorn_rev3)
Updated 1/23/17

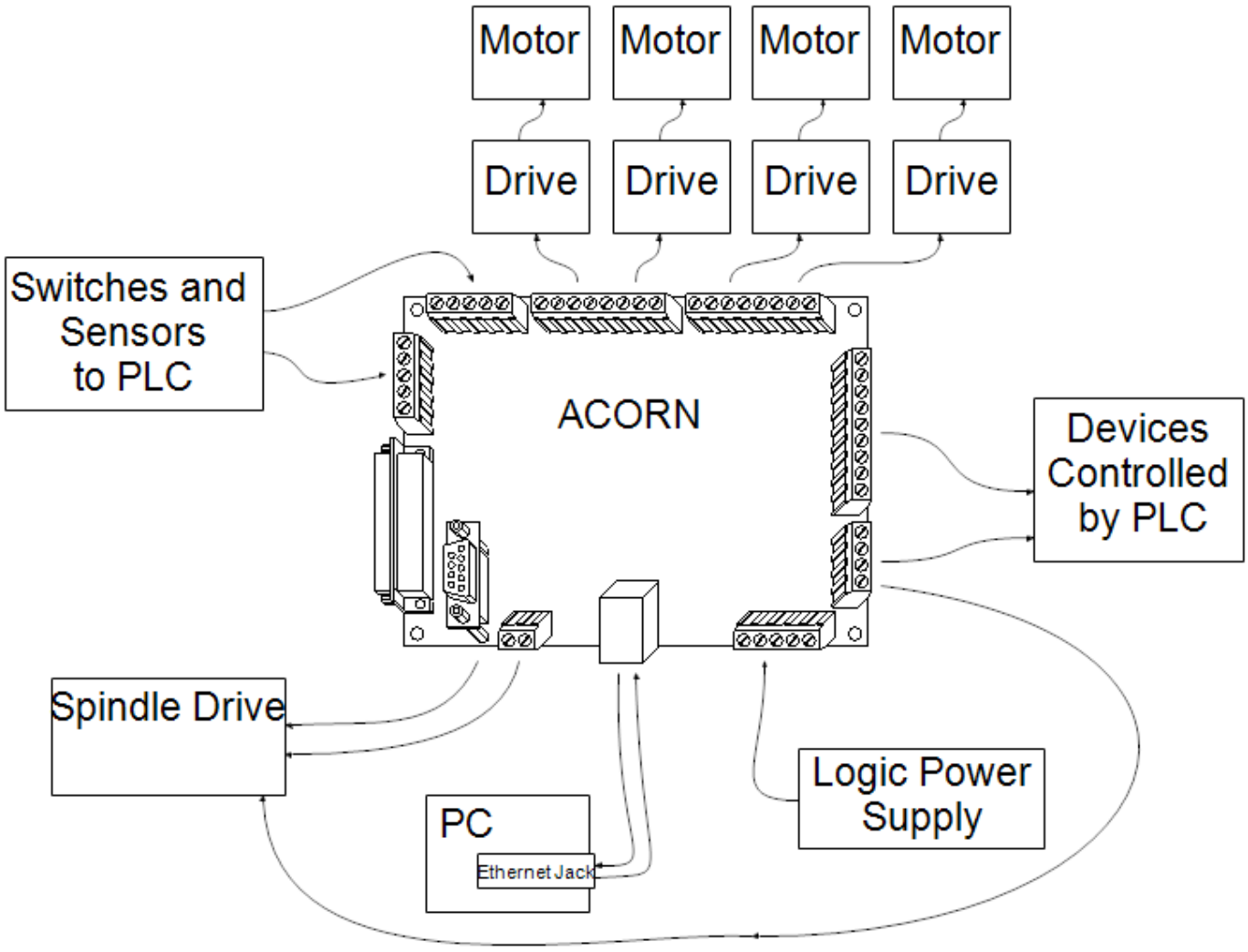
Overview

ACORN is technically a breakout board for the BeagleBone Green or BeagleBone Black embedded computer. The remainder of this document will refer to the breakout board with BeagleBone installed as ACORN. It is a low cost motion control processor, PLC, and drive interface board. It is intended to operate entry level machining equipment with up to four axes that does not require a large number of I/Os.

Features

Function:	Motion Control Processor, PLC, and Drive Interface
Maximum number of Axes:	4
Maximum pulse rate:	400kHz
Control Interface:	100 Mb/s Ethernet to PC
Drive Application:	Drives with step and direction inputs
Digital PLC Inputs:	8
Digital PLC Outputs:	8
Analog Output resolution:	12 bits
Dimensions (W*D*H):	5.4 * 4.2 * 0.7 inches

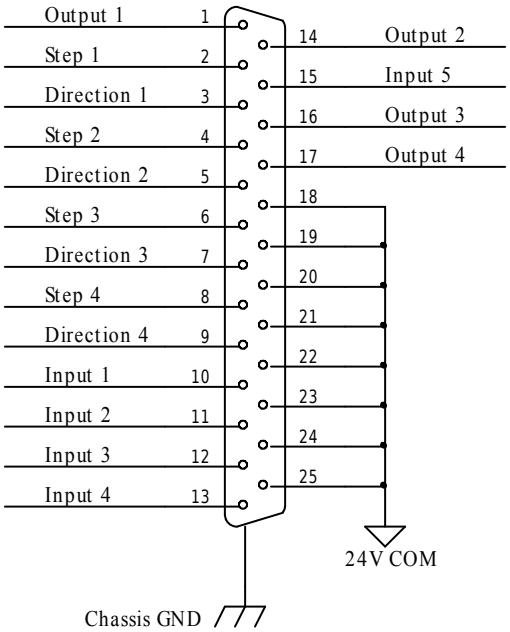
Typical Connections



Connections

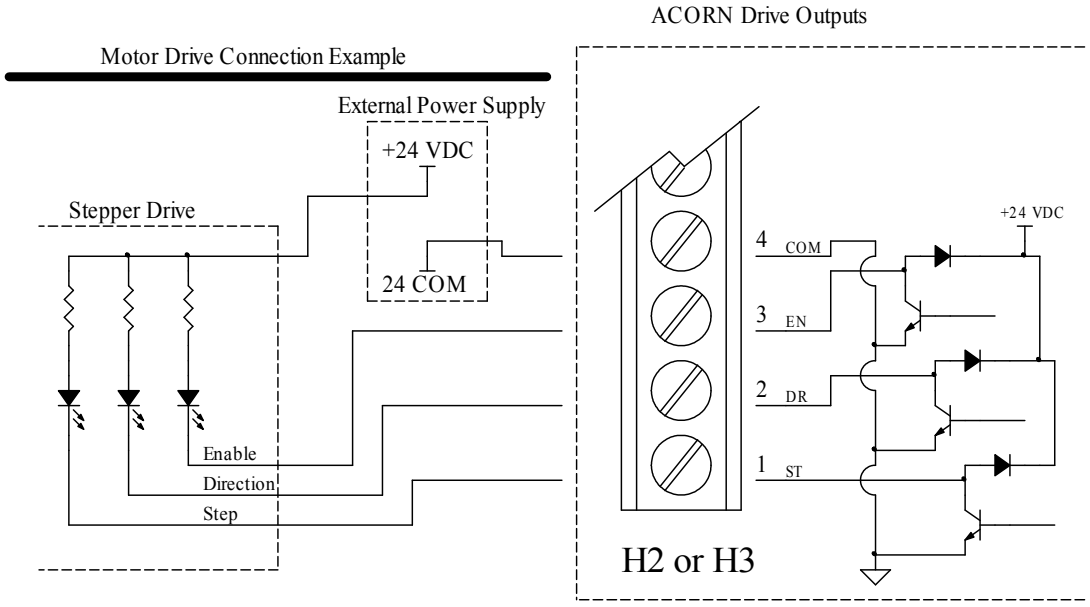
Two connection methods are available. A female DB25 connector is available that can mate with many stepper control units with a straight through cable. The inputs and outputs are 5V compatible. Check the DB25 pinout and circuit descriptions to determine if it is compatible with a particular control unit.
The DB25 provides the simplest and quickest connection method if it is compatible.
Screw terminals are available for custom configurations. This allows for additional I/O and the most connection versatility. All input and output signals on the DB25 connector are available on the screw terminals except with 24V levels.
Outputs 1 and 2 are SPDT relay contacts at the screw terminals.
Inputs may only be used on the DB25 or screw terminal, not both. For example, only screw terminal input 1 or DB25 input 1 may be connected at the same time. However, screw terminal input 1 may be used at the same time as DB25 input 2.

DB25 (H6) Signals



Drive Interface Section

Four sets of step, direction, and enable outputs are provided to control motor drives. The outputs are open collector type and can provide up to 400kHz step frequency.

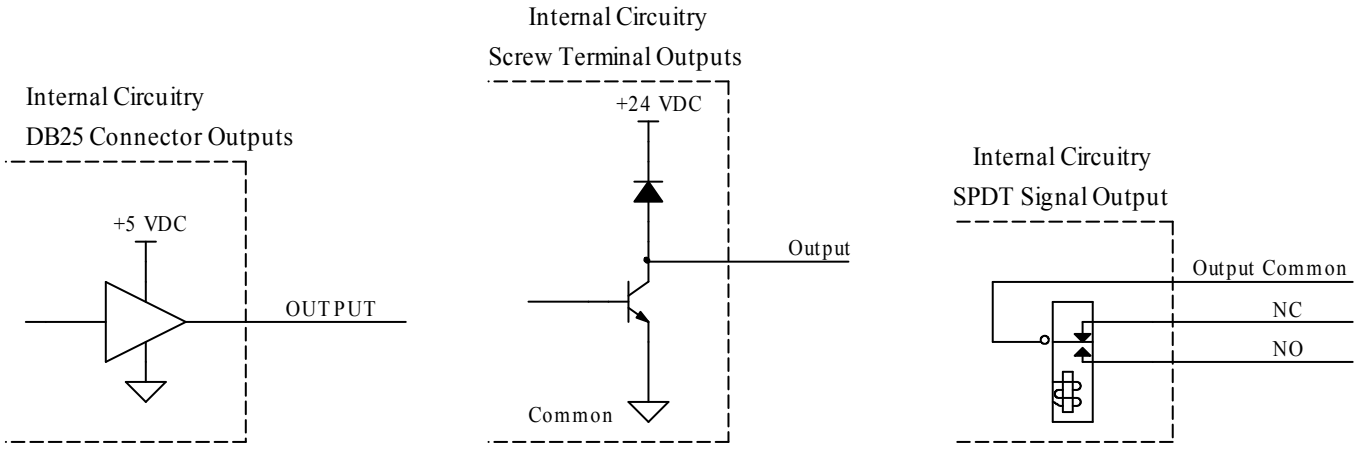


PLC Section

The ACORN has 8 digital inputs, 8 digital outputs, and one analog output. Check the “ACORN I/O Map” and “ACORN Specifications” sections to determine I/O type and capability.

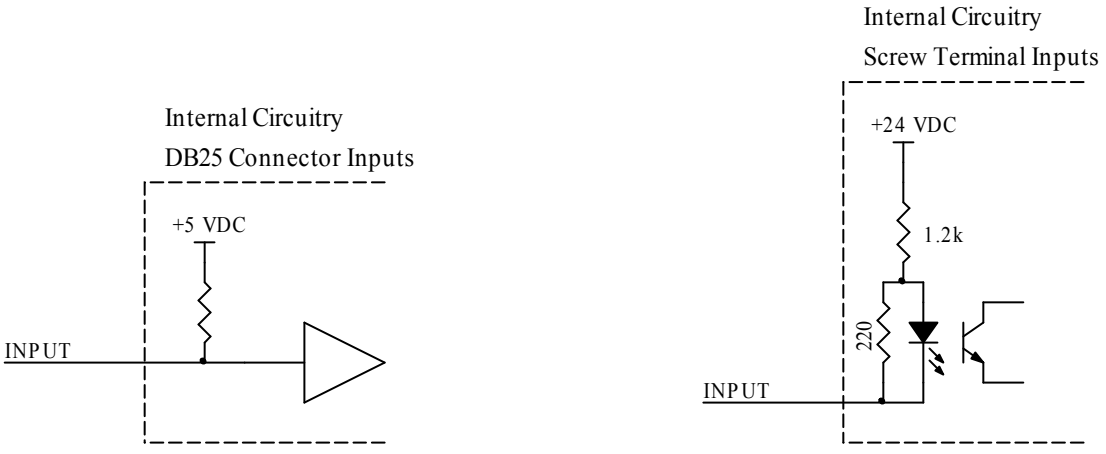
Outputs

Two SPST relay outputs are available on board, as well as 6 open collector outputs.

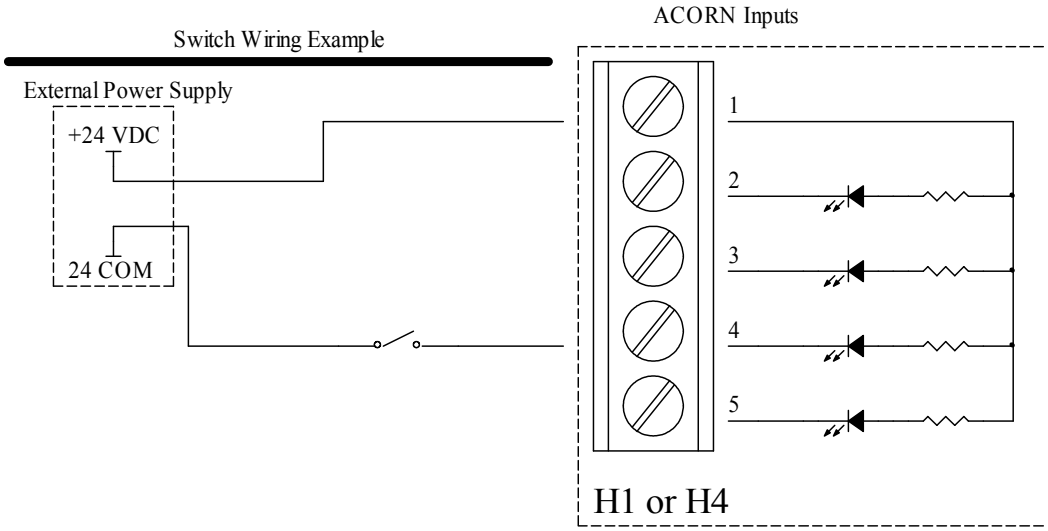


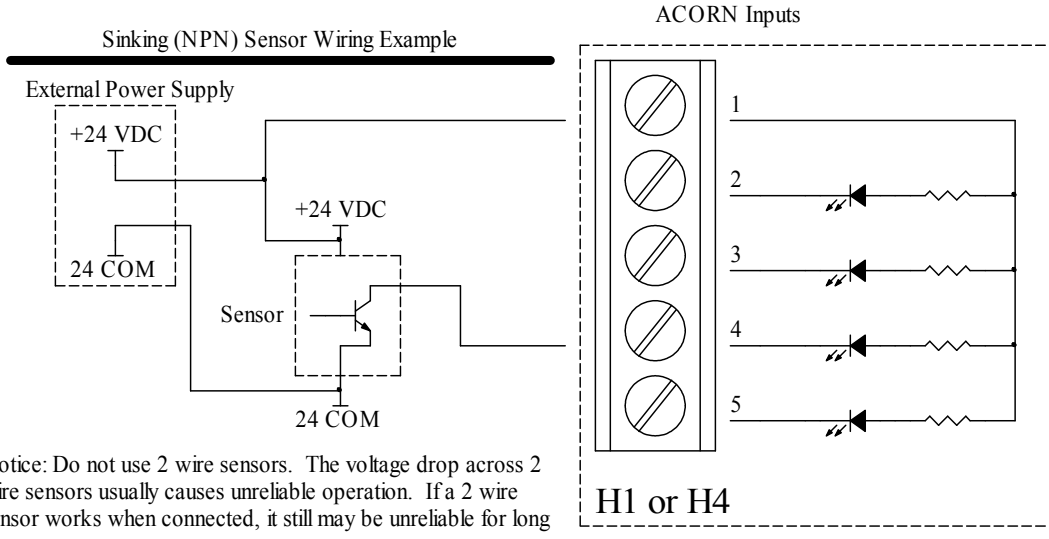
Inputs

ACORN uses optically isolated inputs for screw terminal inputs. These inputs can be used with 24 VDC sensors or switches. The 24 VDC for inputs may be supplied from the ACORN logic supply. For improved isolation and noise immunity, a separate 24 VDC may be used to power the inputs. Compare the specifications of sensors to the “ACORN Specifications” chart to ensure reliable operation.



Input Connection Examples

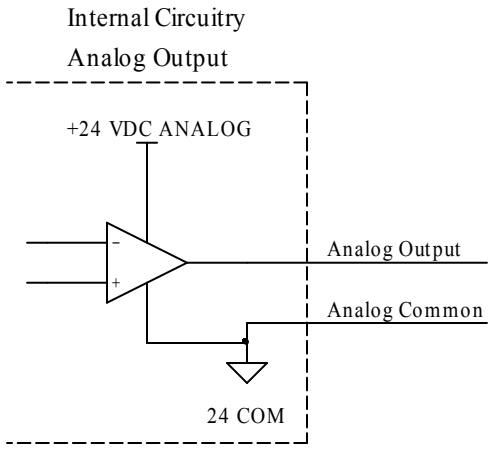




Notice: Do not use 2 wire sensors. The voltage drop across 2 wire sensors usually causes unreliable operation. If a 2 wire sensor works when connected, it still may be unreliable for long term use.

Analog Output

An analog output is provided for controlling spindle speed. The output voltage range is 0 to 10 VDC.



Analog Output Calculations

The analog output uses a 12 bit digital to analog converter (DAC) to generate analog from the DAC request sent from the PLC program. The 12 bit value allows a DAC request of 0 to 4095, which corresponds to 0 to 9.998 volts in the 0 to 10V range.

0 to 10V Range

$$\text{output voltage} = \frac{\text{DAC Request}}{4096} * 10$$

Analog Output Wiring

The analog output should be wired using a shielded twisted pair for best results. The analog output terminal is paired with a common terminal for direct wiring of the signal, common, and shield. In most cases, it is best to connect the shield to the common only at the ACORN. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “ACORN Connections” section for terminal locations.

ACORN I/O Map

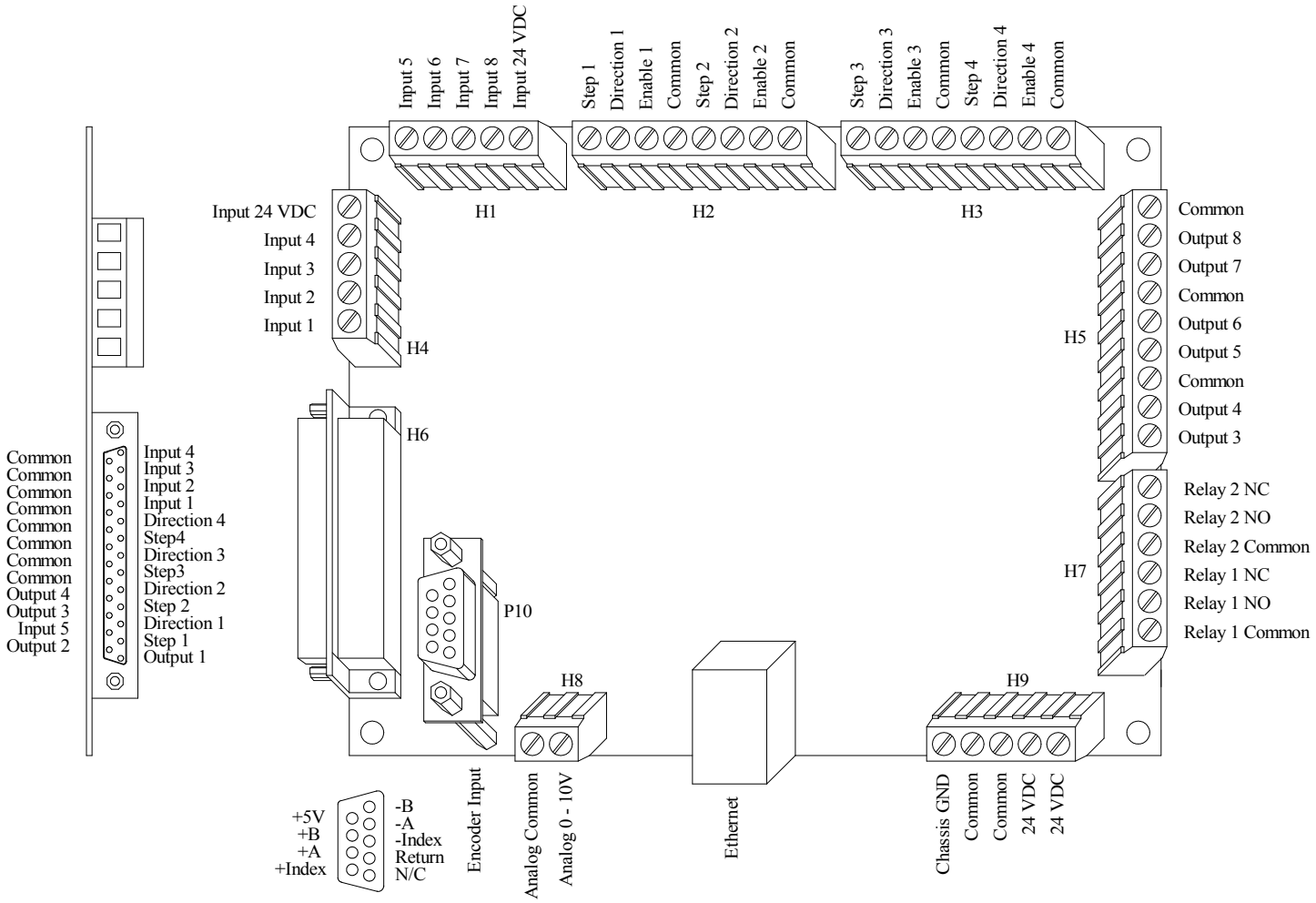
Input Specification		Input Location 1			Input Location 2		
Number	Function	Type	Connector	Pin	Type	Connector	Pin
1	General Purpose	Sourcing	H4	5	Logic w/ 5V Pullup	H6	10
2	General Purpose	Sourcing	H4	4	Logic w/ 5V Pullup	H6	11
3	General Purpose	Sourcing	H4	3	Logic w/ 5V Pullup	H6	12
4	General Purpose	Sourcing	H4	2	Logic w/ 5V Pullup	H6	13
5	General Purpose	Sourcing	H1	5	Logic w/ 5V Pullup	H6	15
6	General Purpose	Sourcing	H1	4	-	-	-
7	General Purpose	Sourcing	H1	3	-	-	-
8	General Purpose	Sourcing	H1	2	-	-	-

Output Specification		Output Location 1			Output Location 2		
Number	Function	Type	Connector	Pin	Type	Connector	Pin
1	General Purpose	Relay SPDT	H7	4,5,6	5V Logic	H6	1
2	General Purpose	Relay SPDT	H7	1,2,3	5V Logic	H6	14
3	General Purpose	Open Collector	H5	1	5V Logic	H6	16
4	General Purpose	Open Collector	H5	2	5V Logic	H6	17
5	General Purpose	Open Collector	H5	4	-	-	-
6	General Purpose	Open Collector	H5	5	-	-	-
7	General Purpose	Open Collector	H5	7	-	-	-
8	General Purpose	Open Collector	H5	8	-	-	-
17-28	Analog out	12 bit DAC	H8	1	-	-	-

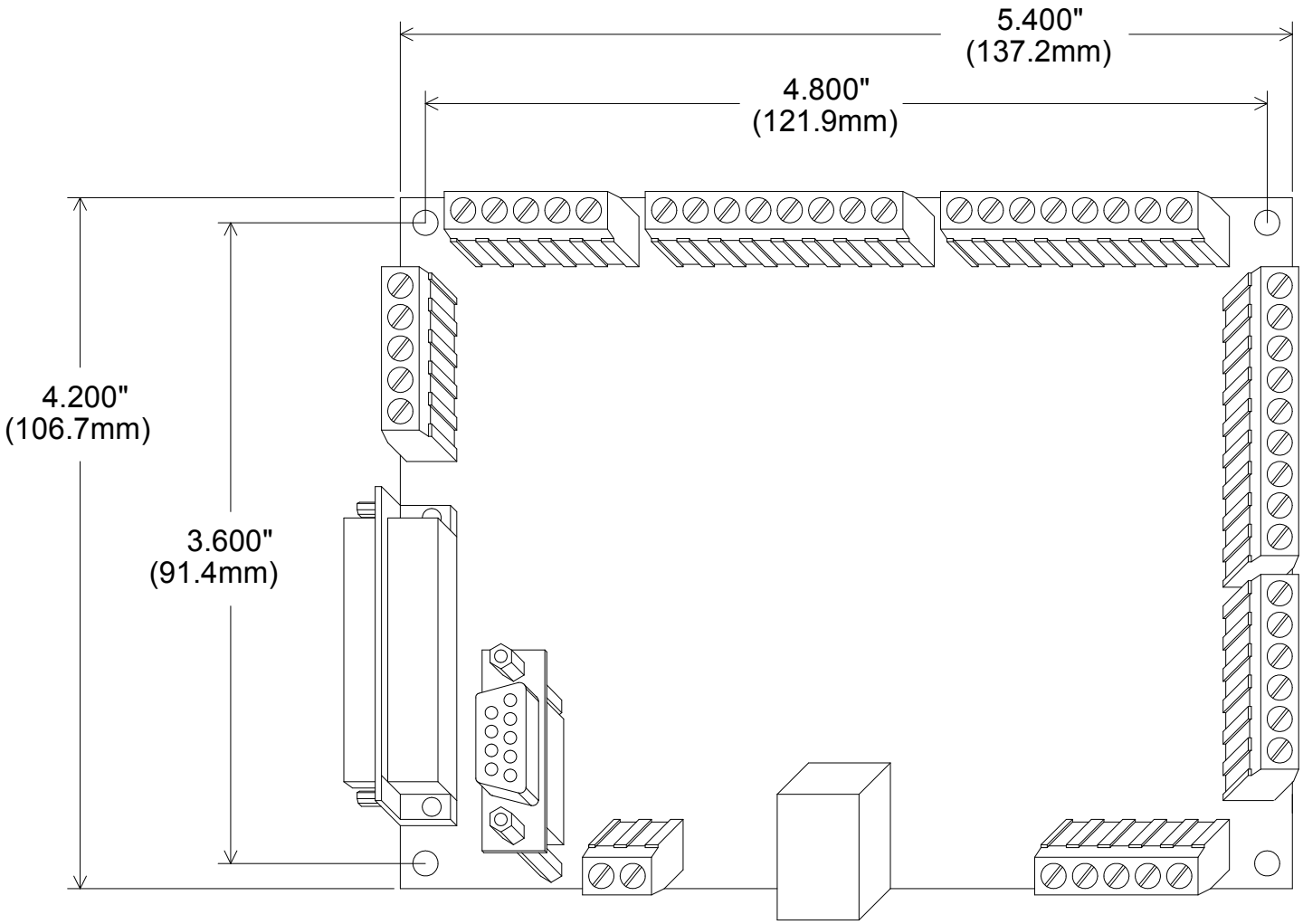
ACORN Specifications

Characteristic	Min.	Typ.	Max.	Unit
24 Volt Supply Current (Vsupply)	0.5	-	-	A
24V Input Pullup Voltage (Vinp)	22	-	26	VDC
24V Input Off Voltage	19.1	-	26	VDC
24V Input On Voltage	0	-	5.9	VDC
24V Input Operating current	17	20	22	mA
Relay Output Current	0.1	-	10	A @ 125VAC
Relay Output Current	0.1	-	5	A @ 30VDC
Open Collector Output Current	0	10	50	mA
Open Collector Output Voltage	0	24	Vsupply	VDC
DB25 Input Pullup Voltage (internal) (VCC)	3.8	4.4	5.5	VDC
DB25 Input On Voltage	VCC x 0.7	-	-	VDC
DB25 Input Off Voltage	-	-	VCC x 0.3	VDC
DB25 Output High Voltage	3.66	4.4	VCC	VDC
DB25 Output Low Voltage	0	0.1	0.44	VDC
DB25 Low Level Output Current	0	3	20	mA
DB25 High Level Output Current	0	3	20	mA
Analog Output Current	0	1	10	mA
Analog Output Voltage	0	-	10	V
Analog Output Resolution	-	12	-	bits
Size: 5.4 * 4.2 * 0.7 (W*D*H)				Inches

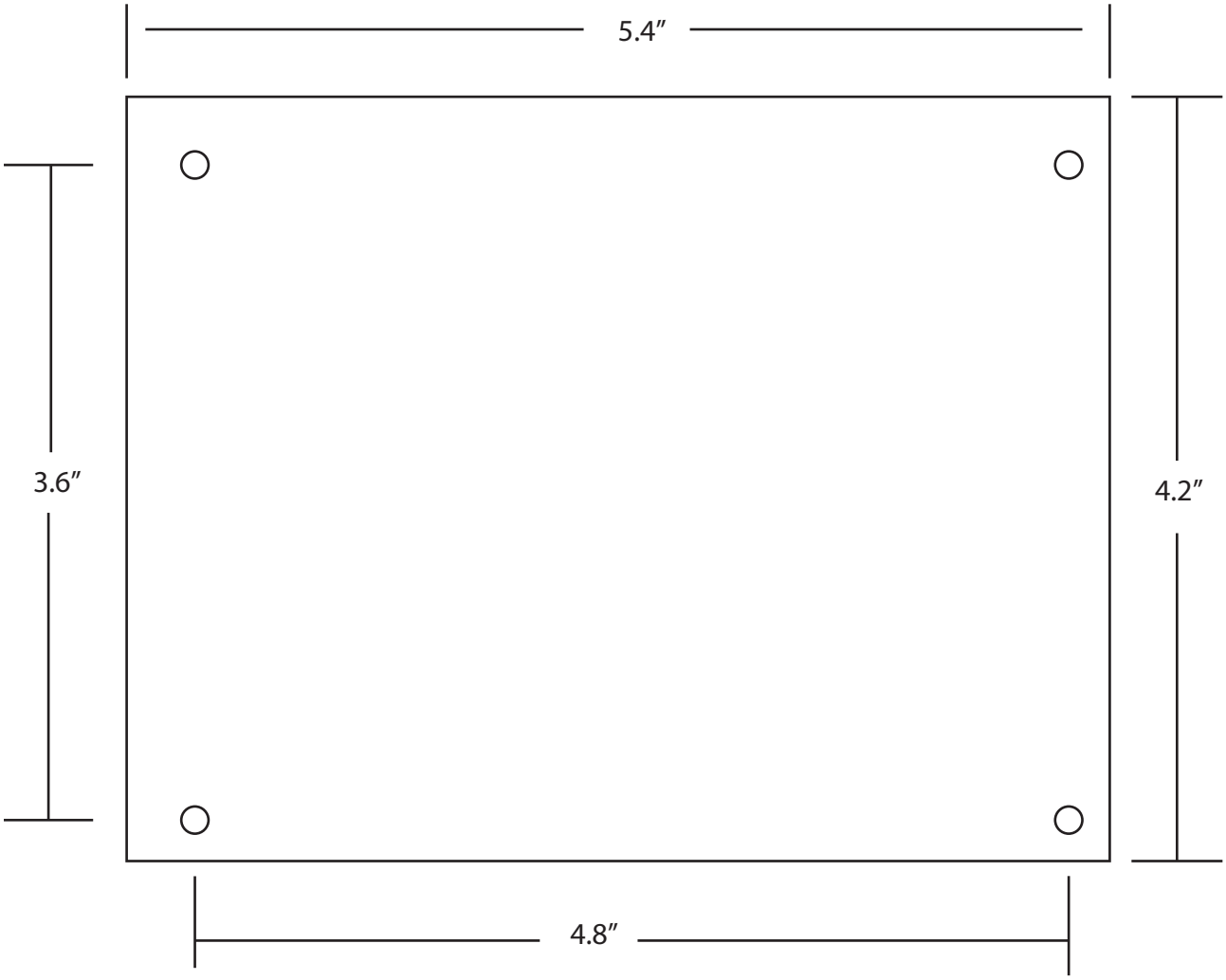
ACORN Connections



ACORN Mounting Footprint



Acorn CNC control board Mounting Footprint.



- Holes are clearence for 6-32 (.1495″ diameter)
- 6-32 standoffs are recommended