Model 822 Drive Controller

Software Version 2.0

Integrated Time Systems, Inc.

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1. DESCRIPTION

The **Model 822 Drive Controller** is a microprocessor-driven, single axis, closed loop motion control systems designed for semiconductor boat loading and cantilever applications. Flexible software and universal interface circuitry allow for integration into a variety of DDC (Direct Digital Control) or process sequencer environments.

Notable features of the **Model 822 Drive Controller** include:

- Pulse Width Modulation (PWM) drive circuitry for improved torque at low speeds
- Digital control techniques for repeatable speed settings.
- Tachometer based closed-loop speed control.

1.1. Front Panel

The circuit board for the drive controller is positioned immediately behind and perpendicular to an operator control panel. This panel contains the switches and displays required for local control of the wafer loading system as well as a switch to select remote mode. In some installations, the entire enclosure is mounted at the load station, while in others the unit is mounted on the drive chassis.

1.1.1. Controls

1.1.1.1. LOCAL/REMOTE

This three-position switch selects the operating mode of the control system.

When the LOCAL/REMOTE switch is in the LOCAL position, remote signals from the host DDC or process sequencer are ignored and the front panel switches and displays are active.

When the LOCAL/REMOTE switch is in the REMOTE position, the IN and OUT switches on the front panel are ignored and signals from the host system control motion.

The STOP switch on the front panel is active during both LOCAL and REMOTE operation. This switch immediately stops motion of the drive regardless of operating mode.

In applications where the DDC or process sequencer is able to provide an analog speed setpoint, the front panel speed setting switches are used only during LOCAL operation. If the DDC or process sequencer is not providing an analog speed setpoint, the front panel speed setting switches also provide the speed setpoint in the REMOTE control mode.

1.1.1.2. Speed Select Potentiometer

In some installations, both the LOAD and the UNLOAD speeds are controlled by a single potentiometer accessible through a small hole in the front panel. In the extreme counterclockwise position, the speed set points are 0%. In the extreme clockwise position, the speed set points are 100%

1.1.1.3. LOAD Speed Select

In some installations, a 2-digit thumb-wheel switch assembly provides for speed control in the load direction while in the LOCAL mode. The range of permissible switch settings is 00 to 99%. To change a speed setting, press the upper (-) button to decrement or the lower (+) button to increment the appropriate digit.

1.1.1.4. UNLOAD Speed Select

In some installations, a 2-digit thumb-wheel switch assembly provides for speed control in the unload direction while in the LOCAL mode. The range of permissible switch settings is 00 to 99%. To change a speed setting, press the upper (-) button to decrement or the lower (+) button to increment the appropriate digit.

1.1.1.5. LOAD Switch

This momentary switch initiates motion in the load direction if interlocks and limit switches are satisfied. Once a LOAD has been initiated, holding the LOAD switch depressed triggers the FAST LOAD mode (full speed).

1.1.1.6. UNLOAD Switch

This momentary switch initiates motion in the unload direction if interlocks and limit switches are satisfied. Once an UNLOAD has been initiated, holding the UNLOAD switch depressed triggers the FAST UNLOAD mode (full speed).

1.1.1.7. STOP Switch

This momentary switch disables the motor drive circuitry during both LOCAL and REMOTE modes of operation. In LOCAL mode, motion resumes when either the IN or OUT switch is again pressed. In REMOTE mode, motion resumes when the LOCAL/REMOTE switch is set to LOCAL and then back to REMOTE.

1.1.2. LED Displays

1.1.2.1. LOAD LED

This yellow LED lights constantly during motion in the load direction. When the load limit is reached, the LOAD LED flashes ten times per second.

1.1.2.2. UNLOAD LED

This yellow LED lights constantly during motion in the unload direction. When the unload limit is reached, the UNLOAD LED flashes ten times per second.

1.1.2.3. STOP LED

This red LED light flashes if motion is aborted before a limit switch is reached and during operational faults such as overheated drive circuitry or excess torque.

1.1.3. Liquid Crystal Display

A 4 line x 20-character LCD display may be connected to the circuit board for diagnostics and setup functions. The format of the information on this display is beyond the scope of this document.

1.1.4. Microprocessor Subsection

The microprocessor section of the **Model 822 Drive Controller** includes a CMOS microprocessor with 176 bytes of RAM and 7 Kbytes of ROM. Timing functions derive their time base from an on-board crystal and are independent of the frequency of the AC power line.

1.1.5. Host Interface

1.1.5.1. Host-to-Drive

The remote command inputs on the **Model 822 Drive Controller** are high-gain, bi-directional optical isolators. This interface permits operation from low-current CMOS signals, TTL signals or from relay contact closures. The bi-directional aspect of the interface permits either high-side switching or low-side switching. The optical isolators electrically isolate the unit from the host electronics so as not to cause ground loops that might compromise other analog functions that the host might control. A dipswitch is provided on the Drive Controller to select the logical sense of the command signals; energized = active, or not energized = active. A second dipswitch informs the drive controller whether to expect pulsed or sustained commands See *DIP Switch Options*, page 15).

In some installations, an analog input is included to allow remote speed settings. When the analog input is included, the drive controller accepts speed settings from the host whenever the LOCAL/REMOTE switch is in the REMOTE position. For proper operation, the host must provide a stable DC voltage in the range of 0 to 4.95 volts corresponding to speed settings of 0 to 99.

1.1.5.2. Drive-to-Host

The logical sense of the two Drive-to-Host reply signals may be reversed with a dipswitch SW1.4 (see *DIP Switch Options*, page 15). These signals are relay isolated for maximum interface flexibility. The relays may be wired to provide contact closures to a positive voltage or to a negative voltage. An isolated 12 volt power supply is available on J2 for applications where interface power is not provided by the host controller.

2. INSTALLATION

2.1. Host Connector (P1)

The circuit board of the **Model 822 Drive Controller** provides for either a 10-pin or a 16-pin IDC header to serve as a parallel communications link between the drive and a host computer or process controller. In most applications, a 10-pin header is installed on the circuit board leaving the remaining signals inaccessible. The unused signals include connections to the drive controllers' 24-volt power supply and to an unused EIA-485 serial port. In this type of installation, the power supply in the process sequencer or Gas Panel Interface is used to power the drive controller interface.

In most applications, an extension ribbon cable plugs into the 10-pin IDC header and terminates at a 9-pin male 'D' connector, designated J1, which is mounted on the drive controller enclosure.

P1 IDC Pin	Function	J1 9-Pin 'D' Pin	Direction of Signal	Color 9540
1	Remote Load Command	1	Host to Drive	Black
2	Command Common	6	Host to Drive	Green
3	Remote Unload Command	2	Host to Drive	Brown
4	BIC (LOAD IN)	7	Drive to Host	Red
5	BIC / BOC Common	3	Drive to Host	Blue
6	BOC (LOAD OUT)	8	Drive to Host	White
7	Analog Input (Speed)	4	Host to Drive	Orange
8	Analog Output (Position)	9	Drive to Host	
9	Analog Common	5		Gray
10	Chassis Ground			Shield
11	24 Volt Return			Violet
12	+24 Volts			Yellow
13	EIA-485 -			
14	EIA-485 Common			
15	EIA-485 +			
16	Unconnected			

2.1.1. Host Connector (P1) Interfaced to ITS GPI-803

The following table details the connections between a **Model 822 Drive Controller** and an Integrated Time Systems Model GPI-803C Atmospheric Gas Panel Interface. Note that J1 on the boat loader board might be a 9-pin 'D' connector or a 15-pin 'D' connector depending on the configuration.

Drive Function	J1 9-Pin 'D' Pin	J1 15-Pin 'D' Pin	Direction of Signal	GPI-803	GPI-803 Signal
					Jumper J10 Pin 8 to J10 Pin 3
Remote Load Command	1	1	Host to Drive	J10 Pin 2	Digital Output 0
Command Common	6	9	Host to Drive	J10 Pin 7	+24 Volts
Remote Unload Command	2	2	Host to Drive	J10 Pin 4	Digital Output 1
BIC (LOAD IN)	7	10	Drive to Host	J10 Pin 1	Digital Input 0
BIC / BOC Common	3	3	Drive to Host	J10 Pin 6	24 Volt Return
BOC (LOAD OUT)	8	11	Drive to Host	J10 Pin 5	Digital Input 1
Analog Input (Speed)	4	4	Host to Drive	J11 Pin 7	ANALOG OUTPUT 8
Analog Output (Position)	9	12	Drive to Host	J11 Pin 13	ANALOG INPUT 8
Analog Common	5	5		J11 Pin 14	ANALOG COMMON
		13			CHASSIS GND
		6			24V RET
		14			+24V DC
		7			RESERVED
		15			RESERVED
		8			RESERVED

2.1.2. Host Connector (P1) Interfaced to ITS GPI-903 or GPI-904

The following table details the connections between a **Model 822 Drive Controller** and an Integrated Time Systems Model GPI-903 Atmospheric Gas Panel Interface or a Model GPI-904 LPCVD Gas Panel Interface. Note that P1 on the boat loader board would be configured with a 15-pin male 'D' adapter cable.

Drive Function	P1 15-Pin 'D' Pin	Direction of Signal	GPI-903/4 J10	GPI-903/4 Signal
Remote Load Command	1	GPI to Drive	1	Digital Output 0
Command Common	9	GPI to Drive	9	+24 Volts
Remote Unload Command	2	GPI to Drive	2	Digital Output 1
BIC (LOAD IN)	10	Drive to GPI	10	Digital Input 0
BIC / BOC Common	3	Drive to GPI	3	24 Volt Return
BOC (LOAD OUT)	11	Drive to GPI	11	Digital Input 1
Analog Input (Speed)	4	GPI to Drive	4	Speed Setpoint
Analog Output (Position)	12	Drive to GPI	12	Position
Analog Common	5	Common	5	Analog Common
Note: Version 'D' of the Drive Controller board provides for power input via either P1 or J4. If P1 is used, the GPI must be configured to provide power to the Drive on these pins.				
	13		13	LDR +24V
	6		6	LDR 24V Return
	14		14	LDR +24V
	7		7	LDR 24V Return
	15		15	LDR +24V
	8		8	LDR 24V Return

2.2. Drive Connector (J2)

J2 provides the signals for the motor and limit switches. This is a 12-pin Molex Minifit header with male pins (Molex 39-29-1123) located near the middle of the back edge of the circuit board. An appropriate mating connector is Molex, part number 39-01-2120 win 39-00-0039 female pins.

The signals on Pins 6, 11 & 12 are provided for installations that include a position feedback potentiometer. In those installations, the wiper of the potentiometer must be connected to pin 6 of J2. The 5.00-Volt Reference (Pin 12) and Analog Common (Pin 11) signals must be connected to the pot such that the pot outputs 5 volts at the IN position and 0 volts at the OUT position.

Pin	Function	Pin	Function
1	Motor 1	7	Motor 2
2	Tachometer 1	8	Tachometer 2
3	Limit 1, Load Over-travel	9	Limit 2, Unload Over-Travel
4	Limit 3, Load Approach	10	Limit 4, Unload Approach
5	Limit Switch Common	11	Analog Common (Position Pot)
6	Position Potentiometer; Wiper	12	5.00 Volt Reference (Position Pot)

2.2.1. End-Of-Travel Sensors

Four end-of-travel limit switch inputs are provided. In many installations, only the two signals labeled 'Over-travel' are used. In all cases, each limit switches must be normally closed and open at end-of-travel. Any unused limit switches must be jumped to 'Limit Switch Common' for proper operation.

The End-of-Travel signals are particularly sensitive to electrical noise. For safety reasons and for mechanical concerns, any momentary signal on the end-of-travel wires is latched in software and motion is stopped. Depending on the routing of the wires from J2 on the circuit board to the motor and sensors, shielding of the wires from J2 to the motor and sensors, and the condition of the brushes in the motor, erroneous signals from the motor may be coupled onto the end-of-travel wires thereby causing motion to stop before the end-of-travel sensor has been tripped. For this reason, it is advisable to use a separate shielded wire for the five end-of-travel signals on pins 3, 4, 5, 9 & 10. The conductors in the cable should be size AWG22 or larger and the shield should be grounded to earth ground at only one end of the cable, preferably the end that connects to the circuit board.

2.2.2. Motor Connections

The polarity of the motor connection is dependent on the installation. If the drive moves the wrong direction after installation, either reverse the connections on the motor or swap pins 1 and 7 on J2.

The cable from the circuit board to the motor should be size AWG18 or larger. In consideration of the sensitive end-of-travel signals, the optimum installation would use 2-conductor shielded cable for the motor signals, with the shield connected to earth ground at the end that connects to the circuit board.

2.2.3. Tachometer Circuit

The AC output from the tachometer, if present, must be connected to Pins 2 and 8 of J2. The polarity of the tachometer signal is not important. A diode bridge on the circuit board corrects the signal.

If the drive controller is to be operated in closed loop mode, the tachometer must be enabled in software by setting SW1.3 to the ON (CLOSED) position.

When SW1.3 is ON, two other dipswitches (SW1.5 and SW1.6) and a potentiometer (POT5) further affect the behavior of the tachometer.

With dipswitches SW1.5 and SW1.6 OFF, POT5 reduces the signal from the tachometer before it reaches the microprocessor thereby causing the microprocessor to increase the output pulse width (speed). Turning the pot clockwise reduces the tachometer signal thereby causing a higher motor speed while turning the pot counterclockwise reduces the motor speed. This pot can thus be used to calibrate the motor speed to match a customer's preference.

If POT5 is at the extreme counterclockwise position, and the motor speed is still too high, the amplitude of the tachometer signal may be too low. In this case, SW1.5 or SW1.6 or both may be turned ON to amplify the tachometer signal in software. These switches should only be

used if satisfactory results cannot be obtained by turning POT5 to its extreme counterclockwise position.

2.3. Power Supply (J4) and Board Revisions

2.3.1. Board 9990269 Revision A & B

Connector J4 provides power to the **Model 822 Drive Controller**. This is the 6-pin Molex header located at the rear edge of the drive controller circuit board.

On units using circuits boards manufactured prior to August 2004, an external, dual-output power supply must be connected to J4 to operate the controller. The supply must be able to provide 1.8 amps at 24 volts DC (motor supply) and 0.5 amps at 10 to 16 volts DC (control supply). If desired, a dual-output +/- 12 volt supply can be configured to provide the two voltages. An example of one such supply is Artesyn's Model NLP40-7627.

The 24-volt section of the supply is used to power the motor, the limit switch circuits and, in some cases, the host interface. If the drive is to be operated in the recommended closed-loop mode, this supply need not be well regulated; an output range of +\- 15% is acceptable. If it desired to use the controller with some DC motor other the recommended 24-volt unit, the circuitry can tolerate an appropriate motor power supply in the range of 10 volts to 40 volts instead of the specified 24-volt supply.

The 12-volt supply is used to power the op amps in the analog portions of the controller and is also regulated down to 5 volts for use by the logic. A range of 10 to 16 volts is acceptable for this supply.

Extra pins are provided on J4 for chassis ground. These pins are connected on the circuit board to two of the four mounting holes and may be used to ground the enclosure. It is more desirable, however, to ground the enclosure directly and leave pins 3 and 4 unconnected.

Note that on connector J4, pin 1 is the pin closest to the 'J4' label on the circuit board. A square solder pad (as opposed to the remaining pins that have round pads) also distinguishes pin 1. The mating connector for J4 is Molex 09-50-8063 with 08-50-0106 pins.

Note also that Pin 1 on J2 of the Artesyn Model NLP40-7627 power supply is the pin closest to the edge of the circuit board near the mounting hole. The mating connector for the power supply is Molex 09-50-3061 with 08-50-0106 pins.

Note also that the Artesyn Model NLP40-7627 uses a power output connector identical to the power input connector, J4, on the circuit board. The pin designation on the two connectors, however, is different. After making a power supply extension cable, be careful to connect the proper end of the cable on the appropriate connector.

Drive J4 09-50-8063 Pin	Function		Artesyn P2 09-50-3061 Pin
1	+24 Volts	RED	3
2	+12 Volts	YELLOW	4
3	Chassis Ground		
4	Chassis Ground		
5	+12 Volts		
6	24 Volt Return	BLACK	1

2.3.2. Board 9990269 Revision C

Connector J4 provides power to the **Model 822 Drive Controller**. This is the 6-pin Molex header located at the rear edge of the drive controller circuit board.

On units using circuits boards manufactured after August 2004, an external, single-output power supply must be connected to J4 to operate the controller. The supply must be able to provide 1.8 amps at 24 volts DC. The Artesyn Model NLP40-7627 power supply mentioned above may still be used, however, the dual output feature of that supply is no longer required and a less expensive linear or switching 24-volt supply may be selected.

The 24-volt supply powers the motor, the limit switch circuits and, in some cases, the host interface. If the drive is to be operated in the recommended closed-loop mode, this supply need not be well regulated; an output range of +\- 15% is acceptable. If it desired to use the controller with some DC motor other the recommended 24-volt unit, the circuitry can tolerate an appropriate motor power supply in the range of 9 volts to 36 volts instead of the specified 24-volt supply. An on-board DC/DC converter derives a 5-volt power supply from the 24-volt supply to power the electronics.

Extra pins are provided on J4 for chassis ground. These pins are connected on the circuit board to two of the four mounting holes but should not be relied on to ground the enclosure. It is more desirable to ground the enclosure directly and leave pins 3 and 4 unconnected.

Note that on connector J4, pin 1 is the pin closest to the 'J4' label on the circuit board. A square solder pad (as opposed to the remaining pins that have round pads) also distinguishes pin 1. The mating connector for J4 is Molex 09-50-8063 with 08-50-0106 pins.

Note also that Pin 1 on J2 of the Artesyn Model NLP40-7627 power supply is the pin closest to the edge of the circuit board near the mounting hole. The mating connector for the power supply is Molex 09-50-3061 with 08-50-0106 pins.

Note also that the Artesyn Model NLP40-7627 uses a power output connector identical to the power input connector, J4, on the circuit board. The pin designation on the two connectors, however, is different. After making a power supply extension cable, be careful to connect the proper end of the cable on the appropriate connector.

Drive J4 09-50-8063 Pin	Function		Artesyn P2 09-50-3061 Pin
1	+24 Volts	RED	3
2			
3	Chassis Ground		
4	Chassis Ground		
5			
6	24 Volt Return	BLACK	1

2.3.3. Board 9990269 Revision D

Rev 'D' board was put into manufacturing in March of 2008.

In this revision, some communications circuitry was deleted. The drivers that were deleted were originally intended for a serial communications feature. That feature was never implemented because the existing processor doesn't have enough available RAM to support it.

The other change that was implemented in Rev 'D' relates to the wiring of P1, the Host connector. In Rev 'D', the last (6) pins of this connector were redefined to allow the 24 volt supply to be provided via this connector instead by J4.

2.4. Diagnostics LED's

There are nine LED's located along the top edge of the printed circuit board which can be used for diagnostics purposes. The green LED indicates the status of the power supply, while the eight yellow LED's indicate the status of various outputs.

The following table lists the function of the LED's:

LED	Color	Name	Behavior
D1	Amber	BIC Relay	On when load limit reached.
D2	Amber	BOC Relay	On when unload limit reached.
D3	Amber	not used	
D4	Amber	*Load* Led	On when loading.
D5	Amber	*Unload* Led	On when unloading.
D6	Amber	*Stop* Led	Flashing when stopped.
D7	Amber	Buzzer	
D8	Amber	Spare Output	Could be defined in software to control an auxiliary output (ex: purge valve)
D9	Green	5 Volt Supply	Omitted on newer boards.
D10	Green	24Volt Supply	

2.5. Calibration

Other than the tachometer calibration discussed above, there is only one calibration potentiometer (POT4). This factory-set potentiometer is used to adjust the reference voltage for the A/D converter and must not be changed.

If the pot becomes inadvertently misadjusted, connect the Black lead of a DVM to P5, Pin 15, and the Red lead to P5, Pin 17. Adjust POT4 for a reading of 2.55 Volts DC.

3. OPERATION

When the **Model 822 Drive Controller** is powered-up, a software module performs several internal tests on ROM, RAM etc. Should any of these tests fail, operation of the drive is inhibited and, when possible, the red LED and the buzzer on the Remote Panel flash.

4. THEORY OF OPERATION

4.1. Pulse Width Modulation

The **Model 822 Drive Controller** produces a motor drive signal using a Pulse Width Modulation technique. With PWM, the DC motor is driven with a series of pulses at a fixed high frequency and constant amplitude. Varying the width of each pulse controls the amount of energy directed to the motor. Due to the constant high amplitude of the pulses, high torque is available at lower rotational speeds than would be available with analog drive techniques. In addition, the amount of energy directed to the motor can be repeatable and controlled precisely.

4.2. Brake

When mechanically over-driven, a DC motor, such as the one often used in a cantilever drive, becomes a DC voltage generator. If an electrical load or a short-circuit is placed across a generator's leads, motion is resisted or inhibited. Motion can be stopped very abruptly when desired by shorting the leads of the cantilever drive motor. Once motion is stopped, releasing the brake (or short-circuit) permits the drive to be physically moved with less resistance.

In the **Model 822 Drive Controller**, the behavior of the electronic brake is controlled by software. In the default configuration, the brake is asserted at either LOAD or UNLOAD end-of-travel.

4.3. Host Interface

4.3.1. Host-to-Drive

4.3.1.1. Digital Commands

Using two digital signals, the host may select a LOAD mode or an UNLOAD mode.

To select the normal LOAD recipe, the host asserts the LOAD input. To select the normal UNLOAD recipe, the host asserts the UNLOAD input. Whether these functions are true when energized or true when not energized is selected by dipswitch SW1.3 (see *DIP Switch Options*, page 15).

4.3.1.2. Analog Speed Control

When the remote analog speed option is enabled, the **Model 822 Drive Controller** detects the presence of a control voltage on its analog input. When the control voltage is present and the LOCAL/REMOTE switch is in the REMOTE position, speed is determined by the voltage level.

4.3.2. Drive-to-Host

The **Model 822 Drive Controller** generates two signals for use by the host:

- The BOAT IN COMPLETE (BIC) signal is active when the drive mechanism has completed motion in the LOAD direction.
- The BOAT OUT COMPLETE (BOC) signal is active when the drive mechanism has completed motion in the UNLOAD direction.

4.4. Limit Switches

The **Model 822 Drive Controller** software supports up to two limits switches at each end of travel. Though variations may be supported upon request, the standard software assumes that normally-closed sensors will be implemented. Normally-closed sensors, those that open at end-of-travel, insure that the software will be able to detect a loose or missing limit switch connector.

The four limit switches are referred to as:
      Unload Over-Travel
      Unload Approach
      Load Over-Travel
      Load Approach

The end-of-travel sensors used with the **Model 822 Drive Controller** may be mechanical switches or photo sensors depending on the application. Photo sensors, where used, are the infrared transmissive type. The sensors have a built-in amplifier, a Schmitt trigger and an output driver transistor that switches to ground when infrared light is present.

In some applications where the **Model 822 Drive Controller** is used with another manufacturer's drive, the limit switches on the drive may have been pre-wired as follows:
- In the LOAD direction, a signal is generated at end-of-travel.
- In the UNLOAD direction, a unique signal is generated **near** end-of-travel.

In this situation, the two extreme end-of-travel sensors (which are wired in series) are used as the LOAD end-of-travel signal. If not handled properly, this apparently conflicting information might cause the drive controller to ignore all LOAD and/or UNLOAD commands whenever the drive is at the extreme unload end-of-travel position. This is due to the fact that both LOAD and UNLOAD sensors would be activated at the same time. When the software in the drive controller, senses this situation, it ignores the LOAD end-of-travel signal and assumes that the carriage is at the UNLOAD end-of-travel position.

4.5. DIP Switch Options

Eight dipswitches provide user control over several software options. Each dipswitch has two positions labeled either OFF / ON or OPEN / CLOSED depending on the manufacturer of the switch. The software responds to the switches as follows:

SW1.1	OFF (OPEN)	Disable Remote Analog Setpoints
	ON (CLOSED)	Enable Remote Analog Setpoints
SW1.2	OFF (OPEN)	Host commands to drive are active when energized
	ON (CLOSED)	Host commands are active when un-energized
SW1.3	OFF (OPEN)	Disable Tachometer Input
	ON (CLOSED)	Enable Closed-loop speed control using Tachometer
SW1.4	OFF (OPEN)	Present actual status of limit switches on BIC/BOC outputs
	ON (CLOSED)	Enable special BIC/BOC mode (for use with Tymkon's)
SW1.5	OFF (OPEN)	Scale speed setpoints by a factor of 2
	ON (CLOSED)	Do not scale speed setpoint
SW1.6	OFF (OPEN)	Scale speed setpoints by an additional factor of 2
	ON (CLOSED)	Do not scale speed setpoint
SW1.7	OFF (OPEN)	Enable Thumbwheel Speed Select
	ON (CLOSED)	Enable Potentiometer Speed Select
SW1.8	OFF (OPEN)	Universal LCD Display Mode
	ON (CLOSED)	Display Analog Inputs on LCD

5. SPECIFICATIONS

The specifications listed below relate to the requirements and capabilities of the electronics enclosures only. The requirements and specifications of any actuators and/or sensors must be considered separately.

5.1. Microprocessor

Microprocessor:	8 bit, CMOS, Motorola MC68HC705B5B.
EPROM:	7 kilobyte x 8 bit, CMOS, One-Time-Programmable.
Crystal:	4 MHz.

5.2. Power Requirements

Voltage:	24 Volts DC
Current:	maximum 1 amp; fused internally at 4 amps.
Power:	50 watts maximum.

5.3. Pneumatic Requirements

None

5.4. Inputs from Host, Digital

Quantity:	(2)
Trigger:	1 mA @ 5 to 36 vdc (12 volts when using internal isolated power supply), edge or level sensitive as determined by software.

> Note: These inputs use high-gain opto-isolators to permit triggering on CMOS host signals and may trigger on leakage currents as low as 50 microamps.

Timing:	Signals must be present greater than 0.1 seconds to guarantee detection.

5.5. Input from Host, Analog (optional)

Quantity:	(1)
Voltage:	0 to +5 volts DC or 0 to +10 volts DC
Current:	0.1 milliamp maximum.

5.6. Outputs to Host, Digital

Quantity:	(2)
Type:	Relay Contacts.
Voltage:	30 volts maximum, AC or DC.
Current:	1 amp maximum.

5.7. Physical

Weight: Less than 1 pound.