H3411

Electric Cylinder Control Operator's Manual

Industrial Devices Corporation • 64 Digital Drive • Novato, CA 94949

OPERATORS MANUAL

H3411 ELECTRIC CYLINDER DRIVE and CONTROL

INDUSTRIAL DEVICES CORPORATION

JANUARY 21, 1990

REV. E

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Preface

This manual is divided into 5 chapters. Chapter 1 gives a quick overview describing how the control is normally operated. Chapter 2 lists the specifications. Chapter 3 describes how to hook up the power and initially get the cylinder to run. This is helpful for first time users because it describes the way the control is normally operated. Chapter 4 goes into detail on each input, output and discusses general features of the control.

Once you are familiar with the way the control is operated, all you need is the "Quick Reference Guide" to be able to set up most applications. This sheet is not bound and is intended to be stored with the control. If more detail is needed on a particular function, refer to Chapter 4.

Chapter 1

Introduction

1.1 Description

An H3411 DC Motor Control provides all the power, logic and solid state switching functions required to drive an Industrial Devices H-Series electric cylinder. This control provides motor direction switching with plug reversing, automatic overload protection, dynamic braking, variable speed, timer, programmable dip switches, and LED display.

The H3411 Drive amplifier is a 20Khz pulse width modulated DC motor amplifier. The drive uses MOSFET technology to give high performance in a small package while giving the user short circuit protection, over temperature protection and a built in power supply.

The H3411 requires no external power supply: it uses 120 VAC directly for its power inputs. It will drive DC brushed motors up to three amps continuous and seven amps peak at 170 VDC.

1.2 Mode of Operation

The H3411 is most often operated by mounting normally open type position sensors, sometimes referred to as limit switches, on the H series actuator and commanding the control to move the cylinder until a position sensor is triggered. At this time the control either stops the motor, reverses direction, or turns on a holding current to provide a continuous torque against some mechanical stop.

There are eight position sensor inputs, each triggering a different type of function. multiple position sensors can be wired in parallel to perform the same function at different points along the stroke.

The H3411 can be operated in a RUN or JOG mode.

1.3 Warranty and Repairs

The H3411 is warranted against manufacturing defects for one year from the date of purchase. Should you have questions about operating the unit, your local Industrial Devices representatives, or distributors are ready to support

your individual needs. Call Industrial Devices at the number below to get the name and number of the representative or field engineer nearest you.

In the event of drive failure you should:

1. Get the serial number of the defective unit.
2. If the unit is out of warranty you should also prepare a purchase order for the repair costs.
3. Call Industrial Devices for a return authorization number. Call (415) 883-3535.
4. Ship the unit to:

Industrial Devices Corp.
64 Digital Drive
Novato, CA 94949

Attn: RMA# _____

1.4 Unpacking

Unpack the H3411 and inspect it for obvious damage. Report any damage to the shipper. It is up to the shipper to provide restitution for the shipping damage.

Chapter 2

Specifications

2.1 Mechanical

Dimensions	Chassis w/o Cover	Chassis w/Cover	Mounting*
Length (inches)	10.16	10.16	9.75
Width (inches)	4.9	5.0	3.30
Height (inches)	5.83	5.85	

*See Appendix E

2.2 Electrical

Input Power:

DRIVE POWER* (power terminal strip, terminals 6 and 7):
20 - 132 VAC, 50/60 Hz, 10A Max.
28 - 170 VDC, 10A Max.

LOGIC POWER: (power terminal strip, terminals 8 and 9):
101 - 132 VAC, 50/60 Hz, .25A Max.
(logic terminal strip, terminals 21 and 22):
10 - 20 VDC, .5A Max.

CAUTION:

*MOTOR MUST BE COMPATIBLE WITH APPLIED DRIVE VOLTAGE. CONTACT THE FACTORY IF YOU ARE USING A MOTOR OTHER THAN THE FACTORY SUPPLIED MOTOR.

2.3 Environmental

Temperature
Drive: 132°F (55°C) maximum ambient

Motor - H Series: 180°F (82°C) maximum allowable motor case temperature. Actual temperature rise is duty cycle dependent. If the motor temperature is near or exceeds 180°F (82°C), you must lower the duty cycle or apply a fan to cool the motor.

REMOTE SPEED INPUT (for remote speed control)

Voltage range (10 volts for max speed) 0 - 10 VDC @ 1 ma.

RELAY 1 & 2 OUTPUTS

Relay contacts, SPDT (common, normally open and closed contacts supplied)

Contact rating

Max. switched power:	100 W or 600 VA
Max. switched current:	2 AMPS @ 30 VDC RESISTIVE
	2 AMPS @ 125 VAC RESISTIVE
Max. switch voltage:	150 VDC or VDC

OUT1, OUT2, OUT3, OUT4, OUT5, OUT6, OUT7, OUT8

Open collector sinking transistors with 10K pull up to logic input voltage from terminal 21 (10 - 20 VDC):

Max high level output voltage (output off)	35 VDC
High level output voltage open circuited	10 - 20 VDC
Low level, current sinking (output on)	.7 VDC Typ
Max low-level output current (output on)	250ma @ 1.6 VDC

2.5 Input Switching

EXTEND, RETRACT STOP, RESET, TRIGGER# 1, TRIGGER# 2, PS1-PS8

Low level pulse width (latched input)	50 ms Min.
Time delay between inputs (time to go from extend to retract or vice versa)	0 sec Min.

2.4 Discrete I/O

EXTEND, RETRACT, STOP, TRIGGER# 1, TRIGGER# 2, JOG/RUN, RESET
Optically isolated, jumper selectable for remote AC or DC power. Each input has a plus and minus terminal. With no power applied the input is off.

When using 90 to 130 VAC to activate an input, connect the corresponding jumper across the two posts labeled AC (i.e. 7AC for input# 7, EXTEND), then connect the pair of wires to the plus and minus terminals. Switch the AC voltage to either terminal to activate the input.

When using 10 to 30 VDC to activate an input, connect the corresponding jumper across the two posts labeled DC (i.e. 7DC for Input# 7, EXTEND), then connect the pair of wires to the plus and minus terminals. Switch the DC voltage to either terminal to activate the input.

NOTE: 14 VDC IS AVAILABLE ON TERMINAL #21 WHICH MAY BE USED WITH THE INPUT JUMPERED FOR 10-30 VDC. THE GROUND TERMINALS ARE 22, 20 AND 1.

WARNING! WARNING! WARNING!
CONNECT THE JUMPER TO ONLY ONE OF THE FOLLOWING POSSIBLE POSITIONS PER INPUT (i.e. for input# 7, EXTEND, connect a jumper only to 7AC or 7DC).

NOTE:
EACH INPUT IS PREJUMPERED FROM THE FACTORY SET FOR "DC" to INTERFACE CALLS FOR 10 TO 30 VDC. IF THE INTERFACE CALLS FOR 90 TO 130 VAC, REMOVE THE JUMPER AND POSITION IT IN THE "AC" POSITION.

Jumper selected for external AC voltage
Isolation voltage range 90 - 130 VAC @ 20 ma.

Jumper selected for external low voltage DC (sourced or sinking)
Isolation voltage range 10 - 30 VDC @ 20 ma.

Opto 1
Optically isolated voltage source for PS1 - PS8. Remove jumper W9 if this input voltage is used.
Isolation voltage range. 10 - 20 VDC @ 200 ma.

PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8
Optically isolated for low voltage DC. Normally "high" or OFF. Requires closed contact to ground to bring "low" or turn ON.

Isolation voltage range 10 - 30 VDC @ 20 ma.
High-level, open circuited 10 - 30 VDC Typ.

Chapter 3

Installation and Setup

3.1 Applying Power

Hook up AC power on the power terminal strip on terminals 5, 6 and 7. Terminal 7 is for the line voltage, terminal 6 is for the neutral and terminal 5 is for earth ground. See wiring drawing (Figure 3-1).

CAUTION! CAUTION! CAUTION!
TURN POWER OFF before wiring motor. Lethal voltages are present inside and on the screw terminals.

WARNING! WARNING! WARNING!
Input power is limited to 132 VAC. Higher voltages may damage drive.

Hook up the motor to the power terminal strip on terminals 1, 2 and 5. Terminal 1 is "MOTOR - ", black motor lead; terminal 2 is "MOTOR + ", red motor lead; terminal 5 is earth ground, green lead. The green lead MUST be connected so the body of the motor is grounded.

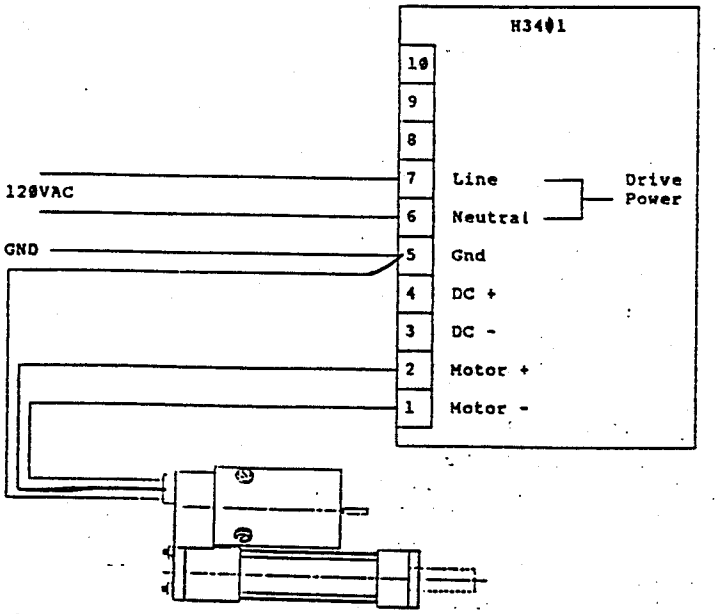

Figure 3.1: Drive Power Wiring Diagram

3.1.1 Alternate Motor Power - Transformer Isolation

The motor power is taken directly from the AC line but the logic power is derived by a step down transformer/power supply which provides an isolated 15 VDC (unregulated). Provisions were made so the customer can add an external transformer to provide motor isolation and/or a lower voltage source for lower no-load motor speed.

The control is shipped from the factory prewired with jumpers between terminals 6 and 8 and terminals 7 and 9. Terminals 8 and 9 are the AC power input for the logic boards. **DO NOT REMOVE THESE JUMPERS** unless the motor is to be powered by a lower AC voltage source (for example when using a transformer to step the voltage down). The logic power requires 95 - 132 VAC.

If the motor power is not 95 - 132 VAC then remove the jumpers between terminals 6 and 8 and terminals 7 and 9 and connect the line voltage to terminal 9 and the neutral to terminal 8. Then connect the lower AC voltage to terminals 6 and 7.

3.2 Checkout - Getting Started

1. MOUNT END-OF-TRAVEL LIMIT SWITCHES:
Once the power and motor are wired, the control is ready to run. However, to ensure a safe start it is advised that End-Of-Travel limit switches be installed on each end of the actuator. This is to prevent the cylinder form making a high speed/high power crash at its end, possibly damaging the cylinder. Wire the extend end-of-travel limit switch to the logic terminal strip pins 1 (ground) and 15 (PS5) and wire the retract end-of-travel limit switch to pins 1 (ground) and 14 (PS6). See Figure 3-2.

NOTE:

Mount position sensors on the right side of the actuator, or 3 o'clock position, when viewing the actuator from the back of the motor housing and the motor is facing up at 12 o'clock.

2. TURN OFF DIP SWITCHES
All dip switches should be in their off position. The off position is the normal state which sets the control for RUN mode and the LED diagnostics to display the output status.

3. SET POTENTIOMETERS
Begin by setting all the potentiometers in their full clockwise position. Then rotate the speed potentiometers, E1 and R1, back to near full counterclockwise for minimum speed. The full clockwise position will set the actuator at full speed. Next, rotate the current sense potentiometer, CUR SENSE, back to about one half way to limit the over current cutoff level. If the

speed potentiometers are set at full counterclockwise the actuators may not move due to too low a speed setting. Increase the speed to operate safely for this initial test.

4. ACTIVATE EXTEND INPUT (INPUT# 7)
To start the cylinder activate the extend input, INPUT# 7, on terminals 41 (INPUT# 7 +) and 42 (INPUT# 7 -). First check the position of the jumper for INPUT# 7 in the middle of the top board. If the jumper is in position "7DC" then the input requires an external 10 - 30 VDC across the two terminals to activate. If the jumper is in position "7AC" then the input requires 90 - 140 VAC across the two terminals to activate.

Activation of the extend input will cause the cylinder to extend until it is told to stop (RUN MODE). The cylinder will stop when it comes in contact with the extend end-of-travel limit switch. Activate the retract input, INPUT# 6, on terminal 39 (INPUT# 6 +) and 40 (INPUT# 6 -). (Check the position of the jumper for INPUT# 6 and position it in the appropriate position, 6AC, 6DC, or 6V, as you did for INPUT# 7.) The cylinder will retract until it is stopped by the retract end-of-travel.

EXAMPLE 1: STOP MID-STROKE IN ONE DIRECTION ONLY
Assume you want to do the following: Extend the cylinder to mid stroke and stop. Then, restart in the extend direction and run the cylinder to the extend end and stop. The restart the cylinder in the retract direction and go back to the first position (retract end-of-travel) without stopping in the center. Let us also assume you are using a contact closure, for example a pushbutton, to start the control in each the extend and retract directions.

1. First, set-up the extend and retract inputs for using the on-board power supply and thus not requiring an external voltage source to activate the inputs. This requires that you position a jumper in location 6DC and 7DC. (That means no jumper will be in location 6AC and no jumper in location 7AC)

2. Mount the end-of-travel limit switches and wire them as described above. Mount the center position sensor and wire one side of the contact to the PS1 input, terminal 19, and wire the other side of the contact to OUT# 1, Extend Direction Output, terminal 11. Extend Direction Output is a NPN open collector sinking transistor which is theoretically a ground output only when the control is in the extend direction. When PS1 is grounded it causes the cylinder to stop. By wiring the position sensor to PS1 and to the Extend Direction Output, the ground is only present when the cylinder is moving in the extend direction. When moving in the retract direction, PS1 will not be grounded which appears as if the position sensor is not there.

3. Connect your extend pushbutton between terminals 44 (ground) and 42 (extend input "-") and the retract pushbutton between terminals 44 (ground) and 40 (retract input "-").

4. Close the contacts on the extend input pushbutton and the cylinder extends to the mid-position sensor wired to PS1 and stops. Press the extend pushbutton again and the cylinder extends to the extend end-of-travel limit switch. If you press the extend pushbutton again the cylinder will not move. The extend end-of-travel limit switch, PS5, triggered the control not to allow another extension. Pressing the retract pushbutton retracts the cylinder to the retract end-of-travel limit switch without stopping in mid-stroke.

5. If you vary the E1 potentiometer and R1 potentiometer, the extend and retract speeds will vary accordingly.

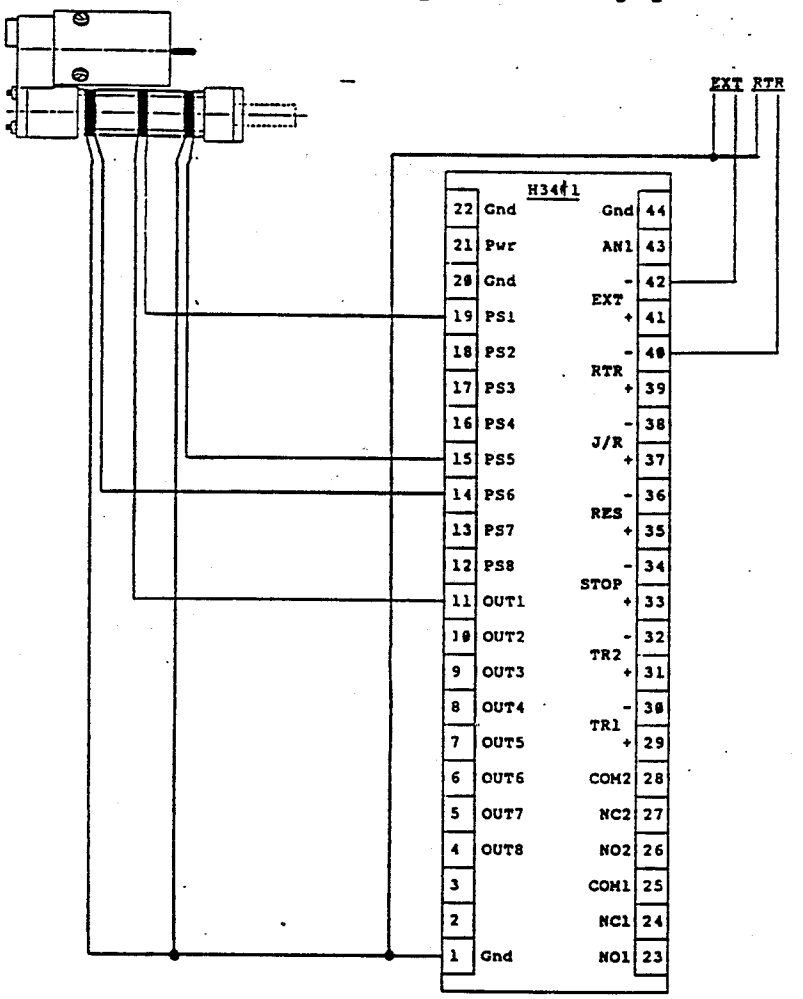

Figure 3.2: Position Sensor Wiring Diagram

Chapter 4

Detailed Operating Definition

4.1 Inputs

There are two types of inputs; one is for remote operation command signals and the other for monitoring position sensors.

4.1.1 Remote Inputs

Remote inputs (terminals 29 through 42) refer to the 7 inputs on the top board. These inputs are optoisolated for either 10 - 30 VDC ("DC") or 90 - 130 VAC ("AC") each of which is jumper selectable. Each input has a plus and minus terminal which enable them to be used with either sinking or sourcing drivers. When using 90 to 130 VAC to activate an input, connect the corresponding jumper across the two posts labeled AC (i.e. 7AC for Input# 7, EXTEND), then connect the pair of wires to the plus and minus terminals. Switch the AC voltage on at either terminal to activate the input.

When using 10 to 30 VDC to activate an input, connect the corresponding jumper across the two posts labeled DC (i.e. 7DC for Input#7, EXTEND). When sourcing the voltage to activate the input, connect the minus terminal to the external power source ground and switch the positive voltage at the plus terminal. To activate the input by sinking, connect the plus terminal to the external power source positive voltage and switch the minus terminal to the external power source ground.

WARNING! WARNING! WARNING!
CONNECT THE JUMPER TO ONLY ONE OF THE TWO POSSIBLE POSITIONS PER INPUT (i.e. for Input# 7, EXTEND, connect a jumper only on one of the following: 7AC OR 7DC).

NOTE:
EACH INPUT IS PREJUMPERED FROM THE FACTORY SET FOR FOR 10 TO 30 VDC. IF THE INTERFACE CALLS FOR 90 TO 130 VAC REMOVE THE JUMPER AND POSITION IT IN THE "AC" POSITION.

EXTEND INPUT: (Input# 7, terminals 41 "+" and 42 "-")
Activation causes cylinder to extend. In the run mode it continues to extend until it receives a new signal or is stopped by a position sensor input. In the jog mode the cylinder moves only while the input is activated. The cylinder is also stopped

in the jog mode by activating a position sensor or current overload.

RETRACT INPUT: (INPUT# 6, terminals 39 "+" and 40 "-")
Activation causes cylinder to retract. In the run mode it continues to retract until it receives a new signal or is stopped by a position sensor input. In the jog mode the cylinder moves only while the input is activated. The cylinder is also stopped in the jog mode by activating a position sensor or current overload.

The extend input (INPUT# 7) or the retract input (INPUT# 6) are the only inputs which are enabled once the cylinder is stopped. After the cylinder is moving, all other inputs are valid. For example, following power-up or activating the Emergency Stop (INPUT# 3), position sensor input PS3, one-shot extend, will not start the cylinder in motion. But, after having begun motion by the extend or retract inputs, PS3 will command an auto extend.

EMERGENCY STOP: (INPUT# 3, terminals 33 "+" and 32 "-")
Activation causes an immediate stop without deceleration. The control will not accept another signal to begin motion while this condition is maintained.

RESET - FAULT: (INPUT# 4, terminals 35 "+" and 36 "-")
Activation causes the motor to stop if moving and resets any faults if present. A fault may be one of the following: short circuit on drive; over-temperature on drive; or activating both end-of-travel limit switches, thus disabling both directions form accepting an input. Once a fault has occurred, the control is disabled and requires resetting before any further motion is allowed.

TRIGGER #1: (INPUT# 1, terminals 29 "+" and 30 "-")
Activating this input causes a one-shot stop if the cylinder is in motion. A one-shot stop means the input causes a stop when it is first activated and is ignored if it is maintained.

If dip switch SW-B#5 is off when this input is activated the cylinder will decelerate to the stop at the rate set on the ACCEL/DECEL potentiometer (clockwise rotation sets maximum acceleration/deceleration time). If dip switch SW-B#5 is on then the cylinder will brake to a stop as fast as possible ignoring the setting on the ACCEL/DECEL potentiometer.

This input operates the same as PS1. The difference is that this input can be activated by various types of interfaces as described above. This input does not respond as fast as PS1 and therefore may not position with the same repeatability when the cylinder is moving at speed above 2 inches per second.

<u>Toggle Speed SW-B#8 on</u>
Activating Trigger #1 as a second speed input causes a change in speed to a different potentiometer setting. The cylinder starts

its motion in what we call first speed and is switched to second speed upon activation of this input or input PS7. Activating the input toggles the speed control to the other speed potentiometer. The cylinder accelerates or decelerates to the other speed and remains in this speed until it is stopped or this input is activated again. Upon reactivation, the cylinder's speed is the same as it was formerly.

There are three speed pots, E1, R1, and E2/R2. Dip switch SW-A#8 selects whether E1 or R1 will be the first speed pot or the E2/R2 pot will be used as first speed.

Normally input PS7 is used as the primary second speed input. But when using as external relay to control the second speed input, the preferred method is to use Trigger #1. The Trigger input are more immune to relay contact bounce that the PS1-PS7 inputs.

TRIGGER #2: (INPUT# 2, terminals 31 "+" and 32 "-")
Activating this input causes a one-shot stop if the cylinder is in motion. A one-shot stop means the input causes a stop when it is first activated and is ignored if it is maintained.

If dip switch SW-B#4 is off, then activation of this input stops the cylinder. If dip switch SW-B#4 is on, then activation of this input causes the motor to switch to the torque mode set by the holding current potentiometer.

JOG/RUN: (INPUT# 5, terminals 37 "+" and 38 "-")
This input allows for remote selection of JOG/RUN modes. Activating the input toggles the state of the JOG/RUN dip switch on the top board, SW-B#2. In other words, if the dip switch is set for the JOG mode, activating the input causes the RUN mode to be active and vice versa.

4.1.2 Position Sensor Inputs

Position sensor inputs are located on the bottom board. These inputs are activated by sinking them to logic ground. This can be accomplished by a contact closure (relay or reed switch) or NPN open collector sinking transistor. The inputs are optoisolated by removing jumper W9 and supplying an external power supply between 10 and 20 VDC to terminal 21. With jumper W9 connected, the inputs use the on board power supply. The board comes with W9 connected. DO NOT connect an AC voltage source to these inputs. All eight of these inputs are interrupt driven for maximum response time.

W9 jumper is located directly behind terminals 21 and 22. There are two gold posts sticking up and a jumper across them. To use an external isolated power source, remove this jumper. Connect the positive side of the power to terminal 21.

CAUTION:

If W9 jumper is removed and an external voltage is not supplied to the OPTO input on terminal 21, the position sensors will not operate.

PS1: One-Shot Stop (terminal 19)
Grounding this input causes a one-shot stop if the cylinder is in motion. A one-shot stop means the input causes a stop when it is first activated and is ignored if it is maintained.

If dip switch SW-B#5 is off when this input is activated, the cylinder will decel to the stop at the rate set on the ACCEL/DECEL potentiometer (clockwise rotation sets maximum acceleration/deceleration time). If dip switch SW-B#5 is on, then the cylinder will brake to a stop as fast as possible, ignoring the setting on the ACCEL/DECEL potentiometer.

This input operates the same as Trigger 1, but responds faster because it is interrupt driven. PS1 input is intended to be used with normally open contact type position sensors, whereas Trigger 1 is intended to be used by some remote sensor or programmable controller I/O.

PS2: One-Shot stop (terminal 18)
Grounding this input causes a one-shot stop if the cylinder is in motion. A one-shot stop means the input causes a stop when it is first activated and is ignored if it is maintained. If dip switch SW-B#4 is off, then activation of this input stops the cylinder. if dip switch SW-B#4 is on, then activation of this input causes the motor to switch to the torque mode set by the holding current potentiometer instead of stopping.

The torque mode refers to the fact the motor now has a maximum available torque limited by the current applied. The current is set by adjusting the holding current potentiometer. If the load is greater than the available current, the motor will stall but will still apply the given torque. If the load is removed, the cylinder will start moving again.

The torque mode is reset by: activating PS1, PS5 or PS6; changing direction by PS3 or PS4; activating the extend or retract inputs; or by activating the Emergency Stop input.

PS3: One-Shot Extend (terminal 17)
Activation of this input causes a one-shot extend command. A one-shot extend means the cylinder will accelerate to the extend speed upon activation and is ignored if it is left maintained. If the cylinder is already extending, it is ignored if activated. If the cylinder is retracting, it decelerates to a stop and accelerates to first speed in the extend direction. This input is only enabled while the cylinder is in motion or during time delay.

PS4: One-Shot Retract (terminal 16)
Same as PS3 but in the retract direction.

PS5: Extend End Of Travel (terminal 15)
Activation of this input while extending causes an immediate stop. No further command will start the cylinder in the extend direction.

PS6: Retract End Of Travel (terminal 14)
Same as PS5 but in the retract direction.

PS7: Toggle Speed (terminal 14)
The cylinder starts its motion in what we call first speed and is switched to second speed upon activation of PS7. Second speed refers to a change in speed to a different potentiometer setting. Activation of this input toggles the speed control to the other speed potentiometer. The cylinder accelerates or decelerates to the other speed and remains in this speed until it is stopped or this input is activated again. Upon reactivation, the cylinder's speed is the same as it was formerly.

There are three speed pots, E1, R1, and E2/R2. Dip switch SW-A#3 selects whether E1 or R1 will be the first speed pot or the E2/R2 pot will be used as first speed.

E1 is the speed set for traveling in the extend direction and R1 is the speed in the retract direction. E2/R2 is the same setting for both direction, yet, the cylinder may move at different speeds in each direction due to differences in load unique to that direction.

PS8: Time Delay Input Trigger (terminal 12)
Grounding this input starts the timer if dip switch SW-T #3, 4, and 5 are set as defined in Appendix C, Table C. See Section 4.6.

4.2 Outputs

There are two types of outputs. One type is a relay output to enable remote wiring of AC signals and the other type uses NPN open collector transistors pulled up to approximately 12

4.2.1 Remote Output Relays

Remote outputs refer to the two relay outputs on the top board. Each output consists of a common post, normally open contact, and normally closed contact. The relay contacts are rated for:

Max. switched power: 100W or 600 VA
3 amps @ 30 VDC or 125 VAC resistive
2 amps @ 125 VAC inductive
2.5 amps @ 250 VAC resistive

With power off, the contacts are in the normally closed position. When the power is turned on, the relays stay in the normally closed position until one of the trigger conditions occur. When the relay is off the normally closed contact is shorted to the common post. When the relay is turned on the normally open contact is shorted to the common post.

There are two relay outputs. Relay #1 references occurrences in the extend direction and Relay #2 the retract direction. Each output is selected to turn on following one of four trigger conditions set by switching the appropriate dip switch on SW-A:

Dip Switch Sw-A (located on lower board)

5 6 7 8	Relay #1 Extend direction Relay #2 Retract direction
OFF OFF	Condition 1: Relay on during any motion regardless of direction. (Break mode)
OFF ON	Condition 2: Relay on when stopped by PS1 in the particular direction. (or TR1)
OFF ON	Condition 3: Relay on when stopped by current sens overload in the particular direction.
ON ON	Condition 4: Relay on when stopped by end of travel limit switch in the particular

Relay 1: Extend Direction Relay (terminals 23, 24, and 25)
This relay turns on following occurrence of one of four trigger conditions while the cylinder is moving in the extend direction, as selected by dip switches SW-A#5 and SW-A#6. If condition 1 is set, the relay turns on whenever the cylinder is moving, regardless of direction. This mode is used to disable a brake

that holds position while the cylinder is stopped or during loss of power. The brake should be a Fail/Safe style, electrically off; braking action occurs when coil is de-energized, or power fails.

If condition 2, 3 or 4 is set, the relay turns on only after the cylinder is stopped by the defined condition, provided the cylinder was previously moving in the extend direction. The relay stays on as long as the cylinder remains stopped. Once motion resumes in either direction, the relay switches off. Relay off refers to the normally closed contact (terminal 24) shorted to the common post (terminal 25). Relay on refers to the normally open contact (terminal 23) shorted to the common post (terminal 25).

Relay 2: Retract Direction Relay (terminals 26, 27 and 28)
This relay turns on following occurrence of one of four trigger conditions as selected by dip switches SW-A#7 and SW-A#8 while the cylinder is moving in the retract direction. If condition 1 is set, the relay turns on whenever the cylinder is moving regardless of direction. This mode is used to disable a brake that holds position while the cylinder is stopped or during loss of power. The brake should be a Fail/Safe style, electrically off; braking action occurs when coil is de-energized or power fails.

If condition 2, 3 or 4 is set, the relay turns on only after the cylinder is stopped by the defined condition, provided the cylinder was previously moving in the retract direction. The relay stays on as long as the cylinder remains stopped. Once motion resumes in either direction, the relay switches off. Relay off refers to the normally closed contact (terminal 27) shorted to the common post (terminal 28). Relay on refers to the normally open contact (terminal 26) shorted to the common post (terminal 28).

CAUTION:

Arcing may occur across the relay contacts when switching inductive loads, especially when using a DC voltage source. This may result in enough electrical noise to cause the on-board microprocessor to stop functioning properly. To avoid this situation, some sort of transient surge suppressor must be connected across the inductor. Contact Industrial Devices Corp. if you need help in this regard.

4.2.2 Output Reference Signals

There are eight output reference signals. These outputs are typically used in conjunction with the eight position sensor inputs. For example, connecting a wire from a reference output back to one of the position sensor inputs can cause an automatic operation to occur.

ach reference output is an NPN open collector sinking transistor apable of sinking .25 amps and switching up to 30 VDC. The utputs are pulled up to the logic power input voltage (typically 2 VDC) by a 10K ohm resistor.

utl: Extend Direction Common (terminal 11)
his output is switched to ground whenever the cylinder is ommanded to go in the extend direction. It is turned off (pulled p to logic power input voltage) once a retract command is given. his output is typically used for wiring position sensors that re to be enabled only in the extend direction. So, instead of iring a position sensor to one of the eight position sensor nputs and ground, wire the ground side to this terminal.

ut2: Retract Direction Common (terminal 10)
ame as Outl except in the retract direction.

ut3: Stopped On PS1 In The Extend Direction (terminal 9) or TR1.
his output is switched to ground if PS1 input is grounded while raveling in the extend direction. The output stays at ground otential as long as the cylinder is stopped. As soon as motion esumes, the output turns off (pulled up to power input voltage).

ut4: Stopped on PS1 In The Retract Direction (terminal 8) or TR1.
ame as Out3 in the retract direction.

ut5: Stopped On PS2 In Either Direction (terminal 7) or TR2.
his output is switched to ground if PS2 input is grounded. The utput stays at ground potential as long as the cylinder is topped. As soon as motion resumes, the output turns off (pulled p to logic power input voltage).

ut6: Timer Output Pulse (terminal 6)
his output is switched to ground for timer functions. If dip witch SW-T#6 is off, the output is grounded for .25 seconds ollowing the time delay period. If SW-T#6 is on, the output is rounded during the time delay period.

ıt7: Extend Current Overload/Extend End Of Travel (terminal 5)
f dip switch SW-B#6 is on, this output is switched to ground ıly following a current overload in the extend direction. If ip switch SW-B#6 is off this output is switched to ground only f the extend end of travel limit switch, PS5, is grounded while ıe cylinder is extending.

ıt8: Retract Current Overload/Extend End Of Travel (terminal 4)
ıme as Out7 except in the retract direction.

4.3 Dip Switch Selectable Functions

Dip switches allow the user to select input or output signals more tailored to their application. There are three sets of dip switches. One is on the bottom board, the UMC31 board, and is identified as SW-A. The other two are on the top board, the IF001 board, and are identified as SW-B and SW-T. The direction for the ON/OFF state of each switch is labeled on the switch itself.

SW-A Dip Switch- Bottom Board

Switch # Hardware Functions

1	2	Set LED Display Status
OFF	OFF	LEDs display output status.
ON	OFF	LEDs display input status.
OFF	ON	LEDs display actual motor current in real time.
ON	ON	LEDs display time period for time delay.

3	Speed Selection
OFF	Speed selection set by Pot #1,2, and 3.
ON	All speed selection set by analog input.

4	Set First Speed
OFF	Speed E1 or R1 is 1st speed, E2/R2 is 2nd speed.
ON	Speed E2/R2 is 1st speed, E1 or R1 is 2nd speed.

5	6	Relay Out#1 - Extend Direction Output.
7	8	Relay Out#2 - Retract Direction Output.
OFF	OFF	Relay on: Due to any motion in either direction.
on	OFF	Relay on: Stopped by PS1 in particular direction
OFF	ON	Relay on: Current sense overload in part dir.
ON	ON	Relay on: End of travel PS in particular dir.

SW-B Dip Switch - Top Board

Switch #		Motion Parameters - top board
1	OFF ON	Stop on current overload. Change to holding current on current overload.
2	OFF ON	Run Mode (Run/Jog state may be reversed by Input#5). Jog Mode.
3	OFF ON	Acceleration with peak current. Acceleration with sense current setting.
4	OFF ON	Stop on PS2. Switch to holding current on PS2 - Torque state.
5	OFF ON	Decel enabled on PS1 and Trigger#1 (Input#1). No decel on PS1 or Trigger#1 (Input#1).
6	ON OFF	OUT7 & OUT8 is grounded only with current overload. OUT7 & OUT8 is grounded only with end of travel PS.
7	OFF ON	One-shot stop on Trigger#2 (Input#2). Switch to holding current on Trigger#2 (Input#2).
8	OFF ON	One-shot stop on Trigger#1 (Input#1). Second speed input.

SW-T Dip Switch

Switch # Timer Functions - top board

2	1	After Time Delay Select Auto Move.
OFF	OFF	No Automatic Move.
OFF	ON	Automatic Extend.
ON	OFF	Automatic Retract.
ON	ON	Alternate Directions (Automatic Return).

5	4	3	Timer Started by One of the Following.
OFF	OFF	OFF	PS8
OFF	OFF	ON	PS1
OFF	ON	OFF	PS2
OFF	ON	ON	Trigger#1
ON	OFF	OFF	Trigger#2
ON	OFF	ON	End of Travel Limit, PS5 or PS6
ON	ON	OFF	Current Overload
ON	ON	ON	PS1 and/or PS8

6	
OFF	After Time Delay, OUT6 Gives Gnd Pulse for .25S.
ON	During Time Delay OUT6 Grounded.

8	7	Timer Direction Enable
OFF	OFF	Timer off.
OFF	ON	Timer on only in extend direction.
ON	OFF	Timer on only in retract direction.
ON	ON	Timer onlin both directions.

4.4 LED Display

here are eight LEDs which display the status of the control. The unction of the display can be selected to display the status of the nputs, the status of various output states, the actual running urrent, or the amount of time set on the time delay potentiometer. et dip switch SW-A#1 and SW-A#2 to select the desired function:

1	2	Set LED Display Status
OFF	OFF	LEDs display output status.
ON	OFF	LEDs display input status.
OFF	ON	LEDs display actual motor current in real time.
ON	ON	LEDs display time period for time delay.

.4.0.1 Output Status

flashing LED is an error message. The error is cleared by ctivating the reset input, INPUT# 4. The messages are defined as ollows:

LED 1	On Flashing	Extend direction mode. Fault: Motion not allowed.
LED 2	On Flashing	Retract direction mode. Fault: Motion not allowed.
LED 3	On	Over current triggered.
LED 4	On	Holding current on.
LED 5	On	Second speed selected.
LED 6	On Flashing	Motor stopped. Emergency stop triggered.
LED 7	On Flashing	"End of Travel" triggered. AM90 Drive fault or reset input on.
LED 8	On Flashing	Time Delay on. Time triggered but not running.

AULT: MOTION NOT ALLOWED: This occurs when a) both the extend and etract inputs are on at the same time, b) an end-of-travel limit has een triggered, thus not allowing motion in the indicated direction or) a current overload has occurred in that direction thus not allowing otion in that direction.

EMERGENCY STOP TRIGGERED: This LED flashes when the emergency stop input is activated. As long as this input is activated, no motion will be allowed.

AM90 DRIVE FAULT OR RESET INPUT ON: If the drive amplifier detects a short circuit or over-temperature condition it cuts itself off and signals the fault condition. Before activating the reset input, check the motor terminals and verify that the motor terminals are not shorted. If the heatsink fins measure near 212°F (100°C), a fan must be installed to cool the drive. It would also be a good idea to check the motor temperature and use a fan to cool it if it measures over 200°F. An alternative is to lower the duty cycle.

TIMER TRIGGERED BUT NOT RUNNING: This situation occurs when a position sensor is used to stop the cylinder and start the timer. The timer does not begin until after the deceleration has finished and the motion has stopped. During the time between when the position sensor was triggered and until motion has stopped, the LED will flash.

4.4.1 Motor Current Status

DISPLAYS ACTUAL MOTOR CURRENT IN REAL TIME
When the display is in this mode the actual running current is displayed. The display shows a bar code reading similar to that of a voltmeter. When there is no motor current, all the LEDs are off. When the motor is drawing 5 amps, all eight LEDs will be lit. A proportion of this current lights a proportion of the LEDs. This is useful when you need to observe the current during acceleration or check the current draw difference from one point in the cycle versus another.

The maximum, or 100%, duty cycle rating for the motor corresponds to about three LEDs on.

4.4.2 Time Delay Period Indicator

Displays the time set on the timer potentiometer in a binary coded format at .1 seconds per bit (0 - 25.5 seconds +/- 4ms). When all the LEDs are off, it indicates the time delay is set for zero seconds. If all eight LEDs are lit, then the time delay period is 25.5 seconds. For example, to program 5 seconds, turn the timer potentiometer until LEDs 6, 5 and 2 are on.

5.0 seconds is 50 binary counts at .1 second/count.

LED BIT:	7	6	5	4	3	2	1	0
binary code:	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
count:	128	64	32	16	8	4	2	1
50 =	0 +	0 +	32 +	16 +	0 +	0 +	2 +	0

4.5 Potentiometer Adjustments

There are eight potentiometers that allow for setting speed, over current level, holding current level, acceleration/deceleration time, time delay and current regulation. The potentiometers are labeled as follows:

```
        E1 POT (R7)  ---EXTEND SPEED 1 -- E1
        R1 POT (R8)  -  RETRACT SPEED 1 -- R1
    E2/R2 POT (R9)   -  SPEED 2 ---------- E2/R2
CEL/DECEL  POT (R10) -  ACCEL/DECEL
 HOLD CUR POT (R11)  -  HOLDING CURRENT - TORQUE STATE
CUR SENSE POT (R12)  -  CURRENT OVERLOAD LIMIT
    TIMER POT (R13)  -  TIME DELAY

          IR POT     -  Current Regulation (located beside
                        terminal 10 of power terminal strip)
```

4.5.1 Speed Setting

There are three potentiometers used to set speeds. Two are speed 1 pots and the other is a speed 2 pot. Setting dip switch SW-A#3 off makes the speed 1 pot setting the first run speed when the cylinder is first set in motion and speed 2 pot the second speed. Setting dip switch SW-A#3 on makes the speed 2 pot the first run speed and the speed 1 pots the second speed. If PS7 is grounded while the cylinder is in motion, the second speed is the new run speed.

Extend Speed 1 pot, E1, only sets the speed while the cylinder is extending. Retract Speed 1 pot, R1, only sets the speed while the cylinder is retracting. The Speed 2 pot, E2/R2, is the same setting for extending and retracting yet, the cylinder may run at different speeds depending upon loading unique to that direction.

Since this control uses open loop speed control, its speed range is limited to 15:1. The reduced speed is accomplished by pulse-width modulation and is regulated by current regulation. There is an IR pot to adjust this regulation if necessary. See section 4.5.5 IR Compensation.

4.5.1.1 External Speed Setting

There is a Ø - 1Ø analog input. It is used for remote speed control. If dip switch SW-A#2 is off, then speed is derived from the three potentiometers. If dip switch SW-A#2 is on then speed in both directions is controlled by this external source. The second speed input, PS7, and the accerlation / deceleration pot are ignored during remote analog speed control.

4.5.2 Acceleration/Deceleration

Pot 4 sets the rate the cylinder accelerates to speed and decelerates to a stop or slower speed. The maximum acceleration or deceleration rate is set with the pot rotated fully clockwise. The minimum rate is dependent upon system inertia and is typically less than 2Ømsec. The same rate is used for acceleration and deceleration, although the deceleration rate may be bypassed by sensing a position sensor which does not use the deceleration rate when stopping. Also, end-of-travel limits, current overload stops, and emergency stops do not use this deceleration rate; they dynamically break to a stop as fast as possible. Acceleration is always used for any increase in speed.

During an acceleration period the current is allowed to go beyond the current overload setting as required by the motor to achieve the given acceleration. This peak current is limited to about .5 seconds. After this time the current overload monitoring is active.

4.5.3 Holding Current and Current Overload

There are two potentiometer adjustments used to set maximum limits on current draw. One sets the current overload limit and the other a current that limits torque.

4.5.3.1 Current Overload - Normal State

The current overload potentiometer, POT 6, sets the maximum current the motor is allowed to use before being classified as an over-current condition. The over-current condition must be present for about one-half second for valid triggering. During an acceleration period the current overload setting is ignored for the one-half second to allow for maximum acceleration. After the acceleration period, current monitoring resumes.

Current overload is monitored to help protect the cylinder and motor from potential damage. It is not intended to protect fragile pieces of equipment from damage. It is always best to stop, whenever possible, on a position sensor instead of using current overload. If current overload stopping is required for positioning accuracy, it is suggested to switch to a slow speed before making the mechanical stop.

If dip switch SW-B#1 is off, then triggering current overload forces the cylinder to an immediate stop. If dip switch SW-B#1 is on, then

triggering current overload switches the motor to a limited torque state (maintains a set maximum current the motor is allowed to use). This is used to hold a constant torque against a mechanical stop.

4.5.3.2 Holding Current - Torque State

The holding current pot, POT 5, sets the current level maximum the motor is allowed to use. This in essence limits the torque of the motor to that equivalent setting.. The holding current range is within 100% operating range of Industrial Device's H series actuator motor. This torque state must be triggered to be active. Triggering is accomplished in one of three ways: 1) setting dip switch SW-B#1 on and current overloading, 2) setting dip switch SW-B#4 on and grounding PS2, and 3) setting dip switch SW-B#7 on and activating trigger #2 input.

4.5.4 Time Delay Adjustment

Adjust the time delay period by turning POT 7. Clockwise rotation increases the time. To calculate the time prior to operation, set the LED display to show a status of the time set (SW-A#1 ON, #2 ON). The display is binary coded for .1 seconds per count. For detail on reading the display see Section 4.4.3 Time Delay Period Indicator.

4.5.5 IR Compensation

The IR Pot is used to regulate slow speed control as a function of motor current. When the motor current goes up, there is a tendency for a DC motor to lose speed (RPM). The IR circuitry enables the control to compensate for this at slow speed settings. The IR pot allows adjustment for the given motor.

This setting is pre-adjusted at the factory; but, if the actuator is losing speed at its slowest speed setting for the given load, this pot may need to be increased. Start with the pot in the full counter clockwise position and increase it clockwise until the same speed is achieved for every given load (within the power limits of the actuator gearing/motor combination). Too high a setting may cause the cylinder speed to become jerky.

4.6 Time Delay Operation

The timer allows the user to add times delays for automatic reversal for control of external devices. The timer cannot be triggered to cause an automatic move unless the cylinder is triggered while in motion. Also, none of the trigger events with the exception of PS8 will start the timer unless the cylinder is triggered while in motion. When the motor is stopped, PS8 is enabled to start the timer to allow for external measurement of the time delay prior to its use. The timer output pulse occurs on OUT6 and may be commanded to output a pulse at the end of the time period (for .25 seconds) or for the duration of the timing period. (See SW-T#6.)

The timer will be reset by activation of the STOP, RESET, EXTEND or RETRACT inputs.

While the motor is off and the timer is running, the only position sensors that are active are PS3 (one-shot extend) and PS4 (one-shot retract). Therefore, the motor may be started in either direction without resetting the timer by activating one of these position sensor inputs during the timing sequence. Bear in mind that the position sensor inputs are not active when the motor is stopped and the timer is not running.

4.6.1 Programming Time Delay

The timer is programmed by selecting dip switches on SW-T. In order to set up a time delay, three functions must be set. You must set: 1) the trigger source, in other words, what signal is going to start the timer, 2) the automatic move following the time delay, and 3) the direction in which the timer is active. In addition, the type of timer output pulse may be changed.

The trigger source is selected by SW-T positions 3, 4 and 5. This allows for eight possible options to start the timer. See Table C in Appendix C.

SW-T positions 1 and 2 set the direction for an automatic move following the time delay period. See Table B in Appendix C. If the time is used only to send an output pulse, no automatic move can be selected. Position 6 selects whether a .25 second pulse will follow the time delay period or whether the output will stay on for the duration of the timing period. The timer output is a sinking transistor on terminal 6. When the output is off, the transistor is off and is pulled up to the logic supply voltage (terminal 21) by a 10k ohm resistor. When the output is on, it is grounded and can sink .25 amps.

The timer direction must be enabled by selecting SW-T positions 7 and 8. See Table D in Appendix C. For example, assume you select the timer to be triggered by activating PS1 and enabled only in the extend direction, then, if you activate PS1 in the retract direction, the cylinder will stop as commanded by PS1 but the timer will not start.

Appendix A

Pinout List

Motor and Power Connections

Terminal	Signal
1	Motor +
2	Motor -
3	DC -
4	DC +
5	Earth Ground
6	Drive Neutral
7	Drive Line
8	NC
9	NC
10	NC

Logic Connections - Lower Board

Terminal	Signal
1	Logic Ground
2	Not Used
3	Not Used
4	Out8
5	Out7
6	Out6
7	Out5
8	Out4
9	Out3
10	Out2
11	Out1
12	Position Sensor Input PS8
13	Position Sensor Input PS7
14	Position Sensor Input PS6
15	Position Sensor Input PS5
16	Position Sensor Input PS4
17	Position Sensor Input PS3
18	Position Sensor Input PS2
19	Position Sensor Input PS1
20	Logic Ground
21	Power - 12VDC
22	Logic Ground

Logic Connections - Top Board

Terminal	Signal
23	Normally Open - Relay #1
24	Normally Closed - Relay #1
25	Common Contact - Relay #1
26	Normally Open - Relay #2
27	Normally Closed - Relay #2
28	Common Contact - Relay #2
29	Trigger #1 + Input
30	Trigger #1 - Input
31	Trigger #2 + Input
32	Trigger #2 - Input
33	Emergency Stop + Input
34	Emergency Stop - Input
35	Reset Fault + Input
36	Reset Fault - Input
37	Jog/Run + Input
38	Jog/Run - Input
39	Retract + Input
40	Retract - Input
41	Extend + Input
42	Extend - Input
43	Analog Speed Input (0 - 10 vdc) (+)
44	Analog speed input (-)

Appendix B

LED Display

Output Status		(SW-A,#1 Off, #2 Off)
LED 1	On	- Ext Direction Mode
	Flashing	- Fault, Motion Not Allowed
LED 2	On	- Rtr Direction Mode
	Flashing	- Fault, Motion Not Allowed
LED 3	On	- Current Overload Triggered
LED 4	On	- Holding Current On
LED 5	On	- Second Speed Selected
LED 6	On	- Motor Stopped
	Flashing	- Emergency Stop Triggered
LED 7	On	- "End of Travel" Triggered
	Flashing	- AM90 Drive Fault/Reset Triggered
LED 8	On	- Time Delay On
	Flashing	- Timer Triggered, Not Running

Input Status		(SW-A,#1 On, #2 Off)
LED 1	On	- PS1 On (One-Shot Stop)
LED 2	On	- PS2 On (One-Shot Stop)
LED 3	On	- PS3 or PS4 On (One-Shot Ext or Rtr)
LED 4	On	- PS5 or PS6 On (End of Travel)
LED 5	On	- PS7 or PS8 On (Second Speed or Timer)
LED 6	On	- Input #1 or Input #2 On
LED 7	On	- Input #6 On (Ext Dir Start)
LED 8	On	- Input #7 On (Rtr Dir Start)

MOTOR CURRENT STATUS (SW-A,#1 Off, #2 On)

Displays Motor Current - Bar Code

TIME DELAY PERIOD INDICATOR (SW-A#1 On, #2 On)

Displays time set on timer potentiometer, binary coded
Ø.1 seconds per bit (Ø - 25.5 seconds)

Appendix C

DIP Switch Settings

DIP SWITCHES

SW-A Dip Switch

Switch #		Hardware Functions - bottom board
1&2		Set LED display status. See Table A.
3	Off/On	Speed Selection: On board Pots/External.
4	Off/On	Pot E1/R1 1st Speed/ Pot E2/R2 1st Speed.
5&6		Relay Out#1 - Extend Direction Output.
7&8		Relay Out#2 - Retract Direction Output.

SW-B Dip Switch

Switch #		Motion Parameters - top board
1	Off/On	"Current Overload": Stop/Holding Current.
2	Off/On	Run Mode/ Jog Mode (May be reversed by Input #5).
3	Off/On	"Accel To": Peak Current/Current Sense Setting.
4	Off/On	"PS2 Causes": Stop/Turn on Holding Current.
5	Off/On	"PS1 and Trig#1 Causes": Adjust Decel/Max Decel.
6	Off/On	"Out7 & Out8": End of Travel/ Current Overload.
7	Off/On	Trigger#2 Causes: Stop/ Turn on Holding Current.
8	Off/On	Trigger #1 causes: Stop/ Toggle Speed.

SW-T Dip Switch

Switch #		Timer Functions - top board
1&2		After Time Delay, Auto Move - See Table B.
3,4&5		Trigger Input Source - See Table C.
6	Off/On	Time Delay Causes Out6: Pulse at End/Pulse During
7&8		Direction Mask - See Table D.

Table A

Switch #		SW-A
1	2	- Set LED Display Status
OFF	OFF	LEDs:Output Status
ON	OFF	LEDs:Input Status
OFF	ON	LEDs:Motor Current
ON	ON	LEDs:Time Delay Period

Table B

Switch #		SW-T
1	2	- Timer Auto Move
OFF	OFF	No Automatic Move
ON	OFF	Auto Extend
OFF	ON	Auto Retract
ON	ON	Alternate Directions

Table C

Switch #			SW-T
3	4	5	- Timer Started By
OFF	OFF	OFF	PS8
ON	OFF	OFF	PS1
OFF	ON	OFF	PS2
ON	ON	OFF	Trigger# 1
OFF	OFF	ON	Trigger# 2
ON	OFF	ON	End of Travel
OFF	ON	ON	Current Overload
ON	ON	ON	PS1 and/or PS8

Table D

Switch #		SW-T
7	8	- Timer Direction Enable
OFF	OFF	Timer Off
ON	OFF	Timer On Extend Only
OFF	ON	Timer On Retract Only
ON	ON	Timer on Both Dir

Appendix D

Inputs and Outputs

INPUTS

REMOTE INPUTS (10-30 VDC:"DC", 90-140 VAC:"AC")

Terminals (-)	Terminals (+)		Identification	Description
30	29	(1)	TRIGGER#1	- One-Shot Stop/ Toggle Speed
32	31	(2)	TRIGGER#2	- One-Shot Stop/Holding Current
34	33	(3)	EMERGENCY STOP	- Stop, Prevent Restart
36	35	(4)	RESET	- Clear Fault Conditions
38	37	(5)	JOG/RUN	- Jog Mode or Run Mode
40	39	(6)	RETRACT	- Retract Direction Start
42	41	(7)	EXTEND	- Extend Direction Start
	44		GROUND	- Logic Ground

LIMIT SWITCH INPUTS:(OPTOISOLATED, 10-20 VDC)

Terminals (-)	Identification	Description
19	PS1	- One-Shot Stop
18	PS2	- One-Shot Stop/Holding Current
17	PS3	- One-Shot Extend
16	PS4	- One-Shot Retract
15	PS5	- Ext End of Travel (No Decel)
14	PS6	- Rtr End of Travel (No Decel)
13	PS7	- Toggle Speed
12	PS8	- External Timer Input
20	Ground	- Logic Ground
1,22	Ground	- Logic Ground
21	12 VDC	- Opto Power

OUTPUTS

REFERENCE SIGNAL OUTPUTS: (OPEN COLLECTOR TRANSISTOR, 30VDC MAX)

Terminals	Identification	Description
11	OUT1	- Ext Direction Active
10	OUT2	- Rtr Direction Active
9	OUT3	- Stopped on PS1 in Ext Dir
8	OUT4	- Stopped on PS1 in Rtr Dir
7	OUT5	- Stopped on PS2
6	OUT6	- Timer Output Pulse
5	OUT7	- Ext Dir: End of Travel/ Current Overload
4	OUT8	- Rtr Dir: End of Travel/ Current Overload

2 REMOTE RELAY OUTPUTS - SPOT
Relay #1 - Triggered in Ext Direction (SW-A: 5,6)
Relay #2 - Triggered in Rtr Direction (SW-A: 7,8)

SW-A 5/6 or 7/8:		
	OFF/OFF	1. Output On: Due to any Motion
	ON/OFF	2. Output On: Stopped by PS1
	OFF/ON	3. Output On: Current Overload
	ON/ON	4. Output On: End of Travel PS

Appendix E

H3411 Control Dimensions