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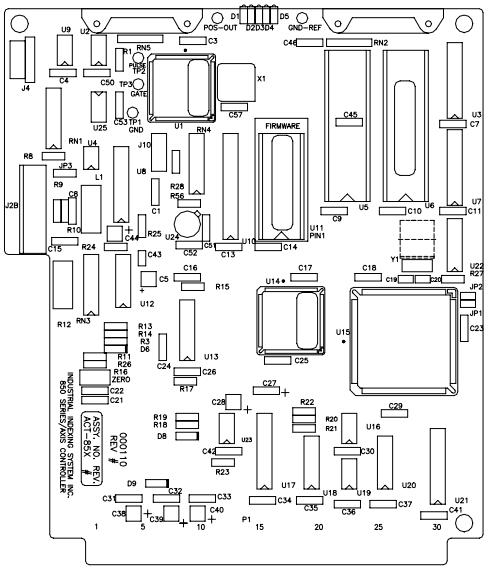
MOTION CONTROL SYSTEMS, MSC SERIES **NOVEMBER 2000**



ACT-850
AXIS CONTROLLER W/ TEMPOSONICS FEEDBACK

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0
Approved By:

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1.0 INTRODUCTION

1.1 About this Instruction Book

This document is part of a series of books that support Industrial Indexing Systems' MSC-850/32 based Motion Control System. It provides product information about the ACT-850 Axis Controller with Temposonics Feedback including: a product overview, product description, product specifications, description of controls and indicators, and connection diagrams.

1.2 Product Overview

The ACT-850 Axis Controller with Temposonics Feedback is an edge connector printed circuit board (Figure 1-1) that can be plugged into one of the controller slots of the MSC-850/32 System Unit. It provides precision position loop control utilizing feedback data from the temposonics transducer connected to a hydraulic servo valve (Figure 1-2).

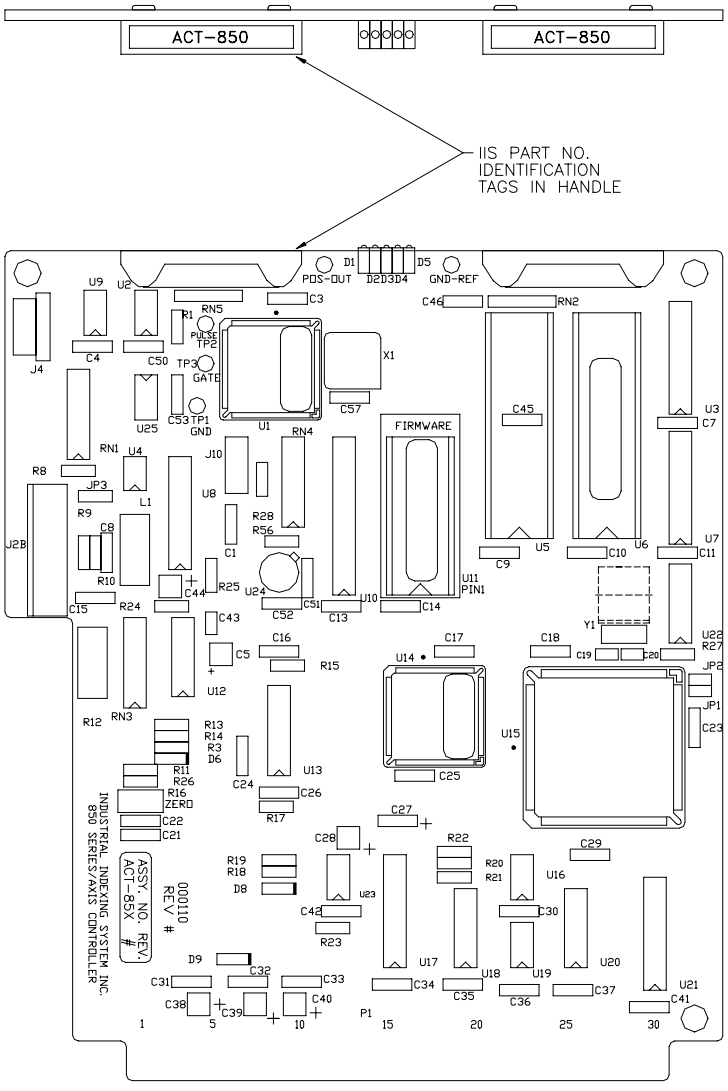


Figure 1-1 ACT-850 Axis Controller with Temposonics Feedback

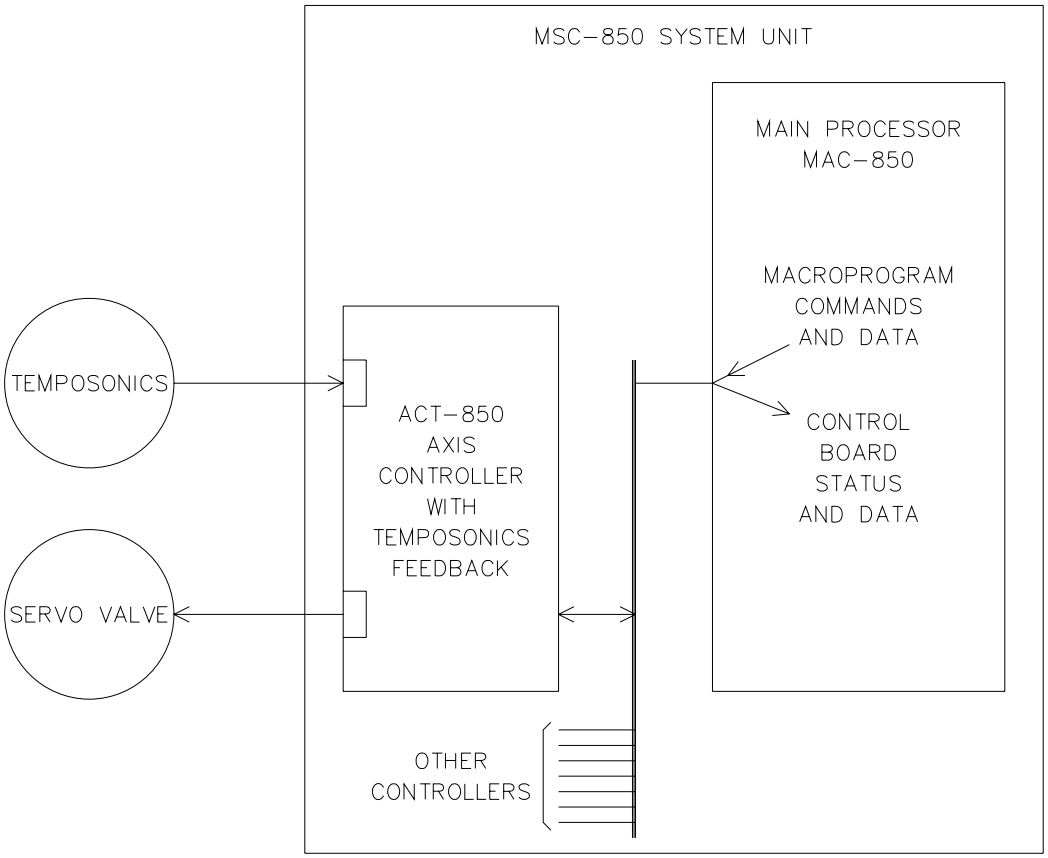


Figure 1-2 ACT-850 Position Loop Overview Diagram

2.0 DESCRIPTION

2.1 General

The ACT-850 Axis Controller with Temposonics Feedback is an intelligent circuit board that works in conjunction with a Temposonics transducer connected to the servo valve. In combination, the two components produce an output signal that causes the shaft of the motion device to move in relation to the commands as instructed by the Macroprogram running in the System Unit. The controller is capable of performing indexing, positioning, cam following, piecewise profiling, and can also be used as a passive position sensing device.

2.2 Temposonics Functional Description

The Temposonics Linear Displacement Transducer precisely senses the position of an external magnet to measure displacement. It is capable of very high accuracy and resolution based on the selected device, the crystal frequency and the number of recirculations. It uses the principles of magnetostriction to measure the time interval between the initiation of an interrogation pulse and the detection of a return pulse. The controller card generates the Interrogation pulse and waits for the Gate pulse to go high. At this time, a counter will count clock cycles until the Gate pulse is removed. The resulting count indicates a particular displacement, which is dependent on the number of recirculations. The maximum amount of displacement is based on the rod length, and the resolution is based on the number of recirculations.

NOTE

The number of recirculations cannot be chosen so as to prevent a valid read in 1 msec. Updates requiring greater than 1 msec will result in a following error.

Update time = 1.2 * # of recirculation * gradient * [stroke length + 3]

i.e. Gradient = 9 μs/inch
Recirculations = 4
Stroke length = 2

Update time = 1.2 * 4 * 9 [2 + 3] = 216 μs

2.3 Position Loop Control Functions

2.3.1 Overall Position Loop Description

The ACT-850 Axis Controller with Temposonics Feedback (Figure 2-1) is the heart of the position loop. Instructions from the Macroprogram tell the controller what the parameters of the motions are for indexing or positioning. The information is processed by the command generator and the resulting position commands are sent to the comparator along with the feedback from the Temposonics transducer. The command generator produces a command position which represents the speed, the acceleration rate, the direction, and the distance that the servo valve must move. This difference between the commanded position and the actual position is the POS OUT signal which is sent to the servo valve. The Temposonics transducer senses the position of an external magnet to measure displacement. As the magent is moved to a new position, the actual position will again equal the commanded position and the command signal will be zero. The difference between the actual position and the commanded is referred to as following error.

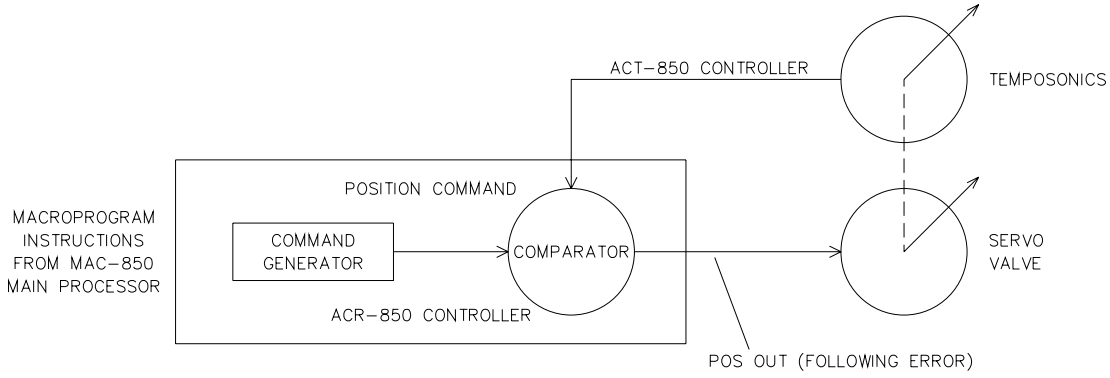


Figure 2-1 Position Loop Block Diagram

2.3.2 ACT-850 Description

The controller (Figure 2-2) is a microprocessor based board running under the control of a unique IIS operating system. The digital signals from the Temposonics transducer are used to determine position. Instructions from the Macroprogram running in the MSC-850/32 main processor send data over the Command Bus (C-Bus) to configure the command generator of the controller. The 24-bit wide counter and the output of the command generator are compared and a resulting error signal is created. The operating system of the controller card then digitally compensates the error and produces a POS OUT command in the form of either current or voltage, based on a jumper selection (JP3).

The controller can communicate over 2 Angle Buses located on the motherboard in the System Unit for a master/slave relationship. The controller can be designated as the master controller (talker) by the Macroprogram or the controller can be a slave controller (listener) as directed by the Macroprogram. This master/slave relationship is communicated over either of the 2 Angle Buses.

Depending upon the specific mechanical motion being simulated, the command generator of the slave controller (Figures 2-3 and 2-4) computes a command position based on the absolute master angle information from the Angle Bus.

As a passive position sensing device, the controller can be used to monitor the position of a Temposonic transducer. This information can be communicated over the Angle Buses or reported to the Main Processor for integration into functions of the Macroprogram.

When 'drive_on' is executed in the Macroprogram, the POS OUT signal is first driven to 0V dc by making the command position equal to the actual position then the Drive Enable control is turned on.

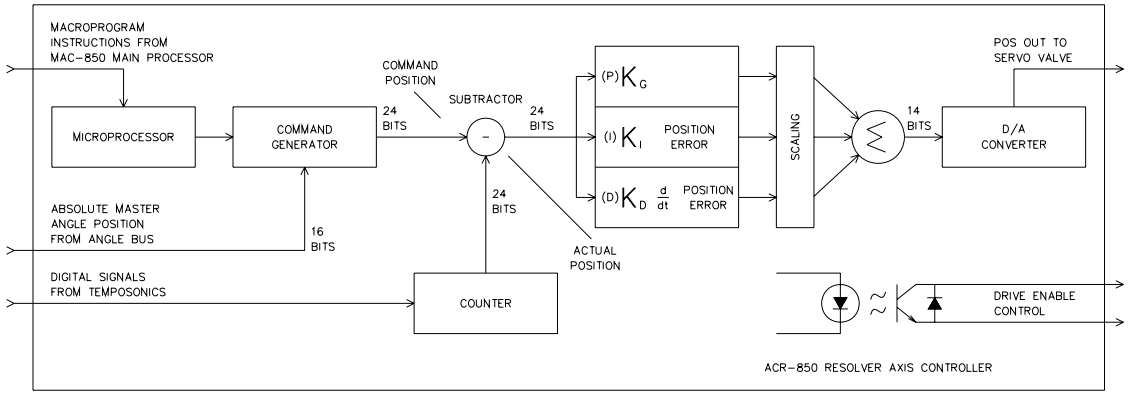


Figure 2-2 ACT-850, Functional Block Diagram

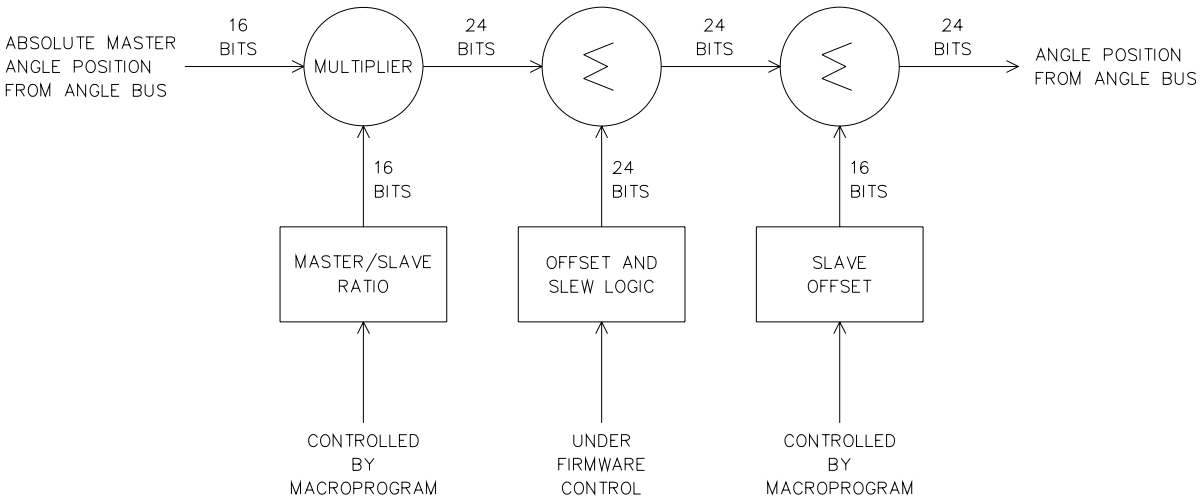


Figure 2-3 Electronic Gearbox Command Generator

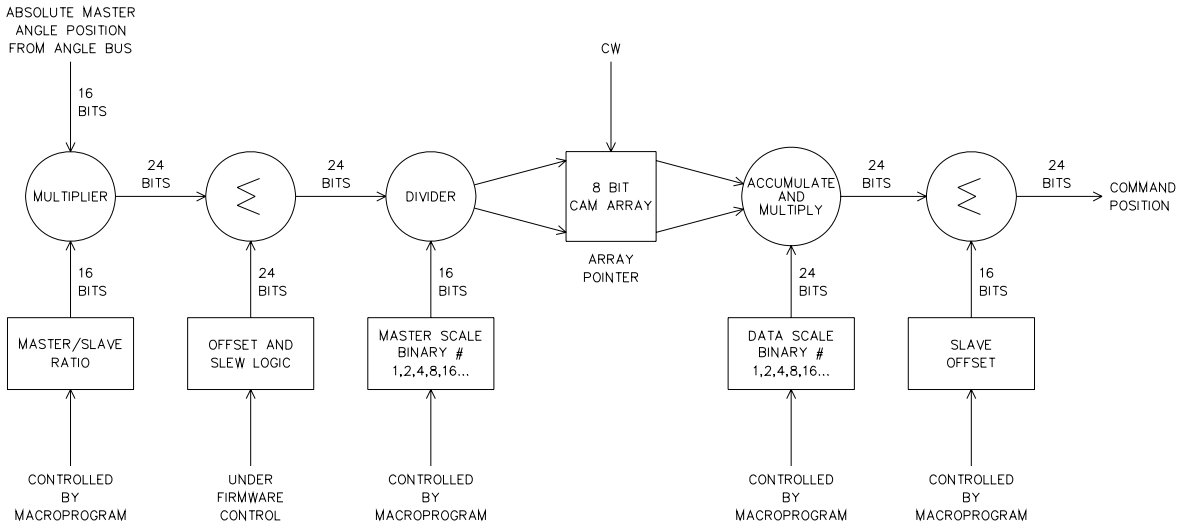


Figure 2-4 Electronic Cam & Gearbox Command Generator

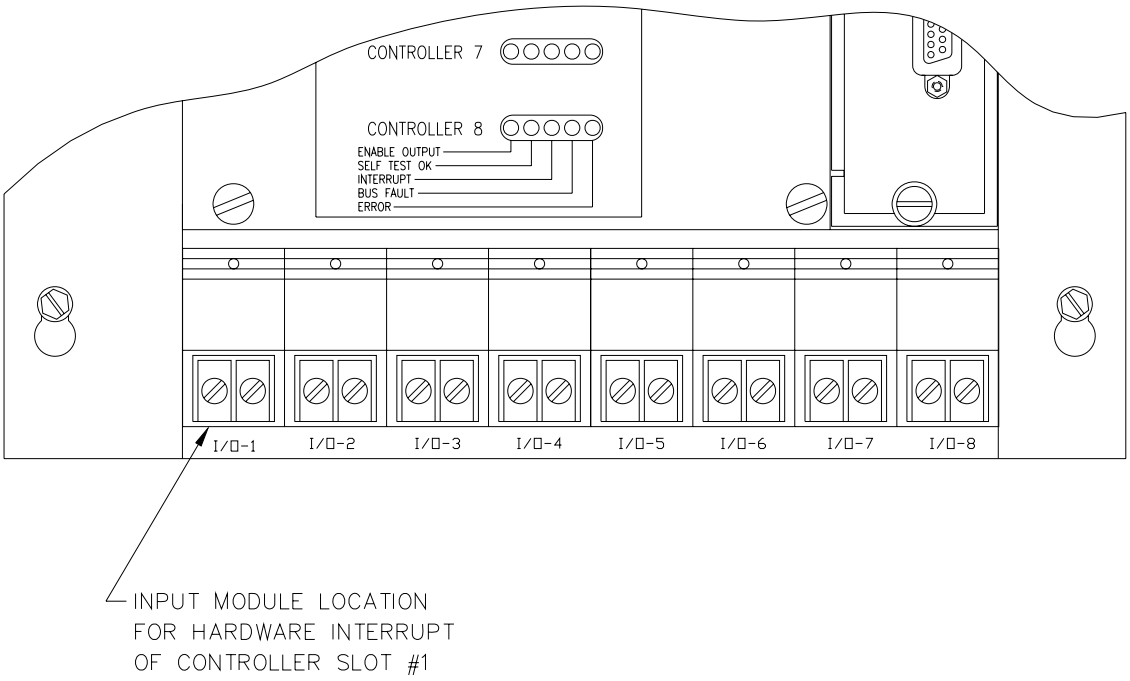


Figure 2-5 On-board I/O Module to Controller Slot Relationship

2.4 Status and Fault Indicators

2.4.1 Power-up Fault Detection

On power-up, the controller's microprocessor, memory, and multiply/divide circuit are put through a series of tests. If the controller passes the tests, then the board is considered to be operational and a green indicator, labeled SELF TEST OK, is lighted. On start-up, the SELF TEST OK indicator may also be lighted along with the yellow INTERRUPT, red BUS FAULT, and red ERROR indicators. If this combination of indicators are lighted on start-up, a controller start-up fault has occurred. This may or may not be a fault in the controller. A start-up retry should be attempted and if the same combination of indicators are lighted, then the controller can be suspected as being faulty.

2.4.2 Operational Fault Detection

The ACT-850 Axis Controller with Temposonics Feedback has built-in fault detection. While the DRIVE ENABLE indicator is lighted, the controller monitors the following error and immediately sets the POS OUT signal to 0.00 Volts and then turns off the drive enable control under the following conditions;

There are two distinct parameters that select the allowable following error. 'Set_nar_ang' is the command used to set the allowable error when stopped. While motion is being commanded, the allowable error is determined by the 'set_wide_ang' command. The default for each is 4096 bits.

2.4.3 Status Indicator Description

During normal operation, the SELF TEST OK indicator is lighted. As the Macroprogram executes the 'drive_on' instruction, the ENABLE OUTPUT indicator comes on to enable the position loop and to start monitoring the following error. As a MAC-850 Main Processor communicates with the controller, the INTERRUPT indicator flickers (or appears to be on steady due to rapid flickering).

If, during normal operation, a problem with the controller or main processor is detected, the BUS FAULT indicator will come on.

If, during normal operation, a following error fault is detected, the ERROR indicator will come on.

The ERROR indicator may also come on if the Gate pulse is active for longer than the loop update rate of 1 millisecond. This can be caused by the magnet not being located in the active stroke area, or possibly the number of circulations was set incorrectly.

For a more detailed description of the physical and functional characteristics of these indicators, refer to Section 4.

3.0 SPECIFICATIONS

3.1 Functional Characteristics

Drive Enable Control	(Optically Isolated)
Off Voltage	30V dc
On Voltage	1.5V dc, 20mA
Drive Command Output (POS OUT)	+/-10V dc @ 10mA or +/-60mA dc
Digital Compensation	PID loop with 1KHz Digital Signal Processing Sample Rate
Feedback Device	Temposonics (Control Transmitter type)

3.2 Performance Characteristics

Positional Range	+/-8388608 bits
Resolution	1 ÷ [gradient * 28 mHz * # of recirculations]
Repeatability	Equals resolution
Acceleration/Deceleration Range	0.004 to 800 revolutions/sec/sec
Speed Range	0.004 to 3600 RPM in 1 RPM increments +/- 1% accuracy of set speed
Environmental	
Operating Temperature	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90% (Non-condensing)

NOTE

Resolution and repeatability are dependent on the Temposonics tranducer and the number of recirculations.

i.e. Gradient = 9 μs/inch
# of recirculations = 4
Resolution = 1 ÷ [9 μs/inch * 28 mHz * 4] = .001 inch

3.3 Physical Characteristics

Dimensions	
Width	5 5/16 in. (135 mm)
Depth	6 5/16 in. (160 mm)
Weight	1 lb. (0.45 Kg.)
Mounting	Occupies any slot in the MSC-850 System Unit

4.0 CONTROLS AND INDICATORS

4.1 General

The ACT-850 Axis Controller with Temposonics Feedback is equipped with five status indicators. These indicators are visible through a cut-out in the faceplate of the System Unit. The indicators are illustrated in Figure 4-1 and listed in Table 4-1.

There is a jumper on the ACT-850 Axis Controller with Temposonics Feedback. This jumper is used to select voltage or current control for the command signal. All other parameters and functional control are established by the MacroProgram.

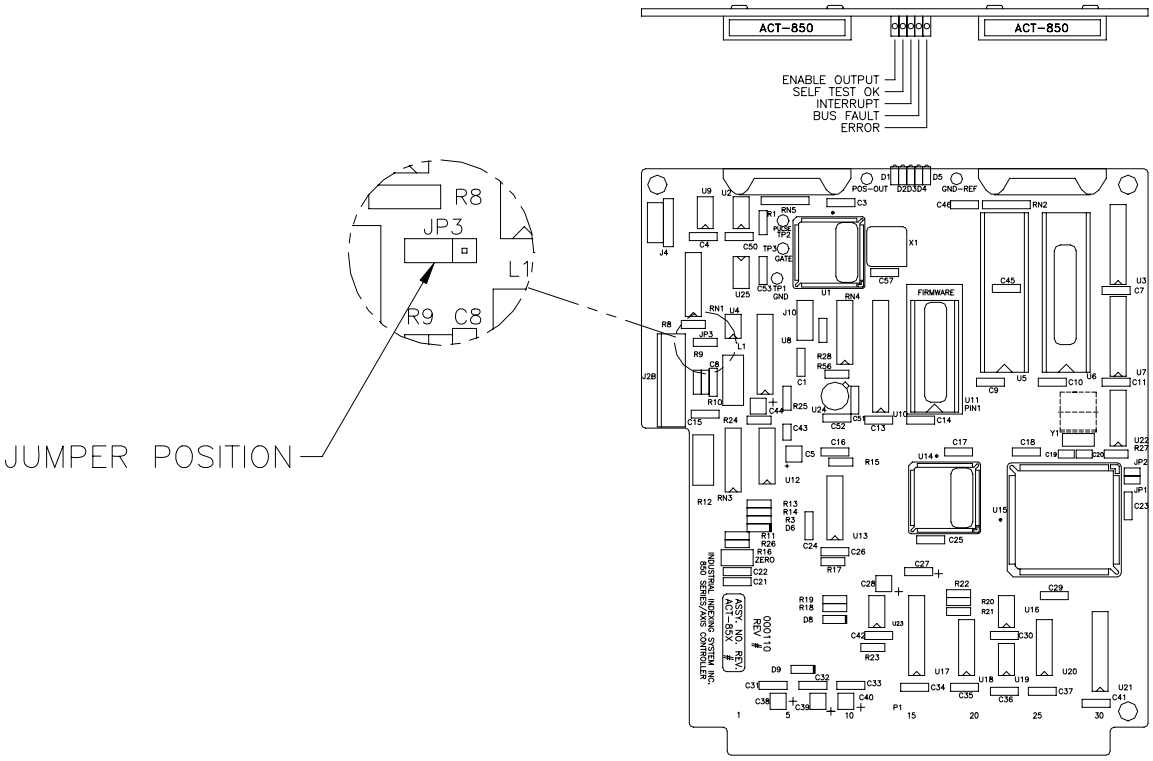


Figure 4-1 Identification of Status Indicators

PANEL MARKING	DESCRIPTION	OBSERVED INICATION	INDICATOR FUNCTION
ENABLE OUTPUT	Green LED	Steady On	The position loop is active and drive enable is closed.
SELF TEST OK	Green LED	Steady On	The controller passed the self test during start up.
		Flashing	The controller is executing self tests.
INTERRUPT	Yellow LED	Flashing	The controller is communicating with the Main Processor.
BUS FAULT	Red LED	Steady On	Communication, on the C-Bus between the controller and the Main Processor was faulty. A subsequent good communication sequence resets the BUS FAULT indicator.
ERROR	Red LED	Steady On	A following error fault has been detected.
		Flashing	A controller fault has been detected. It could be the system watchdog has timed our or a stuck overflow has occurred.

Table 4-1 Description of Indicators

NOTE

If, during start up, the SELF TEST OK, INTERRUPT, BUS FAULT, and ERROR indicators all come on, a controller start-up fault has occurred. A start-up retry should be attempted and if the same combination of indicators are lighted, then the controller can be suspected of being faulty.

5.0 FUNCTIONALITY TESTS

5.1 General

The ACT-850 Axis Controller with Temposonics Feedback provides motion control by controlling the position of a servo valve with a linear displacement transducer. The Temposonics device provides the feedback and is physically connected to the servo valve.

The position loop, consisting of the ACT-850 Axis Controller and the Temposonics transducer, controls a velocity loop consisting of a servo valve. The ACT-850 is capable of controlling a servo valve with either current output or voltage output, selectable with jumper (JP3). The velocity loop polarity must be configured such that a positive voltage will cause the servo valve to extend.

5.2 Indicators

5.2.1 Test No. 1

This test will check the temposonic device, the controller, and the servo valve. It will require the use of a Multimeter to determine output voltage proportional to stroke movement.

1. Turn off power to the system
2. Remove the 6 pin connector P2 from the ACT-850 Controller in the System Unit
3. Turn off power to the Hydraulic pump
4. Place the macroprogram into a mode executing the following code:
5. Set Multimeter on the 10VDC scale
6. Connect the red and black meter leads to POS-OUT and GND-REF respectively (See Figure 5.1).
7. With the cylinder at rest the meter should be reading 0.00 vdc +/- 0.1 volts.
8. Extend the cylinder by hand. The voltage should decrease smoothly . With a resolution of .001 inches the reading should be about -5.0 VDC after 1 inch of travel.
9. Move the cylinder back to its original position, and the reading should return to 0.00 VDC.
10. Retract the cylinder 1 inch (for resolution of .001 inches) and the meter should increase smoothly to approximately +5.0 VDC.

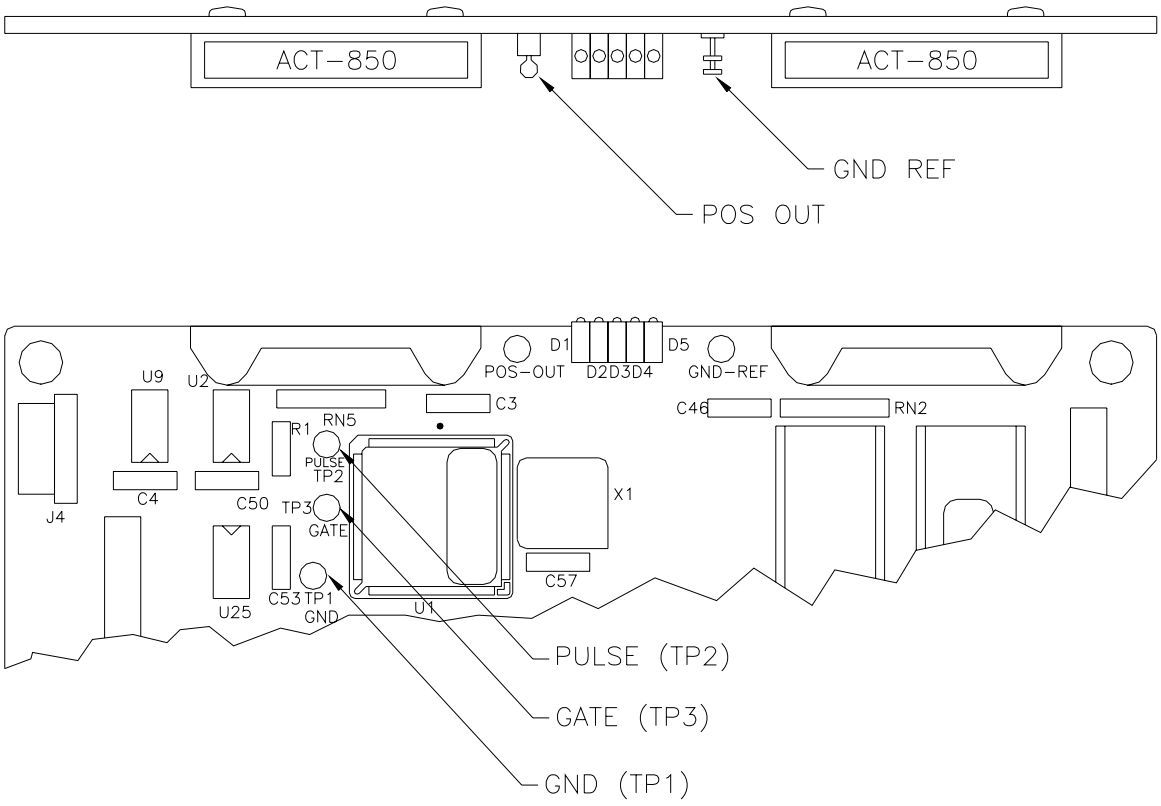


Figure 5-1 Location of Test Points

The maximum allowable swing is +/-10 VDC. Under operating conditions one would expect that a positive voltage output will cause the cylinder to extend and a negative voltage will cause the cylinder to retract.

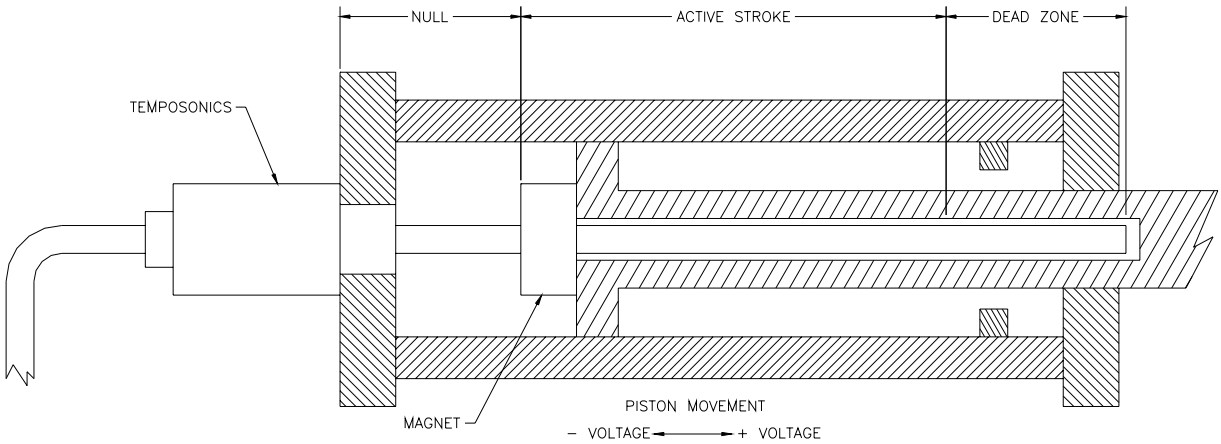


Figure 5-2 Typical Cylinder

6.0 CONNECTION DIAGRAMS

6.1 General

This section contains the electrical connections for the controller to Temposonics transducer and controller to servo valve.

Good grounding of the controller is essential for proper operation. Figure 6-2 illustrates the MSC Ground Strip typical location to which P2-6 must be connected.

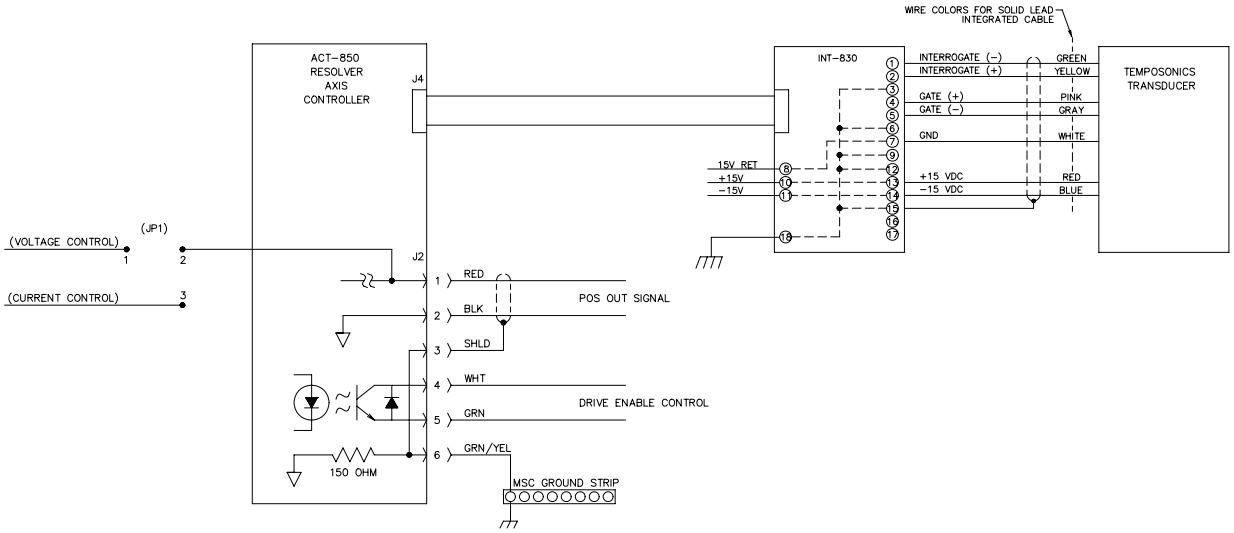


Figure 6-1 ACT-850 Controller, Electrical Connection

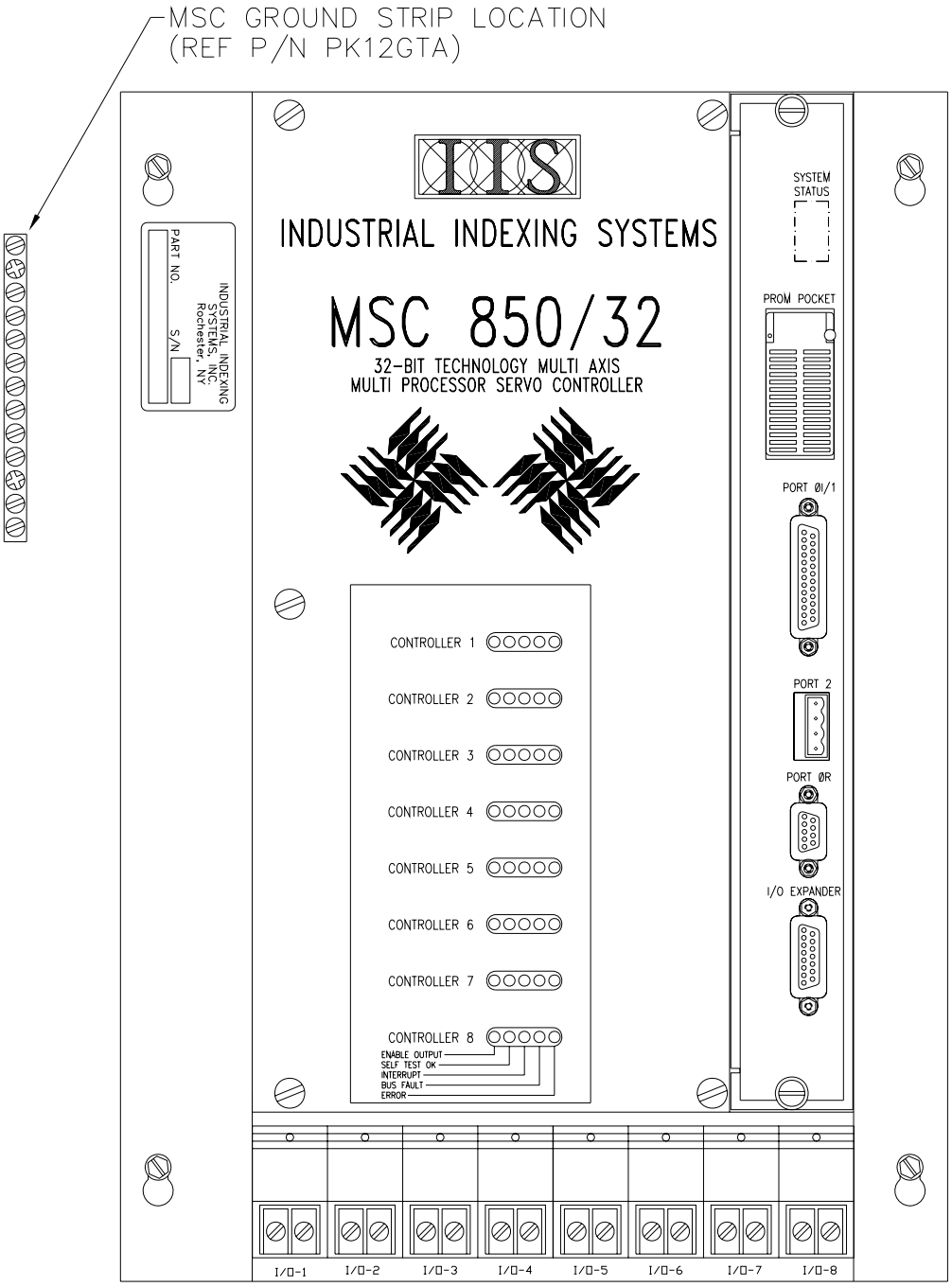


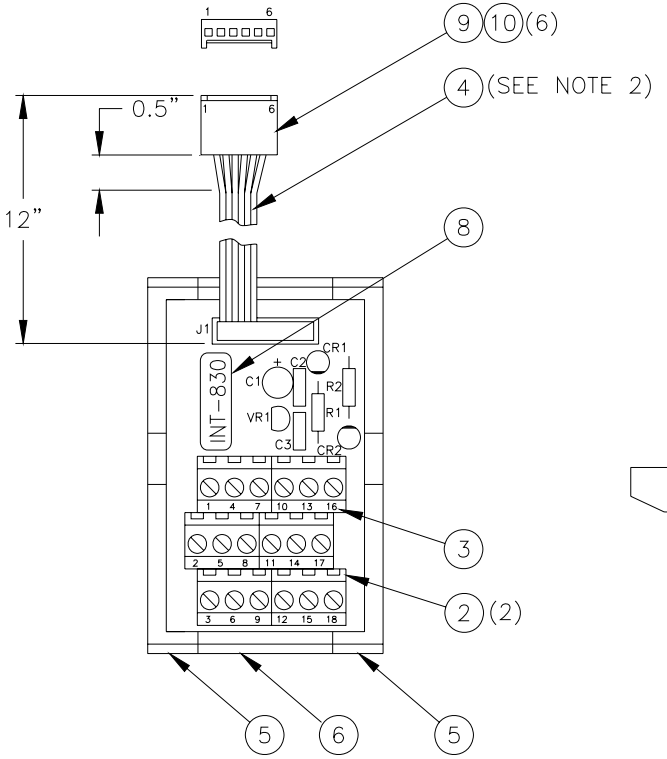
Figure 6-2 MSC Ground Strip

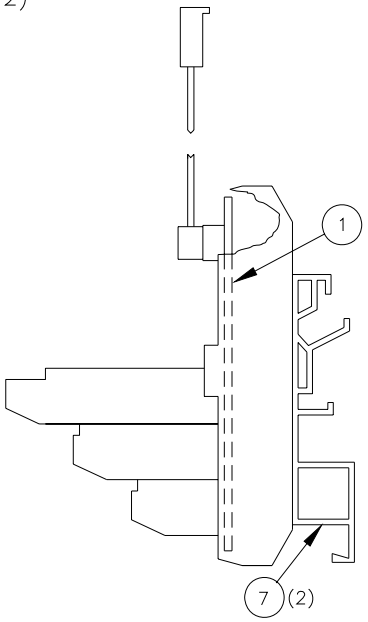
7.0 CABLES & ACCESSORIES

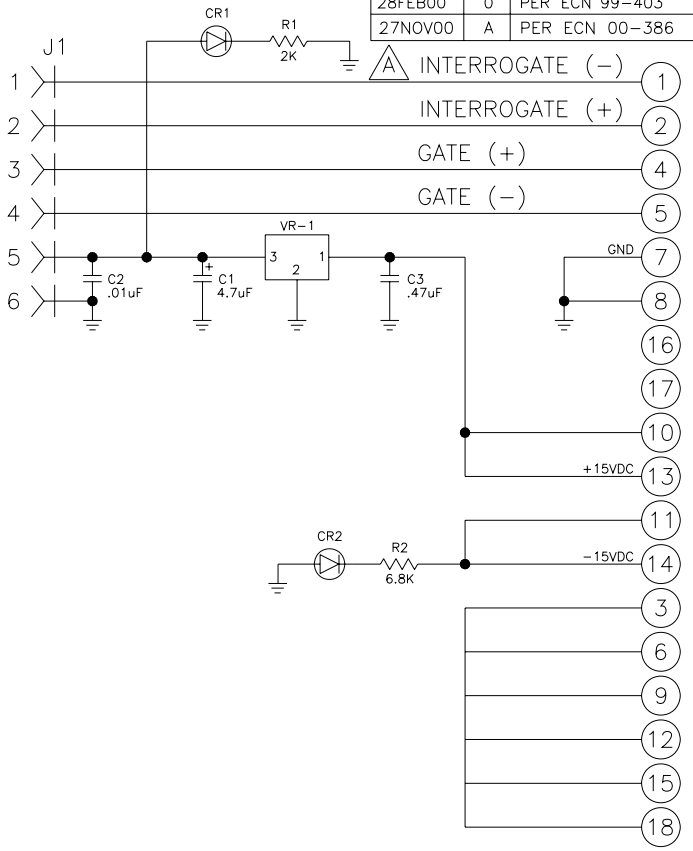
DRAWING NUMBER	DESCRIPTION
INT-830	ENCODER CABLE ADAPTOR

NOTES:
1. SNAP-LOCK ASSEMBLY, NO ADHESIVE REQUIRED.
2. REMOVE CONDUCTORS 7-10 AND DISCARD.

DATE	SYM	REVISION RECORD	DR	CK	CK
28FEB00	0	PER ECN 99-403	CWB	EB	
27NOV00	A	PER ECN 00-386	CWB		







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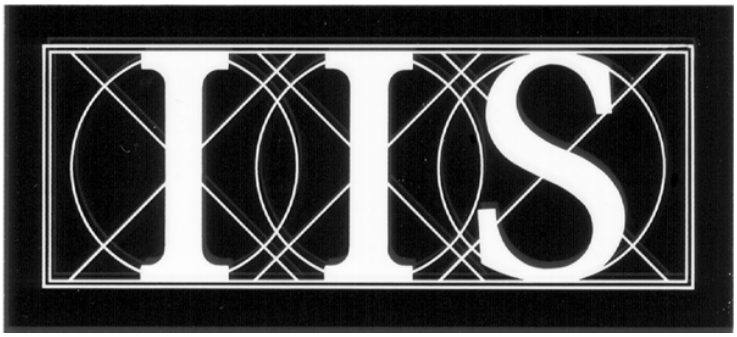

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