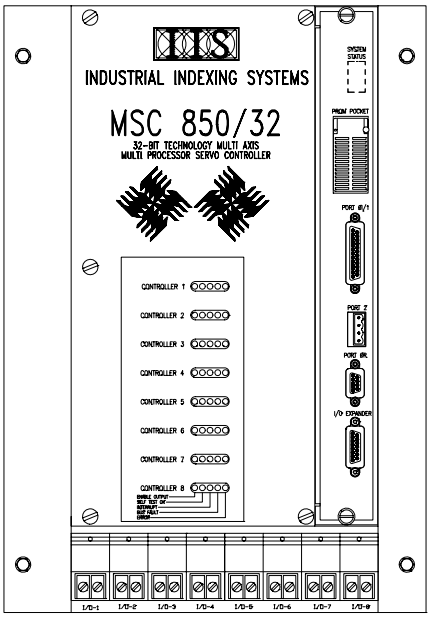
IB-11B014

MOTION CONTROL SYSTEMS, MSC-SERIES DECEMBER 1992



MSC-850/32 SYSTEM UNIT

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0

Approved By:

ER-6025

ERRATA SHEET, IB-11B014 MAY 1997

Date	Rev.	ECN No.	DR	CHK	CHK
1/16/96	0	ECN-96-003 (See Note 1)	KY		
5/19/97	A	ECN-97-160 (See Note 2)	KY		

Notes:

1) Pages 0-2, 5-2, 7-1 & 7-3, dated January 1996, supercedes Pages 0-2, 5-2, 7-1 & 7-3, dated December 1992.

2) Page 6-3, dated May 1997, supercedes Page 6-3, dated December 1992.

INDUSTRIAL INDEXING SYSTEMS, Inc.
626 Fishers Run
Tel: (585) 924-9181 Victor, New York 14564 Fax: (585) 924-2169

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

1.1 About this Instruction Book

This document is a part of a series of books that support Industrial Indexing Systems' MSC-850/32 based Motion Control System. It provides product information about the MSC-850/32 System Unit including; general description, product specifications, installation instructions, controls, indicators, and electrical connection diagrams.

1.2 Product Overview

An MSC-850/32 System Unit consists of the ENC-850 Unit Enclosure and the MAC-850/32 Main Processor utilizing 32-bit technology (Figure 1-1). The MSC-850/32 System Unit is the heart of the Motion Control System. The System Unit houses the electronics that perform the central processing control functions and I/O functions of the Motion Control System.

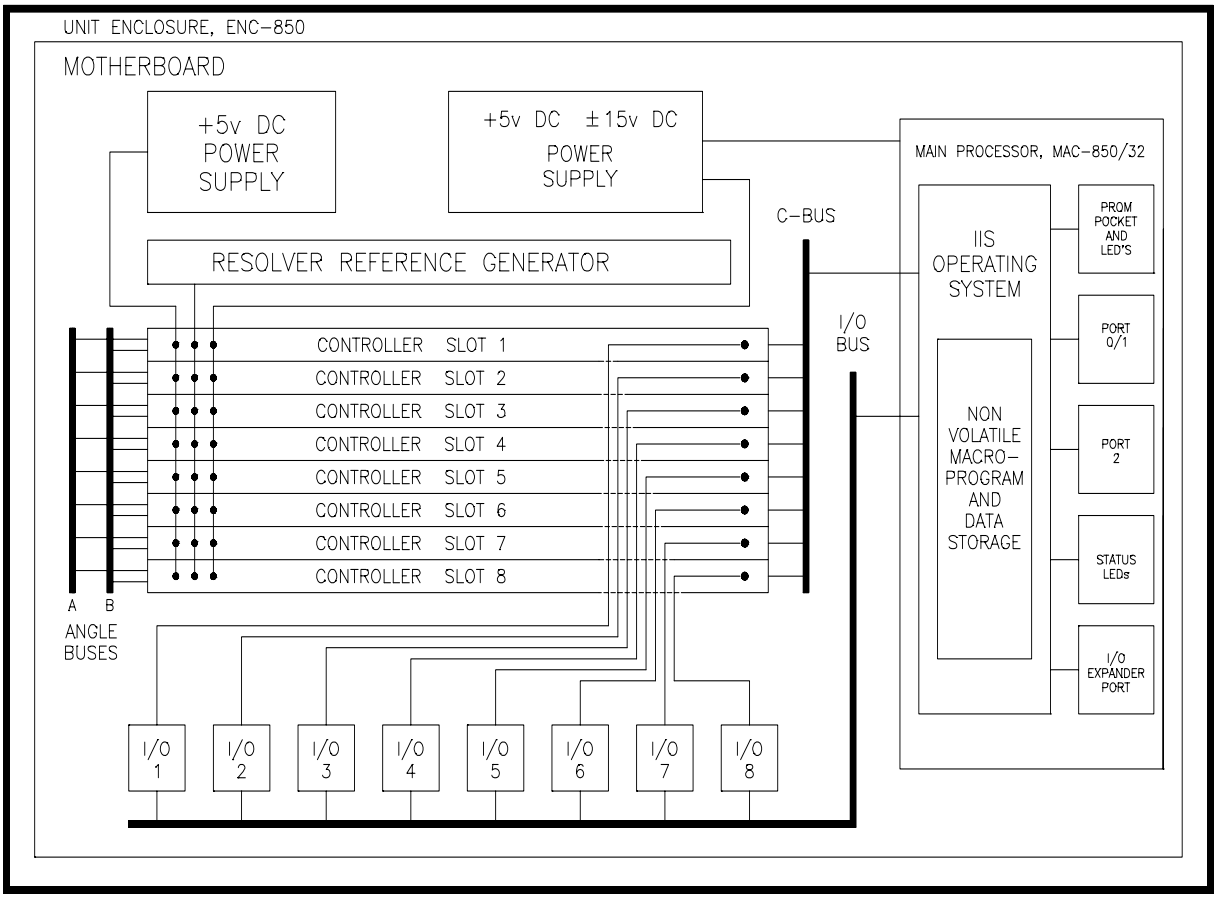


Figure 1-1 MSC-850 System Unit Internal Architecture

2.0 DESCRIPTION

2.1 The ENC-850 Unit Enclosure

The ENC-850 Unit Enclosure (Figure 2-1) consists of a forced-air ventilated metal cabinet and a motherboard to support the functional boards of the Motion Control System.

The Unit Enclosure comprises a Command Bus (C-BUS), 8 controller slots, connections for up to 8 On-board I/O Modules, a Resolver Reference Generator, 2 Angle Buses, an I/O Bus, and 2 Power supplies.

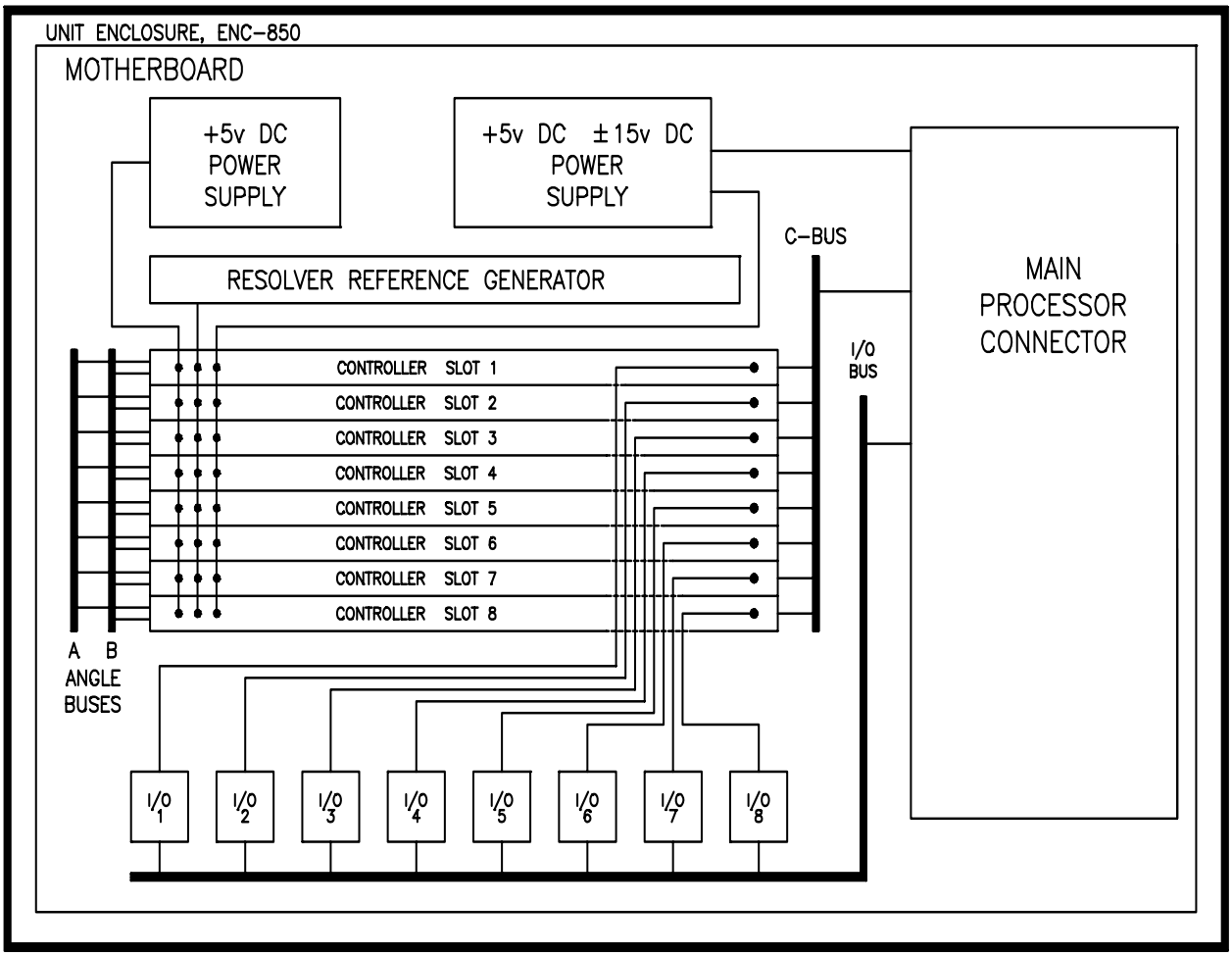


Figure 2-1 The ENC-850 Unit Enclosure

2.1.1 Command Bus

The Command Bus (C-BUS) (Figure 2-2) is a parallel digital communications bus connecting the Main Processor to the controllers. The C-BUS runs under a protocol established by a unique Industrial Indexing Systems' operating system and is accessed by the user's Macroprogram.

The C-BUS allows Macroprogram commands to be sent from the Main Processor to the controllers. It also allows data to be exchanged between the Main Processor and the controllers.

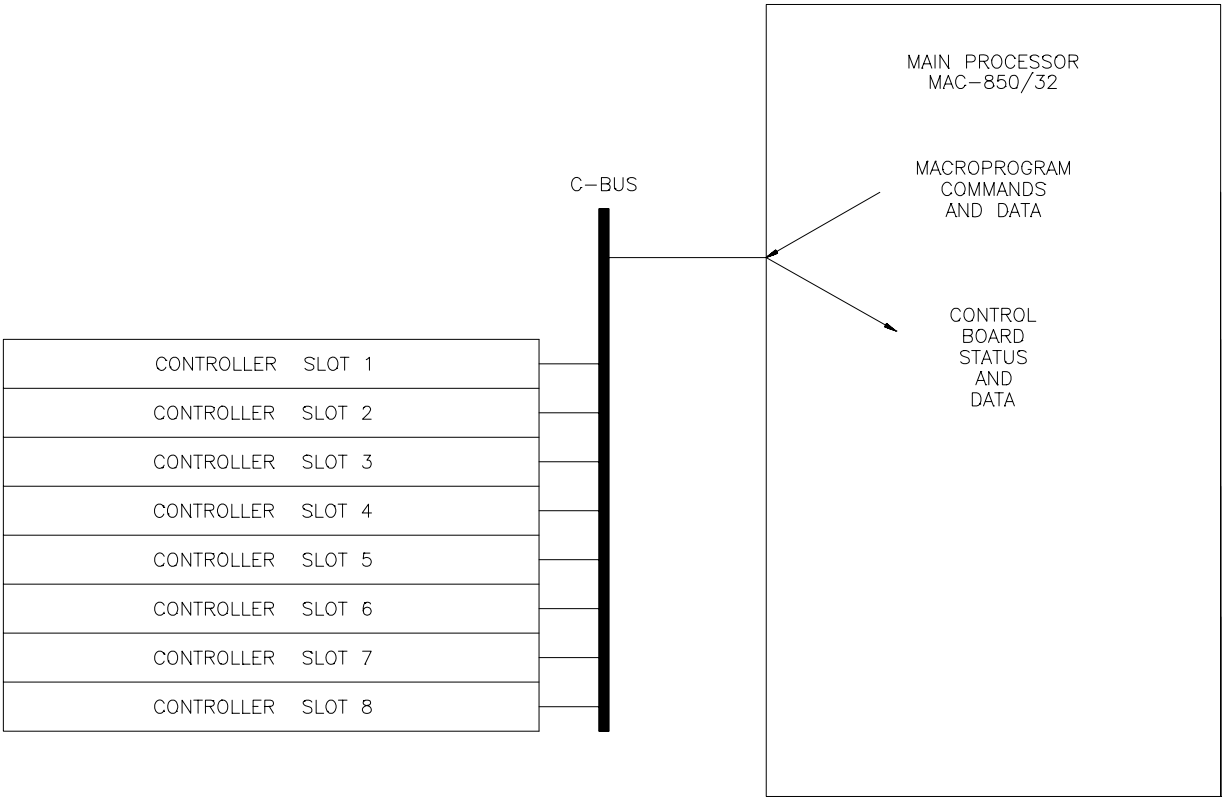


Figure 2-2 The Command Bus

2.1.2 Controller Slots

The 8 controller slots (Figure 2-3) accept any controller in any combination. The controllers are; ACR-850 Resolver Axis Controller, ACE-850 Encoder Axis Controller, MCF-850 Multifunction Controller, HPL-850 High Performance Limit Switch Controller, or ACM-850 Analog Controller.

The controller slots are connected to 2 Angle Buses, On-board Input Modules, and the C-BUS. Power is supplied to the controllers through the controller slots. A 2.6KHz Resolver Reference signal is supplied through the controller slots to the ACR-850 Resolver Axis Controllers.

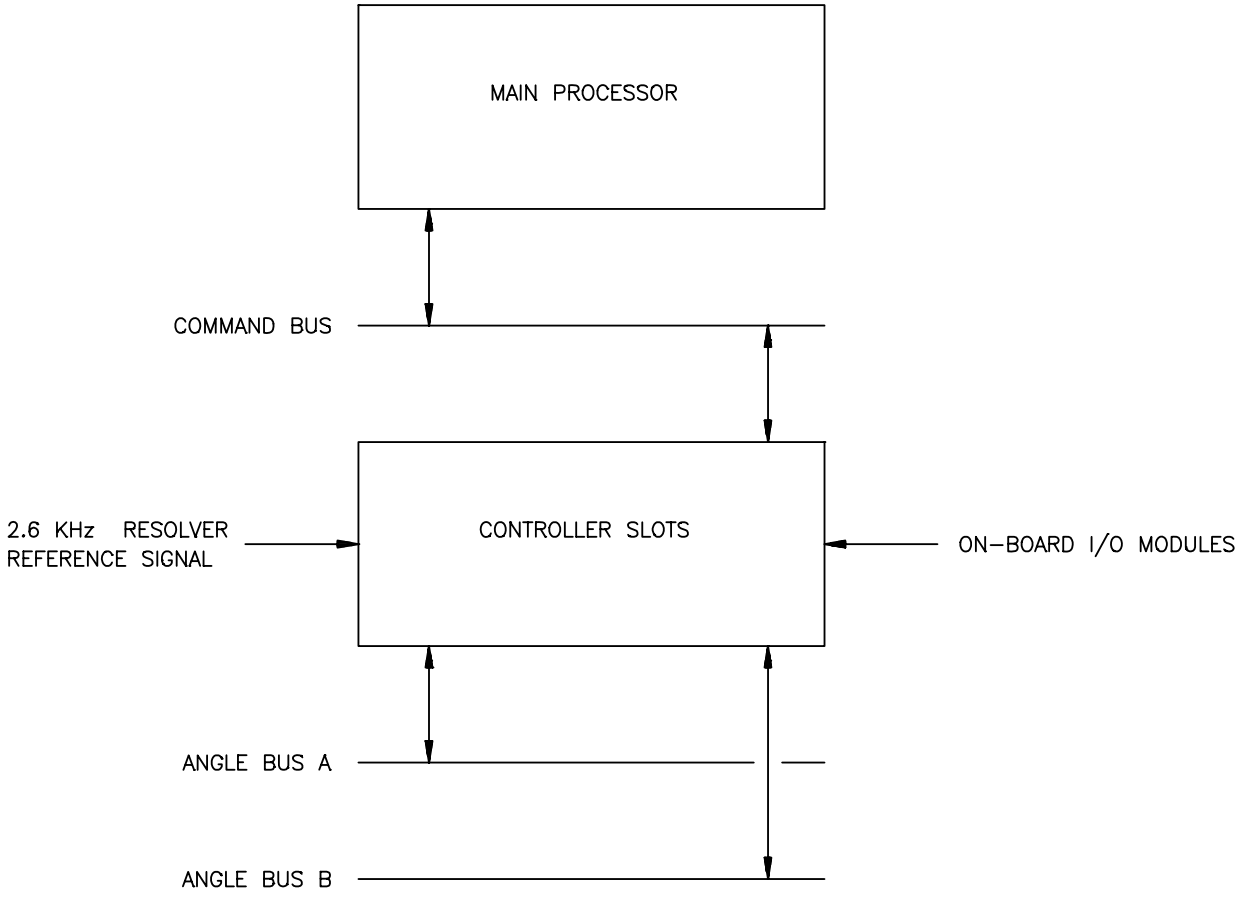


Figure 2-3 The Controller Slots

2.1.3 On-Board I/O Modules

The connections for the eight On-board I/O modules (Figure 2-4) allow process inputs to be connected directly to the controllers. They also connect process inputs and outputs to the Main Processor by way of the I/O Bus. The input and output modules can be either AC or DC. The IIS part numbers for the six different plug-in modules are listed in Table 2-1 below.

Table 2-1 On-Board I/O Modules

FUNCTION	PART #
DC Input, high speed	HSI-850
DC Input	S410
DC Output	S430
AC Input, low voltage	S420
AC Input, high voltage	S421
AC Output	S440

Each On-Board I/O Module Connects to both the Main Processor and a corresponding controller (e.g. I/O Module 1 connects to the controller in slot 1, I/O Module 2 connects to the controller in slot 2, etc..).

The Main Processor can read inputs and set outputs. Inputs are used by the control programs to monitor the status of external devices. Outputs allow the control programs to affect the status of external devices.

The controllers can read inputs from On-Board Input Modules. These inputs are used with control program functions to provide fast hardware interrupts, typically used to initiate a motion or motion related event.

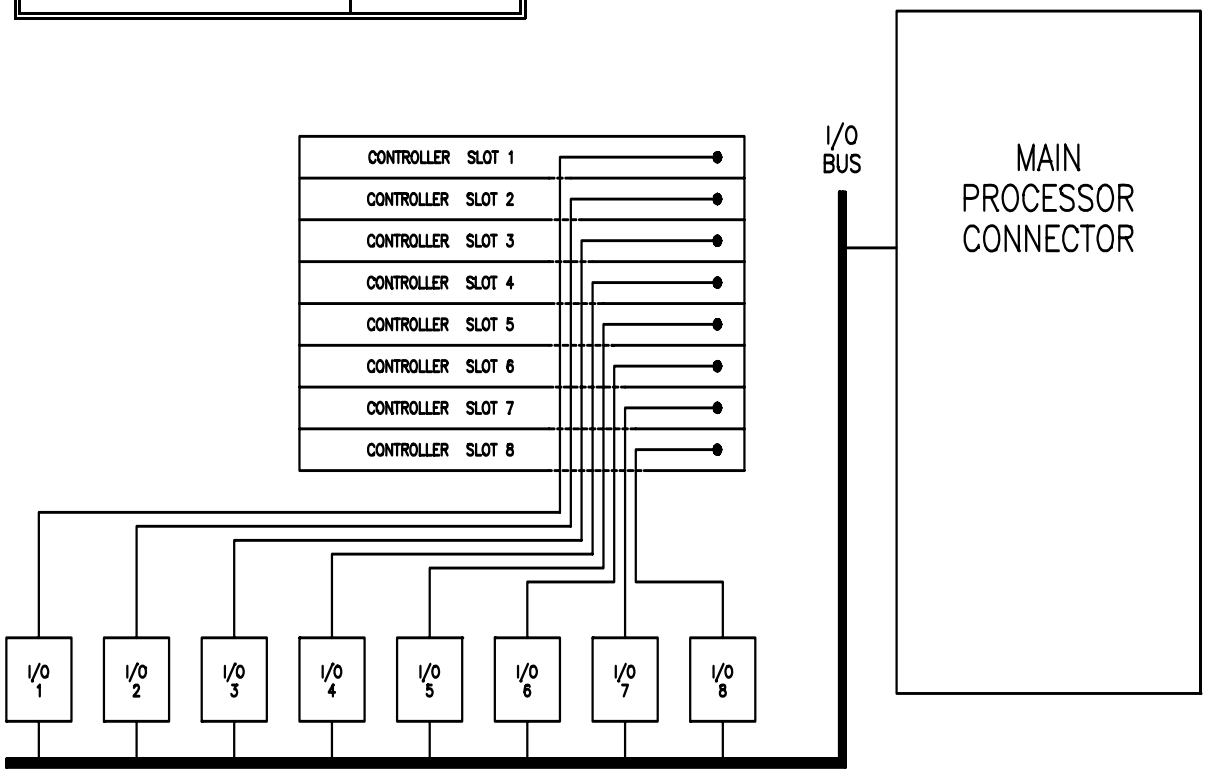


Figure 2-4 The On-Board I/O Module Connectors

2.1.4 Angle Buses

The 2 Angle Buses (Figure 2-5) are serial digital communication buses that interconnect the controllers through their controller slots.

These buses allow each of two master axis controllers per System Unit to transmit its absolute master angle position on one of the master angle buses.

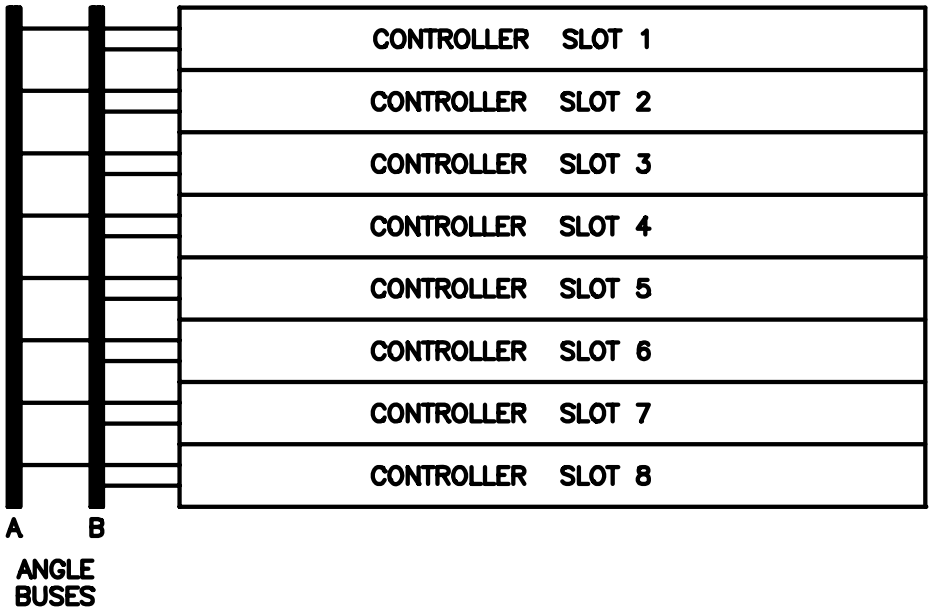


Figure 2-5 The Two Angle Buses

2.1.5 Power Distribution

System Unit Power Distribution (Figure 2-6) provides power for the Main Processor, controllers, and Resolver Reference Generator. A +5v DC Power Supply and a +5v DC, ±15v DC Power Supply convert the 110v AC line voltage into the required voltages for the controllers and the Main Processor.

Power is supplied to the controllers through the controller slots and the Main Processor through the Main Processor connector. Both power supplies are of the linear type. This feature provides extensive incoming line noise filtering and high capacity voltage storage to produce a stable supply of power with very high fault tolerance.

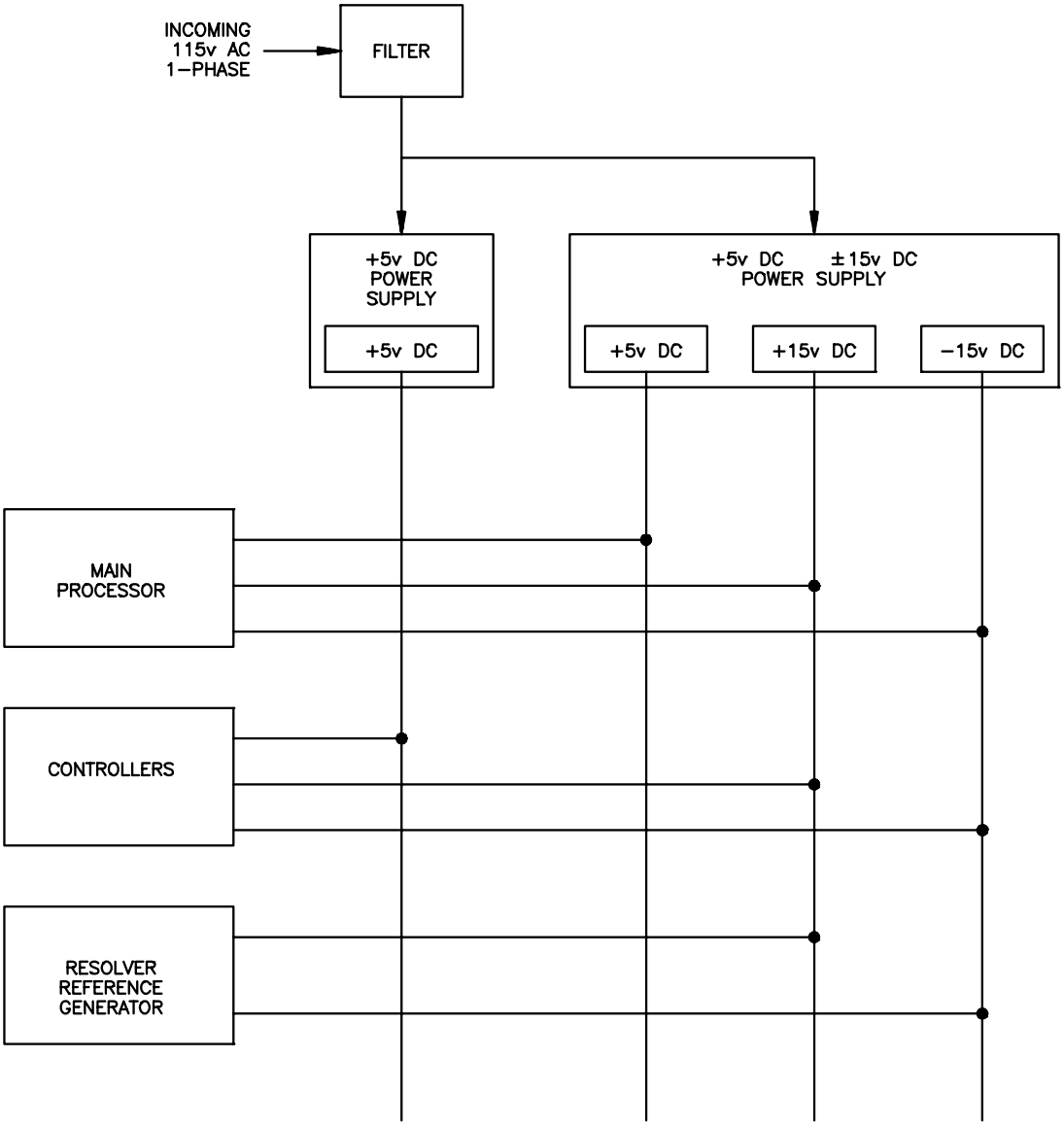


Figure 2-6 System Unit Distribution

2.1.6 Resolver Reference Generator

The Resolver Reference Generator (Figure 2-7) consists of a reference oscillator and amplifier. The reference oscillator generates a 2.6KHz Sine wave signal. The reference signal is amplified by a linear power amplifier which produces an 8v AC output capable of driving 8 resolvers. The amplifier's output is hard-wired to all of the controller slots.

The 2.6KHz Sine wave signal is used by the resolver-to-digital (R/D) converter as a reference signal. Resolver Axis Controllers also provide the reference signal to drive resolvers through their interface connectors.

The ACE-850 Encoder Axis Controller can provide the reference signal to any servo drive requiring a 2.6KHz signal.

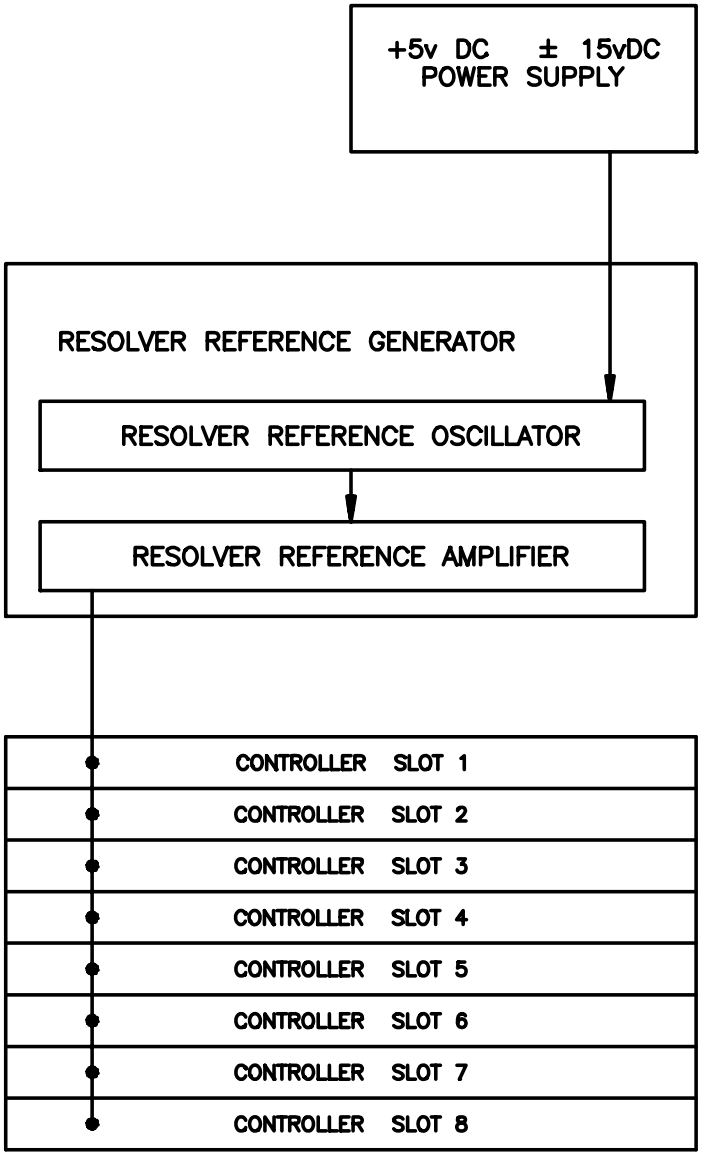


Figure 2-7 The Resolver Reference Generator

2.2 The MAC-850/32 Main Processor

The central processing functions of the Motion Control Systems are performed by the MAC-850/32 Main Processor (Figure 2-8). The Industrial Indexing System's operating system in conjunction with the user's control program utilize the central processing facilities to provide the system control functions.

The Main Processor also provides several external interface ports. The external interface ports allow the Main Processor to integrate external system components, such as, external PROMs, operator interfaces, and I/O expanders with the System Unit.

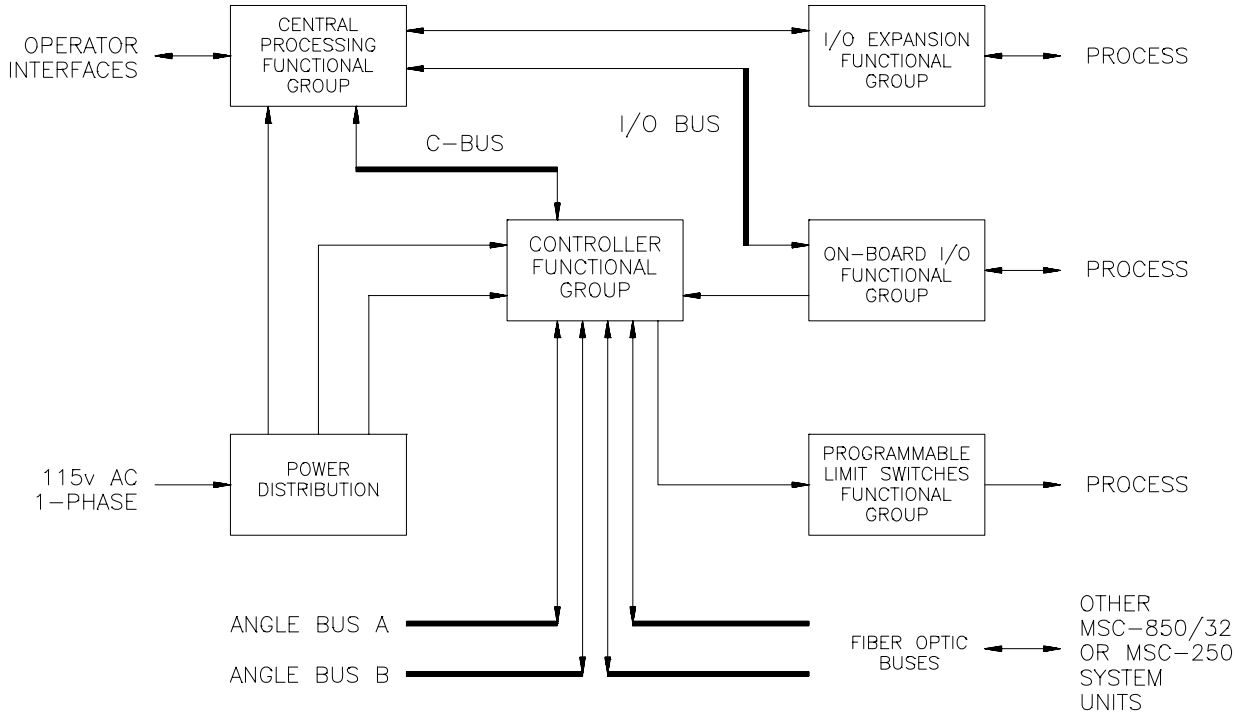


Figure 2-8 System Unit Functional Block Diagram

2.2.1 Operating System Firmware

The operating system is a 192K embedded software package residing in on- board firmware. The operating system firmware also provides access to 128K of nonvolatile memory for Macroprogram and data storage. Figure 2-9 illustrates the internal and external exchange of information being handled by the Main Processor.

The external interface ports (Figure 2-10) provide the Main Processor with an executive port, operator interface ports, an I/O expander port and an external PROM Pocket.

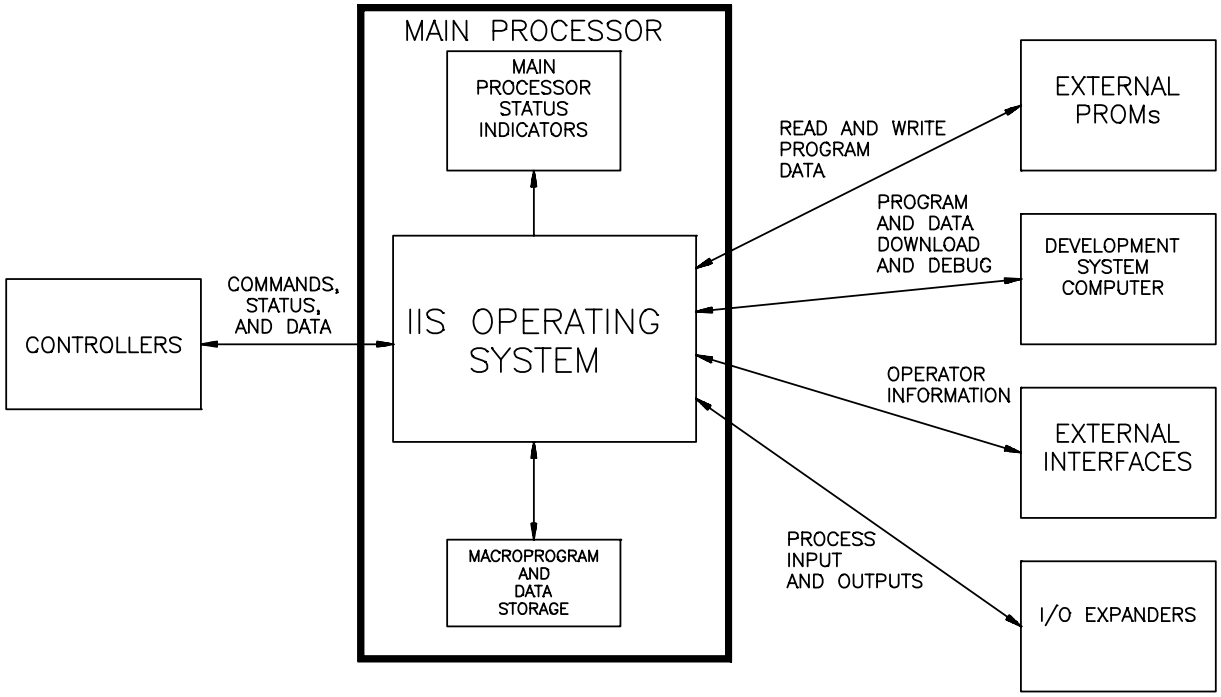


Figure 2-9 Main Processor Information Exchange

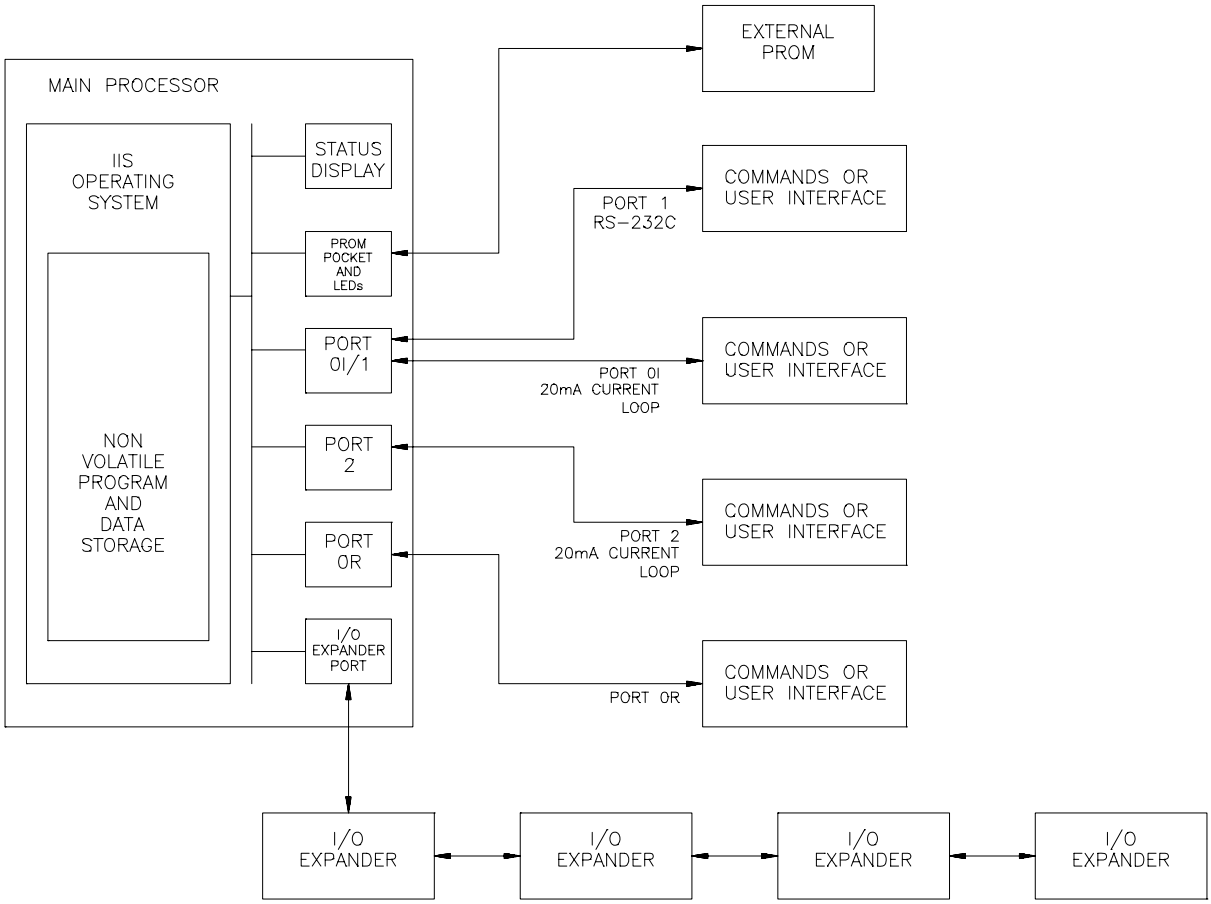


Figure 2-10 Main Processor External Interfaces

2.3 Connectors

Port 0 is configurable between 20mA current loop (Port 0I) or RS232C (Port 0R) using Macroprogram commands.

PORT 0I: This port uses the same 25-pin D-connector as PORT 1 (see PORT 1 below). This port is also configurable to be either an active or passive serial current loop.

PORT 0R: This port is a 9-pin D-connector RS232C serial communications port. It is accessible through the Macroprogram language for sending and receiving data and commands. (Refer to "Section 6" for proper cable pin-outs for this port.)

PORT 1: This 25-pin serial communications port can use either an RS-232C serial communications protocol or an RS-485 multidrop addressable protocol. It is used for communications with the computer using the MSC Tool Kit program. The SW2 switch on the printed circuit board must be set to allow proper communications. (Refer to "Section 6" for proper cable pin-outs for this port.)

PORT 2: This 20 mA current-loop serial port is used for communication with the Industrial Indexing Systems' OPI-1 and similar current-loop communications devices. It is accessible through the Macroprogram language for sending and receiving data and commands. (Refer to "Section 6" for proper cable pin-outs for this port.)

NOTE

An RS-232C to 20 mA converter is available from Industrial Indexing Systems, Inc. This converter allows the user to take advantage of the high-isolation characteristics of the 20 mA current-loop communications protocol.

I/O Expander Assemblies allow 64 discrete inputs or outputs to be connected to the Main Processor. The I/O expander port is a 15-pin connector dedicated to connecting an IOE-850 I/O Expander Assembly to the Main Processor. Three other IOE-850 I/O Expander Assemblies can be daisy-chain connected to the same I/O Expander port. The I/O scan time is increased to 1.2msec in Hi-Scan mode and 12msec in normal mode for each I/O Expander Assembly.

The I/O scan time defaults to 12msec for each I/O Expander Assembly. The Hi-Scan mode is enabled or disabled using the set_hi_scan and clr_hi_scan macro instructions.

External PROMs allow for up to 32K bytes of nonvolatile program/data storage. The PROM Pocket allows an Intel 27256-1 E-PROM or compatible to be connected to the Main Processor. Programs and data can be written to and read from the PROM with the Macroprogram Development System. Macroprogram commands can save and load programs, and write and read data from the PROM. The PROM Pocket has a write-protect feature which is controlled by an automatic write protect feature.

3.0 SPECIFICATIONS

3.1 Functional Characteristics

Serial Communication

Port 0:			
	Port 0I	20mA Current Loop	ASCII Programmable
	Port 0R	RS232C	ASCII Programmable
Port 1		RS-232C or RS-485 (Packet Protocol)	9600 Baud 1 Stop Bit 8 Data Bits No Parity
Port 2		20mA Current Loop	ASCII Programmable

Memory

Operating System	192K bytes
Program nonvolatile RAM	64K bytes
Data nonvolatile RAM	64K bytes
External EPROM	32K bytes

I/O Interface

On-Board, Discrete	8 Positions
Expansion, Discrete	64 Positions

Controller Slots 8 Positions

3.2 Performance Characteristics

System Unit

Input Power

Voltage	100v to 130v AC
Frequency	48Hz to 62Hz
Current	2A Maximum

Environmental

Operating Temp.	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90% (Non-condensing)

On-Board I/O Modules

Interrupt Response Time

Hardware	less than 1msec.
Software	less than 5msec.

S410

Type	DC Input
Voltage Range	10v to 32v DC
OFF Voltage	1v DC Minimum
ON Current	25mA @ 32v DC
OFF Current	0.8mA Maximum

S420

Type	AC Input
Voltage Range	90v to 135v AC
OFF Voltage	30v AC Minimum
On Current	15mA @ 120v AC
Input Impedence	10KΩ Nominal

S421

Type	AC Input
Voltage Range	180v to 270v AC
OFF Voltage	60v AC Minimum
On Current	15mA @ 240v AC
Input Impedence	10KΩ Nominal

S430

Type	DC Output
Voltage Range	10v to 55v DC
ON Current	2.75A Maximum
Voltage Drop (on-state)	2v DC Maximum
OFF Current (leakage)	10mA Maximum @ 55v DC

S440

Type	AC Output
Voltage Range	30v to 140v AC
ON Current	2.00mA Maximum
Voltage Drop (on-state)	1.5v AC Maximum
OFF Current (leakage)	4mA Maximum @ 140v AC

3.3 Physical Characteristics

Dimensions	
Height	15 $^{13}/_{16}$ in. (402 mm)
Width	11 in. (279 mm)
Depth	9 in. (51 mm)
Weight	15 lbs. (6.8 Kg.)
Mounting	Panel
Power Cable	6 foot cord (C-800006)

4.0 INSTALLATION

4.1 General

This section contains the specific information needed to properly install the MSC-850/32 System Unit. For maximum performance, it is recommended that the System Unit be installed in a NEMA 12 type enclosure and certain other criteria be met.

4.2 Enclosure Cabinet Requirements

Ideally, the System Unit, along with other related electronic components, should be mounted on a panel housed in a NEMA 12 enclosure. The enclosure should be mounted as far away as practical from noise generating devices, such as; SCR equipment, but should be within 100 feet (30 meters) of the drive motors being controlled.

4.3 Mounting The System Unit

The MSC-850/32 System Unit is designed for mounting on a grounded panel, and is secured to the panel with four #10 screws. Figure 4-1 gives the dimensions and screw hole locations.

Be sure to provide adequate space around the System Unit for ease of maintenance and proper ventilation. Typically, wire ways can be located up to 3 inches (76 mm) from the edge of the System Unit back plate. Figure 4-2 illustrates an example of the arrangement.

4.4 Cable Isolation Requirements

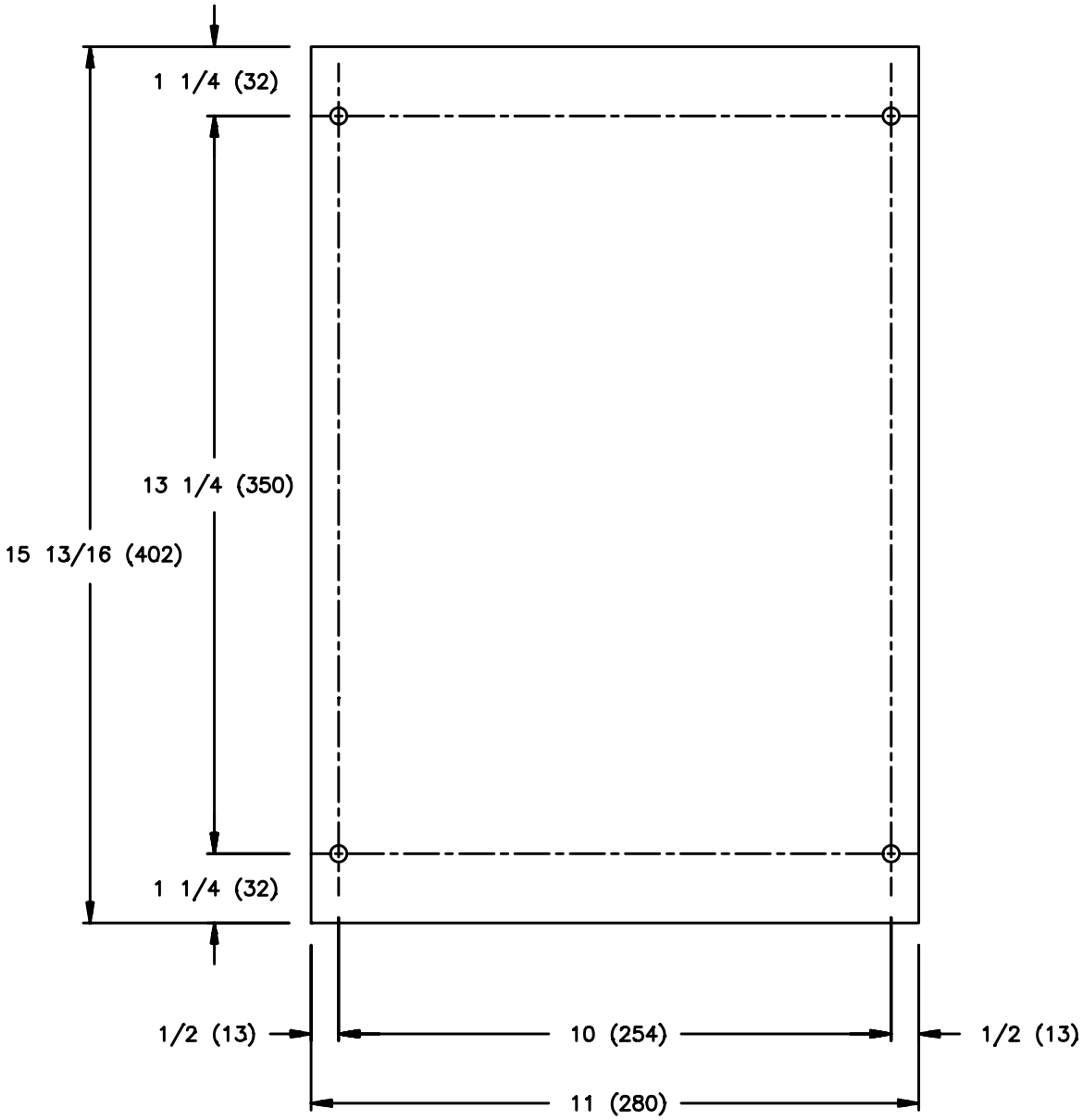
It is imperative that any low-voltage signal conductors, such as resolvers, encoders, drive commands, or communications, (15v or less) be routed in conduits or wire ways separate from high-voltage, such as motor cables, transformer lines, and I/O signal lines (100v or more). This will insure that electromagnetic fields produced by high power transmission do not corrupt the low level signals.

4.5 Grounding Requirements

The site must have a suitable earth ground rod and ground bus installed. The NEMA 12 enclosure, wire ways, conduits, and machine frame must be connected directly to this ground bus. All shields and other earth grounds must be connected to the MSC Ground Strip installed on the panel (Figure 4-2).

4.6 Power Isolation

The System Unit requires 115v AC, 1-phase power and is equipped with a line filter, fuse, and transient protection device. It is recommended that an isolating transformer be installed between the main power source and the outlet servicing the input power cord to the System Unit. The isolation transformer must be dedicated to the motion control system components. Other devices, such as; switched I/O, air conditioners, fans, and lighting, even though these devices are tied to the motion control system, must be powered by a separate AC power source.



Dimensions shown in inches (millimeters)

Mounting holes should be sized for #10 screws

Figure 4-1 Panel Mounting Dimensions for the System Unit

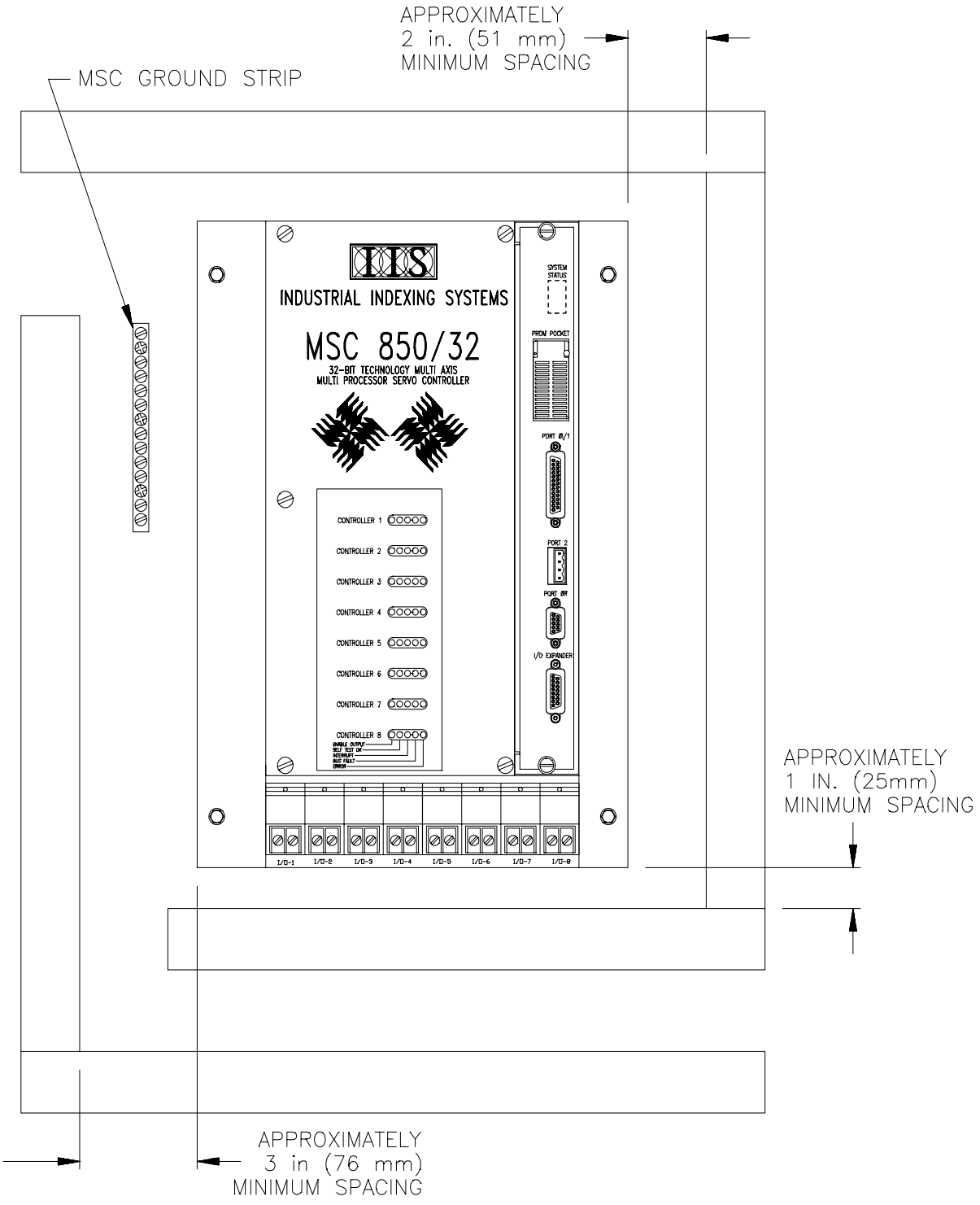


Figure 4-2 Typical Mounting of the System Unit

4.7 Installing The Face-plate

The face-plate is held on by five self-retaining screws. The face-plate is required for proper ventilation and also secures the controllers in their slots.

CAUTION

Proper installation of the face-plate is necessary for ventilating the System Unit. Be sure the face-plate has been properly installed before powering the System Unit.

To remove the face-plate, proceed as follows:

1. Hold the face-plate in place and loosen the five self-retaining screws.

2. Carefully pull the face-plate straight out from the System Unit.

To replace the face-plate, proceed as follows:

1. Set the face-plate in place and move it up and down to seat the controllers in the plastic spacers on the back of the face-plate.

2. Hand tighten the five self-retaining screws.

5.0 CONTROLS AND INDICATORS

5.1 General

The MSC-850/32 System Unit has a seven segment system status indicators on the face-plate of the Main Processor (see Figure 5-1). The status indicators of the controllers are visible through cutouts on the face-plate of the Unit Enclosure.

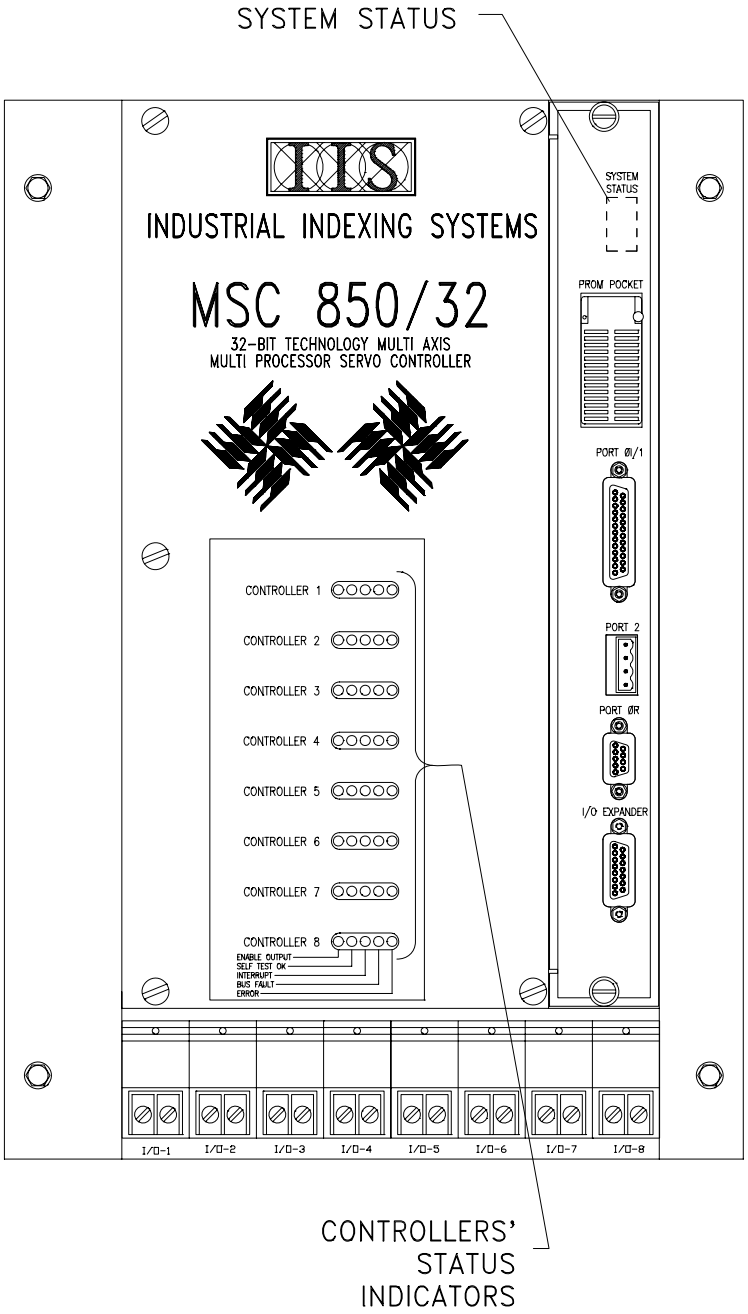


Figure 5-1 MSC-850/32 Status Indicators

5.2 Selector Switches

There are two 16-position rotary selector switches on the MAC-81X circuit board (see Figure 5-2).

MODE (SW1) - This selector switch is used to determine the operating mode of the controller.

Normal Operation = Port 0, 1, & 2 default to 9600 Baud - Packet Protocol.

Position 0 =Normal Operation, Port 0I enabled
Position 1 =Test Mode 1
Position 2 =Test Mode 2
Position 3 =Test Mode 3
Position 4 - 9 = Reserved

The Ports not mentioned in the following setting definitions stay at their "Normal Operation" defaults.

Position A = Normal Operation, Port 0R enabled
Position B = ort 3 = 19200 Baud - Packet Protocol.
Position C = Port 3 = 38400 Baud - Packet Protocol.
Position D = Port 1 = 19200 Baud - Packet Protocol.
Position E = Port 1 = 38400 Baud - Packet Protocol.
Position F = Reserved

These above port settings are only power up defaults, and can be changed by the users' Macroprogram at any time.

ADDRESS (SW2) - This selector switch is used in conjunction with communications Port 1. If this switch is in the "0" position, the port will communicate using the RS-232C serial communications protocol. Any of the other positions - 1 through F - are used to designate the node number of the controller when it is used for RS-485 serial communications.

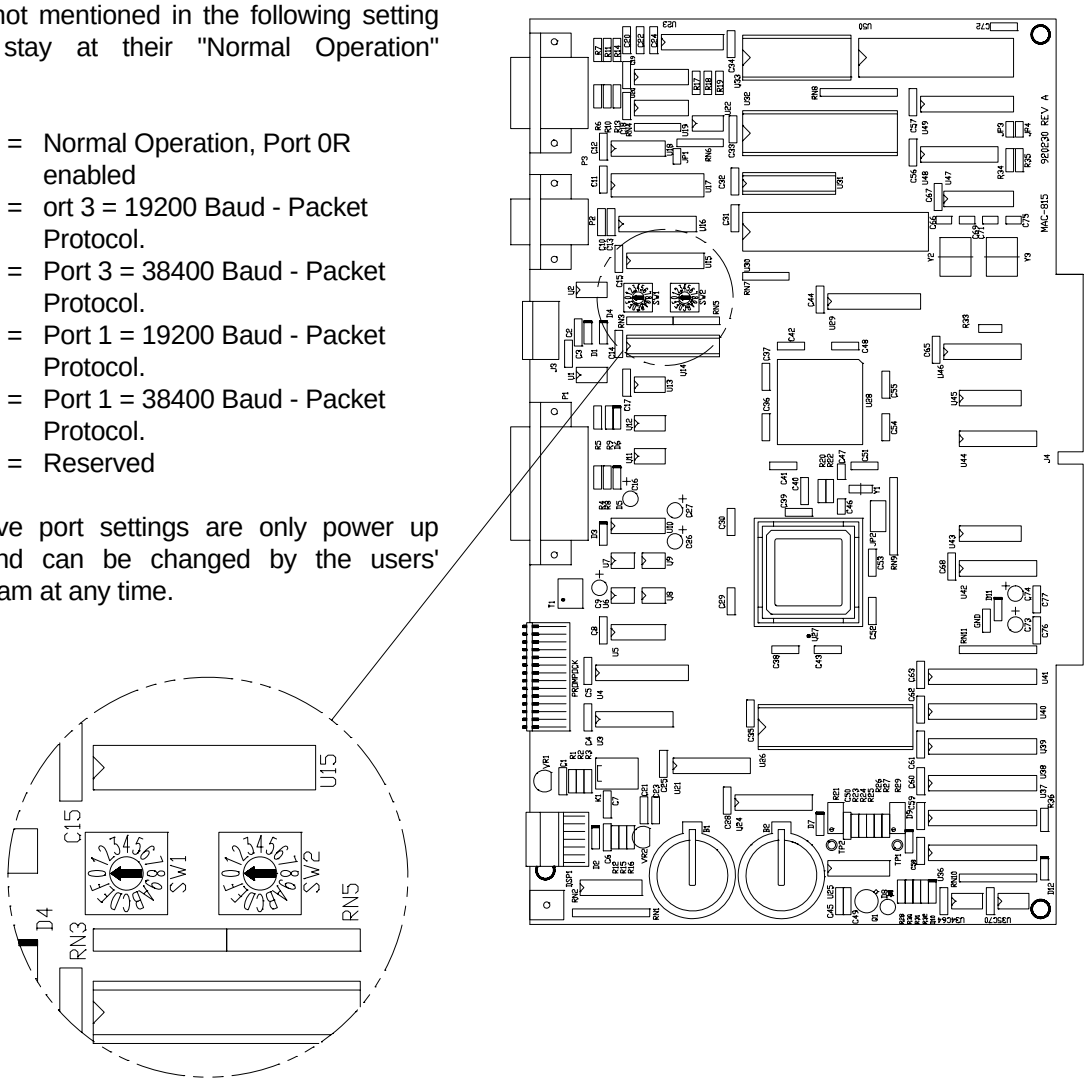


Figure 5-2 MAC-81X Selector Switch Locations

5.3 Indicators

The indicators located on the Main Processor (Table 5-1) of the System Unit provide status indication of various operating conditions. The status indicators of the controllers are desribed in the individual controller instruction books.

The indicator on an Output Type Module is illuminated when the MSC-850/32 System Unit turns the module on.

The indicator on an Input Type Module is illuminated when a user connected activating device turns the module on.

Table I - Main Processor System Status Indicator

SYSTEM STATUS

- A NORMAL
- L PROGRAM LOAD
- C SYSTEM RESET
- - LOW POWER
- P PROM READ
- U PROM WRITE
- H TEST MODE

PROGRAM ERRORS

- ī ILLEGAL COMMAND
- ō STACK OVERFLOW
- ū STACK UNDERFLOW
- n̄ SYS_FAULT
- r̄ SYS_RETURN
- L̄ ILLEGAL ARGUMENT

SYSTEM ERRORS

- 0 FIBER OPTIC
- 1 COM PORT 1
- 2 COM PORT 2
- 3 COM PORT 3
- 4 PROM WRITE
- 5 PROM READ
- 6 I/O EXPANSION
- 7 AXIS TIMEOUT

SYSTEM FAULTS

- 8 SYSTEM HARDWARE RESET
- E NV MEMORY LOSS
- F AXIS PROCESSOR
- 9 SYSTEM PROCESSOR

6.0 CONNECTION DIAGRAMS

6.1 General

This section contains the electrical connection diagrams for wiring the On-board I/O Modules and the pin-connectors for ports 0, 1, and 2.

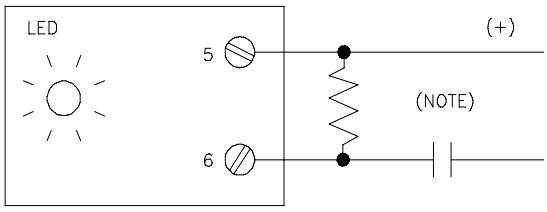
6.2 On-board I/O Modules

Figures 6-1 to 6-6 show the wiring of the six kinds of On-board I/O Modules.

NOTE

Some difficulty may arrise when driving high impedence input modules with solid state outputs. The OFF State leakage current of the Output device can be enough to keep the Input Modules OFF Voltage too high. This can in result intermittent false triggers or failure to be able to turn the Input Module OFF. It is suggested that the Input Modules OFF State voltage be checked when using this configuration. These OFF State voltages should be no greater than;

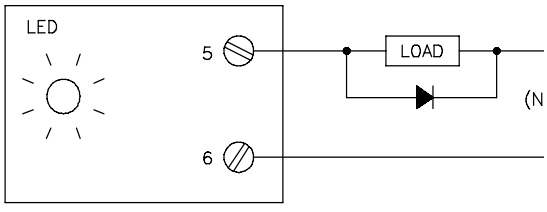
- 30v AC for AC Input Modules.
- 1v DC for DC Input Modules.



VOLTAGE RANGE: 10v to 32v DC
OFF VOLTAGE: 1v DC Min.
ON CURRENT: 25mA @ 32v DC
OFF CURRENT: 0.8mA Max.

NOTE: Higher voltages must be shunted with a resistor. Nominal value: 1K□, 1 WATT.

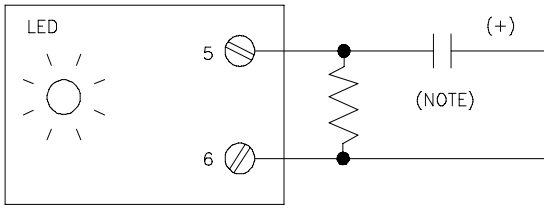
Figure 6-1 DC Input Module S410



VOLTAGE RANGE: 10v to 55v DC
ON CURRENT: 2.75A Max.
VOLTAGE DROP: 2v DC Max.
OFF CURRENT: 10mA Max.

NOTE: Diode Required for Inductive load.

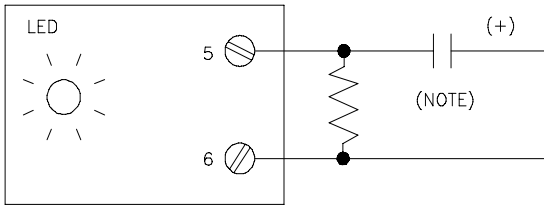
Figure 6-2 DC Output Module S430



VOLTAGE RANGE: 90v to 135v AC
OFF VOLTAGE: 30v AC Min.
ON CURRENT: 15mA
INPUT IMPEDANCE: 10K Nominal

NOTE: Higher voltages must be shunted with a resistor. Nominal Value:
3K, 5 WATT.

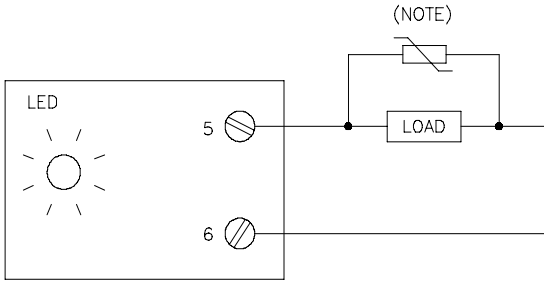
Figure 6-3 AC Input Module S420



VOLTAGE RANGE: 180v to 270v AC
OFF VOLTAGE: 60v AC Min.
ON VOLTAGE: 15mA @ 240v AC
INPUT IMPEDANCE: 10K Nominal

NOTE: Higher voltages must be shunted with a resistor. Nominal value:
6K, 10 WATT.

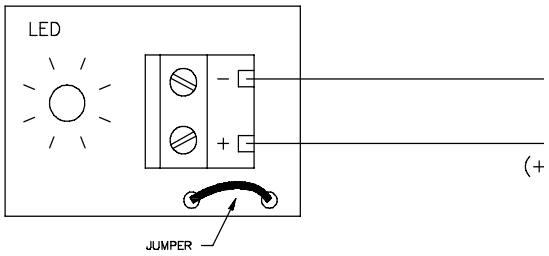
Figure 6-4 AC Input Module S421



VOLTAGE RANGE: 30v to 140v AC
ON CURRENT: 2.00A Max.
VOLTAGE DROP: 1.5v AC Max.
OFF CURRENT: 4mA Max.

NOTE: Required (use GE Transient Suppressor V150LA20A or equivalent).

Figure 6-5 AC Output S440



ON VOLTAGE: 12v to 24v DC
Jumper cut
5v Jumper installed
OFF VOLTAGE: 2v DC Max.
INPUT CURRENT: 20mA Max.

Figure 6-6 High Speed DC Input Module HSI-850

6.3 PORT 0 (0I/0R)

Port 0 is configurable between 20mA current loop (Port 0I) or RS232C (Port 0R) using Macroprogram commands.

Port 0I is a 20mA current loop port configurable for passive or active operation. Figures 6-7 and 6-8 show their respective connections.

Port 0R is a RS232C serial port. Figure 6-11 shows the connections for Port 0R.

6.4 PORT 1

Port 1 (Figure 6-9) is an executive port for the Macroprogram Development System or a host computer using RS-232C standard interface with Packet Protocol.

6.5 PORT 2

Port 2 (Figure 6-10) is a 20mA current loop port dedicated to passive operation.

NOTE
All ports on power-up will support Packet Protocol communications until re-configured by the user's macroprogram.

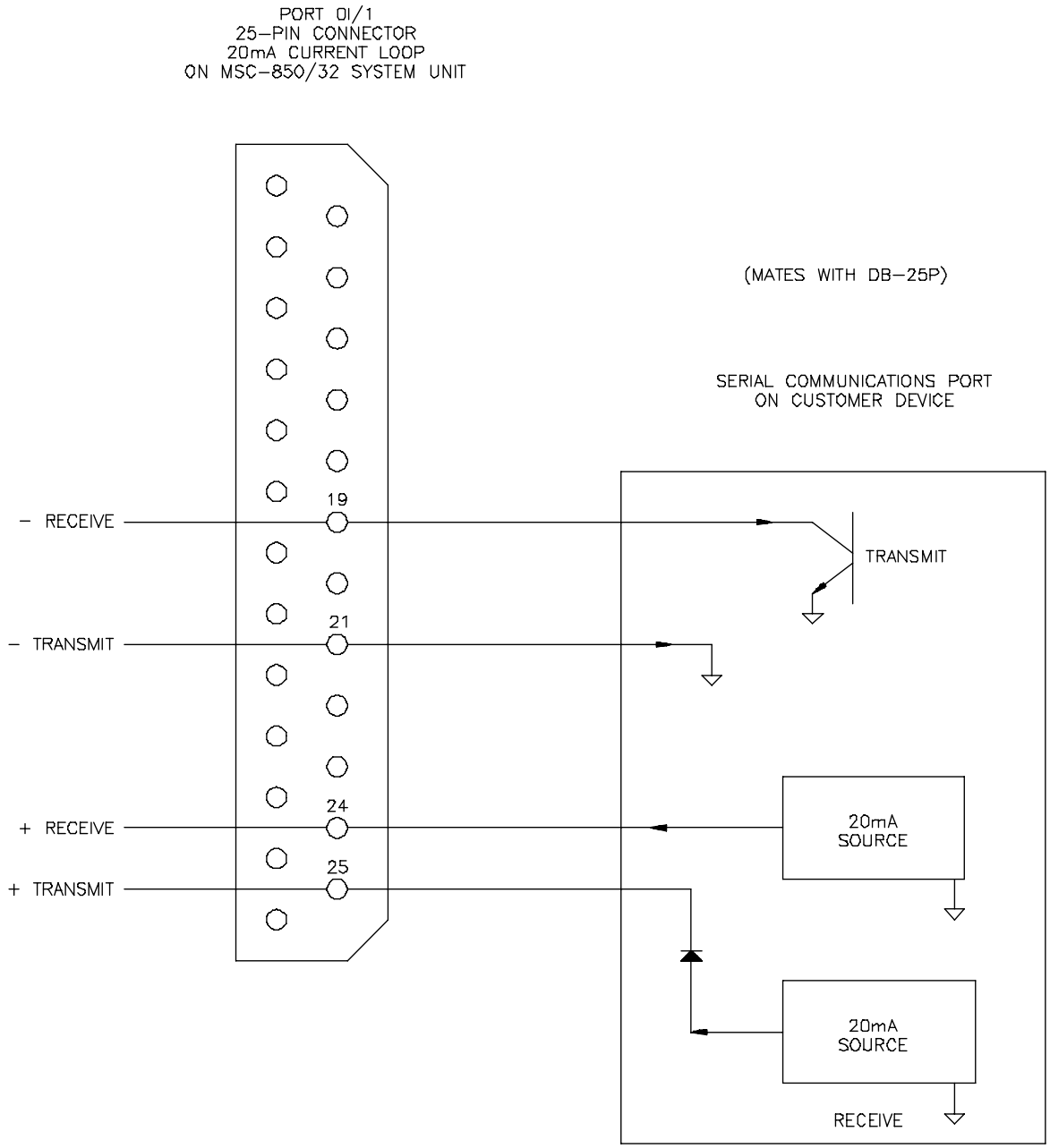


Figure 6-7 Port 0I Typical Passive Configuration

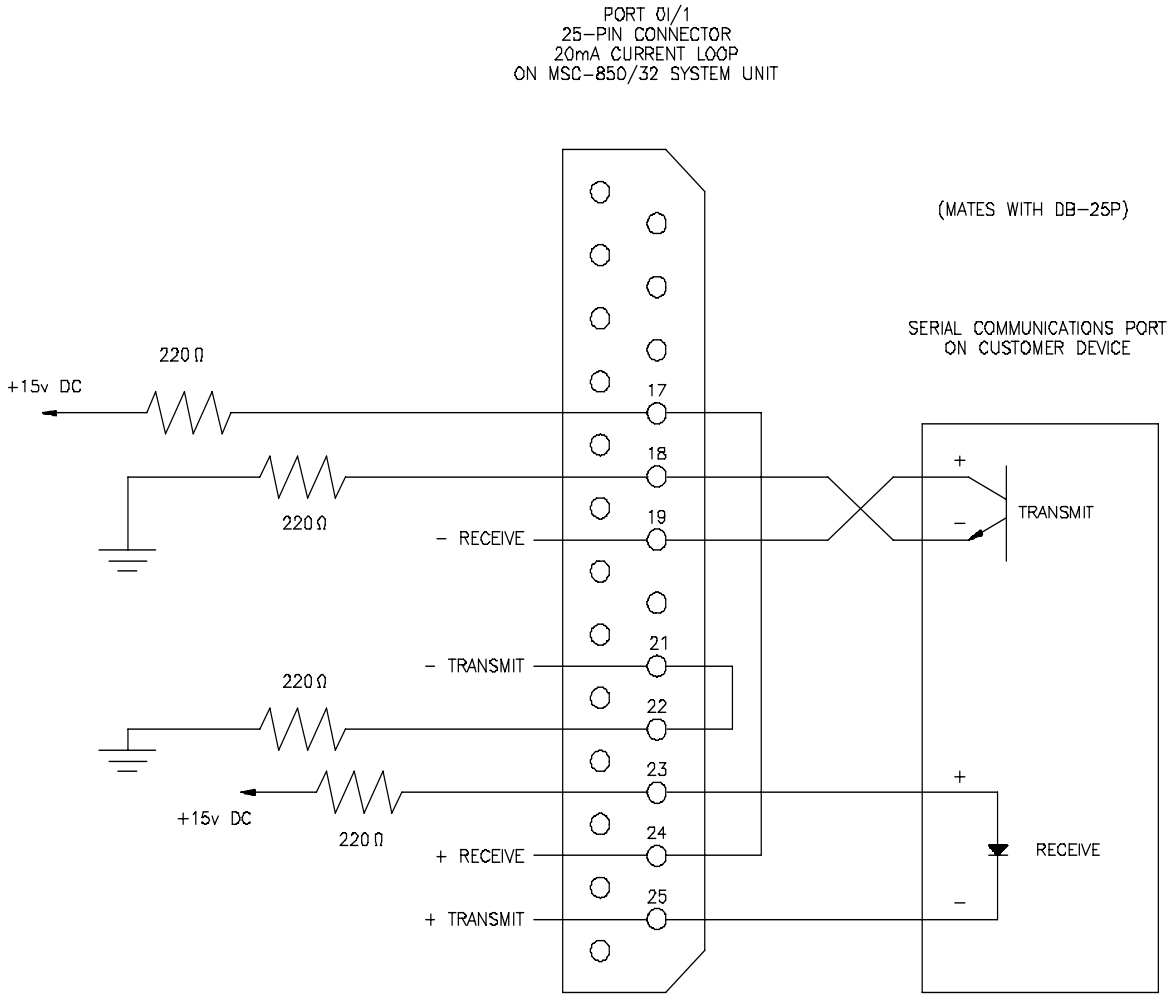


Figure 6-8 Port 0I Typical Active Configuration

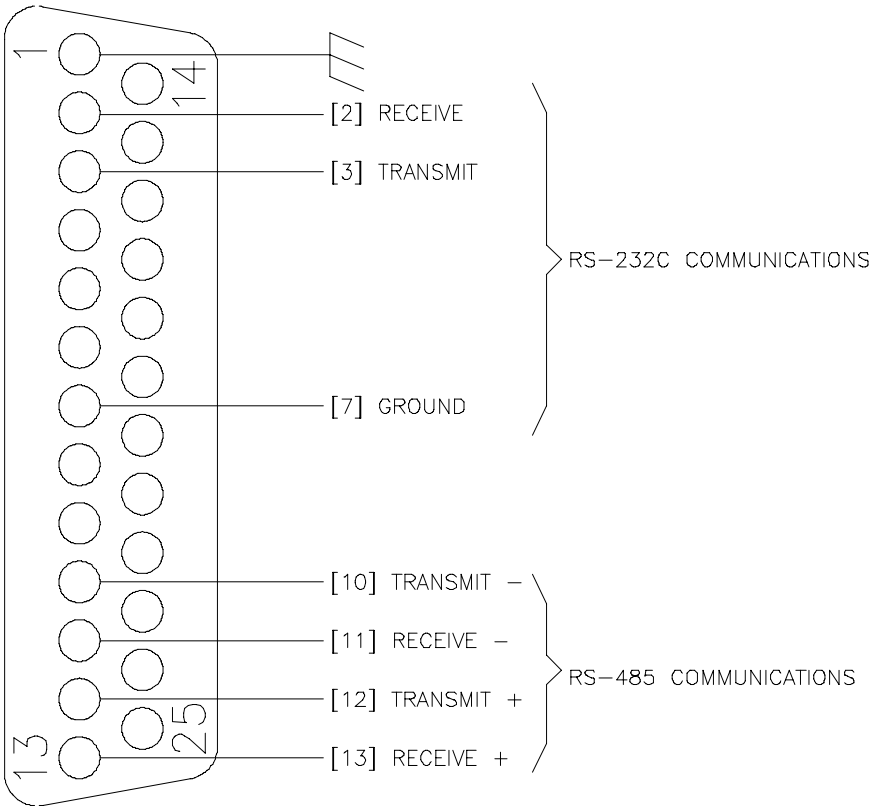


Figure 6-9 Port 1, RS-232C Host Computer Connections

NOTE

The last device in an RS-485 multidrop communications chain must have a 62 , ¼ watt terminating resistor connected between "Receive -" and "Receive +".

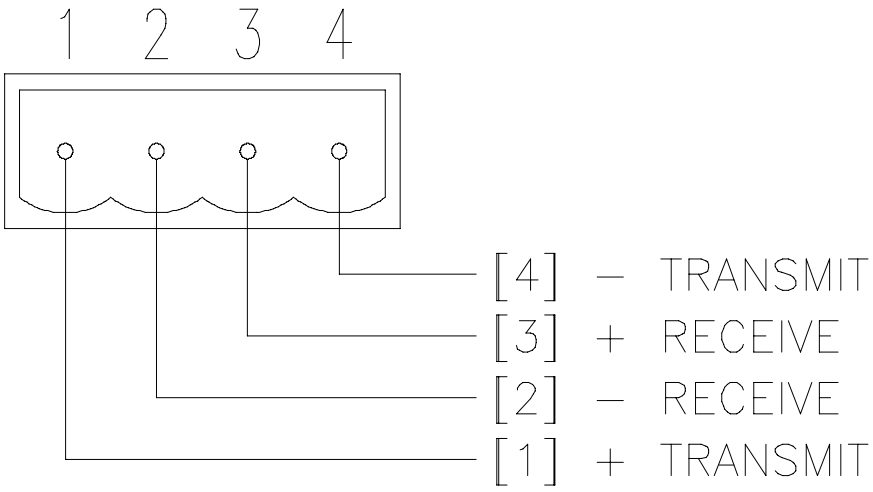


Figure 6-10 Port 2 Typical Connections

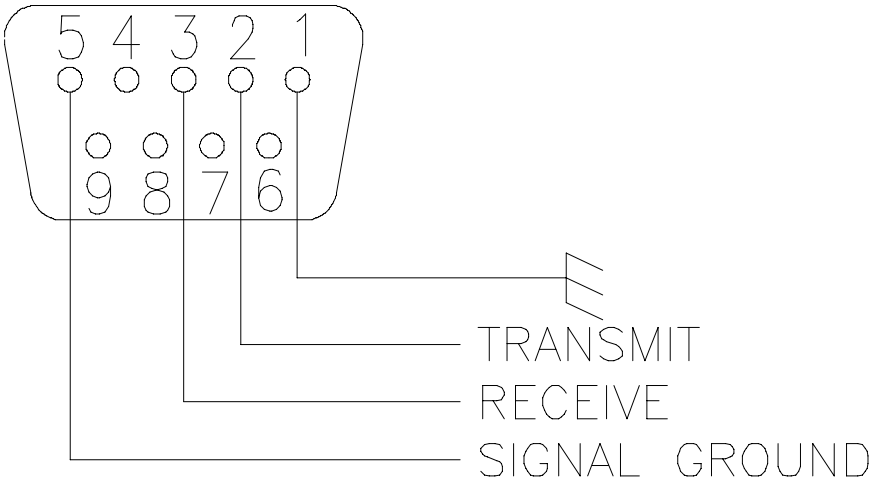


Figure 6-11 Port 0R Typical Connections

7.0 MAINTENANCE

WARNING

DISCONNECT ALL POWER AND FOLLOW PROPER LOCK-OUT PROCEDURES BEFORE ATTEMPTING REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT. ALLOW ONLY PROPERLY TRAINED PERSONNEL TO SERVICE THIS EQUIPMENT.

7.1 COMPONENT REPLACEMENT

Components which may require replacement on the MAC-81X include the batteries and the firmware. The batteries which protect the non-volatile memory must be replaced whenever the battery voltage drops below 2.6 V. This battery is located at the upper left of the MAC-81X circuit board (refer to Figure 7.1).

Industrial Indexing Systems, Inc. is continuously working to improve its products. Occasionally, these improvements are significant enough to warrant upgrades to existing controllers. These upgrades are supplied in the form of new firmware chips which must be replaced by the customer.

7.1.1 BATTERY REPLACEMENT

CAUTION

WHEN THE BATTERY IS REMOVED FROM THE CONTROLLER WITH ALL POWER TURNED OFF, ANY MACROPROGRAM STORED IN MEMORY WILL BE LOST. MAKE SURE THE MACROPROGRAM HAS BEEN BACKED UP ON A PROM OR CAN BE RESTORED FROM A PERSONAL COMPUTER BEFORE REMOVING THE BATTERY FROM THE CONTROLLER.

1. Turn off all power to the controller and open the cover.

2 .Locate the batteries on the circuit board and note the orientation of the positive and negative contacts of the battery.

3. Gently lift the metal spring clip which holds the battery in place and remove the old battery from the circuit board. **DO NOT FORCE THE SPRING CLIP UP TOO HIGH OR IT MAY BE DAMAGED.**

4. Gently lift the spring clip and replace with a similar type battery. Make sure the contacts are properly oriented.

7.1.2 FIRMWARE REPLACEMENT

1. Each firmware EPROM is located in LIF (Low Insertion-Force) sockets on the controller circuit board (refer to Figure 7.1).

> **NOTE**
>
> **When shipped, the EPROM chips will be labeled as SFO8045R for the main firmware or SFO8046R for the I/O co-processor firmware where the " " position represents a revision number. Each chip must be replaced in its proper socket. The main firmware is located in socket U26 and the I/O co-processor firmware is located in socket U33 (refer to Figure 7.1). If the wrong firmware is in the socket, a fault code will be displayed on the Status Display.**

2. Note the location of the #1 pin on the socket as indicated on the old EPROM chip in the socket.

3. Carefully remove the old processor chip by pulling straight up out of the socket so all sides of the chip move away from the socket evenly. Use of a properly-sized chip removal tool is recommended. **DO NOT PULL UP AT AN ANGLE OR UNEVENLY! DO NOT ROCK THE CHIP TO REMOVE IT FROM THE SOCKET!**

4. Gently set the new chip on the LIF socket making sure the #1 pin is aligned in the correct socket.

5. Check to make sure all pins of the chip are started in the holes in the socket. **DOUBLE CHECK!**

6. Gently press the chip straight down into the socket. **DO NOT ROCK THE CHIP TO INSERT IT OR PRESS IN AT AN ANGLE!**

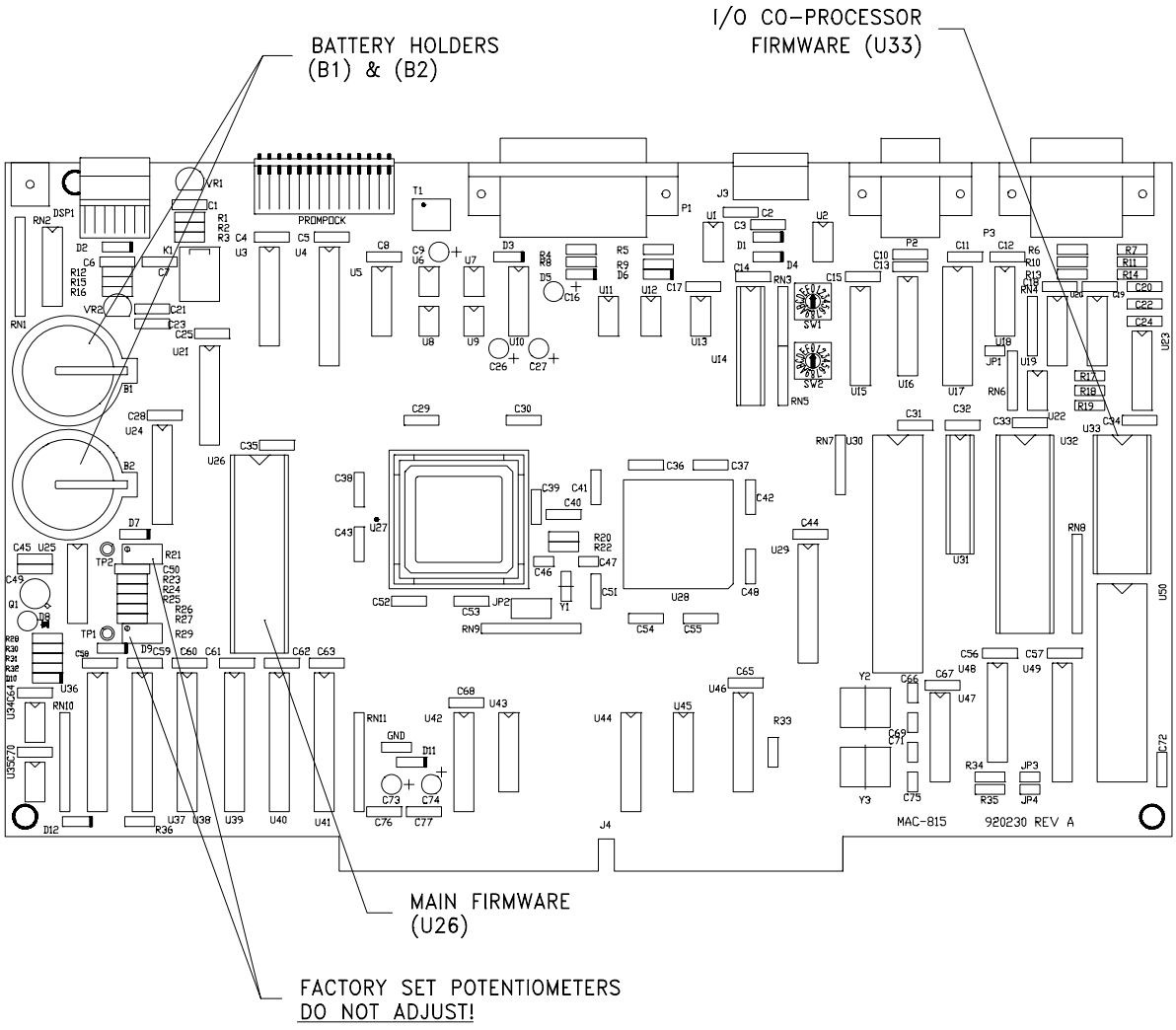


Figure 7.1 - MAC-81X Firmware and Battery locations

TRADEMARKS

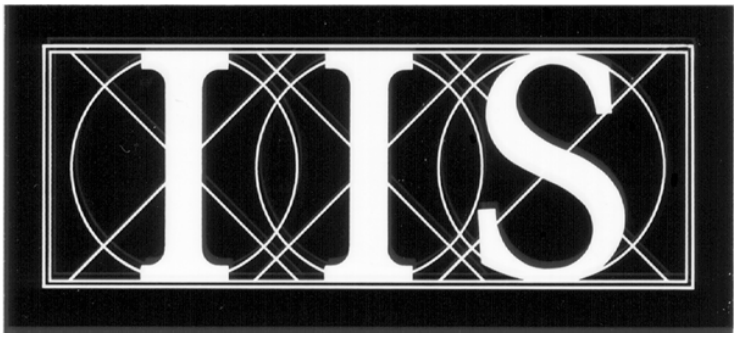
Industrial Indexing Systems, Inc. reserves the following trademarks:

- Macroprogram Development System
- MSC-850/32 Motion Control System Unit

The following trademarks of other companies are used in this publication:

- IBM PC is a trademark of International Business Machines, Inc.
- GE is a trademark of the General Electric Company, Inc.

IB-11B014



INDUSTRIAL INDEXING SYSTEMS INC.

626 FISHERS RUN
VICTOR, NEW YORK 14564

(585) 924-9181
FAX: (585) 924-2169

PRINTED IN USA