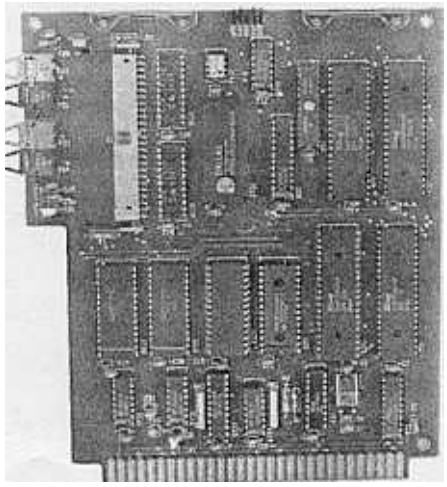
IB-11B004

MOTION CONTROL SYSTEM, MSC-850

OCTOBER
1989



MCF-850 MULTI-FUNCTION CONTROLLER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, INC.

ER-6015

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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 based Motion Control System. It provides information about the MCF-850 Multifunction Controller (Figure 1-1) including a product overview, product description, product specifications, description of controls and indicators, and connection diagrams.

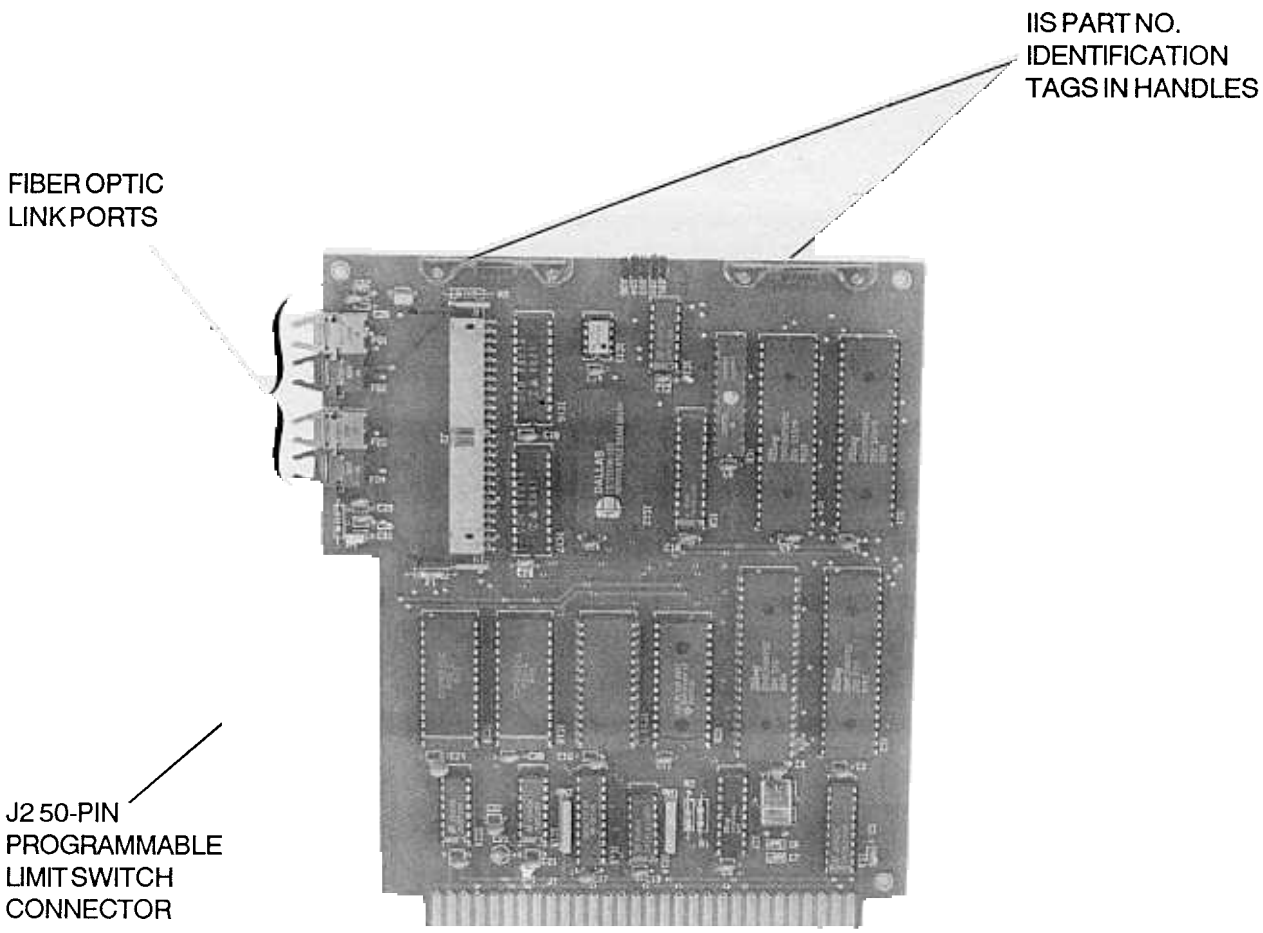


Figure 1-1 MCF-850 Multifunction Controller

1.2 Product Overview

The MCF-850 Multifunction Controller is an edge connector printed circuit board that can be plugged into any one of the controller slots of the MSC-850 System Unit. As the name implies, this controller can be used to perform a number of different functions as follows;

- Pseudo Axis - A command generator used to generate angle data in terms of acceleration, speed, and distance.
- Programmable Limit Switching - Provides programmable position dependent outputs to simulate cam or drum switching.
- Nonvolatile Data Storage - Provides an additional 32K bytes of nonvolatile RAM that can be accessed as data arrays by the Macroprogram for storing and saving data.
- Fiber Optic Link - Provides High Speed inter-controller data buses for transmission of master angle data from one MSC-850 System Unit to another.

To provide these functions, the MCF-850 Multifunction Controller has several data paths as illustrated in Figure 1-2. These data paths are defined by Macroprogram instructions.

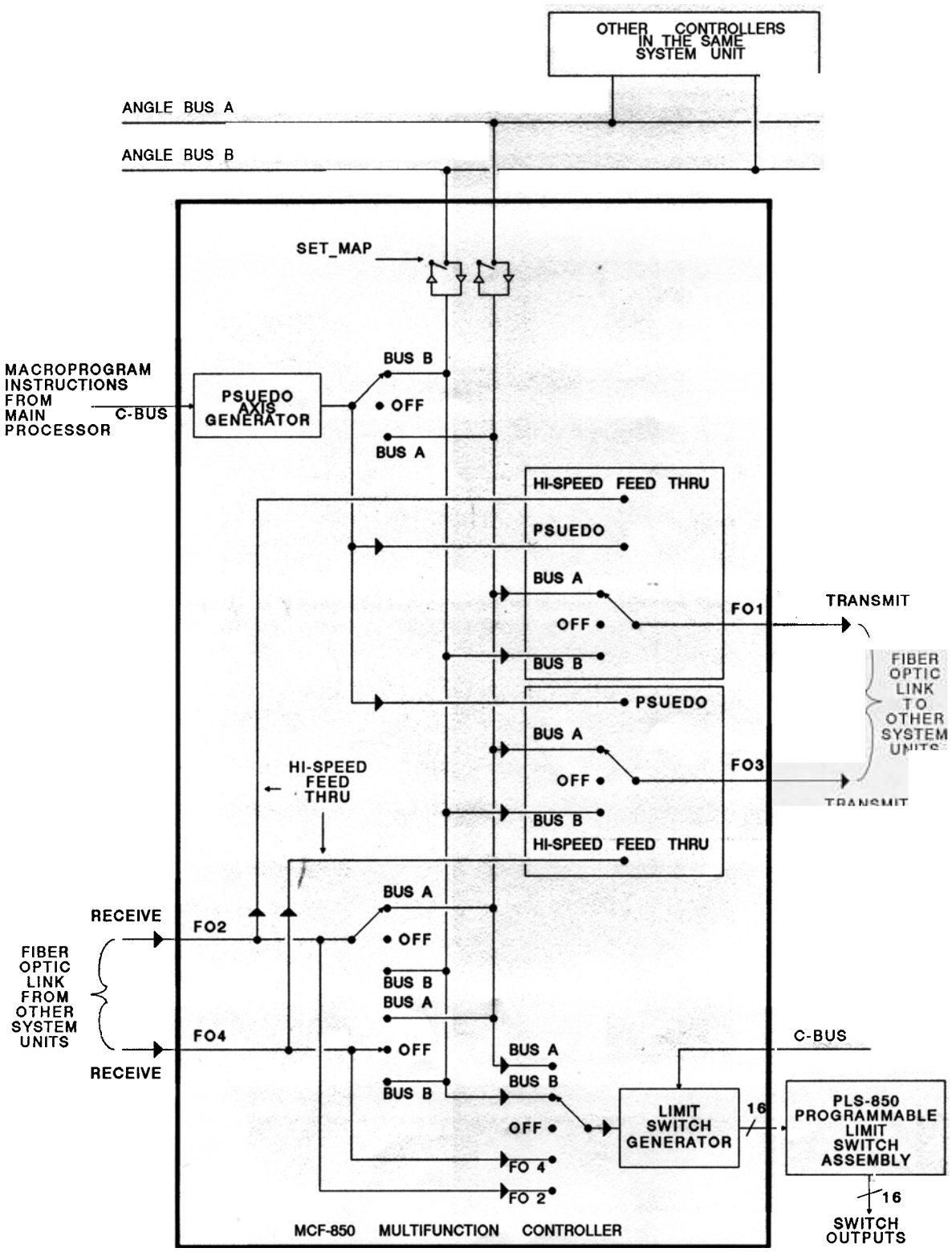


Figure 1-2 MCF-850 Multifunction Controller, Data Paths

2.0 DESCRIPTION

2.1 General

The MCF-850 Multifunction Controller is an intelligent circuit board that provides complementary functions to the MSC-850 Motion Control System.

2.2 Pseudo Axis Functional Description

The Multifunction Controller can be used to accept motion commands which act on an imaginary motor called the pseudo axis. The pseudo is capable of:

- o velocity control
- o positioning
- o indexing
- o master/slave

The pseudo axis (Figure 1-2) is typically used as a master and its command data can be broadcast through software configured switches ('set_map' and 'set_mcf') to one of the Angle Buses in the same MSC-850 System Unit. The pseudo axis output can also be sent over Fiber Optic Links to either of the Angle Buses in other MSC-850 System Units. Other axis controllers can lock onto this angle data.

The pseudo axis may also be used to provide angle data in programmable limit switch applications when an active or passive master is not available.

The motion control commands generated by any of the controllers assigned and locked to the same Angle Bus, are now synchronized to the pseudo axis of the Multifunction Controller.

The pseudo axis can perform any motion that a motion control axis can perform, including certain master/slave locks (refer to IB-11C001 for specific lock types available). The pseudo axis cannot perform any cam profiles.

2.3 Programmable Limit Switch Functional Description

The MCF-850 Multifunction Controller in conjunction with the PLS-850 Programmable Limit Switch Assembly is used to produce position related outputs. These outputs can simulate the functions of mechanical cam switching and drum switching techniques.

The Macroprogram can command the Multifunction Controller to produce an output that closes or opens a solid state relay switch (OPTO 22 type Output Module mounted on the PLS-850 Assembly) at a specific angle for each revolution of the feedback device's shaft. Since the Multifunction Controller does not have a direct position sensor input, the position information is provided through an Angle Bus or Fiber Optic Link (Figure 1-2).

The angles are entered as bits of a revolution with a resolution of 1 part in 4096, where 0 bits is equal to 0 degrees and 4095 bits is equal to 359.9 degrees. Each output can be programmed for one on-angle and one off-angle. For example: on at 1000 and off at 2000 means that an output is on when the feedback device's shaft is between 1000 bits (87.9 degrees) and 2000 bits (175.8 degrees) regardless of the direction of rotation.

The PLS-850 Assembly (Figure 2-1) on which the output modules are mounted requires a separate 115V ac power source. The assembly can support 16 modules of either the DC or AC output type. The assembly is connected through a 50-pin 2-ft. (610 mm) flat ribbon cable (supplied as part of the PLS-850 Programmable Limit Switch Assembly) to the MCF-850 Multifunction Controller.

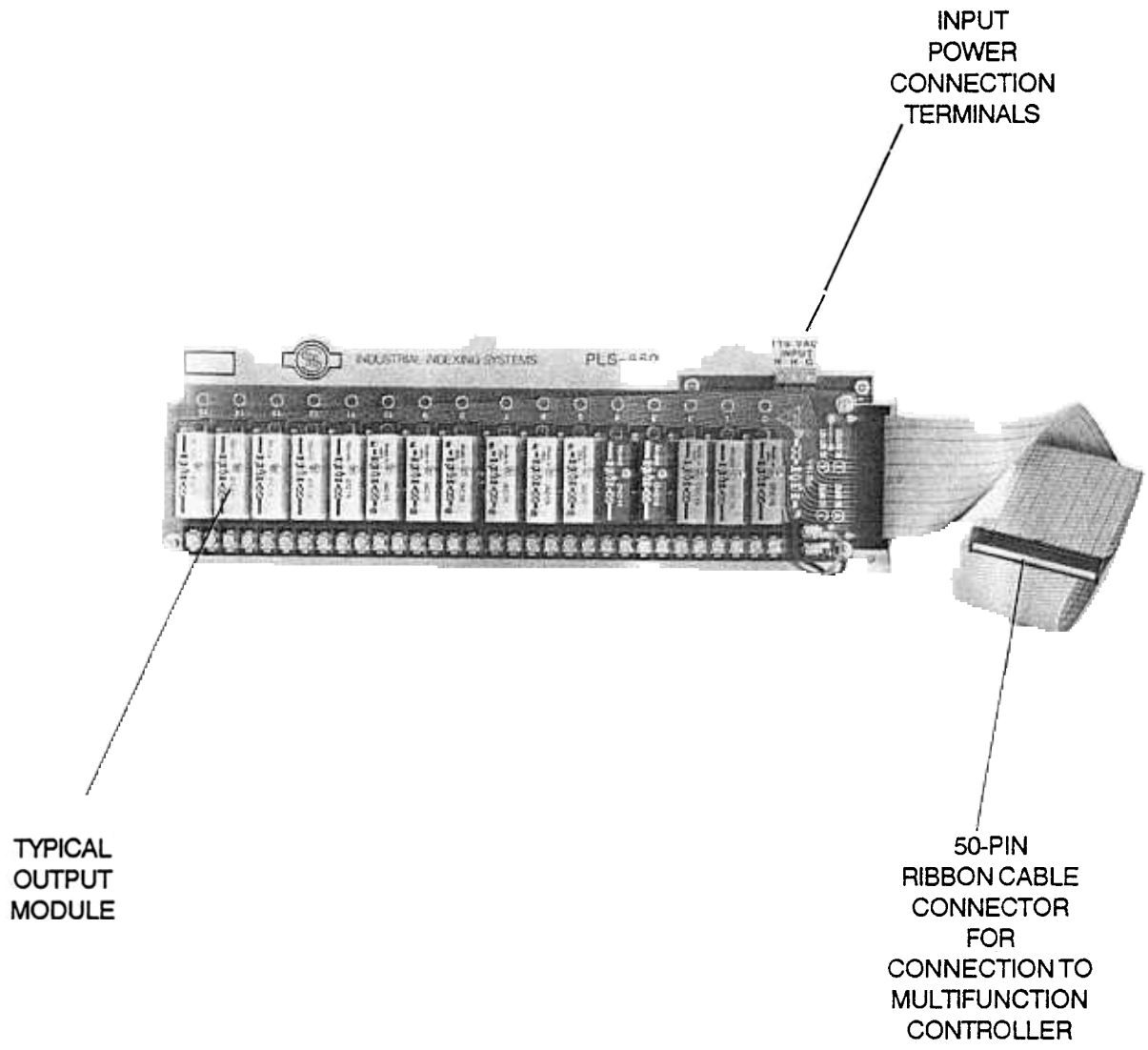


Figure 2-1 PLS-850 Programmable Limit Switch Assembly

2.4 Fiber Optic Link Functional Description

The Multifunction Controller can be used to connect the Angle Buses of multiple System Units together through a Fiber Optic Communication Network. Fiber Optic transmission of data is done at high speeds and can provide excellent noise immunity. Each System Unit in the network must have a Multifunction Controller and the distance between System Units cannot exceed 100 feet (30 Meters).

The controller has 4 Fiber Optic Link ports. Two of the ports are transmit ports and 2 of the ports are receive ports. Any transmit port on one Multifunction Controller can physically be connected to any receive port on another Multifunction Controller. This is done through software switches (Figure 1-2) over the Fiber Optic Communication Network (Figure 6-3). The Macroprograms, unique to each System Unit, instruct their respective controllers to create the link for transmission of master angle data from either Angle Bus of one System Unit to either angle bus of the other System Unit.

The Angle Bus in each System Unit is internally synchronized to its own unit's system clock. The Multifunction Controller takes the master angle data once every millisecond and transmits it over the Fiber Optic Link in a synchronous format. The master angle data being transferred between the two System Units is handled by the sync-encode / sync-decode functions on the Multifunction Controller.

A high-speed feed through path is provided to allow the angle data to pass from one System Unit to another without the 1 millisecond delay caused by the angle bus in the interconnecting System Unit (Figures 1-2 and 6-3).

2.5 Nonvolatile Data Storage Functional Description

The MCF-850 Multifunction Controller contains 32K bytes of nonvolatile RAM that can be used to store program data. The method of accessing this RAM is identical to the method used to access data arrays in the System Unit. Refer to the Macroprogram Development System Instruction Book for a detailed explanation of this method.

2.6 Status and Fault Indicators

2.6.1 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 and remains lighted even if a subsequent fault occurs. On start-up, the SELF TEST OK indicator may also be lighted along with the yellow INTERRUPT and red BUS FAULT indicators. If this combination of indicators are lighted on start-up, a controller start-up fault has occurred. This may or may not be the fault of 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.

2.6.2 Status Indicators Description

During normal operation, the SELF TEST OK indicator is lighted. As the Macroprogram executes the required instruction and the 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.

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

3.1.1 Pseudo Axis Functions

Commands	Velocity Positioning Indexing

3.1.2 Programmable Limit Switch Functions

Hardware Outputs	16 industry standard ODC15 and OAC15 output type solid state relay modules
Optically Isolated Output Modules	
AC Output Module (OAC15)	
Operating Voltage Range	12 to 140V ac
Current Rating @ 70 C	2 Amps Max
Output Voltage Drop (Peak)	1.6V ac Max
Off-state Leakage @ 120V ac	5 mA rms
DC Output Module (ODC15)	
Operating Voltage Range	5 to 60V dc
Current Rating @ 70 C	2 Amps Max
Output Voltage Drop	1.6V dc Max
Off-state Leakage @ 60V dc	1 mA
Software Outputs	8 polling flags of which 4 can cause software interrupts
Source of Angle Data	Programmable from either Angle Bus or either Fiber Optic Link.

3.1.3 Fiber Optic Link Functions

Data Ports	2 Transmitters 2 Receivers
Data Type	Master Angle Data with synchronization

3.1.4 Data Storage Functions

Data Retention Method	Nonvolatile RAM
Storage Space	32 K Bits
Data Type	Macroprogram variables

3.2 Performance Characteristics

3.2.1 Pseudo Axis Functions

Positional Range	+/- 2047 Revolutions
Positional Resolution	1/4096 Revolution increments
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

3.2.2 Programmable Limit Switch Functions

Reaction Time Delay	
Hardware Outputs	
Type ODC15	1.2 milliseconds max
Type OAC15	1.2 milliseconds + line cycle
Software Flags	Program dependent
Input Power	
Voltage	100 to 130V ac
Frequency	48 to 62 Hz
Current	0.5 A max

3.2.3 Data Storage Functions

Nonvolatile RAM Battery Life	7 years min @ 25 C

3.2.4 Environmental

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

3.3 Physical Characteristics

3.3.1 MCF-850 Multifunction Controller

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 MSC-850 System Unit

3.3.2 PLS-850 Programmable Limit Switch Assembly

Dimensions	
Height	5 in. (127 mm)
Width	15 3/4 in. (400 mm)
Depth	2 1/2 in. (63.5 mm)
Weight	3 lbs (1.36 Kg)
Mounting	Panel

3.3.3 Fiber Optic Link Cable

Length	100 ft. (30 M) Max

4.0 CONTROLS AND INDICATORS

4.1 General

The MCF-850 Multifunction Controller 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 are no setable devices on the MCF-850 Controller. All parameters and functional controls are established by the Macroprogram.

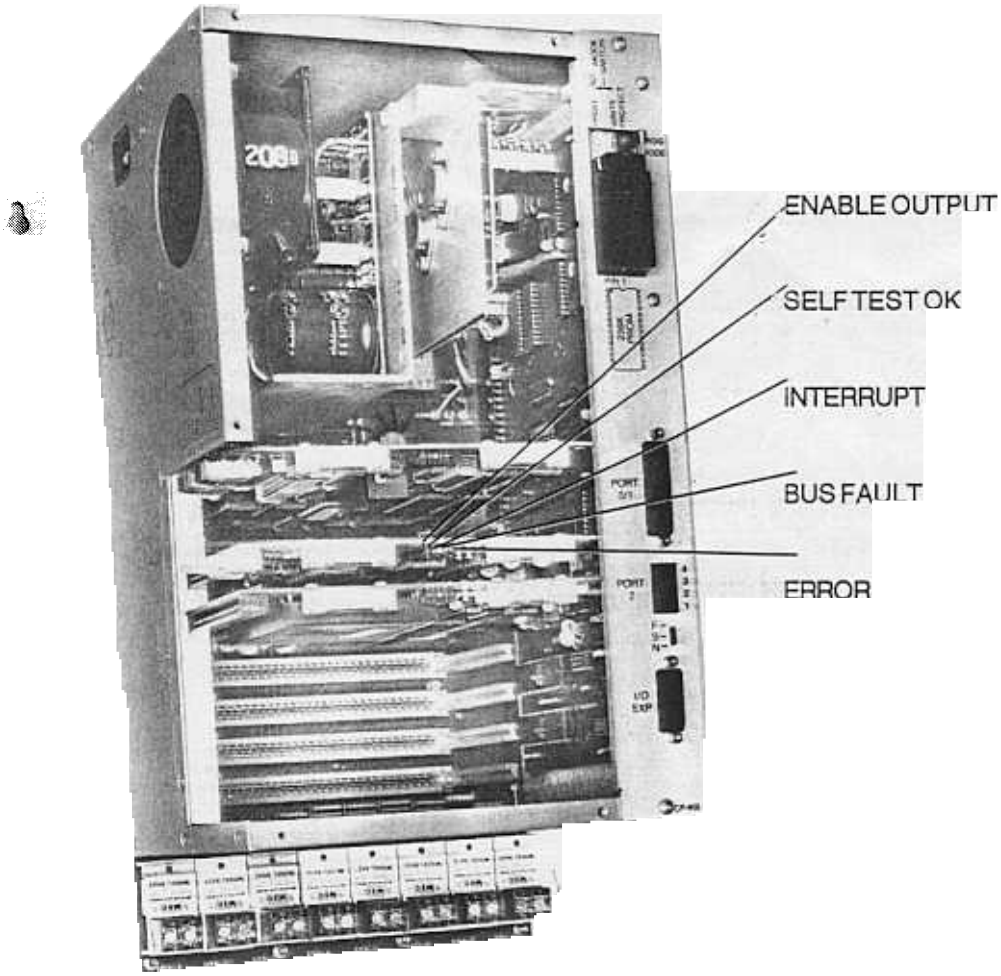


Figure 4-1 Identification of Status Indicators

Table 4-1 Identification of Status Indicators

PANEL MARKING	DESCRIPTION	OBSERVED INDICATION	INDICATION FUNCTION
ENABLE OUTPUT	Green LED	Steady On	When angle data to PLS-850 function is zero.
SELF TEST OK	Green LED	Steady On	The controller passed the self test during start up.
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 Main Processor was faulty. A subsequent good communication sequence resets the BUS FAULT indicator.
ERROR	Red LED	Flashing	A controller fault has been detected.

NOTE

If, during start up, the SELF TEST OK, INTERRUPT, BUS FAULT and ERROR indicators 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 MCF-850 Multifunction Controller has 4 different functions. These functions can be used independently or in any combination.

For an MCF-850 Multifunction Controller that is performing multiple functions, a simple observation can indicate the controller's functionality. That is:

- If just one function is not operating properly then the problem may not be on the controller and the tests described in this section can help isolate the fault. The tests provided in this section treat each function independently.
- If all functions are not operating properly, then the controller is probably faulty. In this case the controller should be replaced and if the functions are still not operational, then the problem is probably in the MSC-850 System Unit.

5.2 Pseudo Axis Functions

If the Multifunction Controller is performing the pseudo axis function and the Motion Control System seems to be lacking this information, proceed as follows:

1. Turn off the system power.
2. Check to make sure the controller is in the correct slot based on your Macroprogram and is properly seated in the connector.
3. Verify that the 'set_map' instruction in the Macroprogram is directing the angle data generation command to the correct slot in the System Unit. Refer to 'set_map' instruction in the Macroprogram Development System Instruction Book.
4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.
   - The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.
   - If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.3 Programmable Limit Switch Functions

When the MCF-850 Multifunction Controller is operating as a programmable limit switch, it works in conjunction with a ribbon cable and a PLS-850 Programmable Limit Switch Assembly. The output module logic circuits on this assembly are powered by an on-board 15V-dc Power Supply. This power supply is connected to a 115V-ac source. The following tests can help isolate the faulty element in this group of components.

5.3.1 Mechanical and Software Tests

1 Turn off system power.

2. Check to make sure the controller is in the right slot and is properly seated in the connector.

3. Verify that the Macroprogram is directing the programmable limit switching commands to the right slot in the Svstem Unit.

4. Restart the system and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.

   o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.

   o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.3.2 PLS-850 Programmable Limit Switch Assembly Tests

1. Turn on the system power

2. Observe the indicators on the PLS-850 Programmable Limit Switch Assembly in which output modules are located. If none of the indicators are lighted, proceed as follows:

   o Set a Multimeter to the 15V-dc scale.

   o Connect the red and black meter leads to the + and - terminals located next to the ribbon connector.

   o The meter should indicate 15V dc +/-1V dc. If the 15V-dc indication is within specifications, go to step 3. If not, proceed as follows.

   o Set the Multimeter to the 115V-ac scale.

WARNING

Lethal voltages. Proceed with caution.

   o Connect the meter leads to the "N" and "H" terminals.

   o The meter should indicate between 100 and 130 V ac.

   o If the meter indication is within specification, replace the PLS-850 Programmable Limit Switch Assembly. If out of specification, check the incoming power cord and the ac power source.

3. Turn off the system power and check the 50-conductor ribbon cable between the PLS-850 Programmable Switch Assembly and the controller for open conductors or shorts between conductors.

   - o Replace the PLS-850 Programmable Limit Switch Assembly if any problems are suspected.
   - o Turn on the system power and if problems still exists, replace the MCF-850 Multifunction Controller.

NOTE

Output Module must be installed for LED to function.

5.4 Fiber Optic Link Functions

When the MCF-850 Multifunction Controller is operating as part of a Fiber Optic Network, multiple controllers linked together with fiber optic cables are involved. Any of these elements can be at fault. The following tests help isolate the faulty component.

5.4.1 Mechanical and Software Test

1. Turn off the system power.
2. Check to make sure the cards are properly seated in the controller slots.
3. Verify that the Macroprogram is directing the transmit and receive commands to the correct ports of both controllers and to the right slots in each of the System Units .
4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controllers.

   - o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.
   - o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.4.2 Light Transmission Tests

The light transmission tests are conducted by visually checking for the presence of light at the source and destination at each Multifunction Controller in each System Unit in the Fiber Optic Network. This is accomplished by following the instructions in the Fiber Optic Network Troubleshooting Chart, Figure 5-1.

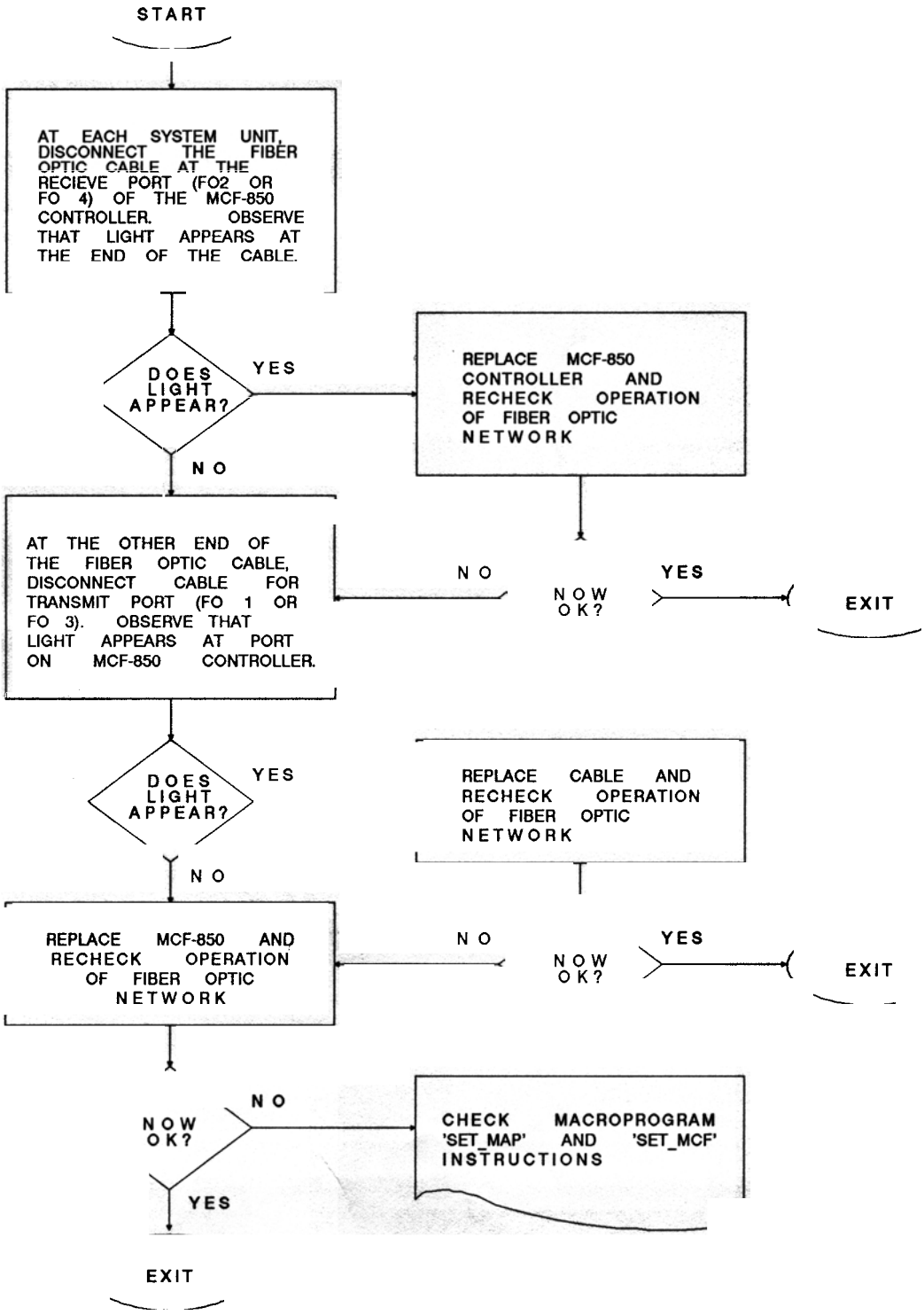


Figure 5-1 Fiber Optic Network, Troubleshooting Chart

5.5 Nonvolatile Memory Functions

1 Turn off the system power.

2. Check to make sure the controller is in the right slot and is properly seated.

3. Verify that the Macroprogram is directing the data to the right slot in the System Unit.

4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.

   - The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.

   - If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, and if the red ERROR indicator is flashing, replace the MCF-850 Multifunction Controller.

6.0 DIAGRAMS

6.1 General

This section contains the electrical connections for the programmable limit switch functions and fiber optic link functions of the MCF-850 Multifunction Controller. Detailed information on the proper connection of the OPTO type output relay modules is included in Figures 6-1 and 6-2. The multiple combinations of Fiber Optic Link configurations is given in Figures 6-3 and 6-4. The 50-pin connector which connects the PLS-850 Programmable Switch Assembly to the Multifunction Controller is given in Figure 6-5. The physical make up of the Fiber Optic Link Cable is given in Figure 6-6.

Figure 6-7 illustrates the mounting dimension requirements for the PLS-850 Programmable Limit Switch Assembly.

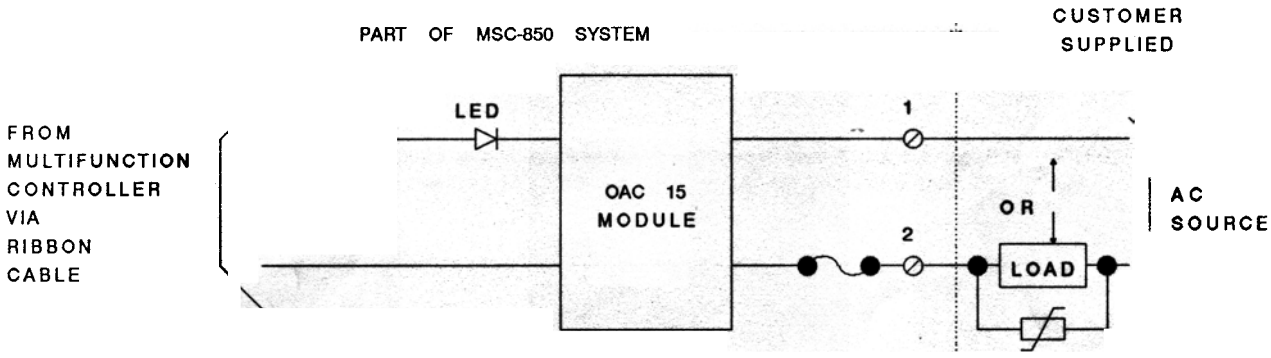


Figure 6-1 AC Output Module, Connection Diagram

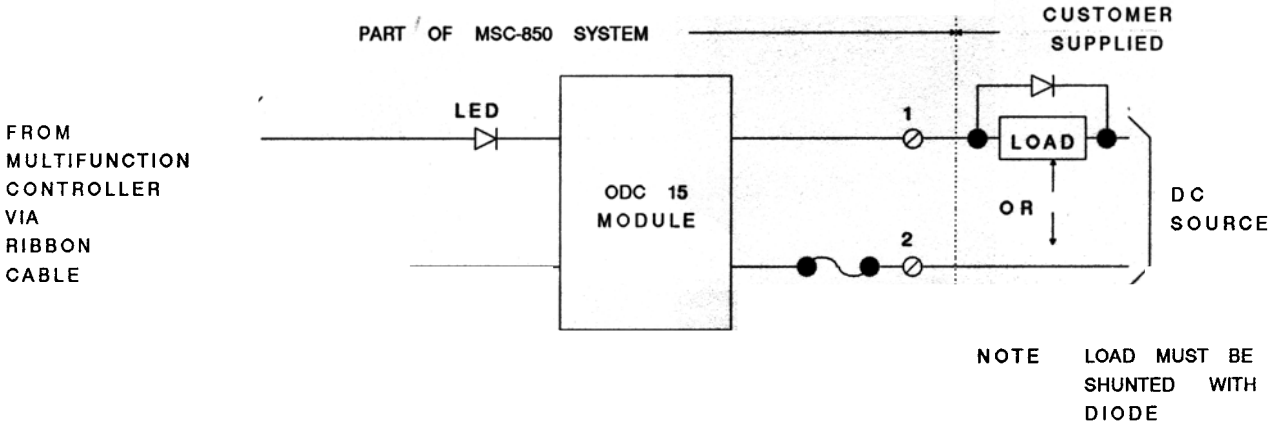
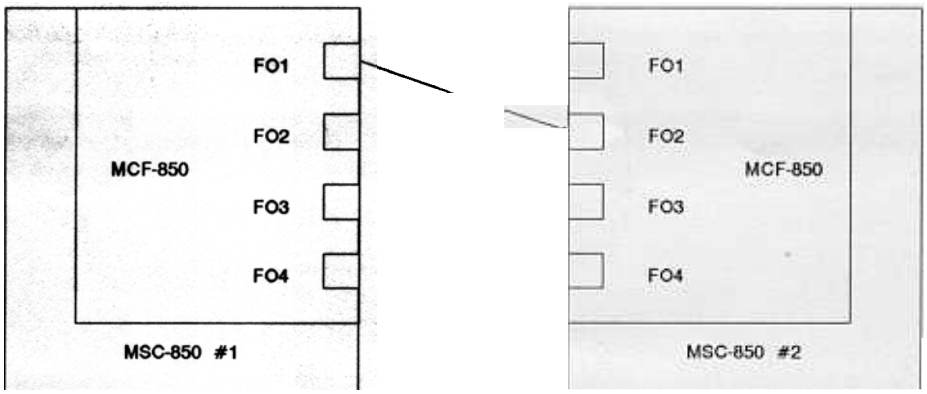
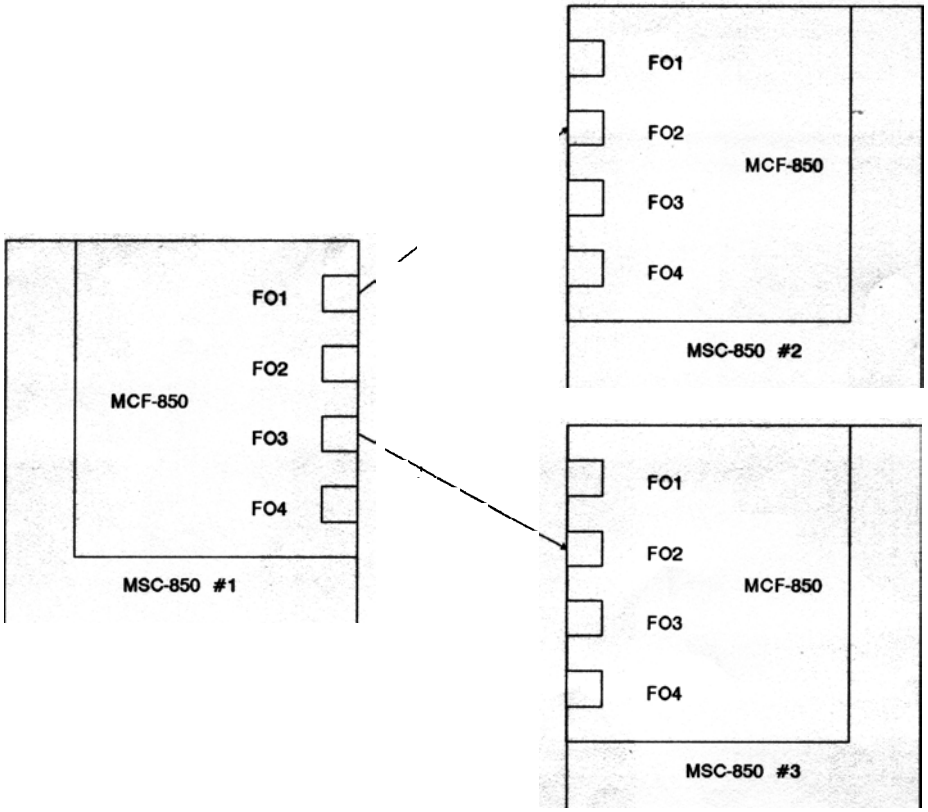


Figure 6-2 DC Output Module, Connection Diagram



CONFIGURATION NO. 1

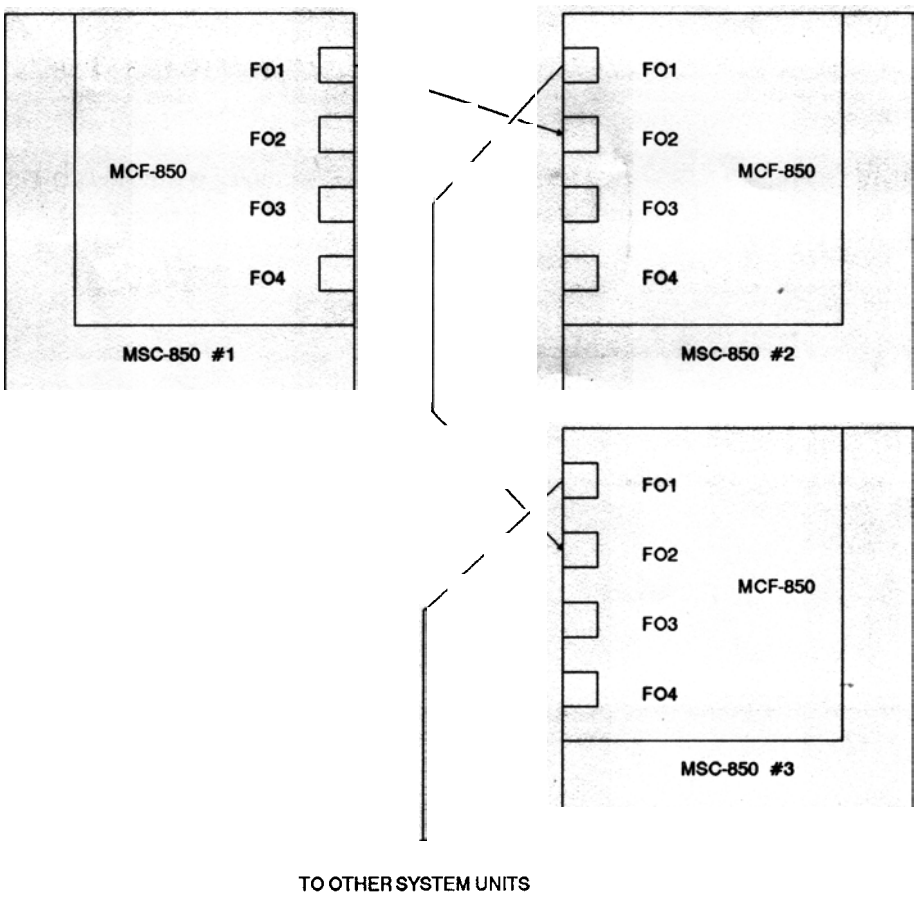
1 ANGLE BUS IN A
SYSTEM UNIT TO
1 ANGLE BUS IN
ANOTHER SYSTEM UNIT



CONFIGURATION NO. 2

2 ANGLE BUSES IN A
SYSTEM UNIT TO
1 ANGLE BUS IN
2 OTHER SYSTEM UNITS

Figure 6-3 Fiber Optic Link Configurations 1 and 2



CONFIGURATION NO. 3

1 ANGLE BUS IN A SYSTEM UNIT THROUGH HIGH-SPEED FEED-THRU TO 1 ANGLE BUS ON MULTIPLE SYSTEM UNITS

Figure 6-4 High-speed Feed-thru Fiber Optic Link Configuration

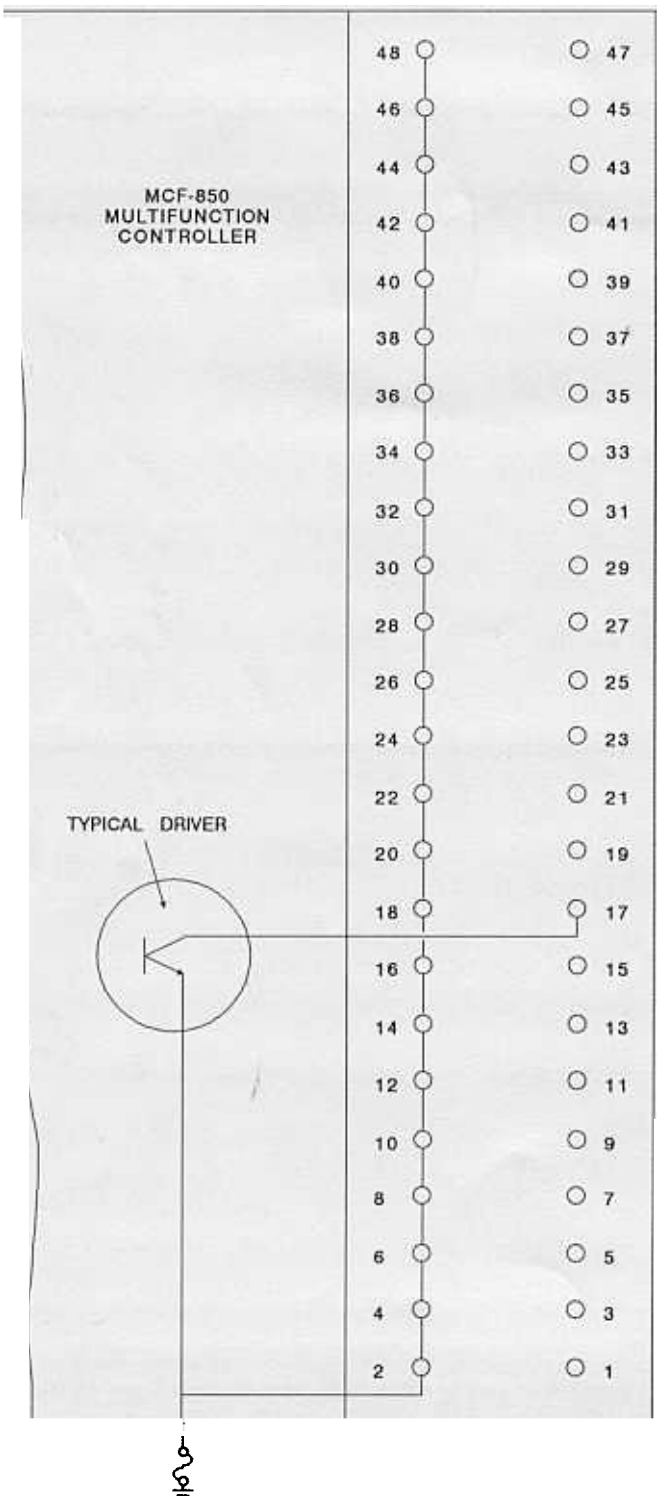
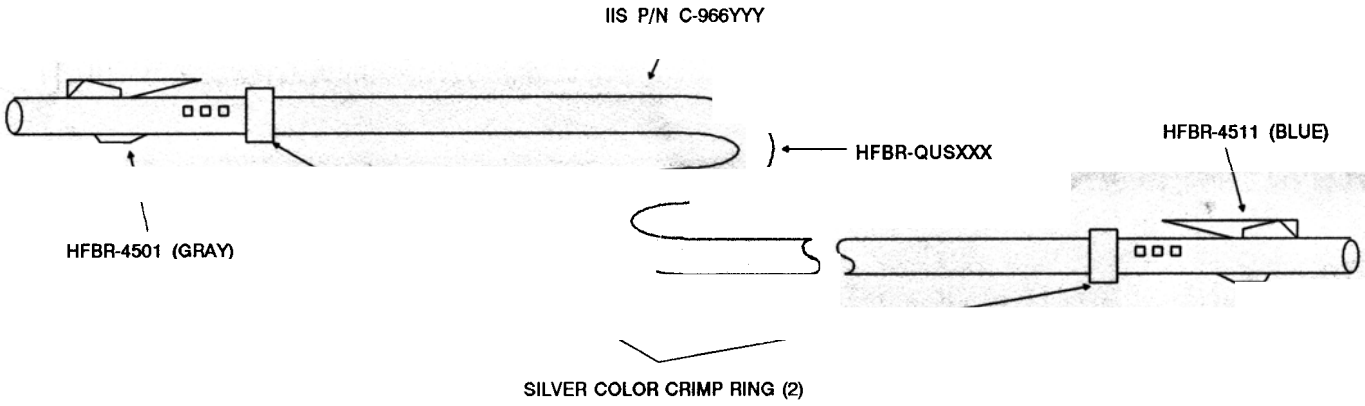


Figure 6-5 PLS-850 Programmable Limit Switch 50-Pin Connector



PREMADE CABLES

HEWLETT-PACKARD P/N	LENGTH (METERS)
HFBR-QNS001	1
HFBR-QNS005	5
HFBR-QNS010	10

NOTE: LENGTH NOT TO EXCEED 100 FT (30 M)

Figure 6-6 Fiber Optic Link Cable, C-966YYY

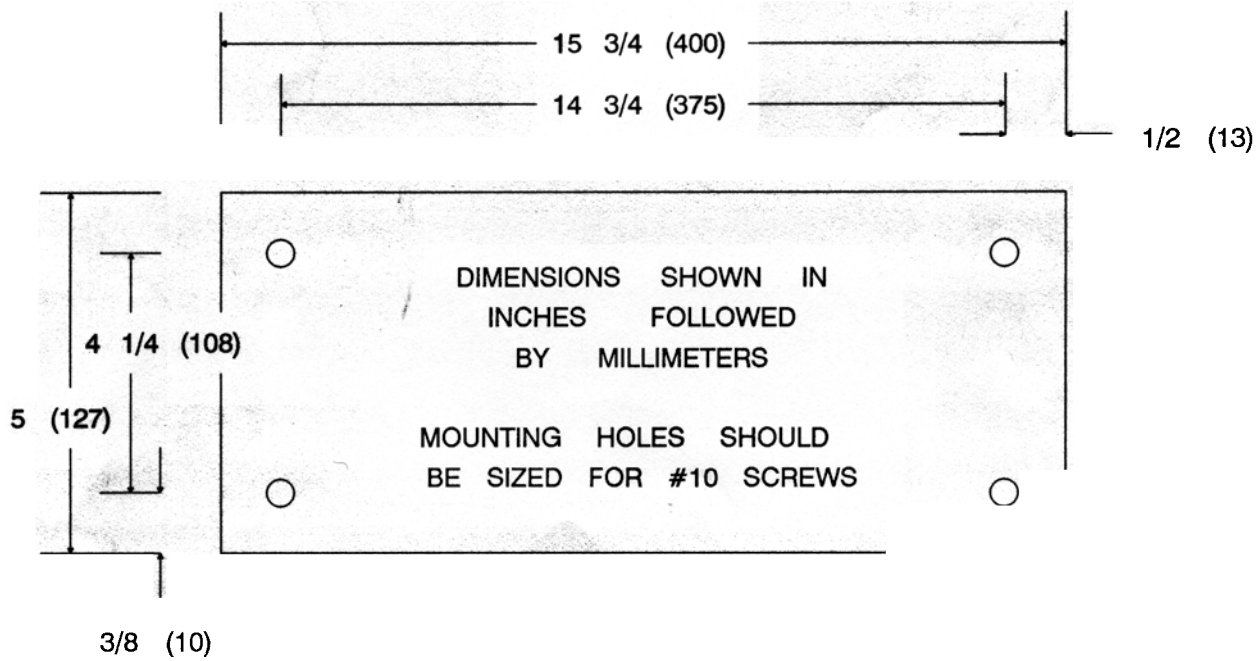


Figure 6-7 PLS-850 Assembly, Mounting Requirements

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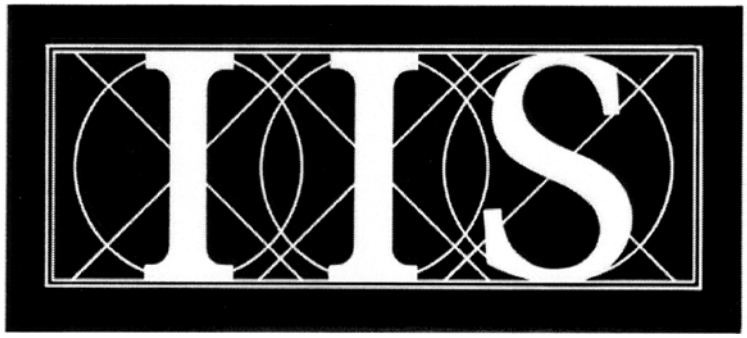

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