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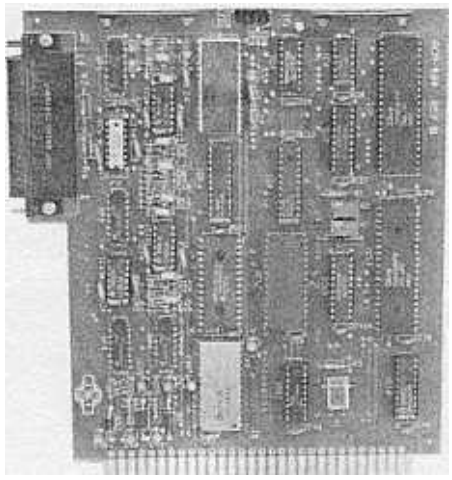
MOTION CONTROL SYSTEM, MSC-850

SEPTEMBER
1989



ACM-850 ANALOG CONTROLLER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, INC.

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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 ACM-850 Analog Controller (Figure 1-1) including a product overview, product description, product specifications, description of controls and indicators, and connection diagrams.

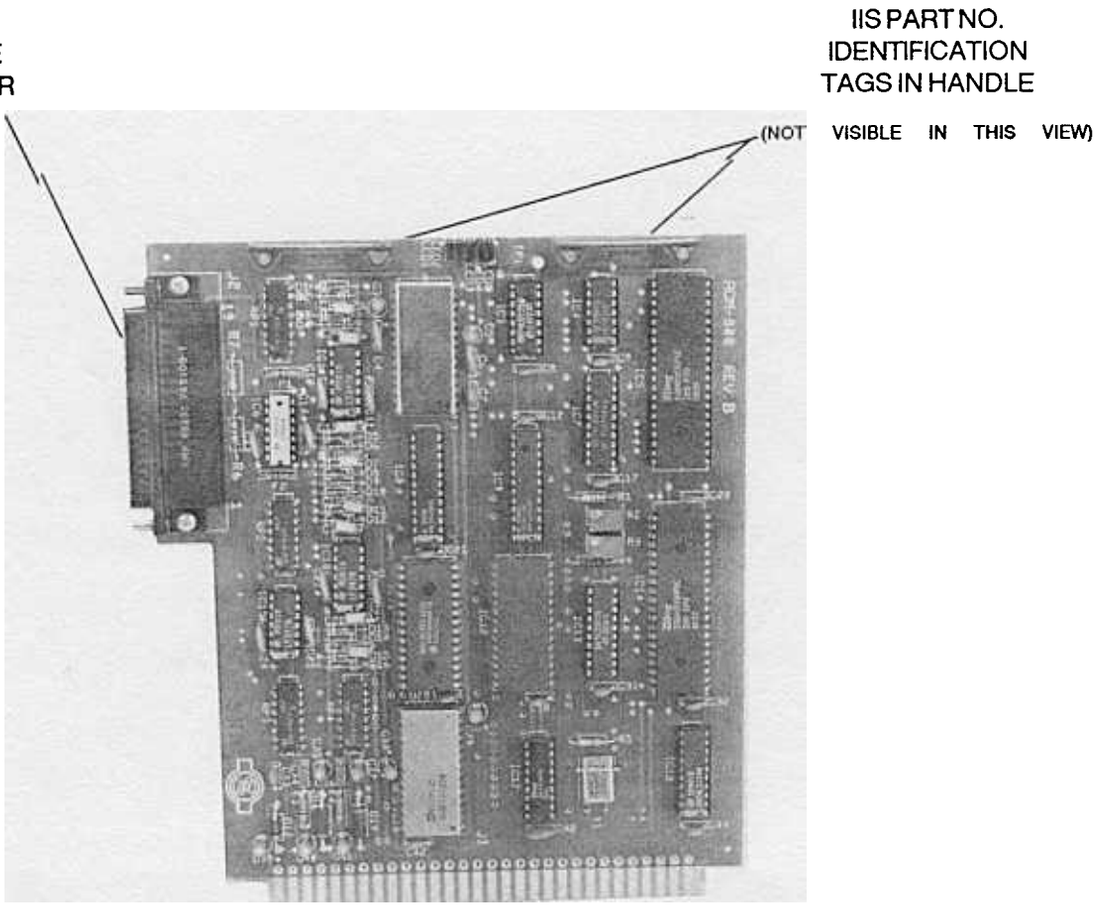


Figure 1-1 ACM-850 Analog Controller

1.2 Product Overview

The ACM-850 Analog Controller is an edge connector printed circuit board that can be plugged into any one of the 8 controller slots of the MSC-850 System Unit It provides 12 analog data channels as follows:

- o 8 single-ended input channels or 4 balanced analog input channels.
- o 4 output channels.

In conjunction with the Macroprogram instructions, the ACM-850 Analog Controller provides analog data acquisition capabilities to the MSC-850 Motion Control System. Voltages can be measured, set, or controlled. Reads and writes of the analog data are done on a 10-millisecond time loop basis. Slew rate control provides a means of limiting the rate of change. This feature can be used to overcome the effects of noise spikes on input signals or for ramping an output signal.

The 2 reference Voltages provide a convenient method of supplying a Voltage source to potentiometers thus possibly eliminating the need for an external source.

At start-up all offsets are set to zero, slew rates to 2048 bits per 10 millisecond, and the output of the analog output channels to zero Volts.

2.0 DESCRIPTION

2.1 General

The ACM-850 Analog Controller is an intelligent circuit board that provides a means of interfacing analog signals to the MSC-850 Motion Control System. The Macroprogram can set up software closed loop control by utilizing the Analog Controller's analog input and analog output circuits. It can also provide open loop control by utilizing the analog output circuits and can be used to monitor machine variables by utilizing the analog input circuits. In addition, two +10 Volt and -10 Volt-dc reference voltages can supply a Voltage source for potentiometer (joystick, etc.) inputs.

2.2 Analog Inputs

The analog input channels, designated channel 1 through channel 8, consist of 8 amplifiers with the common internally tied to ground. These 8 channels can be used independently as ground referenced unbalanced channels or they can be used in groups of 2 for as many as 4 isolated ground balanced channels.

The analog input signals (Figure 2-1) connected to these channels are read and then added to the offset value. The rate of change is limited by the specified slew rate. This limited result is the 12-bit sign extended channel input value.

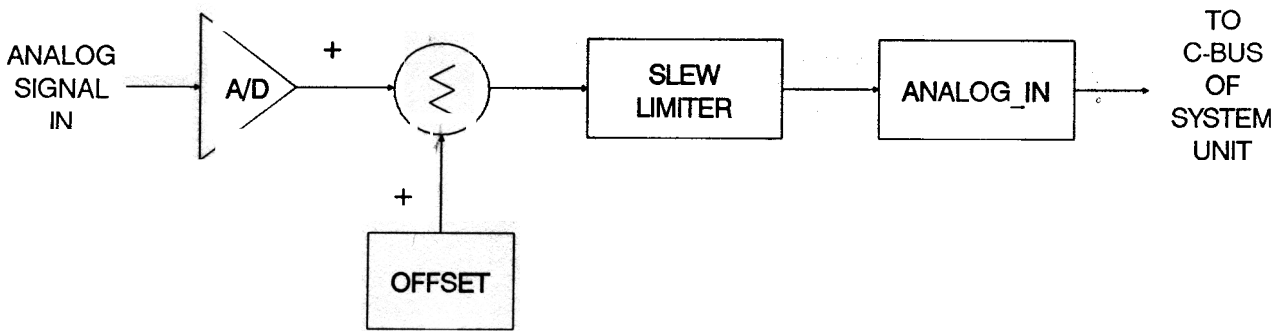


Figure 2-1 Analog Input Channel, Block Diagram

The equivalent circuit of an input channel used as an unbalanced line is illustrated in Figure 2-2. Note that the analog input signal is connected between the input of the amplifier and common on the controller.

When the 2 channels are used as a balanced line, the 2 input circuits become a differential input with the aid of the Macroprogram as illustrated in Figure 2-3. Note that in this application the analog input signal is connected between the inputs of the 2 amplifiers and that the commons are not used. The Macroprogram reads both channels and performs a subtraction instruction thus yielding a differential result.

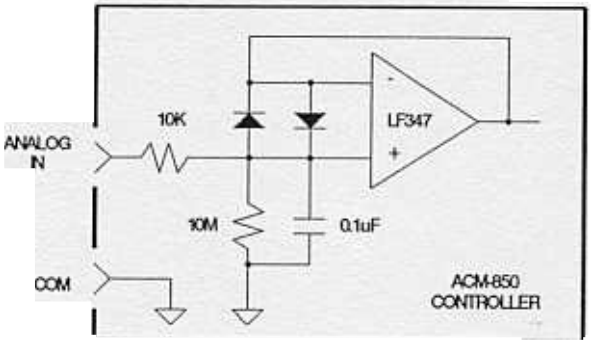


Figure 2-2 Unbalanced Analog Input Circuit

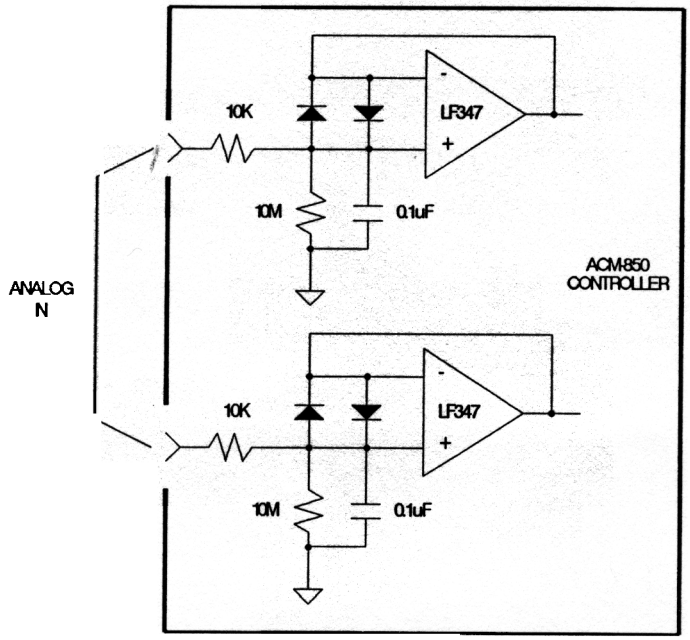


Figure 2-3 Balanced Analog Input Circuits

2.3 Analog Outputs

The analog output channels consist of 4 channels with the commons referenced to ground. These 4 channels can be used independently.

The ACM-850 Analog Controller provides analog output signals (Figure 2-4) by adding the offset value to the analog output specified in the Macroprogram and rate of change limit.

The equivalent circuit of an output channel is illustrated in Figure 2-5. Note that the analog output is generated by a single amplifier and that the user's device is connected between the amplifier's output and common on the controller. Differential inputs are recommended on the user's device to minimize ground loops.

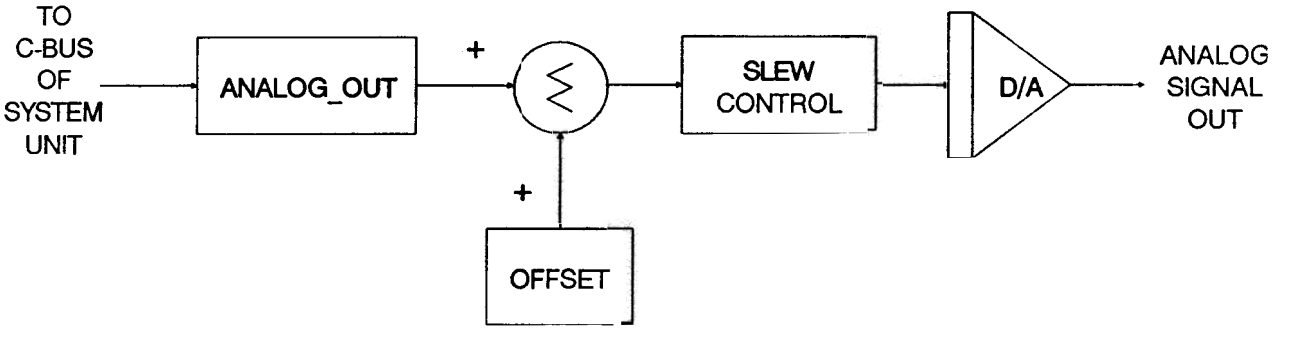


Figure 2-4 Analog Output Channel, Block Diagram

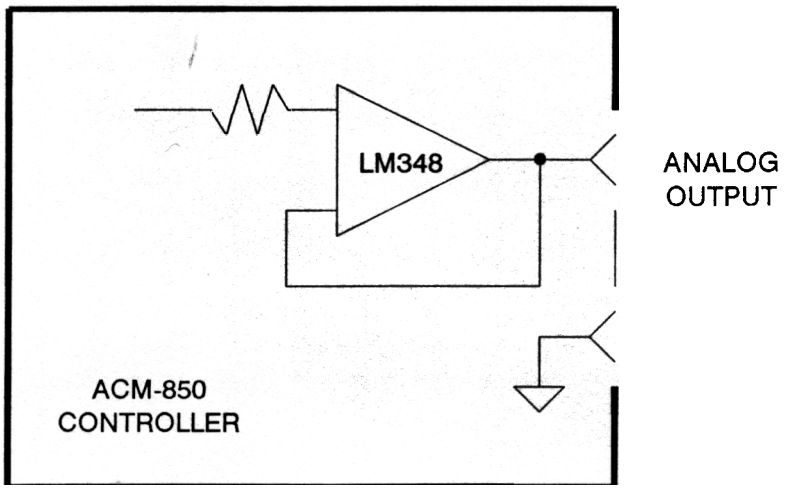


Figure 2-5 Analog Output Circuit

2.4 Voltage References

Two pairs of Voltage references are available for connection to potentiometers. Each of these references provide nominally -10V and +10V dc and each can deliver up to 10 mA. Figure 2-6 illustrates a typical interface to a potentiometer.

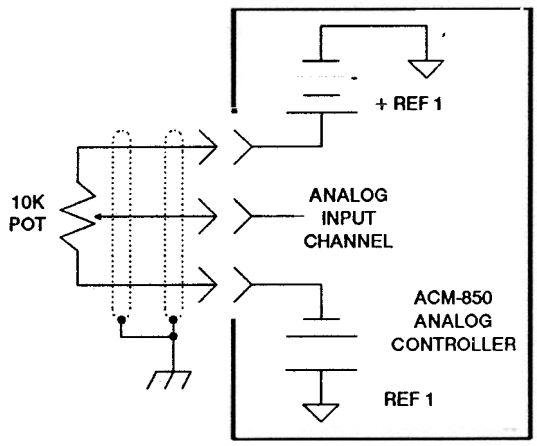


Figure 2-6 Reference Voltage Interface to a Potentiometer

2.5 Status and Fault Indicators

2.5.1 Power-up Fault Indicators

On power-up, the controller's microprocessor, and memory 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 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.

2.5.2 Status Indicator Description

During normal operation, the SELF TEST OK and ENABLE indicators are lighted. As the Macroprogram executes the required instructions and the MAC-850 Main Processor communicates with the controller, the yellow 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 red BUS FAULT indicator will come on.

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

3.0 SPECIFICATIONS

3.1 Functional Characteristics

Analog Input Channels	8 total
Unbalanced	8 Ground Referenced
Balanced	4 Input to Input Referenced
Analog Output Channels	4 total
Unbalanced	4 Ground Referenced
Voltage Reference Source	2 +10V Ground Referenced
	2 -10V Ground Referenced

3.2 Performance Characteristics

Analog Input Channels	
Voltage Range	-10 Volts to +10 Volts
Resolution	12 bit (1 part in 4096)
Accuracy	10 bit
Update Rate	10 millisecond loop
Input Impedance	10K Ohm Single Ended
Analog Output Channels	
Voltage Range	-10 Volts to +10 Volts
Resolution	12 bit (1 part in 4096)
Accuracy	10 bit
Update Rate	10 millisecond loop
Output Drive	10 mA maximum
Voltage References	+/-10 Volts +/-0.5 Volts at 10 mA Maximum
Digital Filtering (slew control)	
Unit	Bits per 10 Milliseconds
Range (programmable)	1 to 2048 bits
Resolution	1 part in 2048 bits
Environmental	
Operating Temperature	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90 % (Non-condensing)

3.1 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 Controller Slot in the MSC-850 System Unit

4.0 CONTROL AND INDICATORS

4.1 General

The ACM-850 Analog 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 ACM-850 Controller. All parameters and functional controls are established by the Macroprogram.

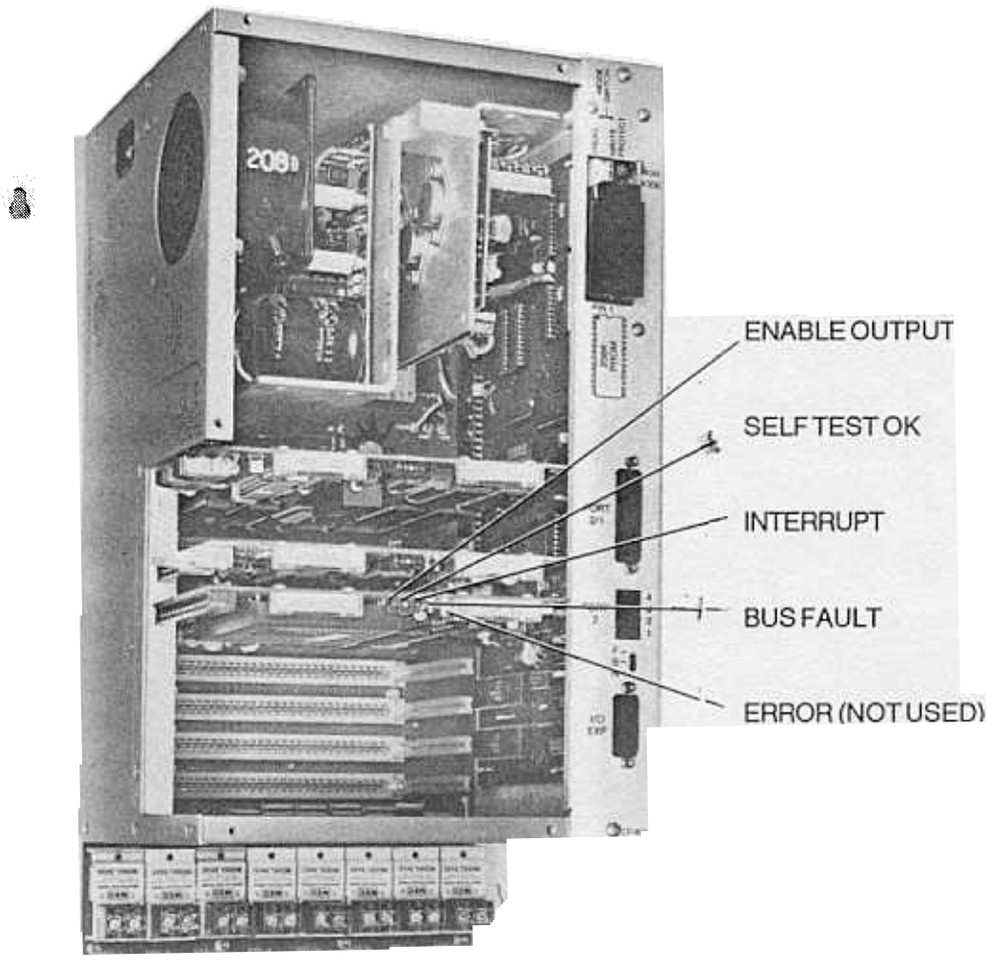


Figure 4-1 Identification of Status Indicators

Table 4-1 Description of Status Indicators

PANEL MARKING	DESCRIPTION	OBSERVED INDICATION	INDICATION FUNCTION
ENABLE OUTPUT	Green LED	Steady On	Microprocessor is running
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	Not Used	

NOTE

If, during start up, the SELF TEST OK, INTERRUPT, and BUS FAULT 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

General

The ACM-850 Analog Controller processes analog inputs and provides analog outputs. In addition, 2 reference voltages are available for application to potentiometers. The input circuits and the output circuits as well as the reference Voltages can be used independently or in conjunction with each other.

To simplify testing of the controller in the System Unit, a test that utilizes all the circuits simultaneously is provided in the following paragraphs. The test requires the use of the MSC Software Toolkit running in an IBM compatible PC.

Test Equipment Required

IBM compatible PC complete with monitor and MS-DOS 3.0 or greater

MSC Software Toolkit

Test Jumper Plug (If not available, fabricate in accordance with Table 5-1)

Test Diskette (If not available, contact Industrial Indexing Systems, Inc.)

Table 5-1 Test Jumper Plug, Wiring Details

NOTE

Make using a D 37P type connector.

FROM	TO
Pin 1 Out 1	Pin 10 In 1
Pin 2 Out 2	Pin 11 In 2
Pin 3 Out 3	Pin 12 In 3
Pin 4 Out 4	Pin 13 In 4
Pin 5 + Ref 1	Pin 17 In 5
Pin 6 - Ref 1	Pin 16 In 6
Pin 9 + Ref 2	Pin 15 In 7
Pin 8 - Ref 2	Pin 14 In 8

5.3 Test Setup

1. Remove the 115V-ac power from the MSC-850 System Unit.
2. Connect the PC through an RS-232C Serial Communication Cable to Port 1 of the MAC-850 Main Processor in the MSC-850 System Unit (Figure 5-1).
3. Remove the connector Plug P2 from connector Jack J2 on the controller under test.
4. Connect the Test Jumper Plug, fabricated in accordance with Table 5-1, to J2 on the controller.
5. Apply ac power to the System Unit.

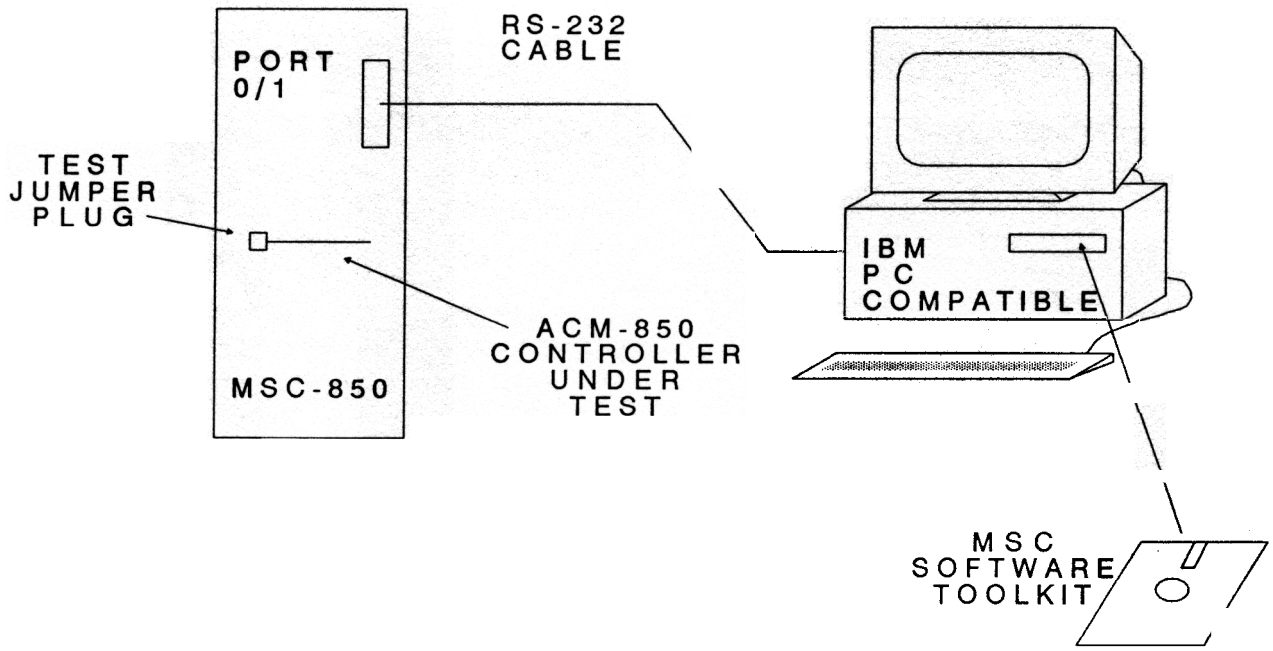


Figure 5-1 Test Set-up, Block Diagram

5.4 Test Description

This test checks out the various possible connections and functions of the controller by conducting a series of software setups followed by measurements to determine whether the circuits are performing within the design specifications. The tests are run on the PC and test results are shown on the PC Monitor.

The test results are provided in a variable called 'test_stat'. When the test is completed and the results are requested, the value of 'test_stat' is displayed.

If:

- the value of test_stat is a 0, then the controller has passed all the functional tests.
- the value of test_stat is any other number, the controller has failed one or more of the functional tests and should be replaced.

5.5 Test Procedure

1. Change the directory to the directory where the MSC Toolkit resides. Type 'IIS' and press the RETURN key. The MSC Software Toolkit menu is displayed.
2. Insert the Test Diskette SFO#### into drive.
3. Move the cursor to 'SYSTEM CONFIGURATION' and press the RETURN key. The System Configuration menu is displayed.
4. Change the drive designation to match the drive in which the Test Diskette was inserted and press function key F4 (ACCEPT DATA). The MSC Software Toolkit menu is displayed.
5. Move the cursor to 'CREATE/SELECT FILE' and press the RETURN key. A list of files is displayed.
6. Move the cursor to 'ST21' and press the RETURN key. The MSC Software Toolkit menu is displayed.
7. Move the cursor to 'MPEDIT/MPCPL' and press the RETURN key. The ACM-850 firmware test is displayed.
8. The ACM EQU is set at '6'. If necessary, change the ACM EQU to match the controller slot in which the controller under test is located and press 'F8 EXIT/SAVE' and press the RETURN key. The MSC Software Toolkit menu is displayed.
9. Move the cursor to 'MPDEBUG' and press the RETURN key.
10. Press function key 'F5 (MSC COMMANDS)'
11 Press function key 'F1 (STOP PROGRAM)'
12. Press function key 'F2 (RESET)'
13. Press function key 'F3 (SEND PROGRAM)'
14. Press function key 'F4 (START PROGRAM)'
15. Press function key 'F9. Note that a new set of soft key labels are displayed.
16. Press function key 'F2 (READ)'
17. Press function key 'F7 (MACRO STATUS)'
18. Press Function Key 'F2 (DATA)'
19. Type 'test_stat' and press the RETURN key. The test results are displayed as described in paragraph 5.4 Test Description.
20. To return to the root directory, press function key 'F8' 3 times.

6.0 CONNECTION DIAGRAMS

6.1 General

This section contains the electrical connections for the use of the 8 analog input channels, 4 analog output channels, and the 2 Voltage reference channels. All user connections are made through Jack J2 as illustrated in Figure 6-1. A mating connector and cable designed to meet the specific requirements of the user can be fabricated in accordance details provided in Figures 6-2 and 6-3.

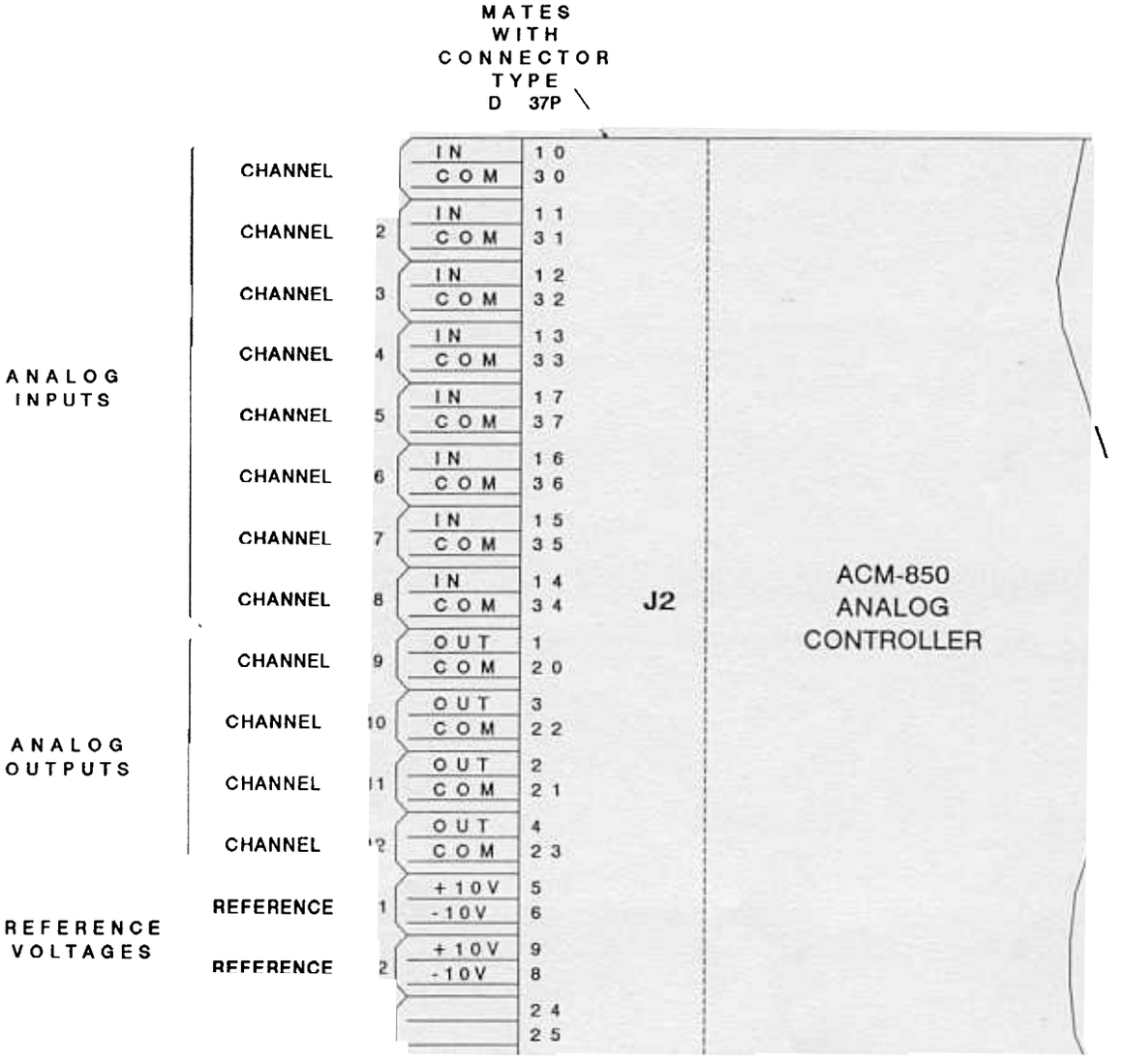


Figure 6-1 ACM-850 Controller, Electrical Connections

ALL WIRES MUST BE SHIELDED AT ACM-850 SIDE ONLY,
BRING SHIELD TO EARTH GROUND, NOT ACM COMMON.

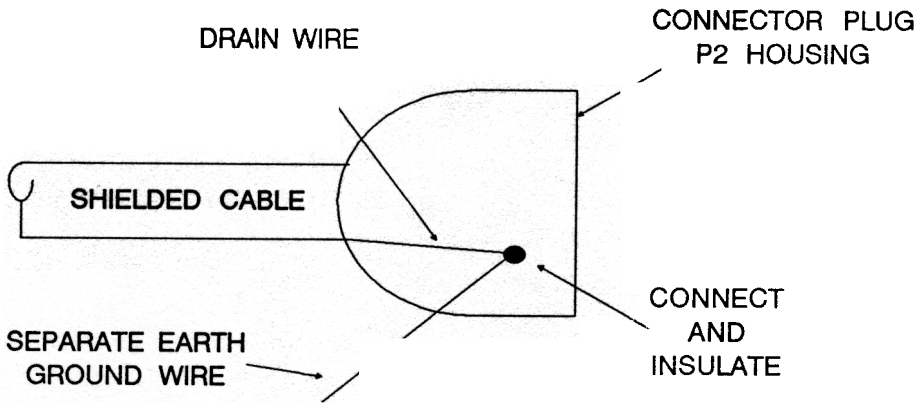
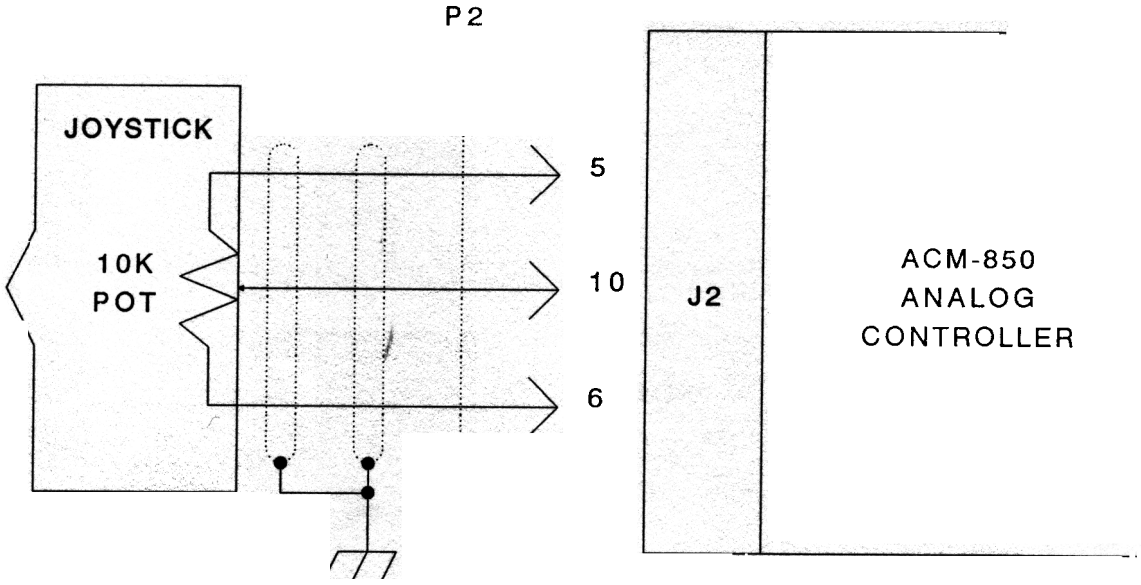


Figure 6-2 Recommended Cable Shielding Connection Technique



5 = +10V REFERENCE
10 = ANALOG INPUT CHANNEL 1
6 = -10V REFERENCE

Figure 6-3 Typical Potentiometer User Connection

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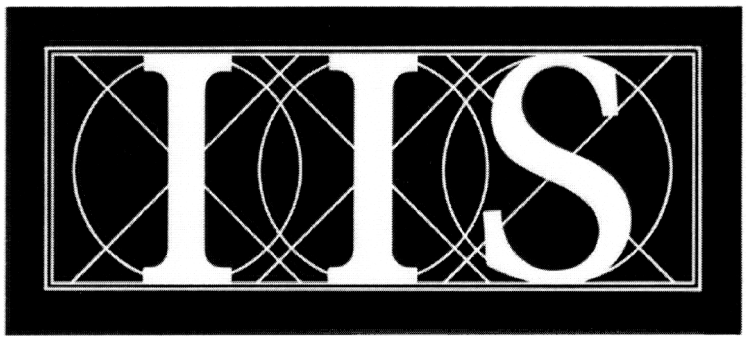

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