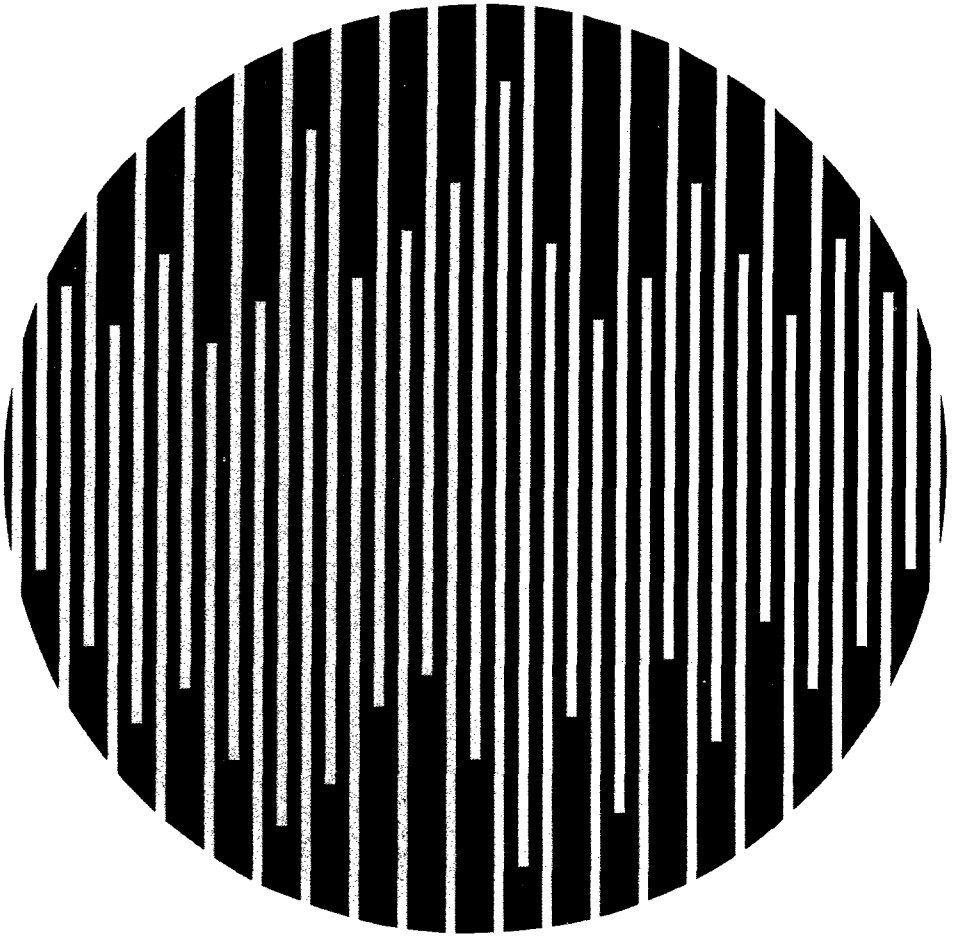
Modicon
484 Programmable Controller
Maintenance Manual

ML-C484-MTN Rev B



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SECTION I
484 GENERAL INFORMATION

1.0 INTRODUCTION

The introduction provides a general overview of Programmable Controllers (PC) and specific orientation to the MODICON 484. All topics discussed here are discussed in more detail in other sections of the manual. For information on family trees refer to Appendix A and for information on external cables to Appendix B. A Glossary of Terms is included at the back.

1.1 GENERAL SYSTEM DEFINITION

A Programmable Controller (PC) is a solid-state device designed to make logic decisions in industrial control situations. Relays and solid-state electronics can be replaced with a PC.

Outstanding features of a PC include:

- Reliable, fast responses in hostile environments.
- Programmable and reprogrammable with ladder diagram language.
- Simplified troubleshooting with diagnostic indicator lights at major points.
- Easy maintenance with modular replacement.

The MODICON 484 is one of the finest examples of PC technology available. It is designed to replace control systems of 10 to 400 relays. Advantages over relays and other solid-state devices include:

- Lower hardware costs.
- Faster scan rate: 4 to 20 ms depending on memory size.
- Expandable memory in six sizes: 1/4K to 8K.
- Expandable Input/Output (I/O) with four point modules.
- Easier installation.
- Retentive memory for logic and timer/counter values.
- Direct plug-in programming devices.
- Real-time, on line programming.

Table I-1 lists the specifications for a basic 484 Controller, and Figure I-1 shows the controller system.

Table I-1. Basic 484 Controller Specifications

Power Requirements:		
Standard		115 VAC ± 15%, 60 Hz ± 150 Volt amps (max) 3 amp peak start-up transient
Optional		115/220 VAC ± 15%, 50 Hz ± 5% 150 Volt amps (mac) 3 amp peak start-up transient (2 amp on 220 V)
Environmental Requirement:	Operating	Storage
Ambient Temperature	0° C to 60° C	-40° C to 80° C
Humidity (non-condensing)	0% to 95%	0% to 95%
Dimensions (WxHxD):		
Processor (w/Power Supply)		15 in. x 20.5 in. x 6.5 in. (38 cm x 53 cm x 16.5 cm)
Single I/O housing (including I/O Duct)		5 in. x 32 in. 6 in. (13 cm x 81 cm x 15 cm)
Eight Housings (One Channel)		40 in. 32 in. 6 in. (102 cm x 81 cm x 15 cm)
Weight:		
Processor (w/Power Supply)		33 lbs (15 Kg)
I/O Module		1 lb (0.5 Kg)
Single I/O Housing (w/Modules)		15 lbs (7 Kg)
Eight Housings w/Modules & Duct)		136 lbs (62 Kg)
Controls and Indicators:		
CPU		RUN light POWER on light BATT OK light MEMORY PROTECT key
I/O Modules:		Circuit Terminal Voltage light Blow Fuse light (outputs ONLY)

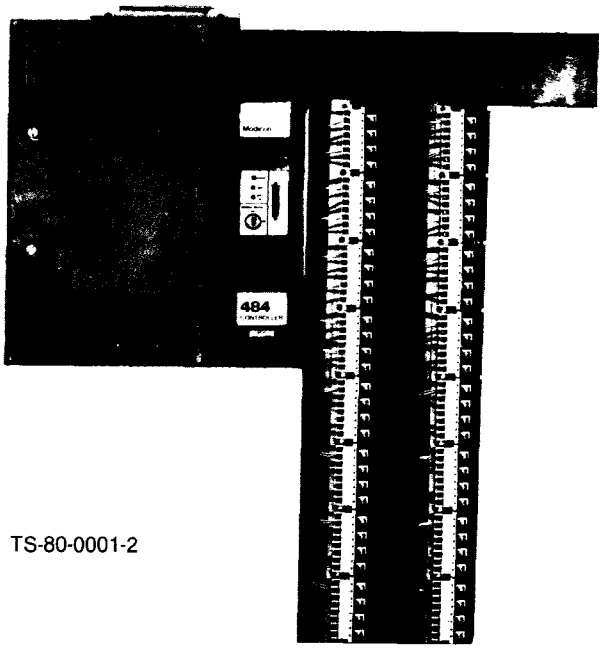

Figure I-1. 484 Controller System

A typical PC (Figure I-2) is divided into four components: Processor, Power Supply, I/O Section, and a Programming Device.

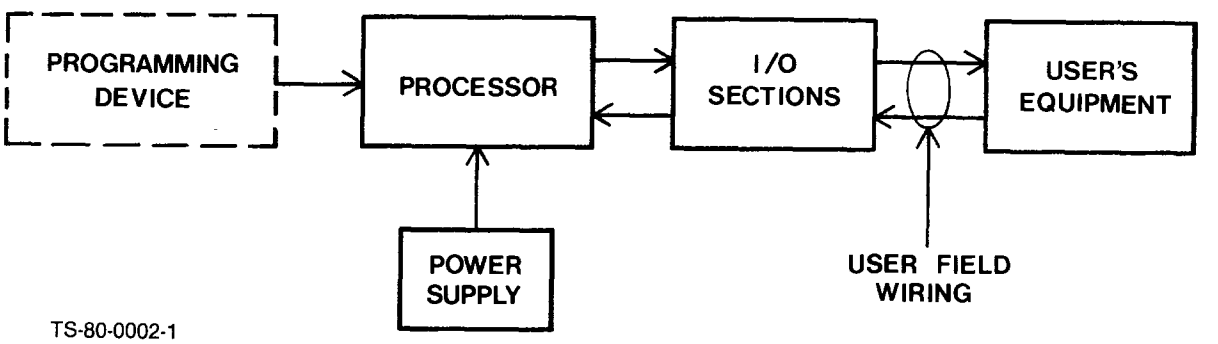

Figure I-2 Basic Block Diagram

1.2 COMPONENTS: SYSTEM DESCRIPTION

Each of the four components of a PC are described briefly in this section (Figure I-3). Peripherals available for the Modicon 484 are also introduced.

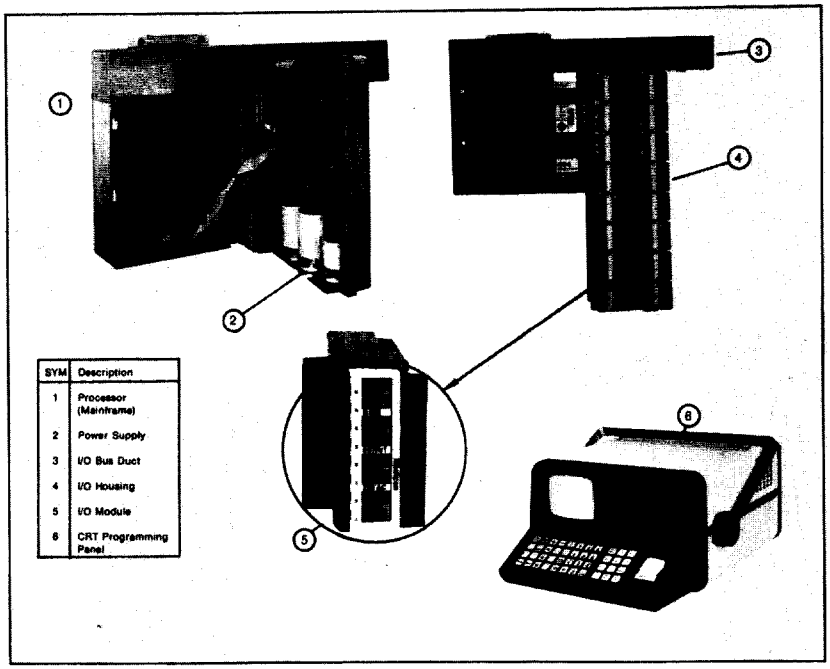

Figure I-3. 484 Components

1.2.1 PROCESSOR

The processor or brain of the PC is a completely solid-state device. It is sometimes called the Central Processing Unit (CPU) and sometimes called the mainframe. This is the part of the PC which actually replaces relays and timer/counters. In the MODICON 484 the processor is expandable for computational functions or for simulation of stopper switches.

The processor is programmed in relay ladder diagram language. The program uses up to ten relay contacts per rung.

The processor operates on DC power furnished by the power supply. This internal DC power is routed throught the processor to operate the I/O Section. When the program is entered into the processsor it remains until changed deliberately by a user. Power failure or power-off conditions do not destroy the program.

An access port enables entry of instructions and data and permits monitoring of perviously entered information. The most common method of entering data or programs into the processor through this port is with the P180 CRT Programming Panel. Other devices that may be connected to this port are a Tape Loader, a Computer, or a Telephone Interface. Communication with these devices is done via an adapter which allows simultaneous operation with the CRT Programming Panel.

1.2.2 POWER SUPPLY

The Power Supply mounts inside the front cover of the processor. It operates on 115 VAC, 60Hz or 115/220 VAC, 50Hz (non interchangeable). No adjustments or maintenance are required. A lamp indicates power-ready status. No external cooling is necessary, although free air circulation is required. The Power Supply has sufficient capacity to operate the processor; 128 inputs, and 128 outputs. An expander power supply is used to extend the PC/s capability to 256 inputs and 256 outputs.

1.2.3 INPUT/OUTPUT (I/O) SECTION

A major characteristic of the 484 Controller is the input and output control devices that are directly connected to the controller. User wiring to and from the controller is accomplished through heavy duty housings. These housings are designed to hold up to eight I/O modules. Each module contains four circuits; either input or output. A smaller I/O housing accommodating up to four I/O modules is available. The covered wireway (I/O duct) enables easy installation and access to the wiring.

A wide variety of I/O modules is offered. The modules are output driving or input handling circuits. These solidly constructed units are easily removed from or plugged into their housings. Once inserted, electrical contact is automatically made through plated spring connectors. I/O modules can be removed and replaced without removing power on the field devices or internal logic. There is no need to shut down the system to replace I/O modules.

Each input and output circuit is isolated by photo diodes thus preventing transients on the field wiring from affecting the internal logic. No periodic maintenance is required. The 484 output modules, AC or DC, have individual output fuses. Indicators on each module show the field power status and output fuses condition. I/O modules and field wiring can be located in any possible configuration regardless of voltage level.

There are four classes of signals between the 484 system and the user's equipment:

- Discrete I/O connections.
- Register I/O (three-digit numeric interfaces, to and from the register multiplexer; analog I/O; special purpose modules).
- RS232C peripheral interface from the EIA Adapter, using the appropriate MODICON protocol.
- MODBUS Communication Interface - Used in connecting communication options to a computer or other intelligent device.

Field inputs consist of up to 128 discrete points or 256 with the I/O expander unit. Each has an ON or OFF state. Each has up to 32 inputs or register data. Register data is represented by a decimal number in the range of 0 to 999. All discrete inputs are read once during every scan.

1.2.4 CRT PROGRAMMING PANEL

The Model P180 CRT Programmer (Figure I-4) is a 5-inch CRT in a rugged case. It is easily carried to the work site near the controller. The entire CRT unit is well suited to the industrial setting. It is designed to operate in locations where electromagnetic noise, high temperatures and humidity, mechanical shock, or other threatening environmental problems may be present.

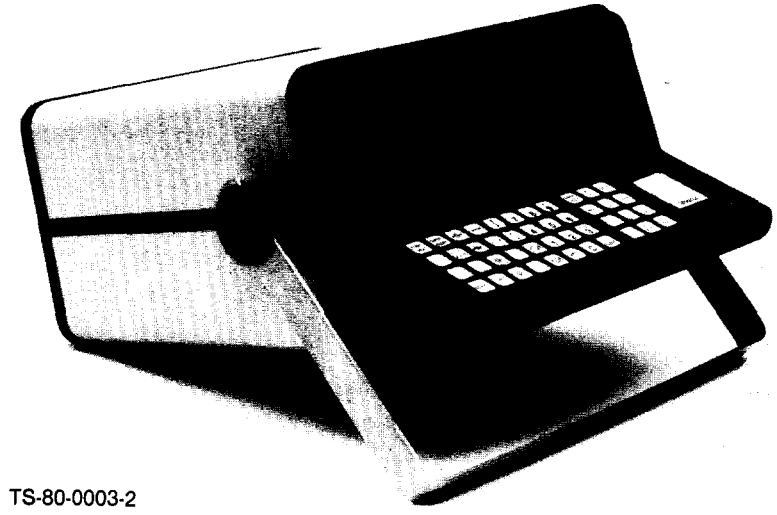

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Figure I-4. P180 CRT Programming Panel

The P180 CRT connects directly to the 484 Controller. It provides a simple method to program the processor. The ladder diagram language used for programming the PC is familiar relay symbology. There are no required programmer languages to learn. The CRT also allows easy, rapid system checkout and maintenance.

A delux CRT permits the use of a standard RS232C printer. Thus, a hard copy of the ladder diagram contained in the controller can be generated.

1.2.5 PERIPHERALS

Several standard MODICON support units are available for use with the 484 Controller. These units provide a wide variety of support functions. Complete system support is always

available. The support units use the J470 EIA Adapter for connection to the processor. This adapter allows a P180 Programmer and another peripheral device to be connected to the controller simultaneously.

Available support equipment includes:

- o T158 Telephone Interface for communication with MODICON's service center.
- o L206 Universal Tape Loader for local recording of the user's program.
- o MODBUS Interface (J474) which allows plant-wide or nation-wide communications.
- o P180 CRT Programmer for entering user logic.
- o J470 Communications interface.
- o J471 I/O Expander for additional I/O capacity.

1.3 SUMMARY

Programmable controllers are used in industrial settings to replace relays and other solid-state electronic devices. Controllers are faster to respond to instructions and operate with maximum reliability. They are easily programmed with ladder diagram language. Because they are modular they are easier to maintain and install, and less space is required. Hardware costs are lower. They operate in hostile environments.

A typical controller is divided into four components: Processor, Power Supply, I/O Section, and a Programming Device.

The processor is the brain of the PC. The processor operates on DC power furnished by the power supply. The I/O Section is the controller's link with the "real world". The programming panel is the main device used to program the controller.

The MODICON 484 Programmable Controller is desigend to replace control systems of 10 to 400 relays. It has an expandable I/O with four point modules. It also has an expandable memory in six sizes ranging from 1/4K to 8K. The P180 Programming Device is connected directly to the 484.

All of these features make the MODICON 484 Programmable Controller one of the most up-to-date PC's on the market today.

SECTION II
INSTALLATION

2.0 INTRODUCTION

The MODICON 484 Controller is a microprocessor-based controller. Its circuitry allows relay ladder diagram control logic to be programmed.

Section II describes the system configuration and gives information necessary for installation.

2.1 SYSTEM CONFIGURATION

2.1.1. MAINFRAME CODE

The 484 is manufactured with several basic options. The customer chooses from six memory sizes, two power supply variations, and three instruction sets. These choices are reflected in the Mainframe Code shown in Table II-1.

Table II-1. C484 Mainframe Code

Code: C484-XYZ		
X represents Instruction Set	Y represents Power Supply	Z represents Memory Size
0-Basic 1-Enhanced I 2-Enhanced II	5-50Hz 115VAC 6-60Hz 115VAC	1 - 1/4K 2 - 1/2K 3 - 1K 4 - 2K 5 - 4K 6 - 8K

A C484-162, for example, indicates a C484 with an Enhanced I Instruction set, 60Hz 115 VAC Power Supply, and a 1/2K Memory Size.

2.1.2 HARDWARE CONFIGURATION

A typical system layout is shown in Figure II-1. This figure includes mounting dimensions for all major components of the system.

For proper heat flow, all units should be mounted vertically. Vertical orientation allows the fullest removal of heat via the heavy-duty housing fins. A ful-size mounting template may be purchased from any MODICON sales office.

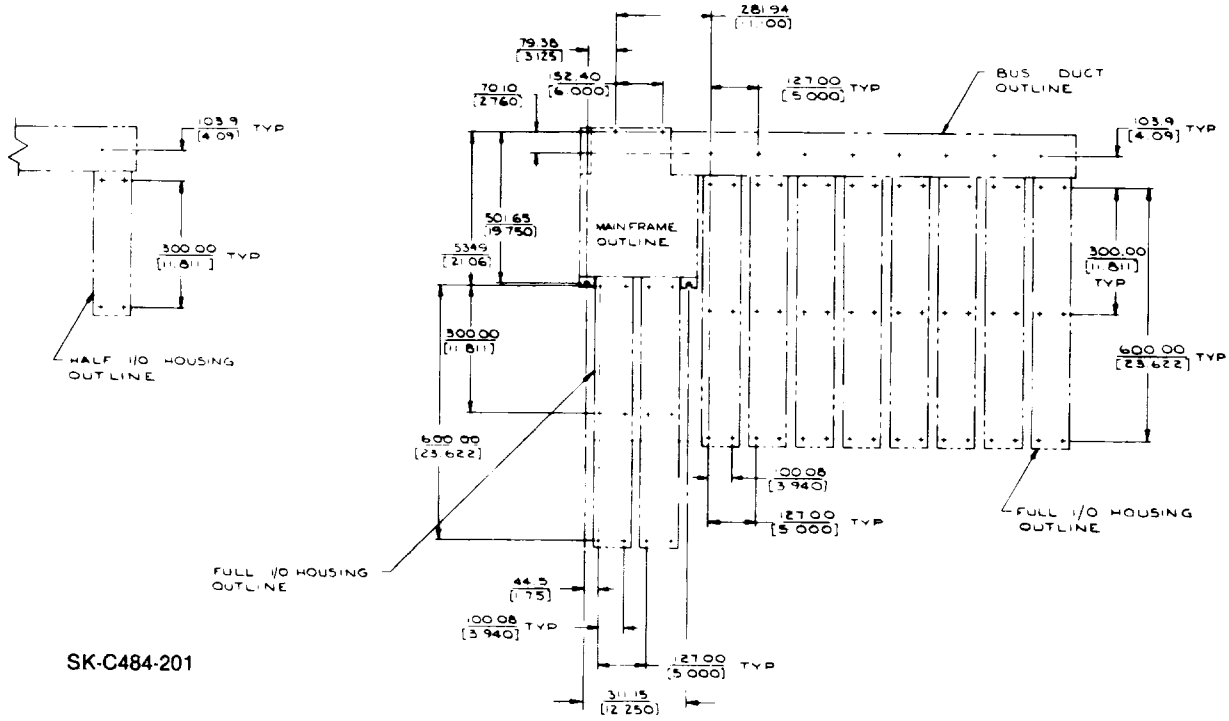

Figure II-1. Typical System Layout

Another system layout frequently used is shown in Figure II-2. This configuration is referred to as Half-Housing. The housing is four I/O modules in the vertical orientation and up to 16 modules in the horizontal orientation.

2.1.3 PROCESSOR/POWER SUPPLY

The latest techniques in CMOS semi-conductor memory with battery backup are used in the 484 Controller. Controller memory is not affected when the AC power supply is lost provided good batteries are installed in the unit. Batteries can be removed while the system is operating on primary AC power. When loss of primary power occurs, the alkaline batteries will maintain memory for approximately 1-1/2 years. Shelf life is two years. Lithium batteries that maintain memory for approximately five years are available as an option. Their shelf life is ten years. Battery life is calculated for worst case temperature, memory size, and bit configuration.

The processor is mounted directly onto a back panel for other vertical support. The power supply is joined to the front door of the processor. It may be removed separately. System operation is not interrupted when the door is opened. The internal components of the processor and power supply may, therefore, be accessed without halting the system. System operation is halted only when the power supply is completely halted. Table II-2 summarizes the AC power requirements.

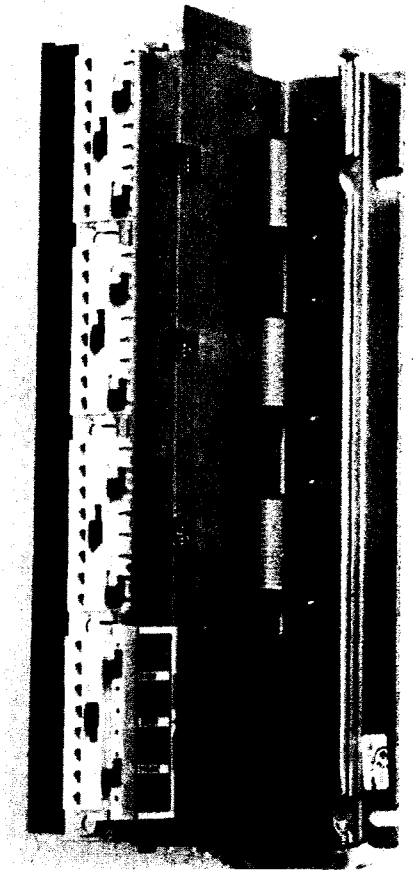

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Figure II-2. Half-Housing Configuration

Table II-2. Summary of Required AC Power

Normal Voltage: Standard Optional	 115V RMS ± 15% (100-130V RMS) 220V RMS ± 15% (187-265V RMS)
Transient Voltage (Standard): Max. 10 seconds Max. 17 m sec	 115V RMS ± 30% (80-150V RMS) 115V RMS ± 100% (0-200V RMS)
Transient Voltage (Optional): Max. 10 seconds Max. 17 m sec	 220V RMS ± 30% (160-300V RMS) 220V RMS ± 100% (0-400V RMS)
Line Spikes:	100V max 500 usec duration, (0.5% max duty cycle)
Frequency: Standard Optional	 60 Hz ± 5% (57-63 Hz) 50 Hz ± 5% (47.5-52.5 Hz)
Normal Load:	50 Volt-amps min 150 Volt-amps max (depending upon I/O and peripheral devices connected)
Recommended Distribution: Transformer	 500 Volt-amps (fuse secondary at 5 amps) (3 amp peak ON transient)

On the front of the processor power supply unit are three LED indicators, a memory protect lockswitch, an interface connector, and AC power connections (Figure II-3). They are as follows:

- LED Indicators

  The three LED indicators show proper operation of:

The power supply:	POWER
The controller:	RUN
The batteries:	BATT OK

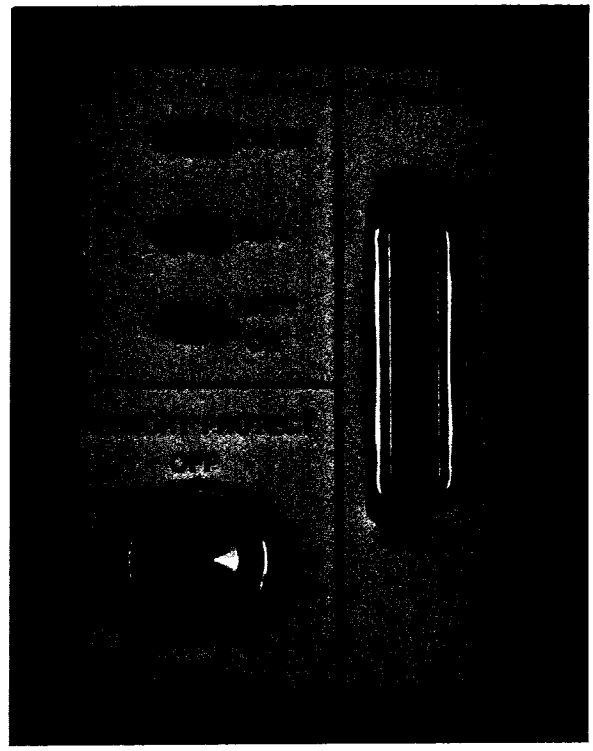

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Figure II-3. Mainframe Controls and Indicators

- Memory Protect

  The MEMORY PROTECT lockswitch protects the user logic from being changed or lost when the lockswitch is in the ON position. Items that must change during normal operation are not included in the operation of the MEMORY PROTECT lockswitch.

- Interface Connector

  The connector next to the indicators is used to connect the auxilliary devices to the controller. P180 CRT Programmer is connected directly to this receptacle when used with no other auxilliary devices. Adapter J470 is connected to this receptacle when additional peripheral devices are required.

o AC Power Connections

Below the Mainframe Controls and Indicators is a terminal board to which AC power is supplied (Figure II-4).

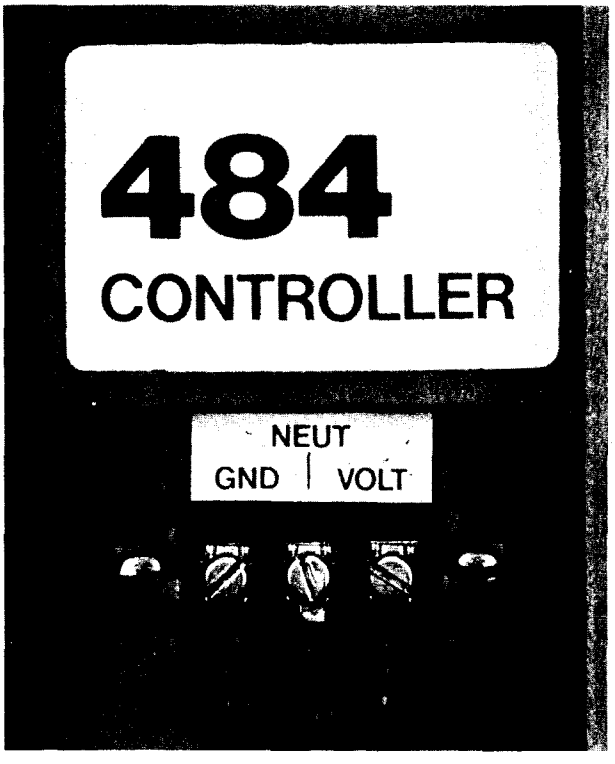

Figure II-4. Mainframe AC Power Connections

Voltage sensing circuitry is provided in the power supply to detect out-of tolerance line voltages. If the AC power is not within the specifications (Table II-2), the processor may stop operating. Operation will be automatically restored when AC power is within tolerances. There will be a one-scan delay in restoring processor operation after a failure. During this time the processor goes through its power-up sequence.

2.1.4 INPUT/OUTPUT (I/O) CHANNELS

All 484 Controllers communicate with an I/O channel. Each channel has a maximum of 128 input points and 128 output points (Figure II-5). The system can be expanded to 256 input points and 256 output points with the use of the Enhanced II Instruction Set and a Model J471 Expander.

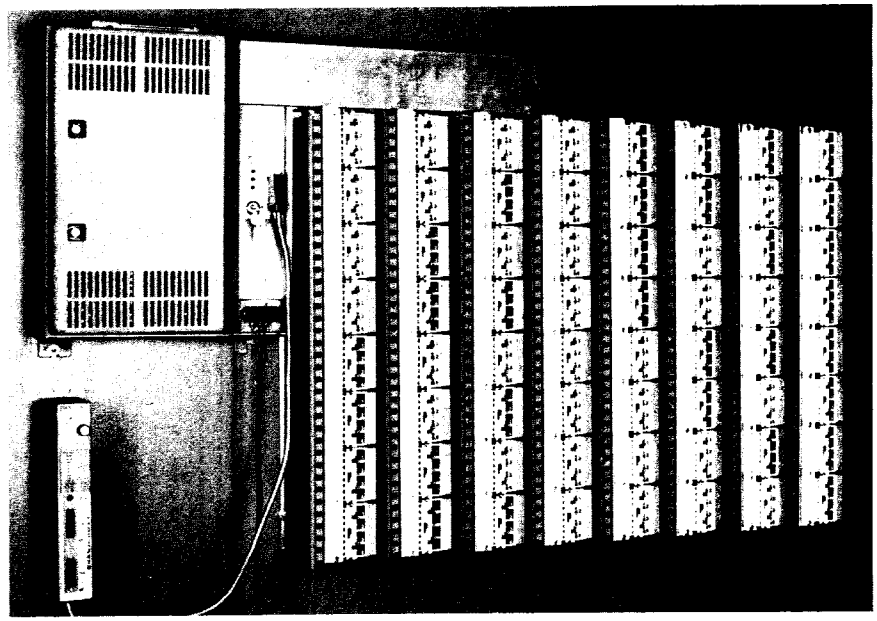

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Figure II-5. Typical 484 with Single I/O Channel

Specific I/O circuitry is provided on I/O modules (Figure II-5). This circuitry converts various voltages to input/output signal levels compatible with the processor. Input/output modules have four circuits each which must be used as either all input or all output.

The modules are installed in I/O housings which accomodate up to eight modules of either type. Usually, eight housings are connected to a processor making one complete channel.

2.1.5 INPUT/OUTPUT (I/O) BUS CONNECTOR CABLE

The I/O Bus Connector Cable is connected to the processor and to the I/O channel. Processor board connection locations are found on the right and left top of the processor board (Figure II-6).

Connections on the I/O channel are made on intermediate connectors on each housing (Figure II-7). These connections are shielded in an I/O duct which mechanically connects the I/O section to the processor. Up to eight discrete I/O housings can be connected to a single bus cable.

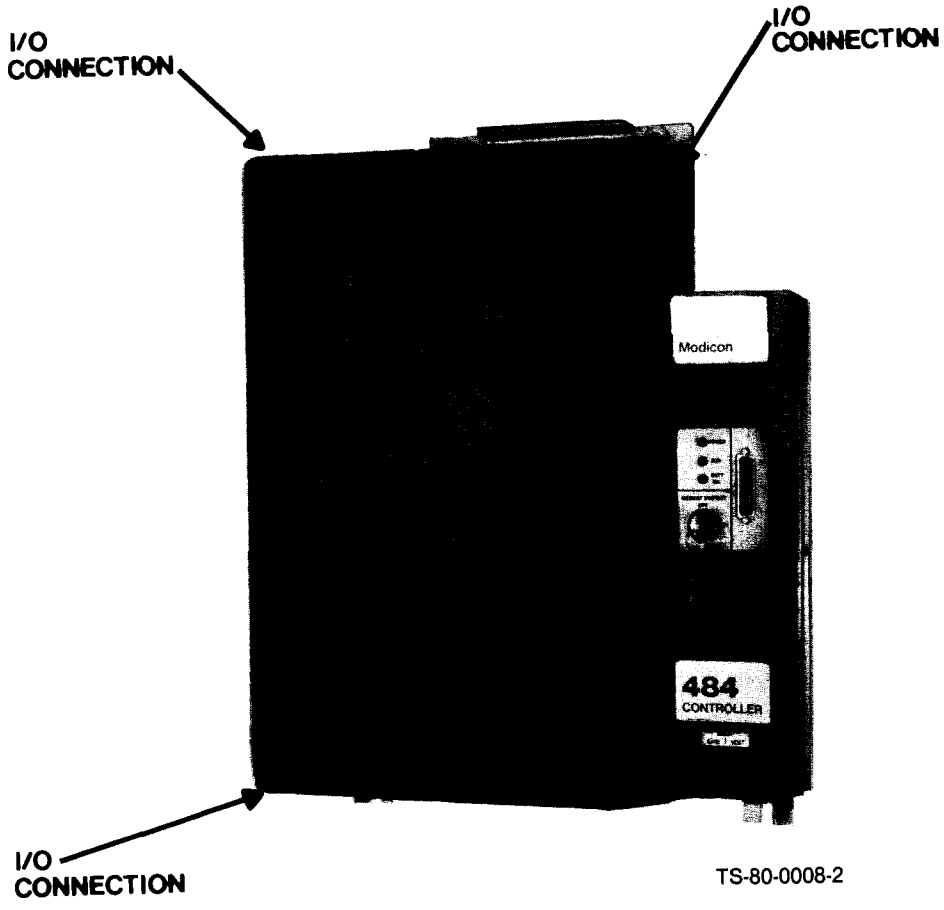

Figure II-6. Processor I/O Connection Options

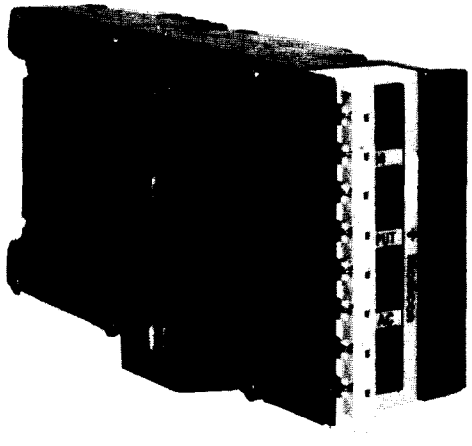

Figure II-7. Typical I/O Module

2.1.6 I/O MODULE FUSES AND BUS CONNECTIONS

All output circuits (AC or DC) have field replaceable fuses and a blown-fuse indicator. The blown-fuse indicator is viewable from the front of the module (Figure II-8). There is one blown-fuse indicator per circuit. To replace fuses the module must be removed from the housing. Fuses are located on the left side of the module. Figure II-9 shows bus connections also viewable from the front of the module.

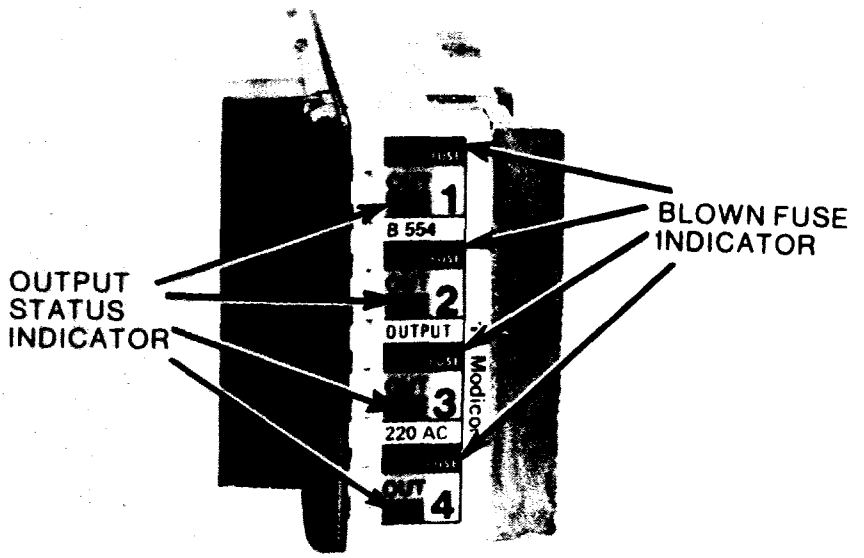

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Figure II-8. Input/Output Module Indicators

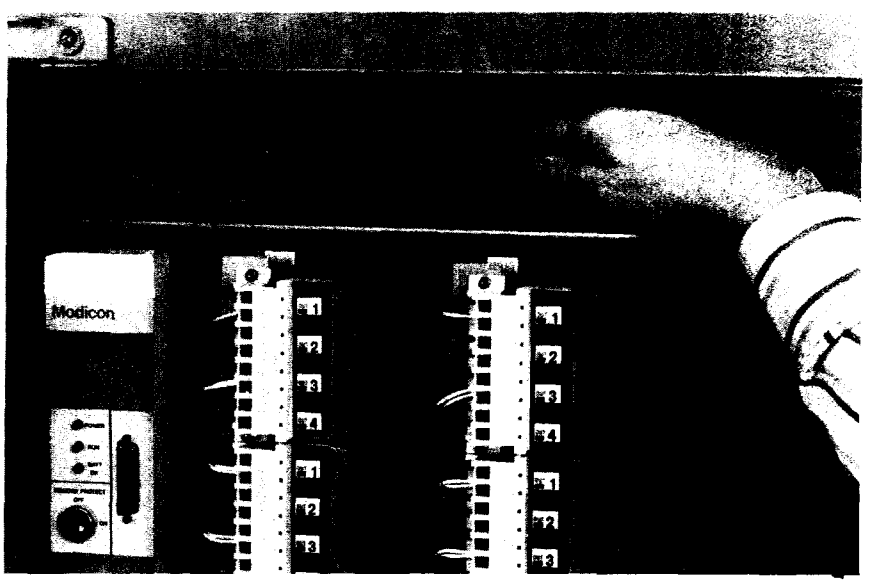

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Figure II-9. Input/Output Bus Connections

2.1.7 I/O ADDRESSING

Addressing is done within the channel at each housing. At the top of each housing is a set of four switches to address the housing (Figure II-10).

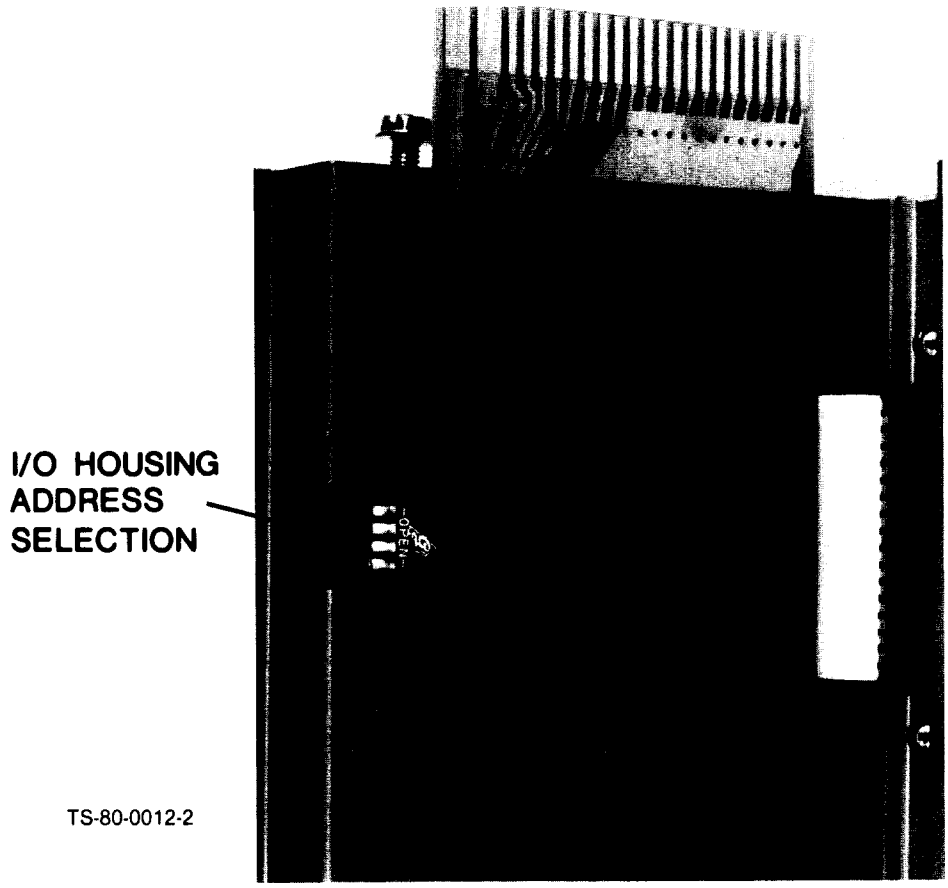

Figure II-10. Address Selecting of I/O Housings

One switch is closed to select address. Any housing can have any address from one to four. Within a housing, the eight modules can be of any type, input or output. However, since there are a maximum of eight housings and only four index positions, two housings can have the same address selected. Any two housings with the same address must have I/O configuration which are opposite from each other. Thus, the top module in one must be an input and the other an output if the housings are addressed the same. The same is true for every module position in the housing pair.

A channel with four I/O housings can be addressed one to four and I/O modules may be inserted in any order. There is no

restriction relative to the mixing of voltages. Beyond four housings, each housing must contain the exact opposite of the previously similarly addressed housing.

2.1.8 I/O FIELD WIRING

Field wiring can be installed on the I/O housings either before or after the I/O modules are installed. However, for user convenience, it is recommended that the field wiring be installed prior to I/O modules. The I/O housing address can be readjusted at any time by removing the I/O modules (Figure II-11).

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Figure II-11. Field Wiring in I/O Housing Conduit

2.2 SYSTEM INSTALLATION

The various parts of the MODICON 484 Controller system are packaged in separate containers as follows:

Container	Contents
C484	Processor unit with power supply.
B545/546	Discrete I/O Housing (up to four housings per box).
B547/548	Register I/O Housing (up to four housings per box).
5540/5541	Input/output Duct with I/O cable.
BXXX	Input/output Modules (up to four modules per box; 4, 8, or 12 boxes per carton).
J 471	Discrete I/O Expander.
B571/570	Register Multiplexers (up to four multiplexers per box).
J470	EIA Adapter.

The 484 Controller is easily installed on any vertical surface capable of sustaining its specified weight. Each unit has holes for mounting. Figure II-1 shows a typical mounting plan. This may be used to mark the wall prior to bolt-hole drilling. Input/output housings can be mounted to the left of the processor, to the right of the processor, or below the processor. A maximum of two locations may be used.

Regardless of the location of mounting, no more than 32 input and 32 output modules can be connected to the processor unless a J471 Expander is also used. Table II-3 summarizes the installation requirements of the 484 Controller.

Table II-3. C484 Controller Installation Specifications

Power Requirements:	
Standard	115 ± 15%, 60Hz ± 5% 150 Volt amp (max). 3 amp peak start-up transient (2 amp on 220V).
Optional	115/220 VAC ± 15%, 50Hz ± 5% 150 Volt amps (max). 3 amp peak start-up transient (2 amp on 220V).
Environmental Requirement:	
Ambient Temperate	0° C to 60° C.
Humidity	0% to 95% (non-condensing).
Dimensions (WxHxD):	
Processor (w/Power Supply)	15 in. x 20.5 in. x 6.5 in. (380 mm x 520 mm x 165 mm).
Single I/O Housing (One channel)	5 in. x 32 in. x 6 in. (130 mm x 815 mm x 155 mm).
Eight Housings (One channel)	40 in. x 32 in. x 6 in. (1020 mm x 815 mm x 155 mm).
Weight:	
Processor (w/Power Supply)	33 lbs (15 Kg).
I/O Module	1 lb (0.5 Kg).
Single I/O Housing (w/Modules)	16 lbs (7.5 Kg).
Eight Housings (w/Modules & Duct)	136 lbs (62 Kg).

2.2.1 MOUNTING PROCEDURES

Figure II-5 shows a typical system mounted with one full channel of eight housings, each with eight I/O modules.

Mounting hardware is not provided with the controller. It is suggested the 5/16 x 1-1/2 inch machine bolts (24UNF) be used.

Step	Procedure
1.	Select type 5540 I/O Duct and mount in place at top of mounting surface. Bolt duct in place. Do NOT install cover.
2.	Select one B545 or 546 I/O housing.
3.	Insert the housing into the bottom of the duct. Keyhole slots are available in the duct to support the I/O housings (Figure II-12).
4.	Bolt the I/O housing in place.

CAUTION

THE KEYHOLE SLOTS ARE NOT CAPABLE OF SUPPORTING FULL I/O MODULES. SECURE THE HOUSING PRIOR TO WIRING AND INSERTING I/O MODULES.

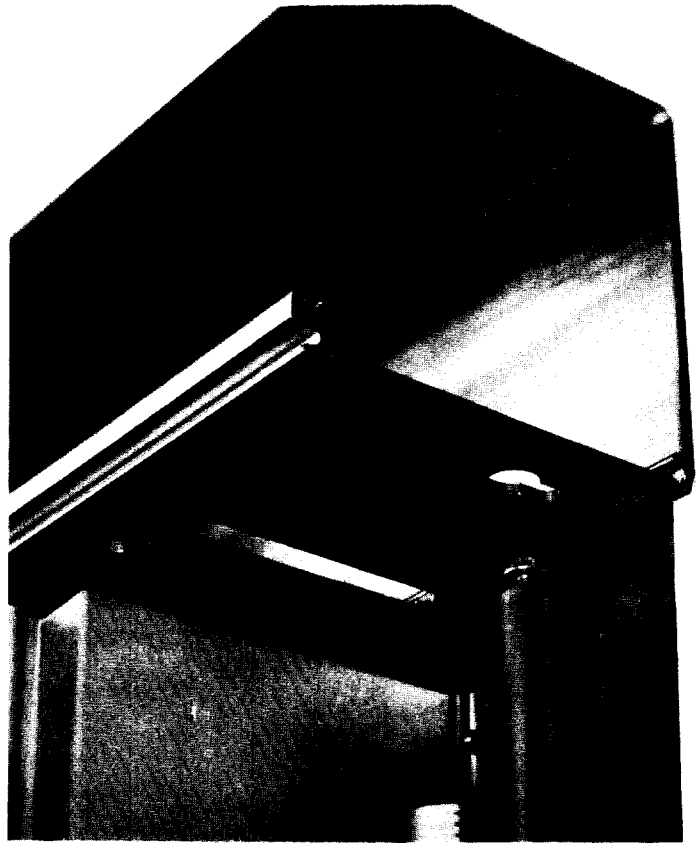

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Figure II-12. Installation of I/O Housing into I/O Duct

Step	Procedure
5.	Repeat steps 2 through 4 for all remaining I/O housings.
6.	Start bottom bolts for mounting of processor.
7.	Remove end plate from processor where I/O duct is to be connected (Figure II-6). Place processor onto bottom two bolts and secure with top two bolts.

NOTE

To reduce weight of processor to 12 pounds, remove the power supply. Disconnection and reconnection procedures for Power Supply are found in Sectio IV of this manual.

8. If I/O housings are to be installed at the bottom of the processor, perform steps 2 through 4 for these two housings. I/O duct is built into bottom of processor. To expand I/O duct to three housings, use Underduct Expander 5566-003.

9. If I/O housings are to be placed on both sides of the processor, repeat steps 1 through 5 for opposite side.

10. Model B547 and B548 I/O Housings are used to mount register type modules, analog or multiplexer. These housings can be placed at any duct position. This does not reduce the number of discrete I/O housings. Follow steps 2 through 4 for installation of register type modules.

11. Obtain I/O bus cable shipped with I/O duct. Connectors are spaced about five inches apart except the ends. The end connectors are 15 inches from the closest connector. Place cable(s) into duct(s) with widely spaced connector at the processor. Red side of cable is facing the rear duct.

12. Open processor and locate I/O connectors (Figure II-13). Route I/O bus cable(s) to I/O connectors and insert (Figure II-14) with red side of cable facing sides of processor. Close processor.

13. Within I/O duct, insert connectors on I/O bus cable into printed circuit board edge connector at top of each I/O housing (Figure II-9).

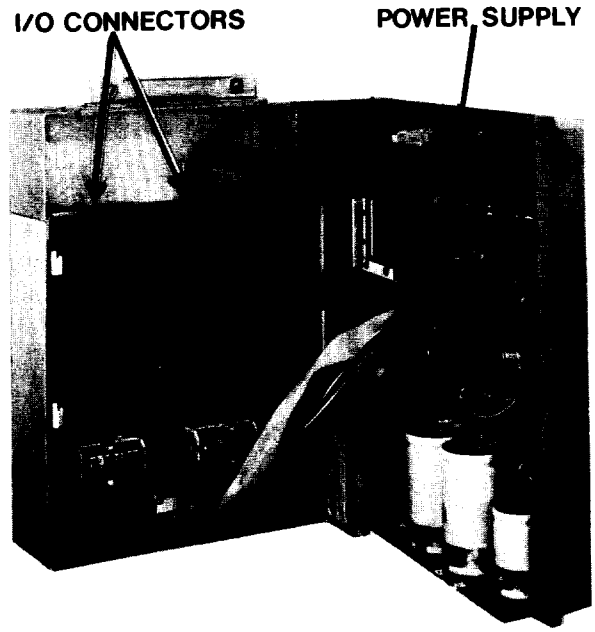

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Figure II-13. Processor - Internal Components

NOTE

Extra connectors on I/O bus cable can be left in duct for future expansion or maintenance purposes.

Step	Procedure
14.	If the J471 I/O Expander is to be installed, remove the end plate from an I/O duct. The expander can be located anywhere near the end of the I/O duct that the optional ten-foot cable used with the expander will reach. Mount expander following procedures used in steps 6 and 7 to mount processor. Route cable to open end of I/O duct and insert end into I/O duct. Secure end plate provided as part of cable to end of I/O duct and connect expander cable to connector I/O bus cable. Expander end of W513 cable is similarly secured to expander. Connection within expander is installed with red side of cable to sides of expander.

CAUTION

MISARTICULATION MAY RESULT IN DAMAGE TO CONNECTOR, J471, OR BOTH.

15.	Secure cover of I/O duct by pushing cover onto duct with sharp blow.

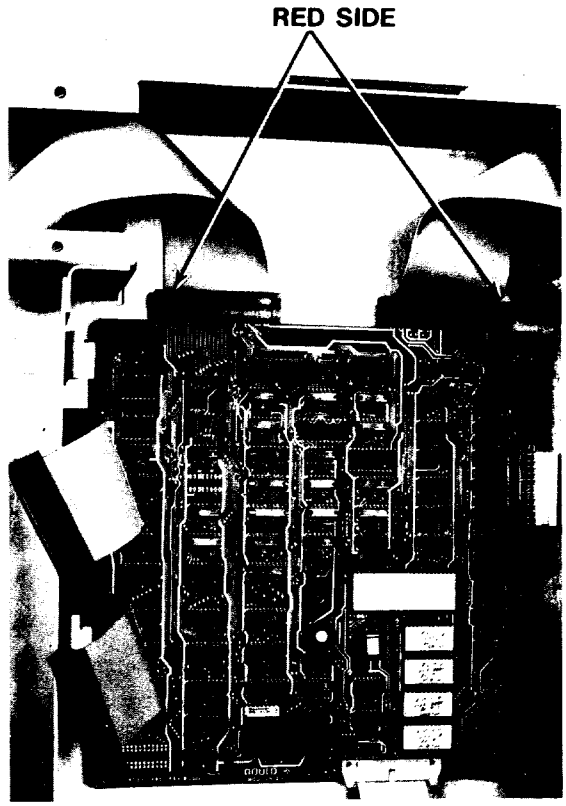

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Figure II-14. Processor with Memory Module Removed

Step	Procedure
16.	If J470 EIA Adapter is to be used, mount the adapter along-side processor whenever I/O connection is NOT made (left, right or bottom). Insert three-foot cable attached to adapter into processor communications connector (Figure II-4).

NOTE

Field wiring can be installed or altered with I/O modules installed. For user convenience, it is recommended that the field wiring be installed prior to the installing of the I/O modules.

17. Install field wiring through conduit on left side of I/O housing (Figure II-11). Connect to screw-down terminals. Each terminal is capable of accomodating eight (Model 545) or four (Model 546) I/O modules, each with eight terminals. Terminal one is at top of each module.

Step	Procedure
18.	Prior to installing the upper module in each I/O housing the housing's address must be established. Behind a small opening to the left of the top of the I/O module is a series of four dip switches (Figure II-10). One of these switches must be depressed (moved toward the wiring conduit) to establish the address of the housing.

NOTE

For proper operation of the I/O channel, only one switch must be selected. If two switches are selected, all housings in that channel with either of these two addresses will respond in parallel.

NOTE

Up to two housings in one channel can have same address. Between two housings with same address, I/O modules must be installed from top to bottom with exact opposite inputs versus outputs.

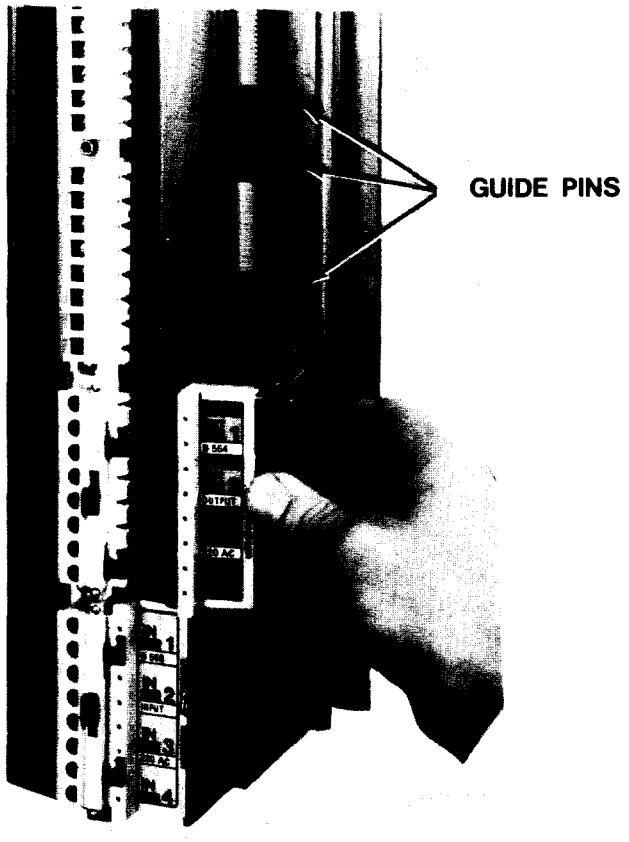

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Figure II-15. Installation of I/O Modules

Step	Procedure
19.	After addressing I/O housings, insert I/O modules. I/O modules are inserted straight into I/O housing using large guide pins (Figure II-15) to align module into rear connector. Once engaged at rear, module is rotated towards wiring conduit to engage field terminals.

NOTE

Red slide lock can be either up or down to allow insertion. It must be down to allow module removal and up to lock module in place.

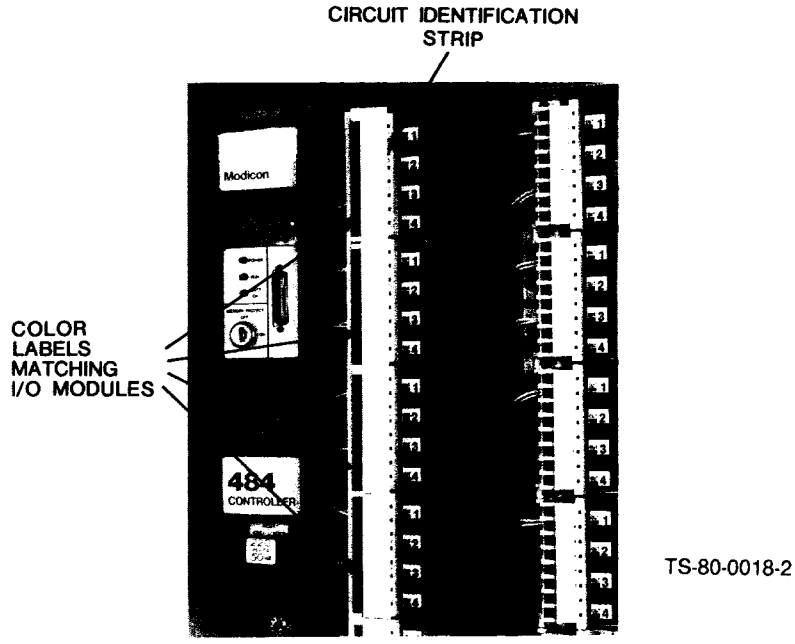

Figure II-16. Installation of I/O Module Labels

20. After I/O modules are inserted the housing identification strip can be inserted (Figure II-16). This plastic strip covers recessed field terminals along entire height of housing. Space is provided on this strip for color coded labels to identify various I/O modules (Table II-4) as well as user identification of field circuits.

21. Finally, AC power is connected to the processor. Single phase, three wire (ground, neutral, and hot) connections are made (Figure II-4). Electrical loads are summarized in Table II-4 and required voltage characteristics are defined in Table II-3.

Table II-4. I/O Module Colors

Module	Type	PMS* Code	Color
B550	115 VAC Output	199	Red
B551	115 VAC Input	197	Pink
B552	DC True High Output	286	Dark Blue
B553	DC True High Input	284	Light Blue
B554	220 VAC Output	151	Orange
B555	220 VAC Input	149	Melon
B556	5V TTL Output	259	Violet
B557	5V TTL Input	264	Light Purple
B558	DC True Low Output	314	Turquoise
B559	DC True Low Input	311	Blue
B560	120 Vdc Output	307	Blue
B561	120 Vdc Input	305	Blue

*Pantone Matching System

SECTION III
OPERATION

3.0 INTRODUCTION

Section III provides information for the basic operation of the MODICON 484 Controller.

As discussed in Sections I and II of this manual, the MODICON 484 Controller is a microprocessor-based controller. Its circuitry allows relay ladder diagram control logic to be programmed and used in various industrial settings. The basic element of programming is the relay contact shown in Figure III-1. The 484 Controller may replace operations which use relay contacts.

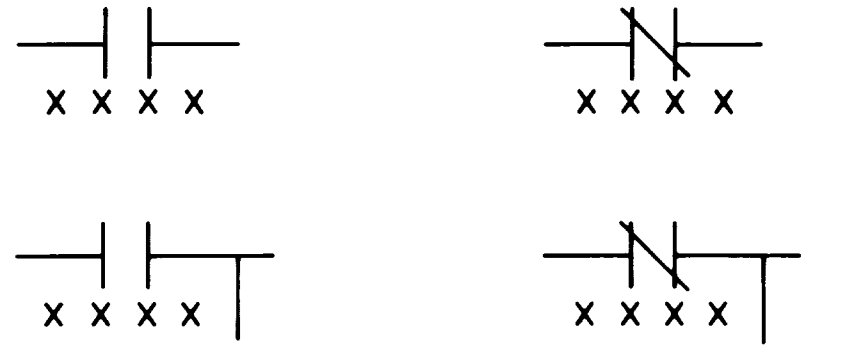

Figure III-1. Relay Contact Types

The C484 is composed of the Processor, the I/O Section, the Power Supply, and a Programming Device. The most commonly used programming device is the P180 CRT Programming Panel.

Section III includes the following information:

- Important machine concepts to enable the reader to understand later descriptions of the 484 Controller functions.
- Detailed discussions of basic logic functions (relay, timer, and counters).
- Detailed discussions of optional functions available with enhanced capabilities.
- Instructions for using the P180 CRT Programming Panel for entering or altering stored logic and other data.
- Instructions for using the L206 Tapeloader, the J470 EIA Adaptor, and the T158 Telephone Interface.

3.1 IMPORTANT MACHINE CONCEPTS

3.1.1 PROGRAMMING FORMAT

The 484 system controls user equipment operation by means of a program stored in the processor (CPU) memory. The CPU program is communicated to the outside world via the I/O Section. The CPU and the I/O Section communicate with each other via the 50 Conductor Ribbon cable. This communication is shown in block diagram form in Figure III-2.

The multi-node format allows up to ten program elements in each horizontal rung of the ladder diagram. Up to seven of these rungs may be combined to form a network of relay contacts. Other program elements such as timers, counters and sequencers may be entered. Each network may have up to seven coils. The coils are automatically placed on the extreme right of the network (Figure III-3). The network is the basic building block of the ladder diagram program. It is defined as a group of program elements compromising one to seven rungs. Each rung has up to ten connected elements.

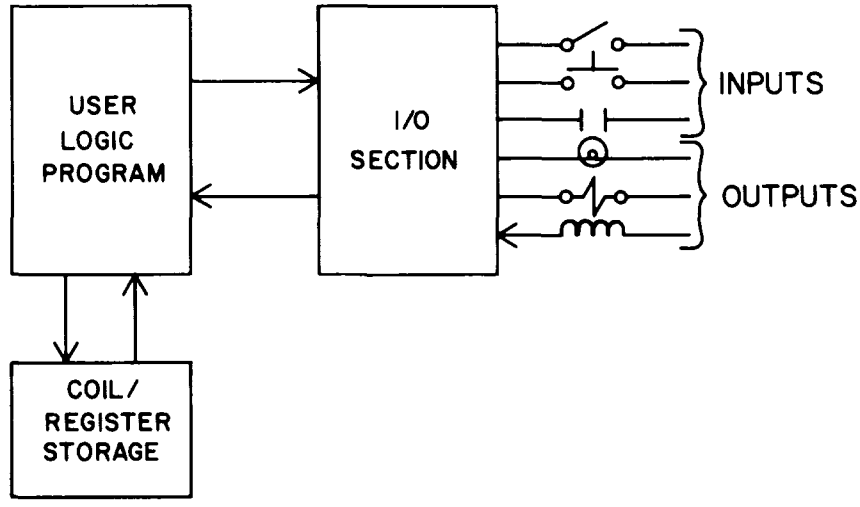

Figure III-2. Mainframe Block Diagram

The quantity of networks or logic elements that may be entered depends upon the memory size of the controller being used and the complexity of each network. Each program element uses two words of memory, as does each coil. This format allows very efficient memory utilization since each word is eight bits long. Efficiency increases as the programmer's efficiency in programming increases.

The basic element of programming is the relay contact, normally open or normally closed (Figure III-1).

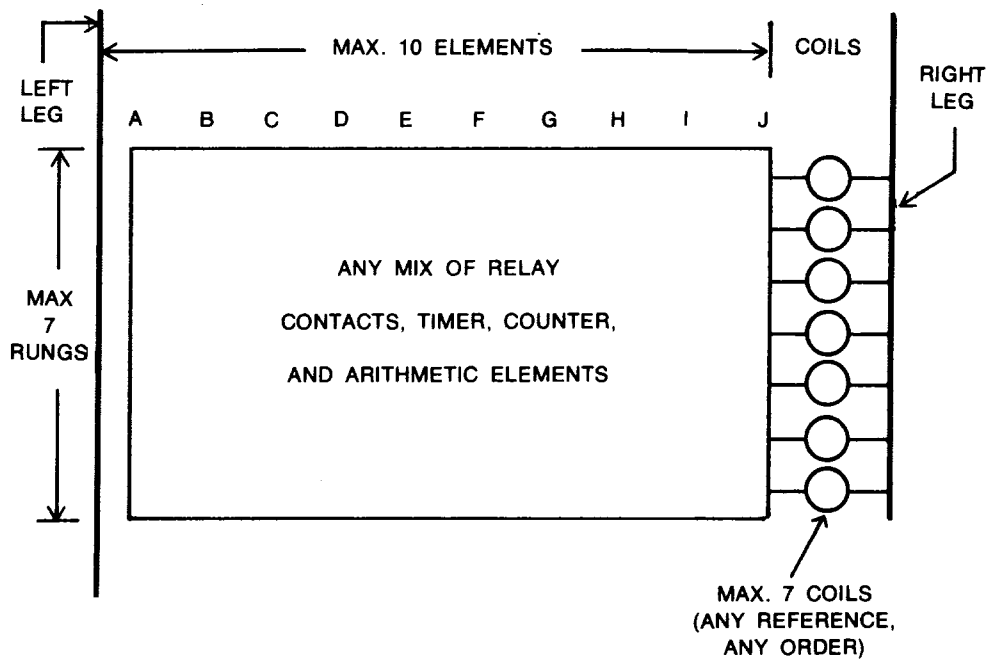

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Figure III-3. Multi-Node Program Format

Below each contact is a four digit reference number that controls the power flow of the contact. (Refer to Controller Reference Numbers discussion later in this section.) Within a network, power flow is allowed from left to right or up and down. It is never allowed to flow from right to left. When properly displayed on the P180 CRT Screen, power is indicated for all relay contacts by intensifying these contact images as power is passed from left to right.

Model P180 Programming Panel displays in real time the number of words used for previously entered logic.

Data entered into the controller is entered directly into the memory of the controller. If power is interrupted before completion of the programming, whatever data already entered is retained. No additional processing is required, such as assembly of data. Data entered is sorted for use by the controller. Networks can be totally or partially changed, added or deleted, at any time with the Programming Panel. This does not interrupt the controller's scan. Any input or output coil may be tested by simulating inputs or outputs with this disable feature. (Refer to Disable/Enable discussion later in this section.)

Pre-formatted ladder diagram forms (Form #484-D) are available through your local MODICON sales offices.

Table III-1. I/O Reference Configuration

B546 Byte Select	Module Number (Top of Bottom)	Circuit Number	CHANNEL ONE HOUSING NUMBER (Strip Select)							
			ONE		TWO		THREE		FOUR	
			Output	Input	Output	Input	Output	Input	Output	Input
Upper Byte	1	1	0001	1001	0033	1033	0065	1065	0097	1097
		2	0002	1002	0034	1034	0066	1066	0098	1098
		3	0003	1003	0035	1035	0067	1067	0099	1099
1		4	0004	1004	0036	1036	0068	1068	0100	1100
	2	1	0005	1005	0037	1037	0069	1069	0101	1101
		2	0006	1006	0038	1038	0070	1070	0102	1102
		3	0007	1007	0039	1039	0071	1071	0103	1103
		4	0008	1008	0040	1040	0072	1072	0104	1104
Lower Byte	3	1	0009	1009	0041	1041	0073	1073	0105	1105
		2	0010	1010	0042	1042	0074	1074	0106	1106
		3	0011	1011	0043	1043	0075	1075	0107	1107
2		4	0012	1012	0044	1044	0076	1076	0108	1108
	4	1	0013	1013	0045	1045	0077	1077	0109	1109
		2	0014	1014	0046	1046	0078	1078	0110	1110
		3	0015	1015	0047	1047	0079	1079	0111	1111
		4	0016	1016	0048	1048	0080	1080	0112	1112
Second B546 Upper Byte	5	1	0017	1017	0049	1049	0081	1081	0113	1113
		2	0018	1018	0050	1050	0082	1082	0114	1114
		3	0019	1019	0051	1051	0083	1083	0115	1115
1		4	0020	1020	0052	1052	0084	1084	0116	1116
	6	1	0021	1021	0053	1053	0085	1085	0117	1117
		2	0022	1022	0054	1054	0086	1086	0118	1118
		3	0023	1023	0055	1055	0087	1087	0119	1119
		4	0024	1024	0056	1056	0088	1088	0120	1120
Lower Byte	7	1	0025	1025	0057	1057	0089	1089	0121	1121
		2	0026	1026	0058	1058	0090	1090	0122	1122
		3	0027	1027	0059	1059	0091	1091	0123	1123
2		4	0028	1028	0060	1060	0092	1092	0124	1124
	8	1	0029	1029	0061	1061	0093	1093	0125	1125
		2	0030	1030	0062	1062	0094	1094	0126	1126
		3	0031	1031	0063	1063	0095	1095	0127	1127
		4	0032	1032	0064	1064	0096	1096	0128	1128

3.1.2 CONTROLLER REFERENCE NUMBERS

Four-digit reference numbers are used to build user's logic throughout the programming of any 484 Controller. These references are divided into two broad categories: discrete and registers. Discrete references are used for individual items that can be ON or OFF. These items include limit switches, pushbuttons, relay contacts, motor starters, relay coils, and solenoid valves. Register references are used to store numerical values such as counters, timers, analog values, and the like. All register references are three BCD digits long (maximum 999).

Only five types of references are required to program a 484 Controller. Any specific reference can be used as many times as needed by a particular application. There are no limits other than memory availability.

References are identified as follows:

0XXX-coils/discrete outputs
1XXX-discrete inputs
2XXX-sequence steps — Available only with
3XXX-input registers — enhanced capabilities
4XXX-holding registers/
output registers

The address of each I/O housing (Section II of this manual) is very important in establishing proper references. Table III-1 defines the exact reference for each I/O module installed in channel one. Similar numbering is used for channel two, with each reference increased by 128.

3.1.3 SCAN

The 484 Controller examines (solves) each network of interconnected logic elements in their numerical sequence. Network One is the first network to be solved on each scan. This is followed by network Two, Three and so on until all available networks are solved. The controller then goes back to network One and solves it and continues solving each network. This fixed scanning occurs at a very rapid speed, typically from four to 20 milliseconds per scan. The scanning begins from the time power is applied to the processor until power is removed. Within each network, logic elements are all solved by columns from the left rail to the right rail where coils are located, and from top to bottom within each column.

The result of each network scan is immediately available to all following networks. It makes no difference whether this result is a change in coil state or a change in numerical value. Networks are solved in order of their numerical sequence number and not by the reference number assigned to any coil.

All inputs and outputs are updated once per scan. The time from solving any individual network on one scan until the network is solved again on the next scan is called the "scan time" of the controller. The scan time varies depending upon the amount and type of logic entered. Typical scans increase with memory size (Table III-2).

Table III-2. 484 Memory Configurations

Model 484	Memory (8 Bit (Words)	Typical Elements (Contacts & Coils)	Maximum I/O		Internal coils	Holding Reg.	Typical Scan Time (M Sec)
			Inputs	Outputs			
01	256	100	64	64	64	62	4
02	512	200	64	64	64	62	6
03	1024	400	128	128	128	126	8
04	2048	800	192	192	192	190	12
05	4096	1600	256	256	256	254	20
06	8192	3200	256	256	256	318	40

3.1.4 MEMORY PROTECT

The 484 Controller is provided with a Memory Protect hardware feature designed to prevent accidental or unauthorized changes to the memory. When the MEMORY PROTECT keylock switch (Figure II-3) is placed in the ON position, the user's logic cannot be altered by any external device, such as the Programming Panel, Tape Loader, Telephone Interface, or Computer Interface. Thus, by placing MEMORY PROTECT ON and removing the key, maintenance personnel can use the Programming Panel to monitor the system but they cannot make unauthorized changes. Only specific personnel who are provided access to the key can change the system.

The Memory Protect feature does not protect those elements that normally change such as registers and I/O status.

3.1.5 DISABLE/ENABLE

The Disable function is another built-in feature in all controllers. This feature simplifies the checkout and maintenance of a control system. The Disable status may be changed only when the MEMORY PROTECT is OFF. Any logic coil selected

by the CRT cursor may be disconnected from its logic by depressing the DISABLE pushbutton (Figure III-17). If the coil was OFF when the pushbutton was depressed, the coil will remain OFF. If the coil was ON it will remain ON. To re-enable a logic coil, the DISABLE pushbutton is depressed a second time while the cursor is under that coil.

When DISABLE is operating the coil disabled is no longer controlled by the operator or user via the CRT Programming Panel. The coil can be toggled ON/OFF/ON/OFF by consecutively depressing the FORCE pushbutton (Figure III-17).

When disabled, the logic coil, all references to this coil in the ladder diagram, and any outputs driven from the coil will be affected by the Disable function. Internally programmed logic remains in the controller and will re-establish control when the coil is enabled. The internal logic is completely by-passed for the coil because of the DISABLE function.

The disable status for any coil is permanent until changed by a programming device. New networks can be displayed, other coils disabled, power interrupted, MEMORY PROTECT turned ON, or any other change made to the system but the disable status of a coil does not change. A programming device must be used to change the disable status of any coil.

CAUTION

THE USER MUST TAKE CARE NOT TO CREATE UNSAFE CONDITIONS WITH MACHINE OPERATIONS BY USING THE DISABLE FUNCTION. ALL COILS DISABLED SHOULD BE RETURNED TO THEIR ORIGINAL STATE PRIOR TO REMOVING THE DISABLE FUNCTION.

Discrete inputs can also be disabled in a manner similar to logic coils. The selected input is placed in the reference area by the GET command. Then the cursor is placed on the input and the DISABLE pushbutton is depressed. This action removes control of that input from the real world and assigns that control to the operator via the CRT Programming Panel. The input can be forced ON or OFF. All logic that uses this discrete input will now respond to the disable status and not the real world.

The disable status is permanent and may be altered only by programming devices with MEMORY PROTECT OFF. At any one time, as many logic coils and discrete inputs as desired can be disabled each ON or OFF.

NOTE

Since the disable status is permanent, a record of all disabled logic coils and inputs should be kept so that they can be enabled later. A ladder listing will show the disable state of any logic or input.

The disable function may be used to verify the proper wiring and operation of all discrete inputs. Each output is displayed in a network on the CRT Programming Panel and then disabled. The coil can be cycled ON/OFF/ON/OFF and so on, so that the operation of the discrete device is observed. It is recommended that the logic coil checked be enabled before the next output is tested to prevent undesirable disable statuses from occuring.

If an input such as a limit switch fails to operate properly, its effect can be temproarily simulated by disabling the input and forcing it to the required state, ON or OFF. This is particularly useful if the input is preventing the control system from functioning.

3.2 BASIC PROGRAMMING

All 484 Controllers are provided with the capability of being programmed and of simulating the function of relays, timers, and counters. All programming is done on the basic format of up to ten elements in each horizontal row or rung and up to seven of these rungs connected together form a network. A network can be a single rung, two rungs or up to seven rungs. There must be some connection between the elements of each rung. This connection may be as simple as the left leg of the ladder diagram. Each network may have up to seven coils. Coils are shown on the CRT screen at the extreme right of the rungs of the network.

These coils may be assigned any valid logic coil number available in the controller. Logic coil numbers can be used only once. The quantity of logic coils, discrete inputs, storage locations and the like, depends upon memory size (Table III-2).

3.2.1 RELAYS

The basic programming element is the relay contact. The possible relay contacts available are shown in Figure III-4.

Contacts cannot be placed vertically. Power flow occurs only form the left leg towards the right or vertically up or down. Power flow is not possible in the reverse direction. Below each contact is a reference number that controls the power flow of that contact.

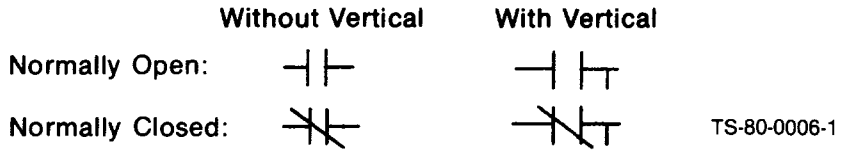

Figure III-4. Relay Contacts With and Without Verticals

Logic coils (0XXX references) are divided into references that can be used to control discrete outputs or to provide completely internal references as follows:

0001-0256	Output Coils
0258-0512	Internal Coils

NOTE

Internal coil 0257 is an internal indicator of battery voltage. This reference is ON as long as the voltage in the batteries is sufficient to ensure retention of memory. Whenever the batteries reduce their capacity to a minimum level coil 0257 will de-energize and the BATT OK LED will extinquish (Figure II-2). This is a warning level only. The batteries will still be able to maintain memory for at least seven days without AC power.

Any output or internal logic coil can be used as a coil only once. References to contacts controlled by a coil can be used as many times as required. There is no limit to how many times any reference is used in a program. Output coils that are not used to drive discrete outputs can still be used as coils in programming. Therefore, any unused output coils can be used for internal functions exactly as internal coils are used. An example of Relay Logic is shown in Figure III-5.

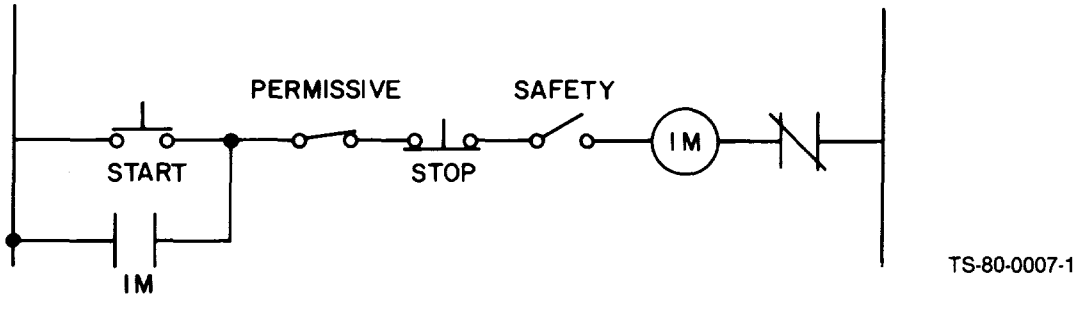

Figure III-5. Relay Logic Example

If the logic (Figure III-5) was implemented in the 484 Controller the control elements must be connected to input circuits in the I/O configuration and outputs assigned. Any available inputs of the proper voltage level may be used. Figure III-6 illustrates the assumed input assignments and wiring details. Output number 12 is assigned to operate the external device. The internal logic programmed into the controller may be seen in Figure III-7.

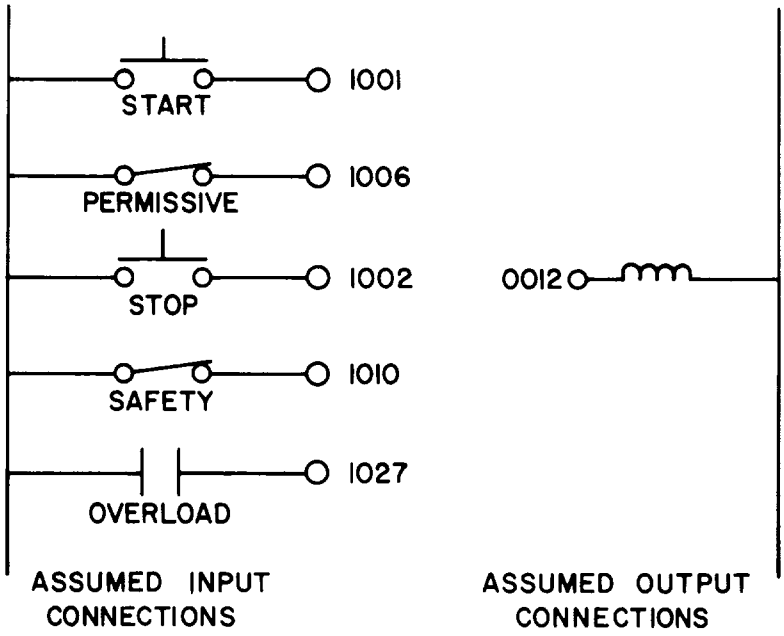

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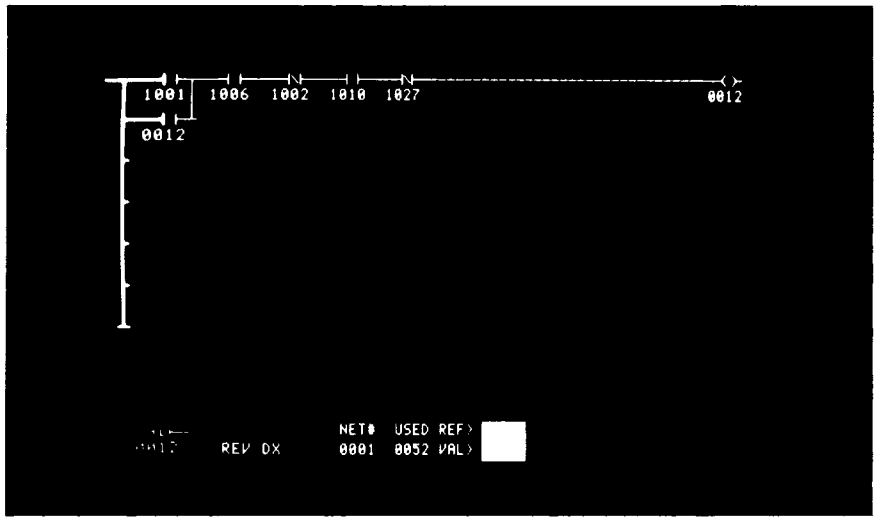
Figure III-6. Assumed I/O Wiring Logic in Figure III-5



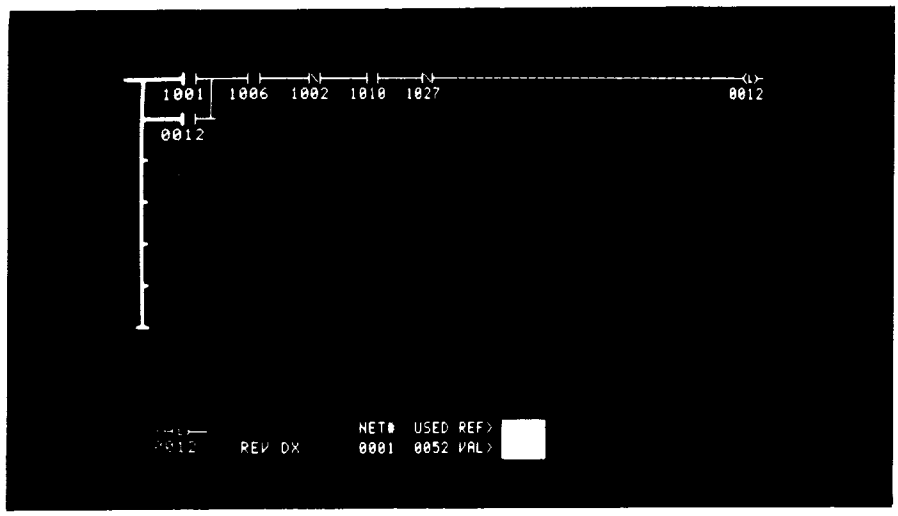
TS-80-0020-2

Figure III-7. 484 Program Equivalent To Assumed I/O Wiring In Figure III-6

3.2.2 LATCHES

Any logic coil can be latched so that it is returned to its previous state (ON or OFF) after a power failure. This is similar to a latching relay. Therefore, if a latched coil is ON and power is lost, it will return to ON state when power is restored regardless of how long the power was off. If the coil was OFF, it will remain OFF when power is restored. All logic coils that are not latched will be de-energized when power is restored.

All logic coils are latchable. If the logic coil in Figure III-7 were latched it would be programmed as such and displayed on the CRT Screen (Figure III-8).

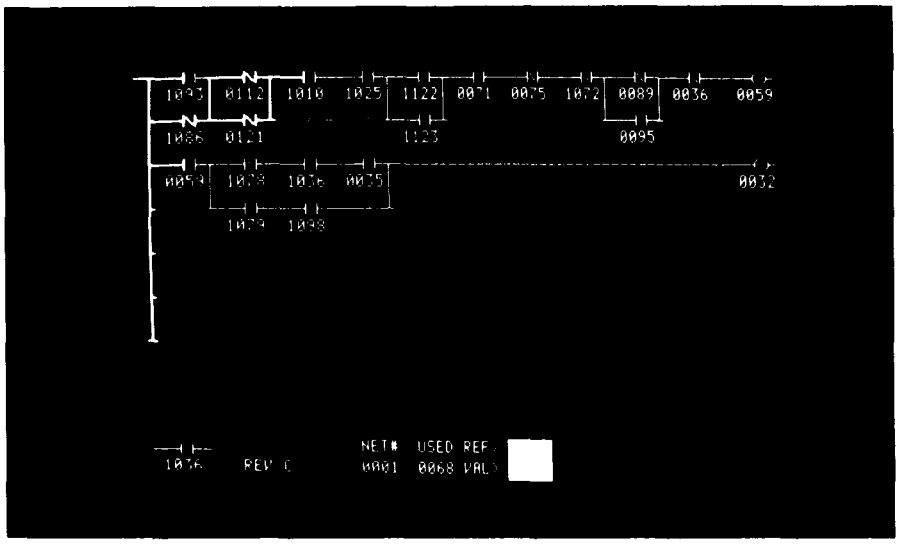


TS-80-0019-2

Figure III-8. 484 Latched Coil Program

3.2.3 EXTENDED LOGIC

If more than ten elements are required in a rung to satisfy a complex control function, an internal coil may be used to represent a partial result. A contact referenced to this coil is then placed as the first element in another network. Additional contacts are entered into the second network. The coil of the second network can be an output that represents the resultant logic of up to 19 series of elements or an internal coil for further extension. The only limit to the number of times the logic can be cascaded like this is established by the memory size of the controller. Internal coils can be used with up to ten elements to represent a single block of logic to be repeated in the program. An example of extended logic may be seen in Figure III-9.

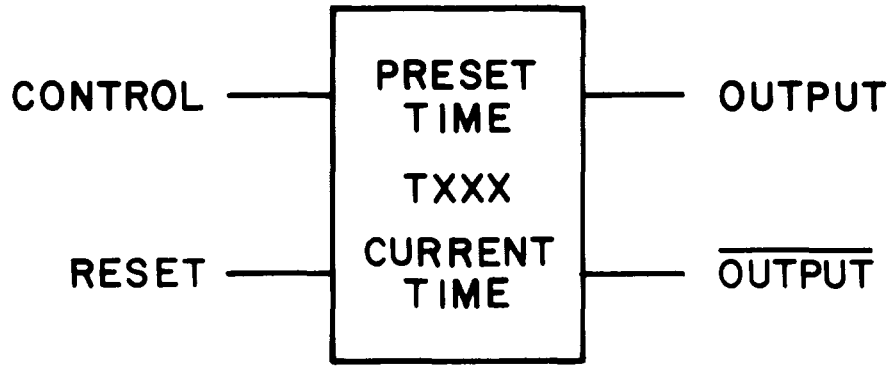


TS-80-0021-2

Figure III-9. 484.Extended Logic Program

3.2.4 TIMERS

Timers can be placed anywhere in a network where sufficient space exists. Timers are built vertically and require two elements, one on top, the other on the bottom (Figure III-10).



TS-80-0009-1

Figure III-10. Timer Format

Within all 484 Controllers are three crystal-controlled clock signals that drive all timers. Any timer can be programmed to respond to either the second clock, 1/10-second clock, or 1/100-second clock. There is no limitation on which or how many timers are referenced to any of the three clock signals.

There are two nodes for entry of relay contact type control to the left of the timer. The upper node controls when the timers accumulate time. The lower node controls when the time is reset to zero. The timer is enabled when the lower node receives power flow. It resets when no power flow is available.

The upper element of the timer contains the preset value which limits the maximum value of the timer. This preset may be fixed value of three digits (0001 to 0999). These digits represent up to 999 seconds, or up to 9.99 seconds. The timer can never exceed this preset value.

The lower element refers to a storage location within the controller where the current timer is stored. In the center of the timer is a display to indicate the rate at which that particular timer is programmed to operate (T1.0 = seconds, T0.1 = tenths of seconds, and T.01 = hundredths of seconds).

On the right of the timer are two nodes from which the logical output of the timer are available. These nodes will provide power to any contact, shunts, or coils programmed to the right of the timer.

The upper node provides power only when the timer is at its preset value. This output is de-energized and stops receiving power. When this output is energized the timer stops. No further accumulating of time beyond the preset is possible.

The lower node provides power whenever the timer is NOT at its preset. This output stops passing power only when the timer is at its preset.

The timer will accumulate time whenever the upper node to the left receives power. The upper signal can be turned ON/OFF/ON as many times as necessary and the timer will accumulate how long the signal was ON up to the preset value. Each time the upper node is re-energized, time begins to be accumulated from its previous value held in the storage location, regardless of how long the signal was OFF.

Timers are accumulative. They are reset only by the lower node signal. They retain their stored information completely during power failure. Whenever the reset signal is de-energized, regardless of the time value, the timer will be reset to zero. It holds at that value until the reset signal is re-energized.

The number entered into the lower element of the timer must be a storage register (reference 4XXX) wherein the current time is stored.

Normally, each timer has its own holding register selected by the user. Thus, the maximum number of timers available with each memory size is the quantity of holding registers. Do not use a holding register as the storage location for more than one timer.

3.2.5 COUNTERS

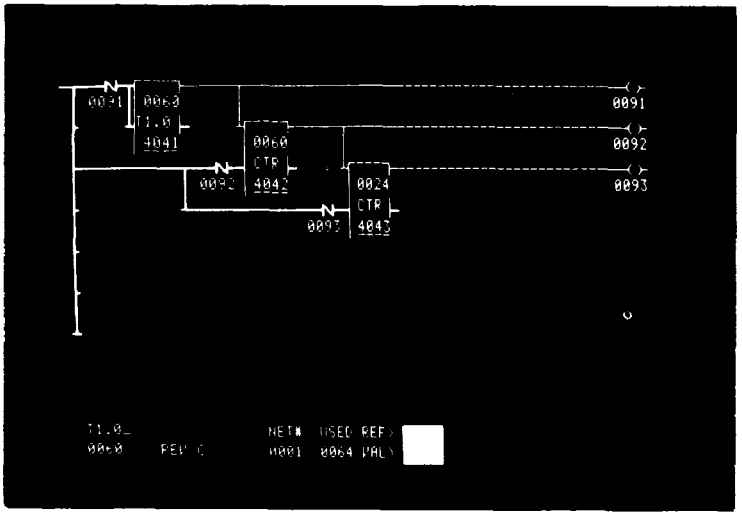
Counters operate the same way as timers except for the control node. The counter increments its current count by one whenever the control signal goes from OFF to ON. Only on this positive transition, OFF to ON, is the count incremental.

The lower left node controls the enable/reset of the counter. Whenever this signal is de-energized the counter is reset to zero. This count is held until the signal is again energized. The number of events to be counted, up to 999, is entered into the upper element of the counter. The current count is stored in a holding register identified in the lower element of the counter. Separate registers should be used to store the current time or count of each timer/counter. Do not share holding registers between timers and counters.

The output of the counter is energized whenever the current count equals preset. Counting stops at the preset value. Whenever the counter is reset to zero via the lower node on the left side, the coil is de-energized. The current count is retained during the power failure since it is stored in a holding register (reference 4XXX). Counters also have a second output that provides power flow as long as count is NOT at its preset.

3.2.6 CASCADED COUNTERS/TIMERS

Timers and counters can be cascaded or interconnected to satisfy any required logic. Figure III-11 shows a cascade of timer and counters to produce a calendar measuring time in seconds, minutes, and hours.



TS-80-0022-2

Figure III-11. Sample Timer/Counter Cascaded Logic

Any 484 Controller can be equipped with a factory installed option that provides extended capabilities in addition to relays, timers, and counters. This option is available without regard to memory size. Features that are included in this option and discussed in the following paragraphs, are as follows:

- o Arithmetic operations (add, subtract, multiply, divide).
- o Register Input/Output.
- o Transitional Contacts.
- o Eight separate sequencers.
- o BCD Convert (Discrete Inputs-to-Register; Register-to-Discrete Outputs).

3.2.7 ARITHMETIC OPERATIONS

This option provides all standard arithmetic operations: addition, subtraction, multiplication, and division. Each arithmetic element has control input (ENABLE line), holding registers, and up to three outputs (Figure III-12). The arithmetic operation is performed on every scan of the controller in which power is applied to the ENABLE line. The outputs can be tied to contacts, other function blocks, or coils as the application requires.

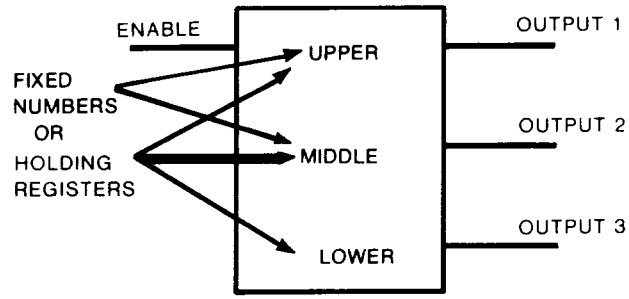


Figure III-12. General Format for Arithmetic Option

The ADDITION function adds the upper value to the middle value and places the result in the lower referenced holding register.

If the result of an add function is a value greater than the holding register can store (three digits - maximum value 999), the portion of the result that will fit into the register is placed there. For example, if 850 is added to 325, the result is 1175. The value 175 (three least significant digits of result) is placed in the holding register and the output energized to indicate an overflow has occurred. Only output 1 is

functional with addition, and always indicates the value 1000 when energized.

The SUBTRACTION function provides one of the most versatile tools available to the control designer. With this function, the designer can compare two numbers located in any holding register and control subsequent operations with one of the three outputs. Thus, this function can be used for set point control of analog loops, alarming functions, dead band functions, etc. The format for subtraction is as follows:

OUTPUTS: 1 is ON if upper value is greater than middle value.
2 is ON if upper value is equal to middle value.
3 is ON is upper value is less than middle value.

The outputs can be tied together so that a "greater than or equal to" or "less than or equal to" logical function can be performed. The outputs are mutually exclusive, that is, only one will be energized when power flows to the enable. The holding register referenced in the lower element will always contain the absolute numerical value of the subtraction operation (i.e., the difference of the two numbers).

In MULTIPLICATION, two 3-digit values are multiplied and a 6-digit product is obtained. Double precision accuracy is a valuable feature of the multiplication function. The register referenced in the lower element is in reality two consecutive registers, the one named and the next one. The one named will contain the three most significant digits of the result. The output coil will be ON as long as there is power flow through the Enable contact.

In DIVISION, a double precision number (up to 999999 in two consecutive registers) can be divided by a fixed number or by a register content. This capability allows the following functions to be performed:

- Scaling of analog signals to engineering units.
- Controlling ratio.
- Solving of formulas.
- Splitting register contents.

The format for division is as follows:

OUTPUTS: 1 is ON if upper value is greater than middle value.
2 is ON if upper values is equal to middle value.
3 is ON if upper value is less than middle value.

The output represents successful division or results of illegal division such as dividing by zero or obtaining a result greater than one register can hold.

3.2.8 REGISTER I/O

Register I/O provides the capability of handling numerical values in the I/O structure. These numerical values can be both received from an external source (input registers) and driven to an external destination (output registers). Each register includes a three-digit quantity, values from 000 to 999. There are 32 input registers assigned references 3001 to 3031 and 32 output registers, references 4001 to 4032. The input registers receive their values from devices connected to the I/O structure and can be only referenced, not altered, from within the controller. The output registers are special holding registers (references 4001-4032) that can perform the dual purpose of storing (holding) numerical values as well as driving them to the outside world.

3.2.9 TRANSITIONAL CONTACTS

In addition to the conventional normally open and normally closed contacts that are available with all 484 Controllers, the Enhanced Instruction Set options also provide transitional contacts (Figure III-13). Transitional contacts can be used anywhere in networks where the more conventional NO and NC contacts had previously been utilized. These transitional contacts will pass power for exactly one scan whenever the signal to which they are referenced is transitioned from either OFF to ON or ON to OFF, depending upon transitional type selected. They can be referenced to any input or coil (output or internal) but cannot be referenced to sequencer steps.

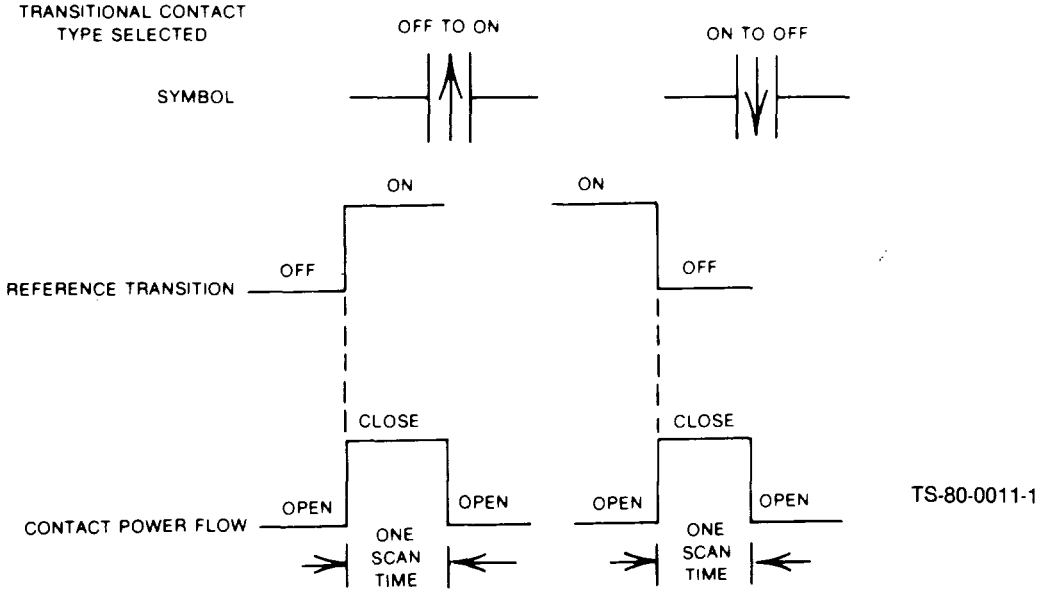


Figure III-13. Transitional Contacts

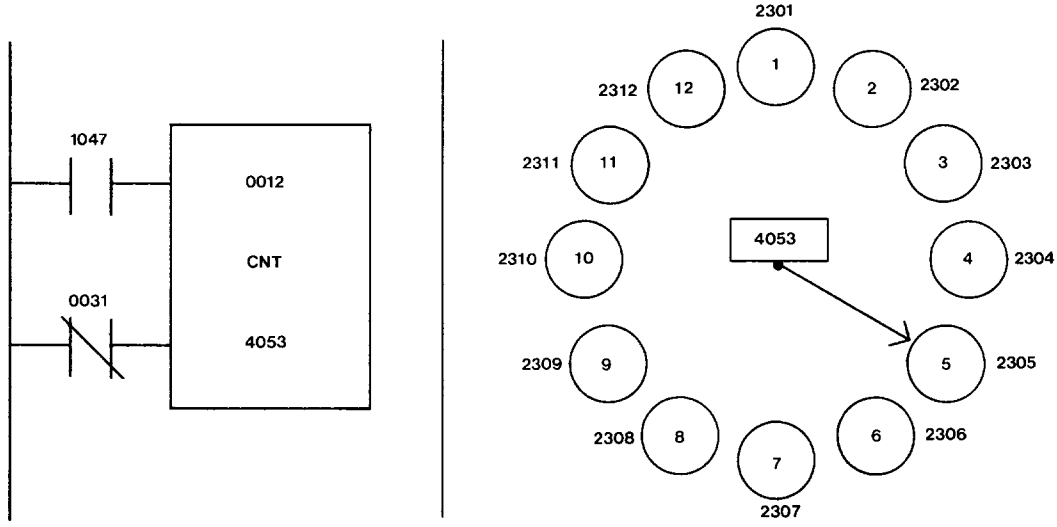
These contacts respresent a "one shot" which is sometimes necessary when performing a function (e.g., multiplication or division) only once.

3.2.10 SEQUENCERS

Eight independent 32-step sequencers are provided. Each sequencer operates similarly to a stepping switch with a single specific reference energized at each position of the stepping switch. These references start with the digit 2 in the form 2XXX. The significance of the remaining three digits of the reference is as follows:

Y - Sequencer No. (1 through 8)
XX - Step Number (1 through 32)

Sequencers are controlled by mumerical values placed in specific registers (4051 to 4058) by any of the non-relay functions such as counter, timers, or any arithmetic operations. A value of zero or above 32 will result in all references to that sequencer being de-energized. Values between one and 32 will result in that single reference being energized and all other references to that sequencer being de-energized (Figure III-14).



TS-80-0012-1

Figure III-14. Twelve-Step Sequencer and Equivalent Circuit

The counter has a preset of 12 and stores its current count in register 4053. Every time input 1047 is energized, the value in register 4053 is incremented by one. This is equivalent to moving the stepping switch one position. If register

4053 contains the value five, reference 2305 (third sequencer, step five) is energized. When the current count equals the preset (0012), the stepping switch stops with reference 2312 energized. Whenever coil 0031 is energized, the counter is reset to zero and the stepping switch goes back to home (no references energized); regardless of its current count, intermediate references are not energized.

Each sequencer is completely independent since it is controlled by separate register values. Sequencer references can be used as often as necessary, anywhere in the logic where relay contacts are appropriate. By using calculate logic, any sequencer can be made to skip steps and jump forward or move backwards as necessary; intermediate references are NOT energized. Sequencers references are updated as soon as a change in the content of a sequencer register is changed. Thus, one network can drive the sequencers, and the next network use the most recent value of the sequencer references. Sequencer references cannot be used on transitional contacts.

3.2.11 BCD CONVERT

The BCD CONVERT function allows discrete (ON-OFF) I/O modules to be referenced as a BCD (Binary Coded Decimal) register. This is, if it is desired to wire a thumbwheel switch input into a set of discrete input modules, the BCD CONVERT function will allow these 12 inputs to be used as a numerical value in the controller. Conversely, if it is desired to connect a LED display to a set of discrete output modules, the BCD CONVERT function will allow a holding register (numerical data) to be transmitted to a display.

3.2.12 ENHANCED II INSTRUCTION SET OPTION

This instruction set is similar to the Enhanced I Instruction option and has the same capabilities, plus the following:

- Binary convert (discrete inputs-to-register; register-to-discrete outputs).
- Register-to-table move.
- Table-to-register move.
- SKIP and BY-PASS I/O.
- MODBUS Communication Interface.

3.2.13 BINARY CONVERT

This function is similar to the BCD CONVERT except that now the input and output modules do not receive numerical data as such, but BINARY data. This BINARY data is in the form of bits (ones and zeros) contained in a register. Conversion is done with ten bits.

The BINARY CONVERT function allows the transfer of discrete inputs to be made to registers, and the transfer of the binary bit pattern of registers to be made to discrete outputs.

This capability is very useful when, for example, a known bit pattern is desired to be outputted upon reaching a step or cycle. The bit pattern (1=energize; 0=de-energize) could be held in a register and then simply moved to the output upon acutation of a cycle. When a new step is reached, a different bit pattern can be retrieved from another register and transferred to the output modules.

In a similar fashion, the status of inputs may be brought into the controller and stored as bits in a register. This may be a method for setting different bit patterns for the output status discussed previously.

3.2.14 MOVE FUNCTION

The MOVE function allows numerical data (register contents) to be moved from one register to another on command. These functions allow a table to be utilized with recipe or source data, report information to be retained and examined at a later time, errors stored in the order they were detected, and data to be multiplexed through the discrete I/O structure with the BINARY CONVERT operation.

The concept is similar to the MOVE codes found in the MODICON Model 184 and 384 Controllers which have made them so powerful. The implementation, however, is somewhat different. The MOVE function can be used for presetting different values in timers and counters, doing comparisons, etc.

The MOVE in the 484 Controller is a form of INDIRECT ADDRESSING. The function takes the form of a block with two register references in it; a TO register on the bottom and a FROM register on the top (Figure III-15).

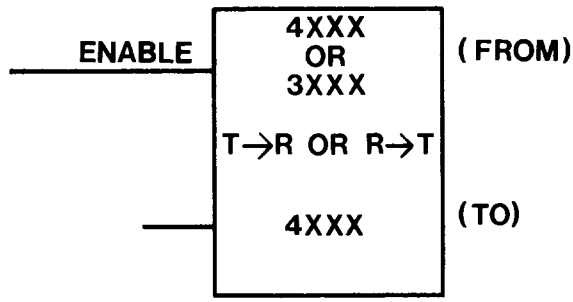


Figure III-15. MOVE Format

The FROM register may be an input register (3XXX) such as a thumbwheel input or a holding register (4XXX). The TO register must be a holding register. A discussion of the two MOVE functions (i.e., Table-to-Register and Register-to-Table) follows.

3.2.15 TABLE-TO-REGISTER MOVE

Similar to the T→R Move, the R→T Move allows the loading of a table of registers from one central register whose contents are changing. When the ENABLE signal receives power flow, the R→T function will lock at the bottom register (TO) content to determine the register to be changed. The upper register (FROM) content is the value to be placed in this register and thus alter its content.

ENABLE

EXAMPLE:	4100	If 4100 contains the value 43, register
	T→R	4043 (4000+043) will have its content
	4001	transferred to register 4001.

In either MOVE function, it is recommended that the 484 Manual and 484 Application Notes be reviewed for operation and typical applications.

ENABLE

EXAMPLE:	4095	If 4120 contains the value 225, register
	R→T	4225 (4000+225) will be loaded with the
	4120	content of register 4095.

3.2.16 SKIP

The SKIP function allows a designated network or set of networks to be "skipped" by the scan of the controller. This effectively reduces the potential scan time from that required to solve all networks to that required by the minimum monitoring logic until a certain event happens (e.g., timer times out, set point reached, limit switch activated, level achieved, etc.).

3.2.17 BY-PASS I/O

Similar to the SKIP function, BY-PASS I/O allows unused I/O to be "by-passed" and not serviced in the scanning function. Portions of both the discrete I/O as well as the register I/O

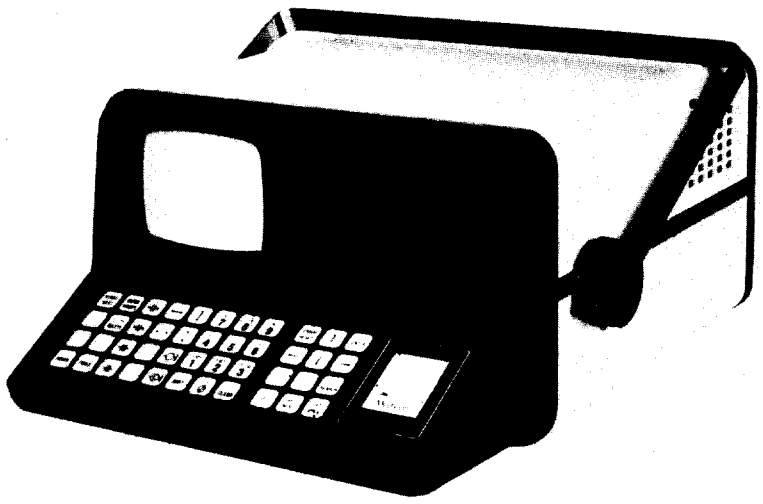
can be by-passed with separate user controlled limits. Maximum savings is 7 msec on the scan time.

Because SKIP and BY-PASS functions are very powerful tools, their use should be considered only by those designers that are totally familiar with the 484 Manual and its precautions. Using both SKIP and BY-PASS I/O, the 484 can be operated at a minimum scan time of 1.5 msec.

3.2.18 MODBUS COMMUNICATION CAPABILITY

Combined with a MODBUS communications interface unit that attaches the controller to a MODBUS communication system, the Enhanced II Instruction Set Option includes the capability to respond to commands received from a remote master. For details on configurations and features, refer to MODICON MODBUS System User's Manual.

3.3 USE OF P180 CRT PROGRAMMING PANEL



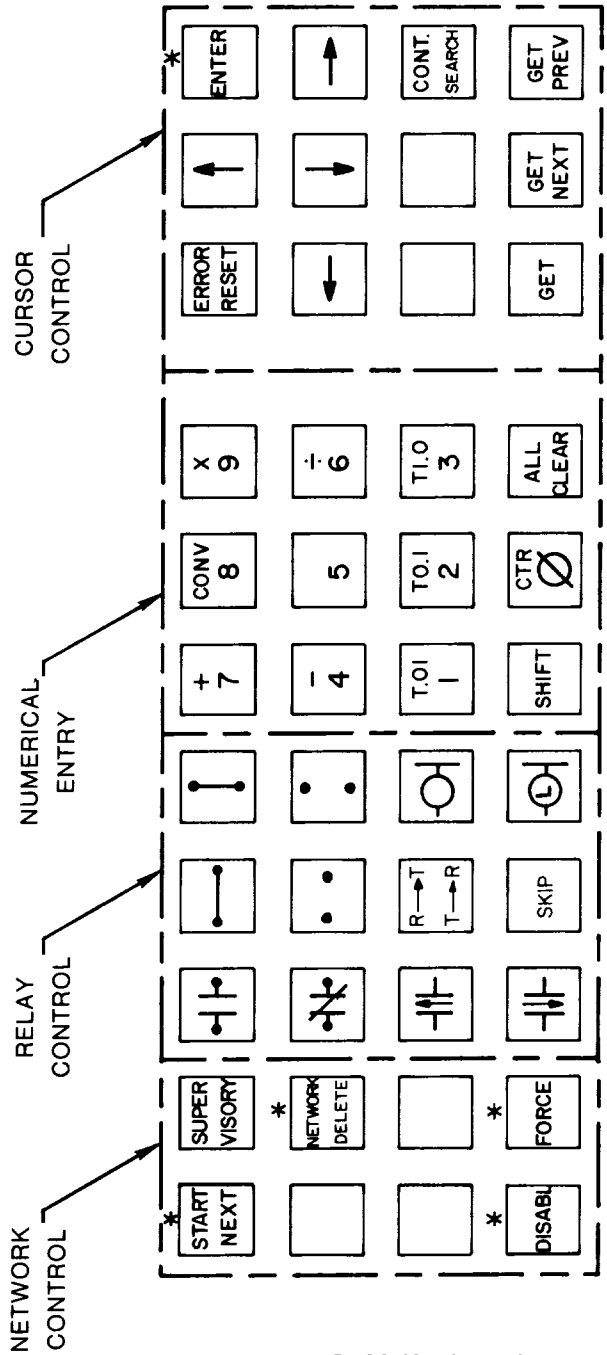
TS-80-0023-2

Figure III-16. P180 CRT Programming Panel

3.3.1 INTRODUCTION

The most commonly used programming device is the P180 CRT Programming Panel (Figure III-16). This device provides the primary human-machine interface that determines how the processor will be used. The programming panel is small, keyboard portable, and ruggedly built.

The keyboard is a dedicated function board (Figure III-17). The keys are divided into four basic types: network control, relay control, numerical entry, and cursor control.

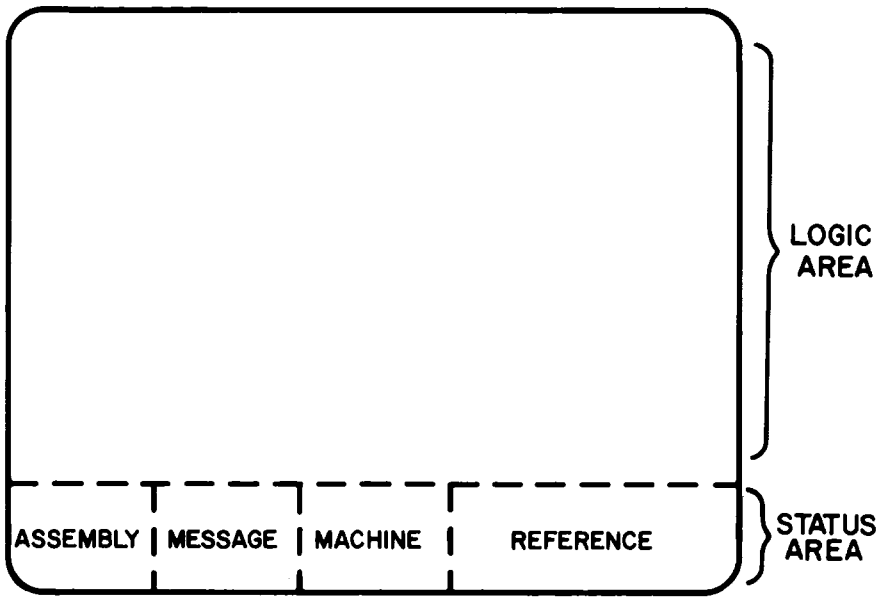


TS-80-0014-1

Figure III-17. P180 Keyboard

3.3.2 CRT DISPLAY

Data is displayed on a 5 inch CRT, white on black screen (Figure III-18). The screen is divided horizontally into two sections: user logic and status/assembly.



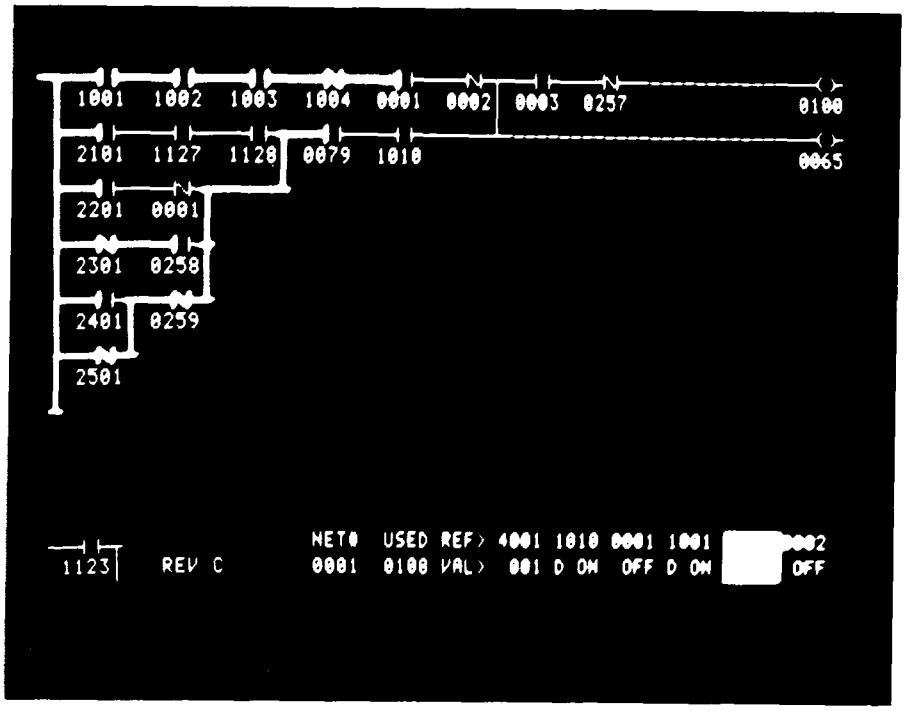
TS-80-0015-1

Figure III-18. General CRT Screen Format

The upper seven lines display the user logic in any order selected by the operator. The smallest unit displayed is a network. A network is a group of logic elements (relay contacts, fixed numerical values, register references, coils and so on). These are connected together at some point or points. Networks are identified by a step number assigned when a network is constructed. The minimum size of a network is one rung of the ladder. Maximum network size is seven rungs. Figure III-3 shows the program format for the user logic display. Figure III-19 shows typical programmed networks.

The lower two lines contain four status areas (Figure III-18) which provide information to the operator. The first is the assembly area on the left. Program elements must be assembled here before being entered into ladder diagram. All portions of an element must be specified before the processor will accept it. Any white area in the assembly portion indicates part of the element is missing.

Next to the assembly area is the message space. Messages such as MEMORY PROTECT ON, Bad Node and Illegal Reference are provided for the operator.



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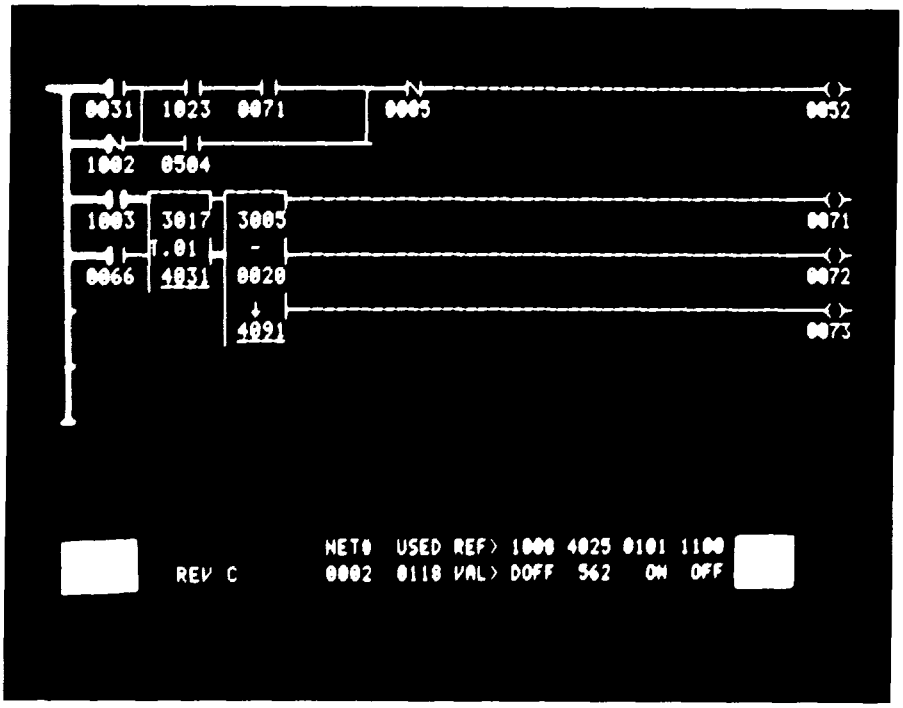

TS-80-0025-2

Figure III-19. Typical Programmed Networks

In the center of the status area, are two values related to the controller program status. First is the step number of the network on the screen. The amount of memory (in 8-bit words) already used is also shown in this area.

The final status area is at the right. It is programmed by the operator with up to six legal references. These can be logic coils, inputs or registers. References will have their current status displayed at all times no matter where the cursor may be. Discrete references 0XXX and 1XXX are indicated as ON or OFF. Registers have their numerical content displayed (000 to 999).

3.4 PROGRAMMING INSTRUCTIONS

3.4.1 NETWORK CONTROLS

These controls (Figure III-17) are discussed as follows: pushbuttons indicated with an asterisk(*) will not function unless MEMORY PROTECT is OFF:

*START NEXT - This pushbutton causes a new network to be created immediately after the network on the screen. All networks following the current network will have their step numbers increased by one. If no logic is on the screen, the new network will be created at network number one (before all existing logic). All existing networks will have their step numbers increased by one, providing space for the new logic at network one.

SUPERVISORY - This pushbutton allows the operator to enter the most powerful level of programming the 484 Controller. This mode should be used only with great care, since major changes such as clear all logic can occur once in the Supervisory mode. Depressing the SUPERVISOR pushbutton clears the screen and displays seven options available to the operator as follows:

0	=	EXIT Supervisory State
*1	=	STOP Controller Sweep
*2	=	START Controller Sweep
*3	=	CLEAR Controller Memory
4	=	LOAD Memory through ASCII Port
*5	=	DUMP Memory from ASCII Port
6	=	VERIFY Memory against ASCII Port

Entering the proper numerical digit from the keyboard will cause that function to occur. Exit returns CRT to normal functions; Stop/Start control scanning of controller with all outputs OFF when sweep stopped. Clear removes all stored logic from controller memory. Dump Memory causes the entire 484 Controller memory (logic and coil/register storage) to be outputted via an ASCII port built into the P180 Programmer. The

ASCII device connected to the P180 port should be a simple ASCII tape loader capable of operating at 600 baud. The scanning of the controller is NOT halted when a dump is made. The Load Memory allows a previous ASCII Dump to be placed into the 484 Controller memory; scanning must be stopped prior to a load, and requires either a start command or AC power to be cycled on the controller to restart the scanning following a successful load. Verify will compare controller's memory against tape record made by the ASCII device.

To prevent accidental changes to the control system, whenever a 1 (Stop) or a 3 (Clear) is selected, the CRT will display the option "7 = Confirm." The operation is performed only after the digit 7 is selected as the second step. To cancel an operation before it is executed, select any other option (0-6). The controller must be stopped (option 1) prior to selecting a Clear (option 3) or Load (option 4).

*DELETE - When depressed, this pushbutton will cause the element of the ladder diagram where the cursor is positioned to be deleted. Relay elements can be deleted only from the bottom of a column or from the right of the top rung when only one element remains in the column. Elements can always be replaced by horizontal and vertical opens. To delete a non-relay function, the cursor is placed at the top of the function; all numerical elements of this function will be simultaneously deleted. If the shift has been previously selected, the DELETE pushbutton will cause the entire network that the cursor is on to be removed. All existing networks that follow the deleted network will have their step numbers decreased by one. Deletions occur simultaneously both from the CRT screen as well as the memory of the controller.

*DISABLE - Both logic coils and discrete inputs can be disconnected from their normal control when this pushbutton is depressed. The normal control still exists within the controller, but is temporarily bypassed; disables are retentive upon power failure. Coils (0XXX) are disabled by placing the cursor on the coil in the LOGIC AREA and depressing the DISABLE pushbutton. Inputs (1XXX) are similarly disabled by placing the cursor on the input in the REFERENCE AREA. Once disabled, these references are no longer under control of the controller until manually changed. Disabled references "freeze" their state (ON/OFF); as many references as desired can be simultaneously disabled. All contacts/outputs controlled by this reference wherever they are in the ladder diagram, will reflect the ON/OFF state of the disabled reference. Depressing the pushbutton a second time for a disable reference will return it to the normal (enabled) condition.

*FORCE - This bushbutton can be used to alter the ON/OFF state of any disable reference. The cursor is placed on a previously disabled reference in the ladder diagram; only logic

coils (0XXX) and discrete inputs (1XXX) can be disabled. When the pushbutton is depressed, the state of the reference will be altered (e.g., OFF to ON or ON to OFF). Successive depressing of this pushbutton will cause the reference to be toggled OFF to ON to OFF to ON, etc.

3.4.2 RELAY CONTACT CONTROLS

When programming relay contacts into the assembly area, the ten pushbuttons (plus two spares) will control which contact type is selected. Changes are easily made by entering the corrected contact type anytime prior to entry into the network, or construction of a new element if the existing logic element of a network is to be altered. The relay element can be either a normal open contact (⊣ ⊢), a normally closed contact (⊣/⊢), a horizontal shunt (———), or a horizontal open (* *). In addition, any relay element can have a vertical connection to the next lower rung (|), or a vertical connection (:). Vertical connections are possible only to the right of the element; vertical connections are not possible with coils or the bottom (seventh) rung of a network. If enhanced capabilities are available, transitional contacts can be used (—↑— or —↓—), otherwise an error message will appear when these contacts are selected. Transitional contacts pass power for exactly one scan, when their referenced coil or input goes from OFF to ON or ON to OFF. Coils of any network can be normal (-( )-) or latched (-(L)-); all logic coils are latchable. Normal coils will be de-energized if a power failure occurs; latched coils are restored following a power failure to the state (ON or OFF) that they held prior to the power failure.

3.4.3 NUMERICAL ENTRY

This set of controls (Figure III-17) is used basically to enter numerical values into the assembly area. These values can be discrete references to control relay contacts, fixed values or register references for numerical elements, or value for storage in a holding register. All four digits must be entered, with existing digits moved one position to the left with each new digit entered at the units position. Numerical values must first be entered into the assembly area, prior to use as part of the controller's logic.

All numerical keys, except for the digit five, have dual functions controlled by a shift key. In addition to the entry of numerical values, these keys specify non-relay functions to the assembly area. The upper element of the non-relay function is specified by these keys. For example, if the SHIFT is depressed and then the digit zero, the assembly area will be prepared to construct the preset of the counter logic. When this

element is placed into the ladder diagram, the next lower element will be coded to accept a holding register reference (4XXX), since the counter is a two element function. If a SHIFT, then the seven key is depressed, the assembly area is prepared to construct the upper element of an ADD function. When this element is placed into the ladder diagram, the next two elements will be coded for arithmetic references, since the ADD is a three element function. The non-relay functions are listed under the SHIFT operation discussed below.

SHIFT - This pushbutton can be depressed prior to another key to alter its function. A letter S inside a small rectangle is displayed in the message space next to the assembly area after the SHIFT is depressed. The shift will be removed after the depressing of the key a second time, or after any of the twelve dual function keys are depressed. The SHIFT key operates similar to the upper case shift control on a typewriter. A complete discussion of shifted controls is provided as part of the discussion of basic keys' functions. The following is a list of dual function keys:

Basic Key Label	Shifted (Upper Case) Function	Upper Label
DELETE Element	DELETE Network	Netwrk
T → R	Register-to-Table	R → T
Commence SEARCH	Continue Search	Cont
0 (zero)	Counter	Ctr
1 (one)	Timer 1/100 Sec	T.01
2 (two)	Timer 1/10 Sec	T0.1
3 (three)	Timer Seconds	T1.0
4 (four)	Subtract	−
6 (six)	Divide	÷
7 (seven)	Add	+
8 (eight)	Convert	CONV
9 (nine)	Multiply	X
CLEAR Assembly Area	CLEAR Entire Screen	ALL

CLEAR - When depressed, this pushbutton clears the assembly area. If a SHIFT has been commenced prior to the CLEAR, the entire CRT screen will be cleared, including assembly area, error codes, and step (network) number.

3.4.4 ENTRY CONTROLS

These controls (Figure III-17) relate to the entry of the logic elements into the ladder diagram from the assembly area. Changes are made to the controller's memory and these elements checked for validity only when their entry into the ladder diagram is attempted. The element is moved from the assembly area to the ladder diagram where the cursor is positioned. If logic

exists at the cursor position, it will be replaced by the element in the assembly area; any portion of the assembly area not specified (i.e., left blank - indicated by white area), will not be altered when new logic is entered. All portions of the assembly area must be specified if new logic is to be entered into vacant spaces of the ladder diagram.

Any combination of relay contacts, vertical connections, and non-relay functions (timers, counters, arithmetics, etc.), are possible as long as there is space within the 10 x 7 network format. Logic coils can be entered at the end of any rung. The logic format requires the top rung to be complete for any column that will store logic. Each column that stores any logic must be programmed from the top down to the last element desired by the user. Where necessary, elements must be programmed with horizontal shunts or horizontal opens to complete the format.

Non-relay elements can be entered into any column with sufficient space, as long as the existing logic is blank. Non-relay elements cannot be replaced with relay elements directly; the non-relay functions must first be deleted, and then the relay functions entered. Programming starts at the top of the left most column, and can then proceed along the top rung towards the right or down the first column.

There are four pushbuttons marked with arrows (←,↑,→,↓) that control the position of the cursor. When one of these controls is depressed, the cursor is moved one position in the direction indicated, unless the cursor is at the boundary of the screen. At the right and left boundary the cursor will "wrap around" when forced beyond either side to the opposite side. At the top or bottom of the screen, there is no "wrap around" and the cursor will not move beyond these boundaries. Other controls are as follows:

ERROR RESET - If an error is detected in the operation of the P180 Programmer, a message will be flashed and the ENTER and network controls will be locked out. When any other pushbutton (including ERROR RESET) is depressed, the message is erased, assuming the error condition does not continue to exist, and then the keyboard is completely functional.

ENTER - If MEMORY PROTECT is OFF, the ENTER pushbutton will cause the assembly area to be copied into the location selected by the cursor; the assembly area is not altered and the cursor remains at its previous location. If this location is in the logic area, the entire assembly area will be moved as a logic element after passing appropriate error checking. If the cursor is in the reference status area and on a holding register reference, the numerical content of the assembly area only will be moved into the register.

SEARCH - This pushbutton initiates a search of all logic entered into the controller's data base. The search will be started at the first (upper left) contact of network one, and continue through all networks column by column, until either the desired element is located or end of logic is detected. Searches are performed based upon data in the assembly area; portions of the element left blank (undefined) will not be considered during the search. For example, if all references to input 1029 are desired (normally open or normally closed contacts with or without vertical connector), only the reference value 1029 is entered into the assembly area. When this pushbutton is depressed, the search begins and the first network using the reference is displayed in its entirety. If additional networks are desired, the SHIFT key is depressed pripr to closing this pushbutton a second time; the shifted search will continue the search from where the previous match was found (not at start of logic).

GET - This pushbutton is used to load the reference status area. The desired reference is entered into the assembly area, and the cursor positioned in the reference (right side) status area where the operator desires to display its status. The status of logic coils (0XXX), discrete inputs (1XXX), or registers (3XXX or 4XXX) can be displayed; sequencer references (2YXX) cannot be displayed. Up to six references of any type can be displayed simultaneously, with the reference number on top and the status immediately below it. Discrete status will be provided as ON or OFF; a D prior to the input status indicates a disabled reference. Register statuses are provided as a three-digit value indicating the content of the register.

Successive depressions of the GET pushbutton with the cursor on a reference in the status area will cause that reference to increase by one for each depression. The assembly area will also copy this reference regardless of its previous content. To remove a reference from the status area, a DELETE is selected while the cursor is on that reference area.

GET NEXT - When depressed, the network following the one currently on the screen will be displayed. For example, if the network on the screen is step number 23, this pushbutton will cause the network step 24 to be displayed. If no network is on the screen, network one will be displayed.

GET PREV - This pushbutton operates similar to the GET NEXT, except that when depressed the previous network is obtained. Using previous example, with network 23 on the screen, this pushbutton causes network 22 to be displayed.

For complete programming details, see GOULD-MODICON USER'S MANUAL, January 1979, pages A-10 through A-21.

3.5 USE OF MODEL T158 TELEPHONE INTERFACE

3.5.1 DESCRIPTION

The MODICON Telephone Interface (Figures III-20 and III-21) is a device which allows the Programmable Controller to be linked to the MODICON Service Center over standard voice grade telephone lines. The Model T158 is an acoustical data coupler which mates with the standard telephone hand-set. Models T151 and T152 are designed to be used with MODICON 084 and 184/384 Controllers; these units can also be used with the 484 Controller without the specialized interface designed for the 084 and 184/384 Controller. Regardless of which model Telephone Interface is used, all require the use of the J470 EIA Adapter to communicate to the 484 Controller (Section IV of this manual).

The T158 Telephone Interface is housed in a rugged case for portability and safe storage. No special knowledge or training is required to use any MODICON Telephone Interface.

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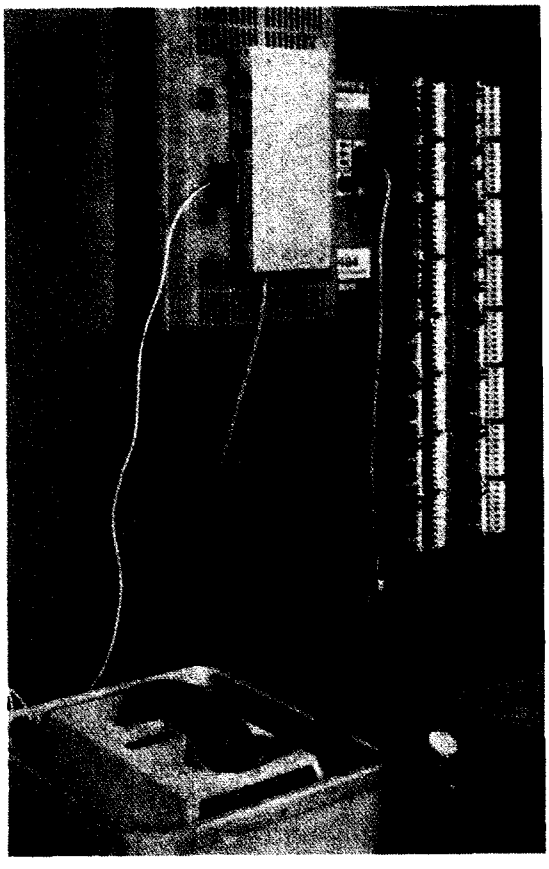

Figure III-20. T158 Telephone Interface

The T158 Telephone Interface in its carrying case weighs 20 lbs and has outside dimensions of 14.75 in. x 14 in. x 10.5 in. The acoustic coupler can operate in 0-50°C ambient air, 10-95% relative humidity (non-condensing). The J470 Adapter has a special mounting hanger that allows it to be temporarily connected to the front of the mainframe. The adapter can operate in ambient air 0-60°C and 10-95% humidity (non-condensing).

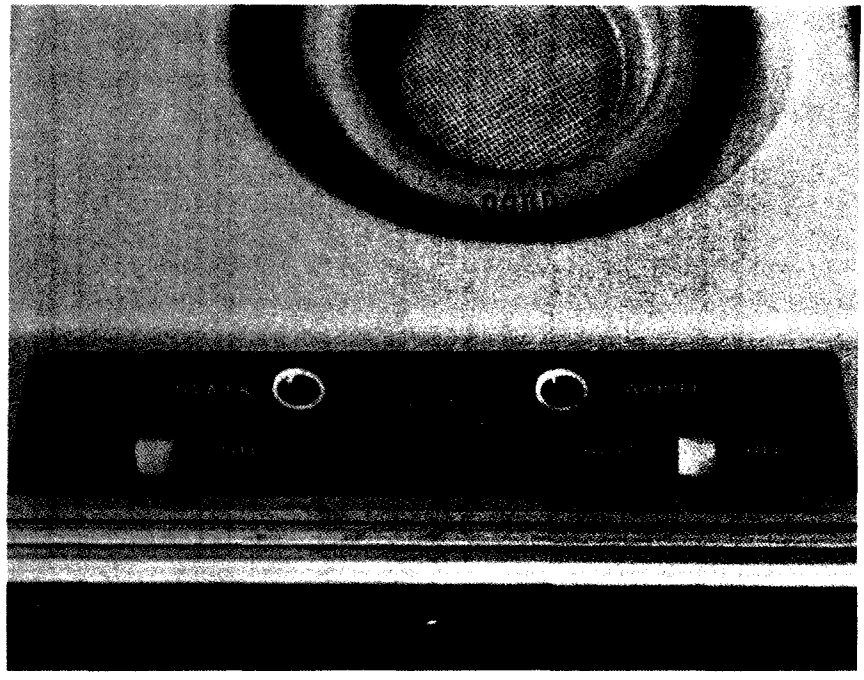

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Figure III-21. Controls on Telephone Interface

3.5.2 OPERATING PROCEDURE

After complete installation the MODICON Service Center can be called at (617-475-1181). Your phone call will be answered by the Service Center Operator who will want to know:

1. Your name and company.

2. The serial number or system number of the controller to which you are connected.

3. What service you desire. If the call is for diagnostic service, the operator will probably ask other questions.

After this discussion, the operator will request that you switch over to "Data." At the MODICON end this entails switching from phone to data. If you are still listening, you will hear an audible tone. At your end to make the "Data" connection, you must place the handset firmly into the rubber cups of

the acoustical coupler. One of the cups is lettered CORD, which identifies the cup receiving the CORD end of the handset. The rubber cups fit snugly about the headset receiver and transmitter, reducing the possibility of room noise affecting the communications.

When you have placed the handset correctly into the coupler, and the Service Center Operator has switched from voice to data, the green CARRIER lamp on your acoustic coupler will light. The Service Center Operator is now in control. During this service, you must watch this green CARRIER lamp. When the lamp goes off, the Operator has switched to voice and is waiting for you to pick up the handset again.

Since reliable error checking cannot be done on communications while the controller is operating, you will notice that shortly after switching to data a short communication will occur which will turn off the controller RUN lamp as well as all outputs. Although the controller will not be scanning its logic (running) when the RUN light is off, it is capable of communicating to Service Center.

It is good practice when placing your call through your company switchboard, to explain to the operator that you are making a data call. Operators have been known to break the connection when they hear a tone rather than voices.

3.6 MODEL L206 PROGRAM TAPE LOADER

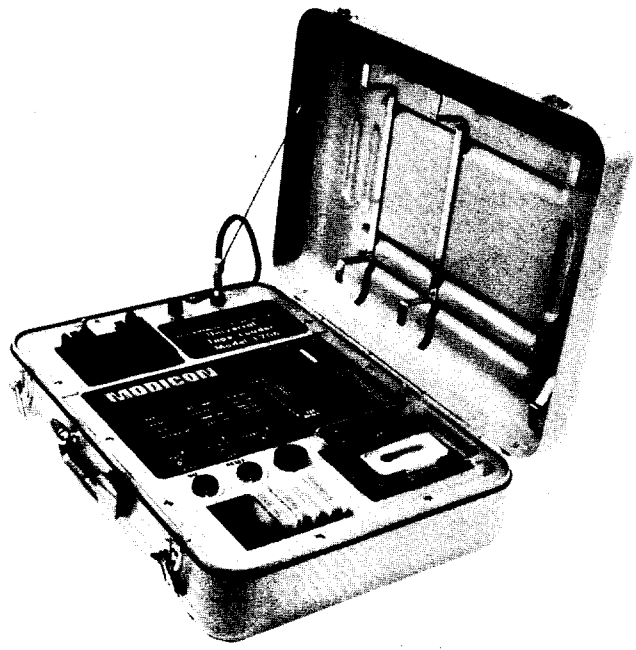

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Figure III-22. L206 Tape Loader

3.6.1 DESCRIPTION

The Model L206 Program Tape Loader (Figure III-22) is a magnetic tape cartridge unit designed for field recording and reloading of user programs from the 484 Programmable Controller. This loader is also compatible with models 084, 184, 284, 384, and 1084 Controllers with different interface units. The Program Loader features ease of operation and fully automatic error detection and protection. The Model 206 Program Loader permits the user to:

- o Record his control programs on magnetic tape cartridges.
- o Load a control program from a magnetic tape cartridge.
- o Verify a tape, either against the controller's memory or internal (tape only) parity check.

The Model L206 Loader is housed in a rugged case and requires a Model J470 Adapter set for any standard baud rate. The case also provides space for storage of up to five magnetic tape cartridges. Each cartridge can store only one MODICON program regardless of controller type. The program from the 484 Controller consists of the entire logic memory as well as the dynamic memory. In addition to user logic, all disabled status, coil states, and holding register contents will be included in a tape record or load.

3.6.2 SPECIFICATIONS

Dimensions:	15"x21"x8" (381 mmx 533mm x 203mm).
Weight:	35 pounds (15.9Kg).
Cartridge Size:	300 feet (9115m).
Cartridge Capacity:	512 blocks, each block 256 eight bit words.
Speed:	Read/Write: 18 inches/sec. Rewind: 100 inches/sec.
Write Protect:	Removing the colored coded flap on the bottom of the tape cartridge inhibits recording on that cartridge.
Baud Rates:	110, 150, 200, 300, 600, 1200, 1800, 2400, 3500, 4800, 7200, 9600, and 19,200 baud.
Power Requirements:	115V + 10%, 50-60 Hz or 220V $\mp$ 10%, 50-60 Hz, 60 VA.

Environment: Ambient Temperatures 10-50° C, Humidity up to 95% non-condensing

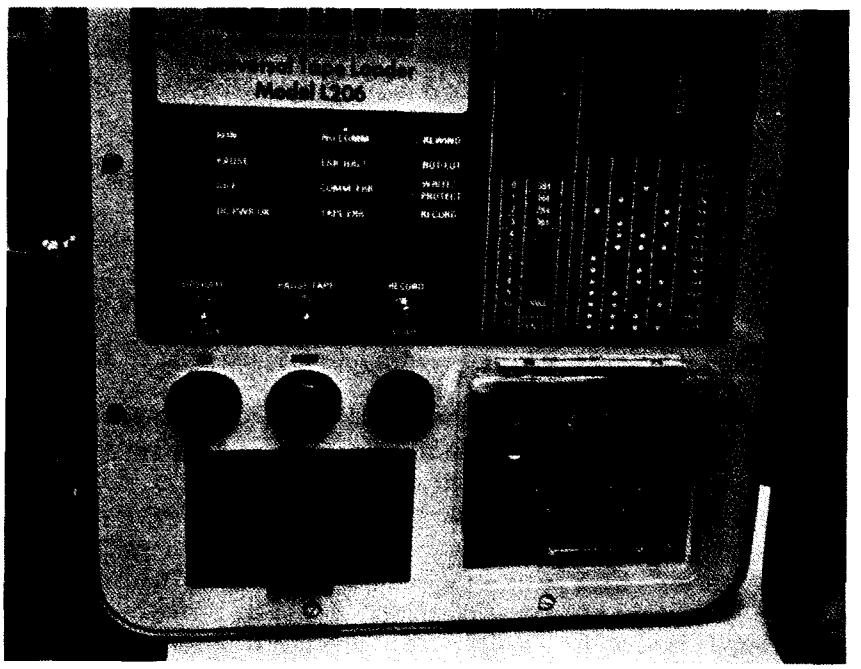

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Figure III-23. L206 Controls and Indicators

3.6.3 CONTROLS AND INDICATORS (Figure III-23)

ON/OFF: Controls application of AC power.

MAIN POWER: Indicates when AC power has been applied.

OPERATE/VERIFY: Selects mode of operation, either operating with tape (record tape of load controller) or verify data on tape.

RECORD/LOAD: Selects type of operation, either recording on tape or load from tape to controller. Spring loaded toward RECORD position.

PAUSE TAPE: Interrupts tape operation; tape operation continued from where stopped by depressing GO or returned to beginning of tape depressing RESET.

GO: Pushbutton that initiates selected mode of operation.

RESET: Pushbutton that terminates operation and returns tape to beginning.

CONTROLLER TYPE:	Twelve position thumbwheel used to select type of controller that is connected to program loader. Set to four for 484 Controller.
RUN:	Indicates when loader is operating condition.
PAUSE:	Blinks when loader is in pause condition.
IDLE:	Indicates when loader is not operating but available.
DC PWR OK:	Indicates DC power from internal power supply is within regulation.
NO COMM:	Indicates when operation was started but terminated due to inability to communicate with controller.
ERR HALT:	Indicates when operation was halted by detection of sufficient errors to result in unreliable operation.
COMM ERR:	Indicates whenever error is detected in communications between controller and loader.
TAPE ERR:	Indicates whenever error is detected in tape operation.
REWIND:	On when rewind in progress or tape has been completely rewound.
BOT/EOT:	On when tape is at beginning of tape (BOT) or end of tape (EOT).
WRITE/PROTECT:	On when tape inserted is protected from being written on.
RECORD:	On when tape is being recorded from controller.
BAUD RATE:	Four indicators that indicate baud rate and an active communication channel to controller.

3.6.4 OPERATING PROCEDURES

Set-up: Connect communications cable to J470 Adapter with X338 on J470 adapter. Select either EIA or both and S5 to zero (no parity).

Turn loader's AC power ON. Ensure controller has AC power applied and RUN light lit.

Select CONTROLLER TYPE (four = 484 Controller). Insert tape cartridge with side A up.

RECORD: Ensure WRITE/PROTECT indicator is not lit. Select OPERATE mode and RECORD operation.

Depress GO pushbutton. Loader will automatically select proper baud rate, starting with 19,200 baud, that matches the setting on the Adapter to which it is connected.

A record of the program can be made with the controller operating or not operating (RUN light out). The record operation will not change the status of the controller's RUN light.

At the end of the record the tape is automatically rewound to the beginning.

LOAD: At controller, turn MEMORY PROTECT to the OFF position. At loader, select OPERATE mode. Depress and hold spring return switch toward LOAD operation; simultaneously depress GO pushbutton. Release both switches.

Loader will automatically select proper baud rate, starting with 19,200 baud, that matches the setting on the Adapter to which it is connected.

Once communication at the proper baud rate is established, the loader automatically "traps" the controller, ceasing its scanning. RUN light goes off. To untrap the controller, a load verify must be done.

At the end of the load, the tape is automatically rewound to the beginning.

VERIFY: Select VERIFY mode. Two types of verify are possible, selected as follows:

(1) Verify tape format (parity check). Select RECORD operation.

(2) Verify tape against controller memory. Select and hold LOAD operation. MEMORY PROTECT must be OFF at controller. After type of verify is determined, depress GO pushbutton to start COMPARE. Verify will NOT alter the RUN light status if it is done against the controller's memory.

Failure of the verify will result in terminating of the operation with ERR HALT indicator ON.

NOTE

When performing a Load Verify, the controller must have perviously been loaded with the tape and the RUN light must NOT have been re-established.

OPERATING:

(1) Once an operation has begun, all controls have no effect on the operation except the RESET and PAUSE. The RESET pushbutton, when depressed, terminates any operation in progress and rewinds the tape to the beginning. The PAUSE TAPE switch causes any operation in progress to be suspended and tape stopped. All other controls can be repositioned without affecting any operation once begun.

(2) The following indicators will be on for the various modes of operation:

MODE	RUN	RECORD	BAUD RATE
RECORD	X	X	X
LOAD	X		X
VERIFY TAPE	X		
VERIFY AGAINST MEMORY	X		X

(3) The dust cover can be opened without affecting an operation in progress.

(4) If a tape is not rewound to the beginning at the start of the operation, it will be automatically rewound prior to commencing the operation.

(5) Whenever an error is detected, a single tone is provided by the loader. If the error is recoverable, the operation continues and a valid result is obtained; if the error is not recoverable, the operation is halted with ERR. HALT indicator lit. Poor communications or gradual degradation of the tape after many uses can be detected by the number of tones issued during a successful load.

(6) Communications are compatible with RS-232 type D. In the Service Center position the communications cable can be connected to a computer (via Telephone Interface, if necessary) to load/record from the computer.

3.6.5 FUNCTIONAL DESCRIPTION

All data is recorded at least twice in 256 word blocks with parity on each block. If the first block has good parity, the second is not used; if the first has incorrect parity, data is obtained from the second block. During a record operation, parity is verified on each block. If incorrect parity is detected, successive blocks are written until at least two blocks have valid parity. The record is terminated if more than seven blocks are required to record any single block due to successive parity failures.

During a load operation, invalid parity when reading from the tape causes successive blocks to be used until good parity is obtained. If invalid parity is obtained for all records of the same block, the operation is terminated with TAPE ERR indicated. Once good parity is obtained, all successive records of that block will be ignored until the next block is located.

Time required to record/load depends upon baud rate and memory size. The following are some typical times to record a 4K 484 program.

Baud Rate	Time
9600	15 Seconds
4800	25 Seconds
1200	90 Seconds
300	5 Minutes
110	14 Minutes

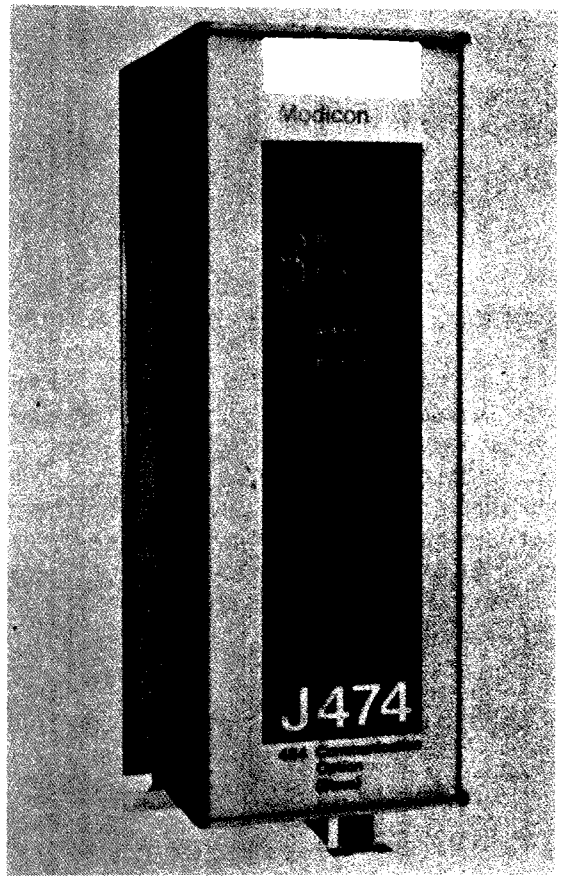
Loading or verifying typically takes 50% of the time required to record a program.

3.7 J474 COMMUNICATION INTERFACE - MODBUS

3.7.1 DESCRIPTION

This interface (Figure III-24) allows a "Master" such as a computer to communicate to a group of 484 Controllers. Up to 32 controllers can be connected together (each with J474) and be monitored/controlled by a single port on the "Master". Each controller can be polled by the "Master", one at a time, based upon the program within the "Master". Hardware interfacing (via J478) conforms to EIA Specification RS-232, a standard

option on most computers. Software protocol is described in a separate document discussing the MODBUS capabilities.



TS-80-0030-2

Figure III-24. J474 Interface

This MODBUS system allows the 484 Controller to be easily integrated into a data processing system. The "Master" can collect information for management reporting while the 484 Controller continues to direct the production equipment. Alternately, the "Master" can down-load receipts/standards into all 484 Controllers at the same time to ensure synchronism of distributed processors. A further capability allows the "Master" to control inputs and outputs and thus simulate or force the operation of th controller's I/O structure. Finally the "Master" could be programmed to alter the logic in any/all controllers; thus, from one station via a TTY or CRT, all controllers could be reprogrammed without use of the P180 Programming Panel. Some of th commands provided in the protocol include:

(1) READ COILS
(2) READ INPUTS
(3) READ INPUT REGISTERS
(4) READ HOLDING REGISTERS
(5) WRITE HOLDING REGISTER
(6) FORCE COIL
(7) POLL STATUS
(8) POLL COMPLETE
(9) PROGRAM

3.7.2 INSTALLATION

The J474 communication interface (Figure III-24) can be mounted adjacent to the 484 mainframe either on the bottom, or to the right or left. It physically replaces a Half High I/O Housing (B547/B549) both in size and mounting dimensions. In addition to data communications, this interface also provides a voice communications between any two or more points along the MODBUS. The 484 Controller must be equipped with an Enhanced II CPU to communicate with a J474. The following is a brief summary specification of the J474 interface. Operating power is obtained form the 484 Power Supply; no external power is required.

3.7.3 SPECIFICATIONS

Temperature:	0 to 60° C (32 to 140 F).
Humidity:	0-95% (non-condensing).
Size (WxHxD):	4.75" x 14.40: x 6.88: (120.7mm x 365.8mm x 174.8mm).
Weight:	6 lbs (2.8Kg).
Communications:	Asynchronous, Frequency Modulated: 20 to 50 Khz band usage.
Maximum Bus Distance:	15,000 feet (4.5Km).
Device Address:	1 to 247 (Max. 32 devices/MODBUS).
Operating Modes:	Remote Terminal Unit (RTU) or ASCII.
Connections Options:	MODBUS or Direct EIA.

3.7.4 INDICATORS

On the front of the J474 interface are four LED indicators that indicate the status of the communications. These indicators have the following functions:

RUN — On whenever DC power is applied via the 484 mainframe and the J474 diagnostic routines indicate proper internal operation of this interface.

ACTIVE — Flashes whenever the J474 interface receives a message via the MODBUS or local EIA port that is addressed to this unit.

474 ERROR — Flashes whenever an error in communications between the J474 interface and the 484 CPU has been detected. Appropriate error response will be sent to the sending device.

BUS ERROR — Flashes whenever a message addressed to this device from either the MODBUS or local EIA port has error within the message. Appropriate error response will be sent to the sending device.

3.7.5 CONNECTIONS

The J474 Interface is connected to the MODBUS or local EIA device via a single 30-pin connector. This connector (Buchanan Part No. PCB 2B30A616798, MODICON part number 52-2109) with mounting bracket (MODICON assembly AS-4965) is supplied with the interface. To service the J474 unit, this connector may be removed without distrubing MODBUS communications to the other units provided physical connections are not distrubed. Since all options such as baud rate, unit number, parity and stop bits are selected by the wiring of this connector, easy replacement and rapid restoration of proper operation are accomplished without extensive testing or interruption of MODBUS operation. During replacement of the J474 Communication Interface, the service technician does not need to set dip switches or rotary switches and possibly set the incorrect address. Assignment of functions are shown in Table III-3, including optional decoding.

Table III-3. J474 Functions

Pins	Function	Pins	Function
1	Protective Ground	16	Binary Address 16
2	Data Transmitted from J474	17	Stop Bit Option
3	Data Received by J474	18	Binary Address 32
4	Ready to Send (RTS)	19	Parity Type Option
5	Clear to Send (CTS)	20	Data Terminal Ready (DTR)
6	Data Set Ready (DSR)	21	Parity Enable
7	Signal Ground	22	Binary Address 64
8	Binary Address 1	23	MODBUS FULL Duplex In
9	Baud Rate 1	24	Binary Address 128
10	Binary Address 2	25	MODBUS FULL Duplex Out
11	Baud Rate 2	26	Signal Ground
12	Binary Address 4	27	Modbus Data in
13	Baud Rate 4	28	Mode Select 1
14	Binary Address 8	29	MODBUS DATA OUT
15	Baud Rate 8	30	Mode Select 2

Note: Pins 1 through 7 and 20 conform to EIA RS 232-C specifications.

The following illustrates (Figure III-25) a typical connection for half duplex operation at 9600 baud, slave number 26 with even parity, one stop bit, and ASCII mode.

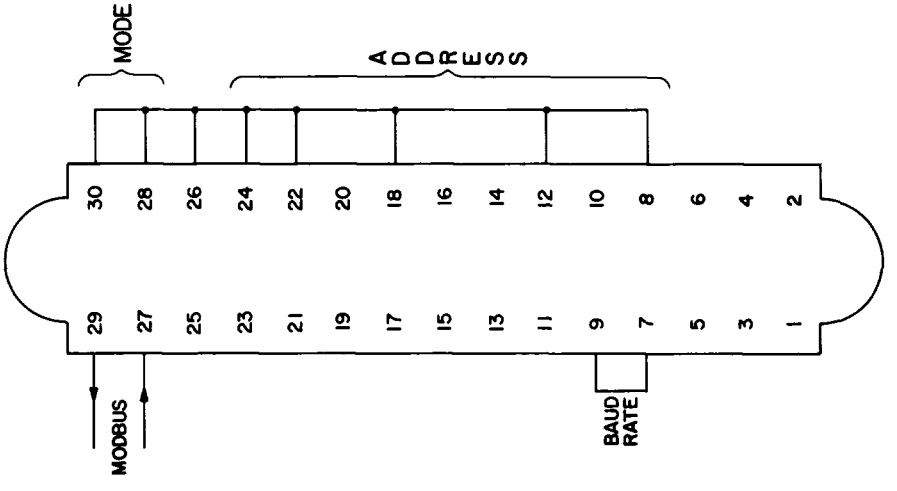


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Figure III-25. Typical J474 Connections

Baud rates are selected by connecting pins 9, 11, 13 and 15 to Signal Ground that is available at pin 7. For convenience, the following chart wil summarize all available baud rates (yes = connect to ground; no = leave unconnected):

	Pins			
Rate	9	11	13	15
50	yes	yes	yes	yes
75	no	yes	yes	yes
110	yes	no	yes	yes
134.5	no	no	yes	yes
150	yes	yes	no	yes
300	no	yes	no	yes
600	yes	no	no	yes
1200	no	no	no	yes
1800	yes	yes	yes	no
2000	no	yes	yes	no
2400	yes	no	yes	no
3600	no	no	yes	no
4800	yes	yes	no	no
7200	no	yes	no	no
9600	yes	no	no	no
19200	no	no	no	no

The slave address is established by binary numbers on pins 8, 10, 12, 14, 16, 18, 22 and 24. Connect to Signal Ground (pin 26) for a zero bit and leave unconnected for a one bit. For example, address 26 in binary is 00011010 which requires connection of pins 24, 22, 18, 12, and 8 to pin 26 as shown in above example.

Specific modes of operation are selected by connecting pins 28 and 30 to Signal Ground (pin 26) in the following configuration (yes = connect that pin to ground; no = leave unconnected):

	Pins	
Mode	28	30
ASCII	yes	yes
RTU	yes	no
Not valid	no	yes
Test	no	no

The remaining options (stop bits and parity are selected by connecting 17, 19, and 21 to Signal Ground available on pin 7. The following chart summarizes available options and their associated connections (yes = connect to ground; no = leave unconnected):

Option	Pins 17	19	21
Two stop bits, no parity	yes	yes	yes
One stop bit, no parity	no	yes	yes
Two stop bits, no parity	yes	no	yes
One stop bit, no parity	no	no	yes
Two stop bits, odd parity	yes	yes	no
One stop bit, odd parity	no	yes	no
Two stop bits, even parity	yes	no	no
One stop bit, even parity	no	no	no

3.7.6 SELF-TEST

Upon power up, the J474 conducts an internal diagnostic test to verify proper operation of: CPU, ROM, RAM, Indicators, Timers, Parallel Port, and Asynchronous Bus. When the error test is being performed, the indicators on the front of the J474 are used as diagnostic indicators. The four indicators will cycle through the following pattern once on power up if no internal errors are detected.

Indicator	Test 1	2	3	4	5	6	7	8
RUN	Off	Off	Off	On	On	On	On	On
ACTIVE	Off	Off	On	On	On	Off	On	Off
484 ERROR	Off	On	On	On	Off	Off	Off	Off
BUS ERROR	On	On	On	Off	Off	Off	Off	Off

Each test pattern lasts for appproximately 150 milliseconds (total 1.2 seconds of power up tests). If an error is detected, testing stops and the indicators can be used to indicate the test level that failed: MODICON Field Service personnel can correlate the test number to the internal component failure. When the MODBUS connector is removed or if the Internal Test Mode is selected (pins 28 and 30 disconnected), the internal Self Test will operate continuously. The J474 will halt its operation when an error is detected during diagnostic testing. While in the Halt mode, no communications with the MODBUS nor the controller is possible. The diagnostic testing can be restated and possible reactivation of communications by cycling J474 ON-OFF-ON.

SECTION IV
TROUBLESHOOTING

4.0 INTRODUCTION

The MODICON 484 Controllers are rugged, heavily protected, modular systems designed specifically for industrial environments. They require no regular maintenance. In the event of failure, components may be quickly replaced. Indicator lights are provided to indicate proper operation of the mainframe's subassemblies.

If a suspected failure is encountered, there are several procedures to be followed by the customer to determine that there is a failure in the MODICON system and to isolate that failure to a particular assembly. These procedures are outlined in this section. They require no special test equipment. As basic understanding of the functions of the components is necessary.

The major troubleshooting methods available to the user are checkouts of the processor using the programming panel. This panel allows any network, input, output, or register to be examined and changed in any proper manner desired.

Through the combination of logic examination and visual inspection or electrical test of field wiring terminals, failures may be isolated to the processor, I/O module, power supply, or customer's hardware. The MODICON maintenance philosophy is based on the assumption that when a major subsystem is proved faulty, it should be immediately removed and replaced in its entirety. This procedure greatly increases system availability.

4.1 INDICATOR LIGHTS

The mainframe has a series of three LED indicators (Figure IV-1). Each LED is energized when a major portion of the mainframe is operating.

NOTE

AC power must be applied to mainframe before any LED will function.

In addition to the mainframe, each I/O module has four indicators to show the field voltage status of each of its circuits. The controller need not be functioning for the input indicators to operate. The only requirement is for the proper field voltage to exist. Output indicators are on only when the controller is in operation.

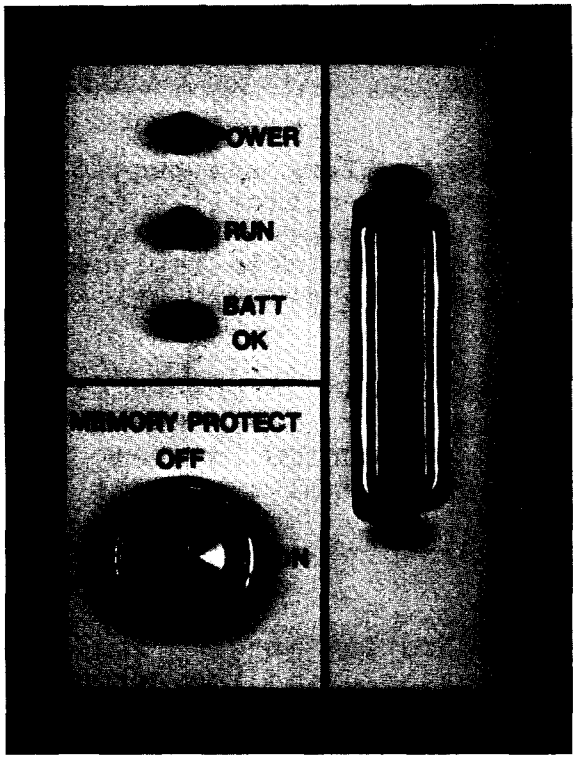

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Figure IV-1. Indicators on Mainframe

4.1.1 POWER SUPPLY

The Power Supply is located in the front cover of the mainframe. Its proper operation (output of both 5DCMF and 12 VDC) is indicated by the DC POWER light on the mainframe. As long as this LED is lit, the Power Supply is supplying the proper voltages. If this indicator is off, verify proper supply voltage at AC power terminals. With proper AC power voltage, the internal fuses should be checked. Open the mainframe and verify continuity of internal fuses (Figure IV-2).

If all internal fuses are operational, the indicator is still off, and the LED itself is operational, the Power Supply should be replaced as follows:

(1) Remove AC power from mainframe terminals.

(2) Unlatch and swing mainframe open.

(3) Disconnect wiring harness and ground strap from power supply side of mainframe (Figure IV-2). Also, disconnect ribbon cable at power supply.

(4) Support power supply (approximately 20 pounds) and lift up to separate hinges that connect power supply section to fixed portion of mainframe.

(5) Remove power supply to work area for further testing or packaging for shipment to MODICON for repair.

(6) Reverse steps 1 through 4 to re-install new power supply.

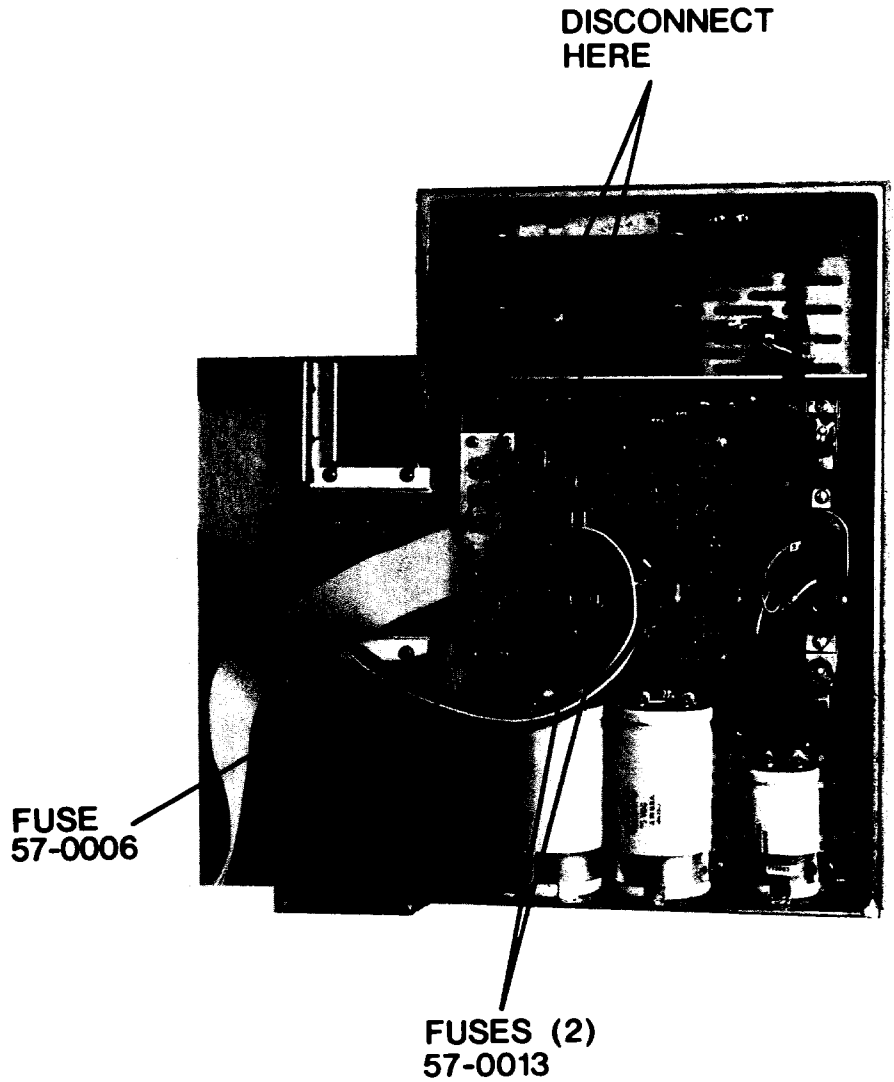

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Figure IV-2. Power Supply - Location of Fuses

4.1.2 PROCESSOR

The main function of the processor is to monitor the staus of all inputs continuously and direct the status of all outputs. There are two LED indicators that, when energized, reflect proper operation of the processor (Figure IV-1). The first indicates proper operation of the processor (RUN), the second proper battery voltage (BATT OK).

If the RUN light goes out, and the DC POWER light is lit, the processor has ceased operation. If the processor fails, its memory should be restored by one of the peripheral devices, such as the model L206 Tape Loader or model T158 Telephone Interface. These are discussed in Section II of this manual. If neither a magnetic tape nor a Service Center "dump" have been made, operation of the controller may be restored by initializing memory with the P180 Programming Panel. Initializing memory will restore all logic to the null state which contains no customer program. If the RUN light cannot be restored by the appropriate peripheral device, the processor should be replaced as follows:

(1) Disconnect AC power connections from power terminals at lower right of mainframe.

(2) Open mainframe and locate I/O connectors (Figure II-13). Disconnect I/O connector(s) on the end of the I/O bus cable(s). Remove from mainframe into I/O duct. If an I/O bus cable is used to connect the I/O housings at the bottom of the mainframe, the entire cable needs to be removed from the mainframe and saved.

(3) Loosen the support of the mainframe at the bottom. Do not remove bolts completely. Support the mainframe (33 pounds) and remove the upper bolts.

NOTE

To reduct the weight of the mainframe to 12 pounds, the power supply section may be removed before the base section of the mainframe.

Lift the mainframe clear of bottom supports.

(4) Take the mainframe to work area for futher testing. If necessary, package and ship to MODICON for repair.

(5) Reverse steps 1 through 3 to install new mainframe.

The second indicator for the mainframe operation is BATT OK. When this LED is energized, there is sufficient battery capacity to retain memory upon loss of AC power.

AC power is required to operate BATT OK indicator or controller system. Batteries are designed only to retain memory. They will not run the controller.

When the BATT OK LED is not illuminated, check the POWER LED. If illuminated, replace batteries. If not illuminated, verify voltage at AC power terminals at bottom right of mainframe.

The BATT OK LED is a warning about battery voltage. When this indicator goes off there is sufficient capacity to maintain memory for at least seven days.

The following procedure should be used when the batteries are to be replaced. It is recommended that AC power to controller be left on while replacing batteries. Memory will be lost if the AC power is removed while either of the alkaline batteries is not installed. Memory will not be lost when AC power is removed if either lithium battery is installed. One lithium battery is sufficient to retain memory.

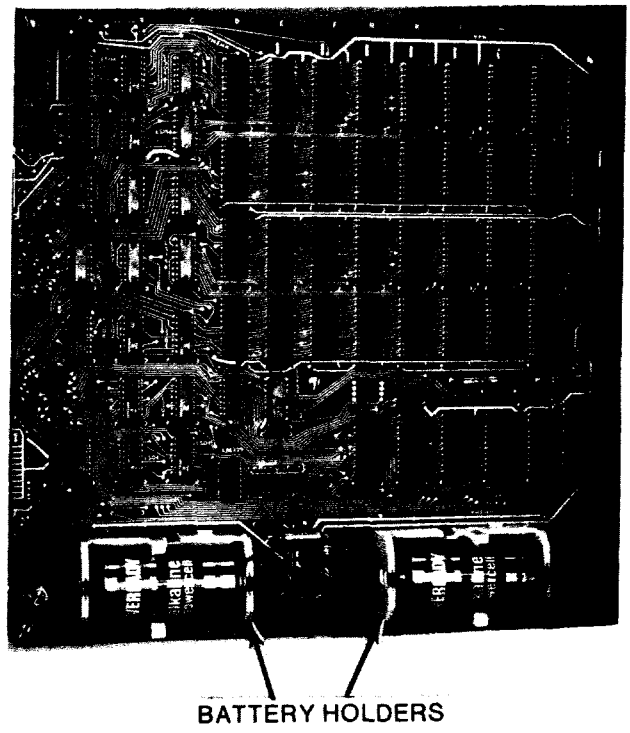

Figure IV-3. Memory Module with Batteries

Procedures for replacement of alkaline or lithium batteries are basically the same and are as follows:

(1) Open mainframe, swing out power supply, and locate memory board (Figure IV-3).

(2) If both battery holders contain batteries, remove ONE to create a vacant holder. Remember that one alkaline battery is insufficient to maintain memory without AC power.

(3) Insert new battery into vacant holder as follows:

- o Lithium batteries are inserted with positive (+) red wire towards center.
- o Alkaline batteries are inserted with positive (+) red wire towards left side.

CAUTION

REVERSE POLARITY WILL CANCEL VOLTAGE OF EXISTING BATTERY AND ELIMINATE BATTERY SUPPORT.

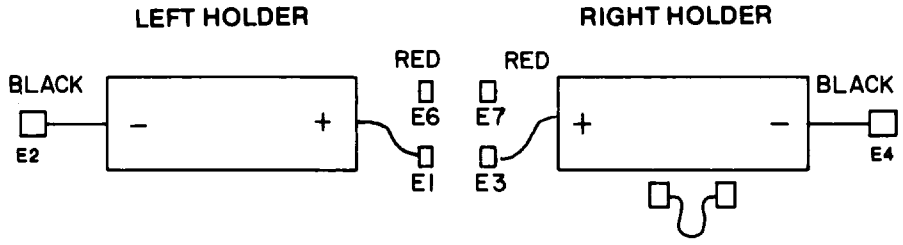

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Figure IV-4. Wiring of Batteries

(4) Connect wires to slide terminals on Rev. C memory board (Figure IV-4).

- o Lithium batteries are supplied with wires for connection. Place batteries in holders and connect red wires to center terminals and black wires to terminals towards side of memory board. Connect jumper between terminals below right holder.
- o Alkaline batteries are placed in spring clip holders. No wires are supplied with these batteries. To connect these batteries in series, jumper is placed between terminals E1 and E3. Connect only one jumper either below right holder or between holders depending upon battery type.

(5) Remove the second old battery from its holder if two batteries are in the controller. Replace with second new battery following steps 3 and 4 above.

(6) Record battery change on memory board in space provided.

(7) Verify operation of BATT OK indicator on front of mainframe and then close mainframe.

(8) If BATT OK indicator is not illuminated, replace LED lamp, or power supply, or memory board (Figure IV-6).

Memory boards can be removed, stored, transported, and exchanged without loss of memory as long as the batteries are inserted. There is no indication of battery level except when installed in controller with AC power applied. Memory sizes of any controller can be changed by replacing the board.

4.1.3 INPUT/OUTPUT SECTION

Communications from the mainframe to the real world is accomplished via the I/O Section. This section isolates all input and output devices to prevent external noise from affecting the internal logic of the 484 Controller system. The circuitry in the I/O Section is specially designed to filter inputs and drive outputs at voltage levels compatible with the user's equipment. There are no limitations on the placement of the modules in the I/O Section relative to their voltage handling capacity. AC circuits do not have to be isolated from DC circuits nor do high voltage (i.e., 220 VAC) have to be separated from low voltages (i.e., 5 DCMF).

Whenever a failure is suspected in the I/O Section, the following steps should be taken to systematically locate the failure:

(1) SINGLE I/O CIRCUIT - Connect Programming Device. Call up input (1XXX reference) or output (0XXX reference) that is suspected. When it is an input, compare its status with that of the indicator of the input module. If they agree, the input is operational and field wiring external device should be examined. If not, the input module should be replaced.

NOTE

When possible, cycle input device such as limit switch, pushbutton etc., ON/OFF/ON to confirm operation.

When it is an output, compare its status with that indicated on output module. If they agree, the output is operational and the field wiring/external device should be examined. If not, the output module should be replaced. Verify that a blown fuse is not being indicated at output module before replacing module.

NOTE

When possible, use DISABLE function (Paragraph 3.1.5) to force output ON/OFF/ON etc. MEMORY PROTECT must of OFF.

CAUTION

BE VERY CAREFUL THAT OUTPUT WILL NOT CAUSE UNSAFE USER EQUIPMENT OPERATION.

(2) MULTIPLE I/O CIRCUITS - Connect Programming Device to verify I/O operation and select appropriate procedure from the following:

- o ON ONE MODULE - Verify proper power supplied to module. If voltage exists, replace module. If not, troubleshoot field wiring and power source.
- o WITHIN ONE I/O HOUSING -

CAUTION

MAIN AC POWER TO 484 SYSTEM SHOULD BE REMOVED FIRST. DO NOT REMOVE CABLES WITH POWER ON 484 MAINFRAME.

- oo Open I/O duct and reseat I/O bus connector. If this does not correct fault, use spare I/O bus connector, rotating connectors within duct as necessary to move spare connector to desired housing.

Remove I/O modules one at a time from suspected housing if fault continues. If faulty module begins to operate when an I/O module is removed, replace that module and inspect its connector on housing backplane.

oo Replace I/O housing or its backplane when removing all I/O modules does not correct fault.

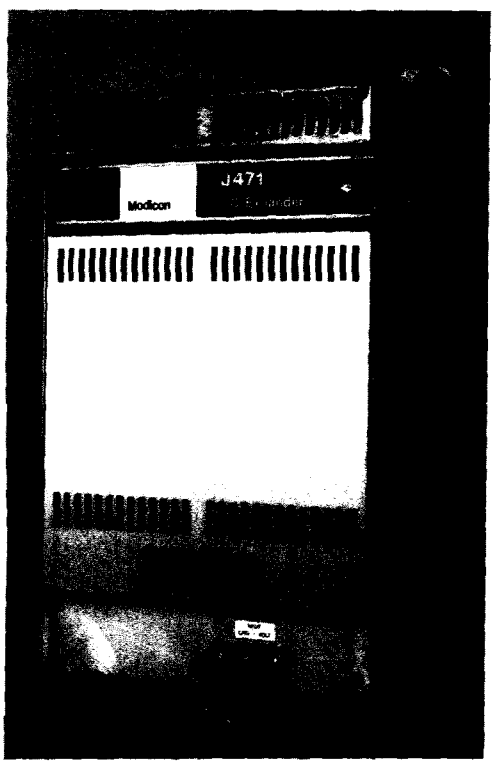

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Figure IV-5. J471 Expander Installation

o MULTIPLE I/O HOUSINGS-

oo Remove top I/O module from faulty housings and verify selection of address. Only one switch should b positioned on any housing (Figure II-14). Reset all switches if no obvious errors are detected.

oo Open I/O duct and remove I/O bus connectors from suspected housings one at a time if the fault still exists. Reconnect in the same order while examining I/O operation with programming device. If one housing creates the fault only when connected to the bus, it or its backplane should be replaced.

oo Remove the entire bus cable, one connector at a time. Replace in same order, searching for a faulty I/O housing. Finally, replace entire I/O bus cable.

(3) OTHER I/O DEVICES - The model J471 Expander (Figure IV-5) is maintained similarly to the power supply discussed above. Its I/O structure can be troubleshot following the procedure listed above.

All I/O modules are parallel to the I/O bus communications, therefore, all I/O data is seen by each module via the I/O bus cable. Only appropriate modules respond to the data. This includes local or expanded I/O's as well as register modules.

B547/B458 are register I/O housings. Register addressing selection is accomplished on the register I/O module.

4.2 FAULT ISOLATION FLOW CHARTS

This part of Section IV contains five fault isolation flowcharts. These are designed for use by MODICON customers. Service personnel recommend users attempt to isolate faults before calling MODICON service center.

The fault isolation flowcharts are as follows:

Figure IV-6. DC POWER Lamp Fault Isolation Flowchart

Figure IV-7. BATT OK Lamp Fault Isolation FLowchart

Figure IV-8. RUN Lamp Fault Isolation FLowchart

Figure IV-9. RUN Lamp Fault Isolation FLowchart (Continuation of A from Figure IV-8)

Figure IV-10. I/O Section Fault Isolation Flowchart.

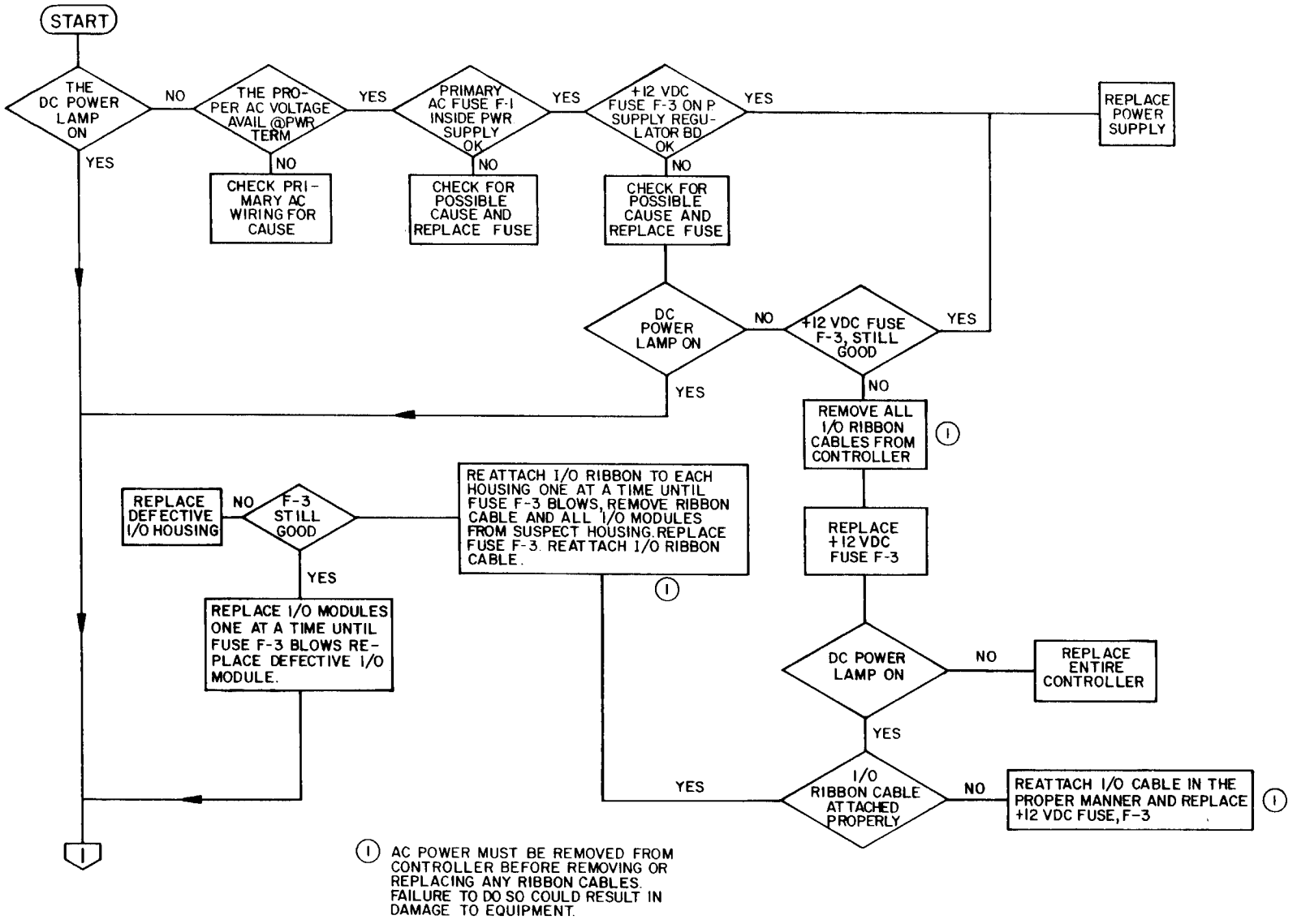

Figure IV-6. DC POWER Lamp Fault Isolation Flowchart

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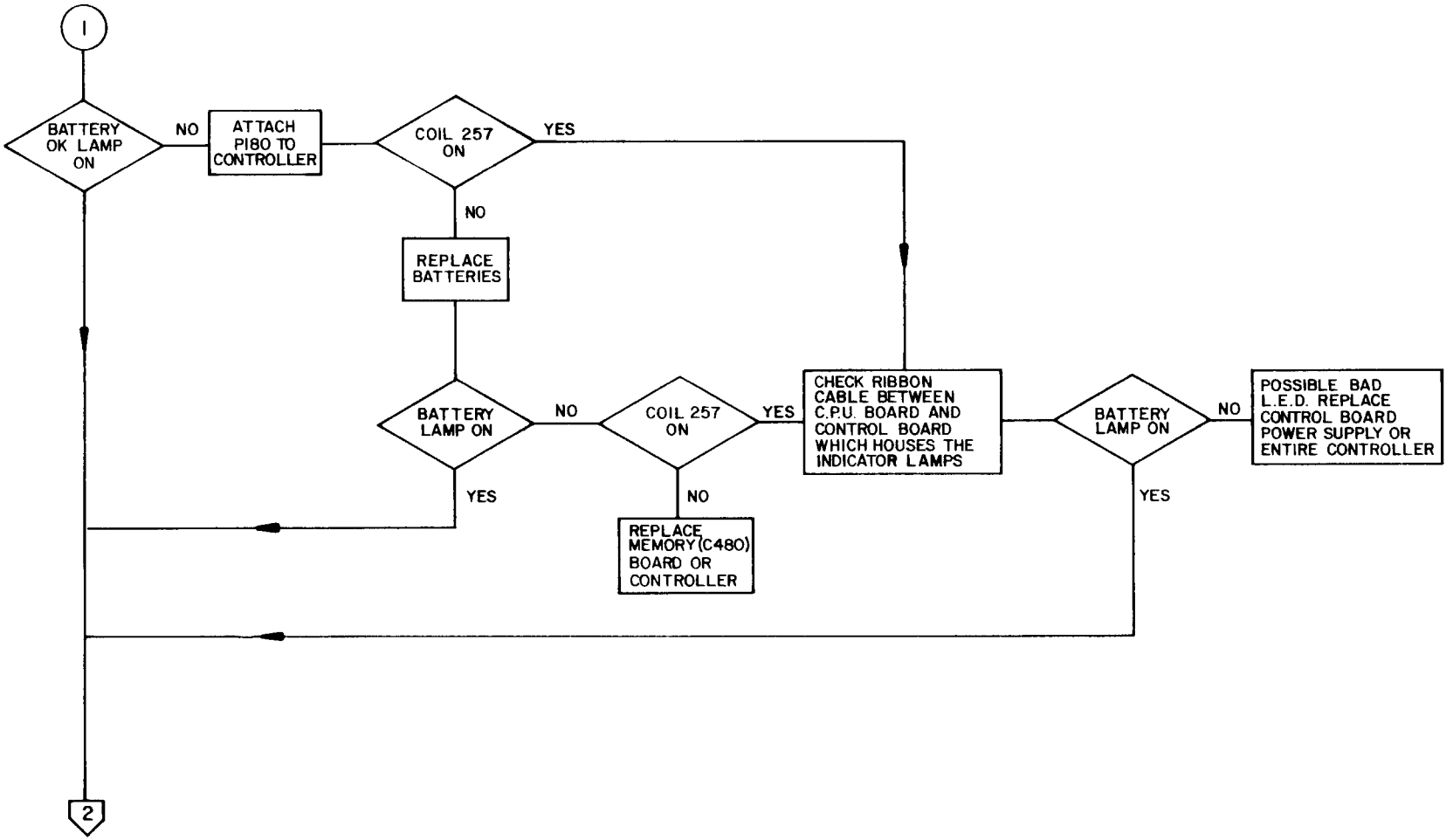

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Figure IV-7. BATT OK Lamp Fault Isolation Flowchart

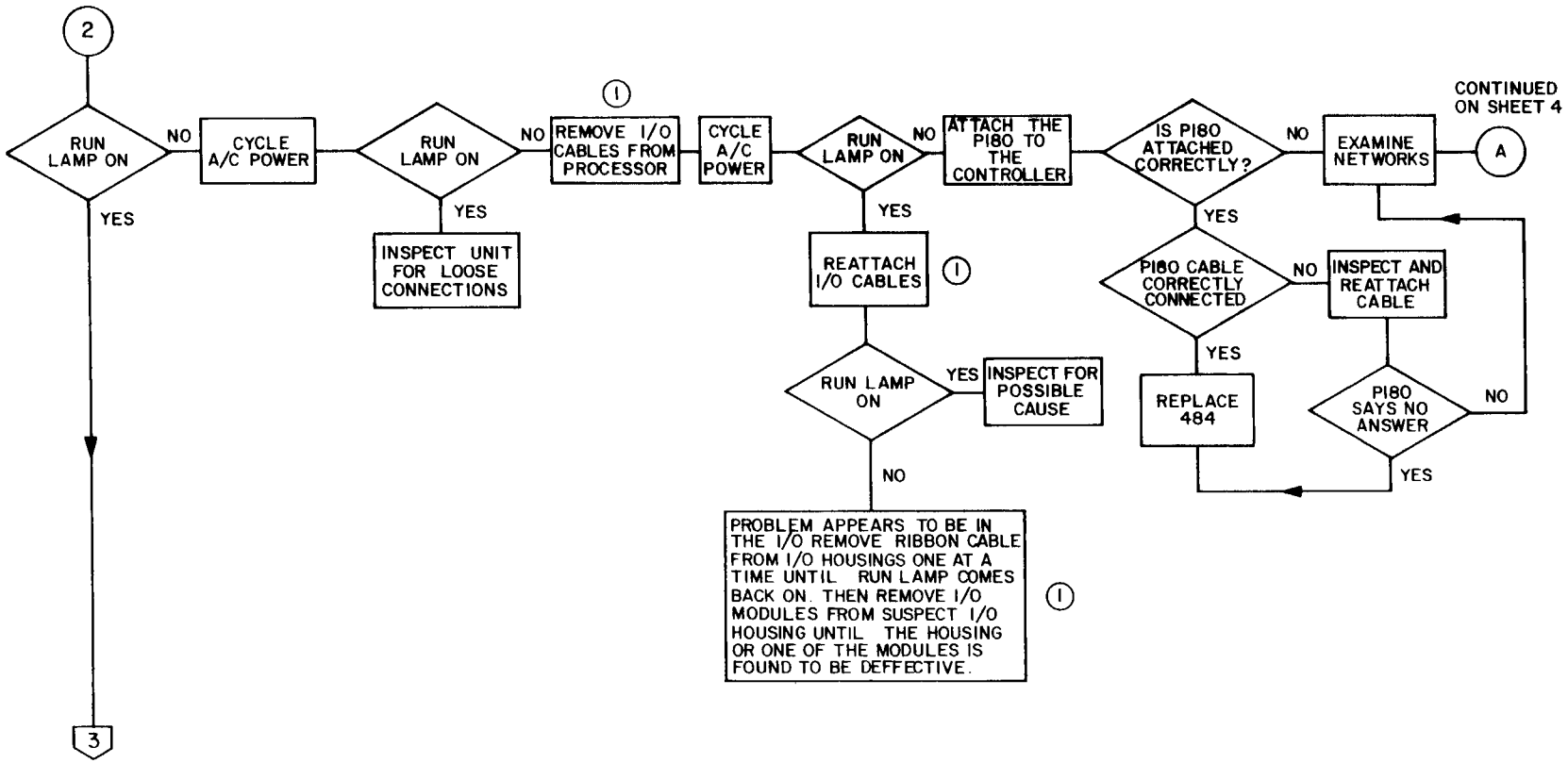

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Figure IV-8. RUN Lamp Fault Isolation Flowchart

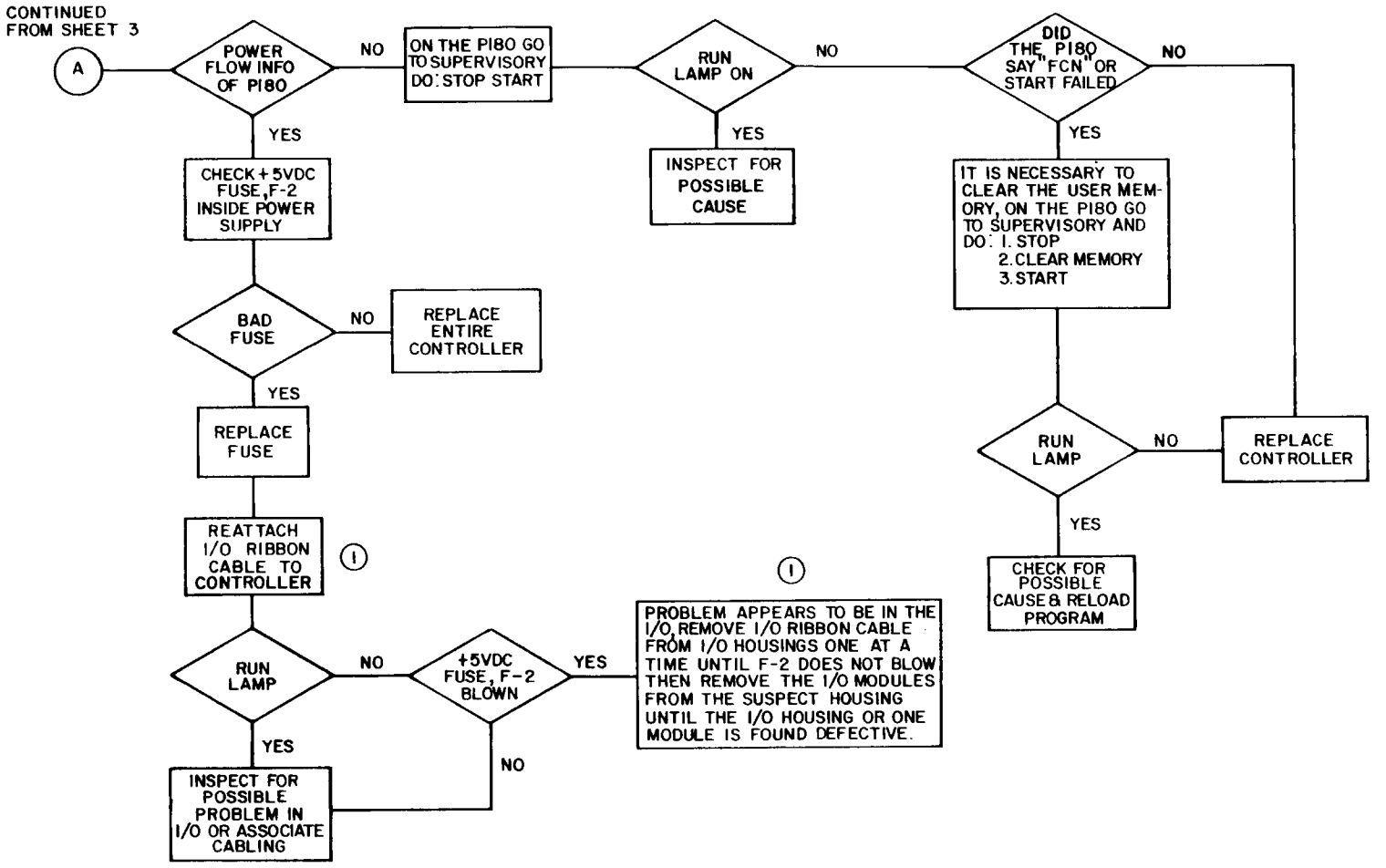

Figure IV-9. RUN Lamp Fault Isolation Flowchart

(Continuation of A from Figure IV-8)

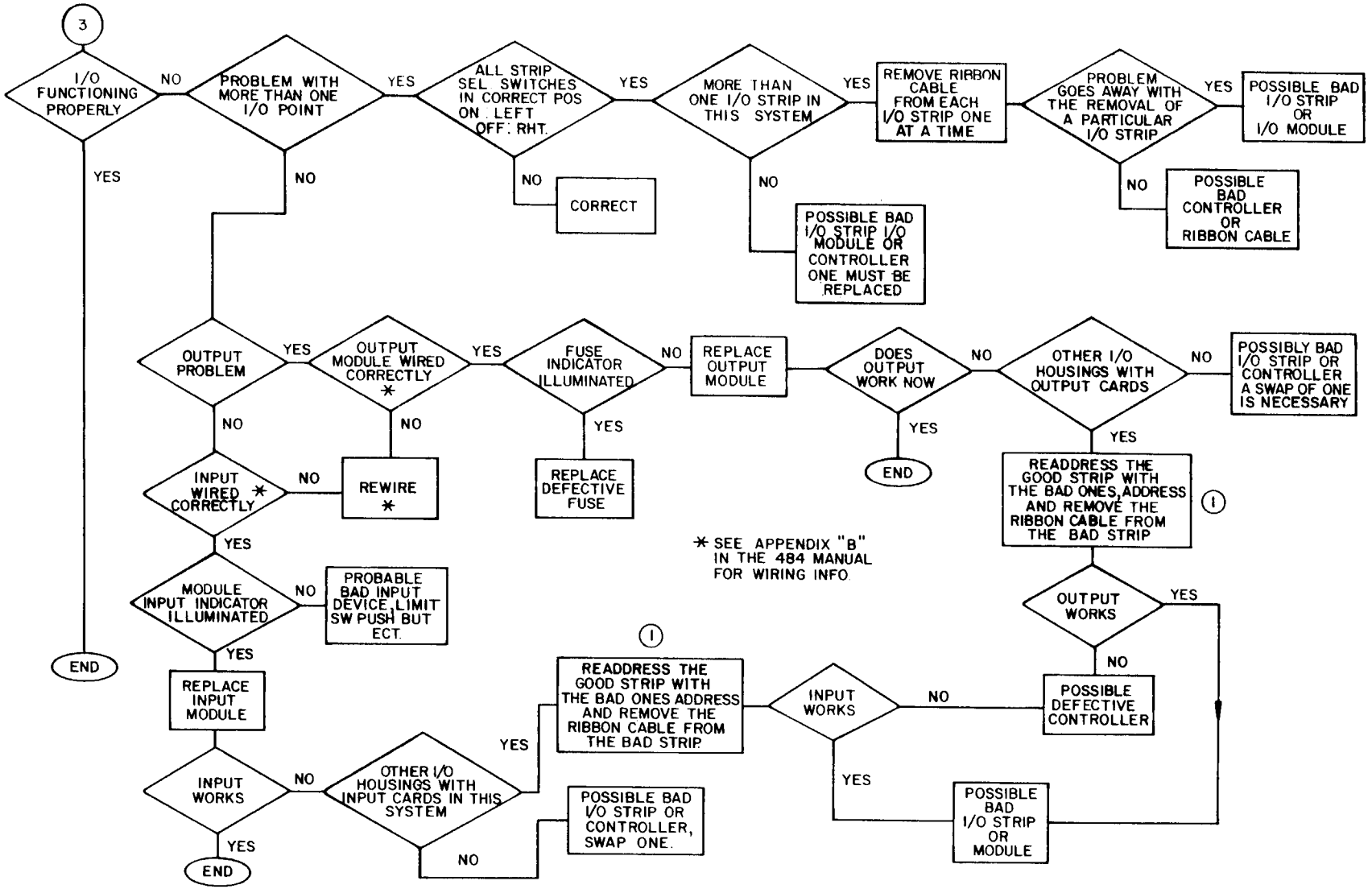

Figure IV-10. I/O Section Fault Isolation Flowchart

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4.3 P180 ERROR MESSAGES

All P180 error messages are detailed here and are organized alphabetically after the 484 Error Code is described.

Many errors are caused by illegal user actions. There are also a number of SYSTEM ERRORS which seldom appear in a functioning system. However, if SYSTEM ERRORS do occur, the system may be in serious difficulty and needs to be serviced.

The following list of SYSTEM ERRORS are messages from the 484 which indicate it has received erroneous information:

1	'PARITY ERROR'
2	'OVERRUN ERR'
3	'CHKSUM ERROR'
4	'BAD ADR RNGE'
5	'ILLEGAL ADDR'
6	'ILLEGAL NODE'
17	'BAD LED REQ'
12	'BAD COMMAND'
15	'BAD LENGTH'

The following list of SYSTEM ERRORS are messages from the P180 which indicate that it has received erroneous information:

'BAD RESPONSE'
'P180 OVERRUN'
'P180 PARITY'
'P180 CKSUM'
'P3 PARITY'
'P3 OVERRUN'
'P3 CKSUM ERR'

4.3.1 484 ERROR CODE

This message appears when P180 is in supervisory status and an error has been detected in the 484. The message will be followed by a two-digit number code indicating error type. The following list contains the error codes and their meanings:

Code	Definition
01	Communications Overrun
02	Memory Checksum Failed
03	Invalid Node Type Found
04	I/O Port Error
05	Scratchpad Diagnostic Failed -Fatal-No Run Light
06	Coil RAM Checksum Failed
07	CPU Diagnostic Failed

10	Illegal Memory Configuration -Fatal-No Run Light
11	Real-Time Clock Not Functioning
12	Watchdog Timer Expired
13	Illegal Column Detected
14	No End-Of-Logic Node

4.3.2 ERROR MESSAGES

BAD ADR RANGE - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request has a serious problem and cannot be processed. Specifically, this message means that the P180 sent a request which would modify memory across an invalid address boundary.

BAD COMMAND - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request has a serious problem and cannot be processed. Specifically, this message means that the request code which the P180 sent is not valid.

BAD LED REQ - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request has a serious problem and cannot be processed. Specifically, this message means that the P180 sent a bad "Element Status" power request.

BAD LENGTH - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request has a serious problem and cannot be processed. Specifically, this message means that the I/O request which the P180 sent had too few or too many characters.

BAD RECORD - This message appears during LOAD, DUMP, VERIFY when the tape being processed has the wrong information.

BAD RESPONSE - This message appears when the P180 has received a response from the 484 but is is so erroneous it is unrecognizable. The P180 and/or 484 are in serious trouble and should be diagnosed.

BAD SHIFT - The 'SHIFT' key was set for a key for which it is meaningless.

BAD TAPE - This message appears during loading or verifying when the tape does not contain the information expected to be on a good tape.

BLANK NODE - This message appears when the user is trying to 'DELETE' a node which is not there or the cursor is on a blank node. The cursor must be on a real node in order to delete it.

BLANK OR - This message appears when the user is entering a new node, but the node above (up-arrow) or to the left (left-arrow) is blank. This is illegal.

BY-PASS I/O - When the user enters registers 4059 or 4060, this message will warn the user that these registers are reversed. This is a warning message only. The P180 will not stop the user from using them.

CHECKING - Although this appears in the error line, it merely tells the user that the P180 must spend time checking to see if a coil is used. This may take several seconds. It is displayed to let the user know that the P180 is still alive.

CHKSUM ERROR - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request cannot be processed the way it was sent. Specifically, this message means that the message from the P180 was received incorrectly. THe 484 is not in agreement with the P180 message.

COIL IN WAY - This error message will occur when any multi-node item is entered and a coil extension is below it. Although the coil may be below and to the left of the multi-node to be entered, the display position of the coil extends across the screen. This prevents any multi-node from extending below the coil.

COIL IS USED - This message means that the coil the user is programming is already used as a coil or in a convert. No coil may be programmed as an output more than once. Converts take 12 coils even though only one number appears on the display. If the user has a convert to coil 15, this uses coil 15 through 26. Later programming to coil 17, for example, will show USED, even though search and display finds NO MATCH.

COIL NO-MATCH - This message appears during VERIFY when the coil bits on tape do not match those of the 484. This error may be disregarded if verifying while running.

COMM BUSY - This message does not appear on the error line and is not strictly an error. It is displayed when the P180 wants to communicate with a 484 but some other device is already communicating. The P180 waits.

END OF LOGIC - This message means that the user tried to call up a network beyond the last network. The user is at the end of the logic.

484 RUNNING - This message appears when the user is trying to perform a function which requires that the 484 be stopped first. (Example: Clear Memory)

ILLEGAL ADDR - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request cannot be processed. Specifically, this message means that the P180 sent an address which is completely wrong.

ILLEGAL NODE - In general this error message comes from the 484 mainframe and means that the most recent P180 I/O request cannot be processed. Specifically, this message means that the P180 sent a node type which is not known by the 484.

ILLEGAL RPLC - This message appears when the user, via ENTER, is trying to change one node type for another and the change is not allowed. These changes are listed:

1 node for 2 or 3 nodes
2 nodes for 1 or 3 nodes
3 nodes for 1 or 2 nodes

INCOMPLETE - This message means that the assemply area is not completely explicitly set for 'ENTER'. When programming a new node, all three fields (contact, reference, vertical) must be stated. The left-pointing arrow directs the eye to the assembly area.

INIT MEM - This message appears when the P180 fails to find the end-of-logic mark in the 484. It means that there is some serious problem in the 484 and the database is not valid. Go to SUPERVISOR and "clear memory".

INV - These three letters do not appear in the error line. They show as register contents in the discrete area when the data in the register is INValid, i.e., exceeds 999.

INVALID KEY - This appears in SUPERVISOR mode for keys which are invalid in that mode only. If the message appears in network display mode, it means that the P180 keyboard hardware has failed.

INVALID # - This message appears when the reference number in the assembly area is invalid for the requested function. Check the memory size and reference rules.

LGC NO-MATCH - This message appears during VERIFY when the network logic (LGC) on the tape does not match the logic in the 484.

MEMORY FULL - This message appears when the user enters information and the 484's logic memory is full.

MEM PROTECT - This message appears when the user is modifying the 484 memory and the MEMORY PROTECT key is ON. MEMORY PROTECT key ON prevents modifications.

MUST BE COIL - This message appears when the user is programming a non-coil node in the coil (right-hand) column. Only "coils" and "horizontal open" are allowed in the right-hand column.

NO ANSWER - This message appears when the P180 makes a request to the 484 and gets no response. Check cables and proper 484 functioning.

NO COIL HERE - This message appears when the user is programming a coil which would be in the middle of the logic.

NODE IN WAY - This message appears when the user is entering a coil and the row already contains another node to the right. Remember that the coil may be entered when the cursor is not in the coil (right-hand) column. It then takes the rest of the row for display purposes only.

NODE TOO LNG - This message appears when entering a two-node item (e.g., counter) on the last row of a three-node item on the next-to-last or last row. The function is too long to fit in the seven row network.

NO MATCH - This message appears during 'SEARCH' when the 484 cannot find a match to the pattern being searched for. Searching for a coil or register implicit in function, e.g., CONVERT, MULT, DIV, shows no match even though it is used.

NO NETWORK - This message appears when the user is performing a function on a network and there is no network displayed or in 484 memory.

NOT 1XXX - This message appears when the user is forcing an item displayed in the descrete area which is not a 1000 series (input) coil. Only 1XXX references can be forced in this area.

NOT ALLOWED - This message appears when the user is getting a reference in the discrete area and the cursor is not in that area. The cursor must be in the discrete area to GET.

NOT DISABLED - This message appears when the user tries to 'FORCE' a coil which is enabled. This is illegal. Disable any coil first before forcing.

NOT ENHANCED - This message appears when the user is trying to program a function which is not allowed in the basic 484.

NOT ENHAN II - This message appears when the user is programming a function which is not allowed in the enhanced or basic 484.

NOT LAST - This message appears when the user is deleting a node which is in the middle of a network. Delete may only be done to:

(1) The last (bottom) node in a column, or
(2) The last node if it is in the top row, the right-most node only.

NOT VERTICAL - This message appears when it is illegal to have a vertical short on a node type; a coil, for example.

ONLY 4XXX - This message appears when the user is entering data into an item displayed in the discrete area and it is not a holding register (4XXX).

OVERRUN ERR - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request cannot be processed. Specifically, this message means that the 484 receiver filled up with characters which were not processed out quickly enough so they got lost.

NOTE

This condition will cause the 484 to lose its RUN light.

P180 CKSUM - This message means that the response from the 484 was received incorrectly and the P180 does not agree with what the 484 sent. This could be a problem in the link between the 484 and P180 or a serious failure in either.

P180 OVERRUN - This message means that the P180 receiver hardware filled and overflowed. This is a failure of the P180. The P180 should be checked.

P180 PARITY - This message means that the P180 receiver detected a bad bit stream. The P180/484 should be checked.

P3 CKSUM ERR - This message means that the message from the device on port 3 was received incorrectly. The P180 does not agree with what the device sent. This could be a problem in the link, the P180, or the device.

P3 OVERRUN - This message means that the P180 port 3 receiver hardware filled and overflowed. This is a failure of the P180. The P180 should be checked.

P3 PARITY - This message means that the P180 port 3 receiver detected a bad bit stream. The P180 and/or device should be checked.

PARITY ERROR - In general, this error message comes from the 484 mainframe and means that the most recent P180 I/O request cannot be processed. Specifically, this message indicates that the 484 message receiver hardware detected a bad bit stream.

PORT 3 EMPTY - This message appears when the user is performing a LOAD, DUMP, or VERIFY and has not plugged in a legal device.

POWER/LED INVALID-NETWORK SKIPPED - This message does not appear on the error line. It is not strictly an error. It displays whenever the current network on the display is being skipped due to the skip command.

REG NO-MATCH - This message appears during VERIFY when the tape does not match the 484. This error may be disregarded if verifying while running.

SPARE KEY - The key which the user has struck has no function.

START FAILED - This message appears when the user tried a START function but the 484 status shows that it would not start. There is a serious problem in the 484 mainframe.

NOTE

In earlier releases of P180, revisions A & B, this message was FCN FAILED.

START LOGIC - This message means that the user tried to call up a network before the first network. Therefore, his is at the start of his logic.

STOP FAILED - This message appears when the user has tried a STOP function and the 484 status shows that it did not stop. There is a problem in the 484. See START FAILED.

TAPE> 484! - This message appears when the user is loading a smaller 484 with a dump from a larger 484. The amount of user logic in the larger is more than the size of the smaller. The P180 tries to load larger to smaller and will succeed if the amount of memory actually programmed in the larger 484 will fit in the smaller 484.

257=BATT OK - This message appears when the user is trying to program a coil with reference #257. Since this is the "BATTERY OK' coil, is is already used and may not be programmed.

UNK CONTACT - This error message appears when the P180 is reading a network and finds a node type which is invalid. It means a serious problem in the 484.

VERT IN WAY - This message appears when the user is trying to program a coil when the cursor is not in the coil column and there is a vertical short coming down immediately to the right of the cursor. There may not be vertical shorts down to the right of the coil.

SECTION V
SERVICE CENTER

5.0 INTRODUCTION

A Service Center is maintained at MODICON Headquarters in Andover, Massachusetts. Maintenance assistance is available 24 hours a day, 365 days a year.

Several data telephone lines, support computers, and extensive files on all controllers manufactuered by MODICON are offered. To make maximum use of the Service Center's capabilities, a T158 Telephone Interface must be available. This interface connects to the 484 via the J470 Adapter. Further, these allow support computers to communicate directly to the controller.

For further information about the MODICON Service Center capabilities and customer options contact any MODICON sales office.

5.1 FORMS

Necessary support forms will be available from any MODICON Sales Office or Service Center.

SECTION VI

500 SERIES I/O DEVICES

6.0 INTRODUCTION

This section describes the discrete I/O modules, register I/O devices, and their associated housings, which form part of the 500 Series I/O System.

The 500 Series I/O System is designed to provide a low profile, reliable, and highly modular I/O system, at a low cost-of goods sold. Performance of user side I/O circuits is equivalent to the high-performance attainable with similar 200 Series I/O devices. 500 Series I/O Modules are designed for compatible operation with each other, and with 200 Series I/O Modules of the same type.

The overall I/O system is designed for direct connection to the 484 Series of controllers. By using a suitable interface assembly, the system may also be used with 184, 384, and 584 Controllers.

The discrete I/O modules plug into I/O housings which contain the user wiring terminal connections and which interface the I/O modules to the controller system. There are two sizes of I/O housings available: B545, one to eight modules, and B546, one to four modules.

The I/O housings are connected to an I/O duct (W55X). A variety of these ducts are available. Choice depends on the system size. The duct forms the mechanical intercommunication among the I/O housings and the controller and serves to support and shield the I/O bus cable assembly.

An I/O channel consists of a maximum of 128 input points and 128 output points, or a total of 256 Input/Output points or 64 modules. An I/O channel can be driven by any one of three possible units: 484 Controller, 484 Discrete I/O Expander, or J540 184/384 Adapter.

A 484 Controller equipped with an optional I/O expander may control a maximum of 256 inputs and 256 outputs for a total of 512 I/O points.

An Input/Output point is referenced by the programmer with a number which depends on:

(1) Which point on the module it is (1 through 4, top to bottom).

(2) Which module on the I/O housing is involved (1 through 8, top to bottom on 8 module housings; 1 through 4, top to bottom on 4 module housings).

(3) Which I/O houing select code has been selected for that I/O housing.

Each module has eigth terminal connection points for user wiring. Each terminal connection point can accomodate up to 2 #12 wires. User wiring is fed to these connection points via a wiring tray provided in each I/O housing from underneath the system.

Data is transferred between the I/O modules and the controller via an 8 bit, open-collector, twelve-volt data bus. When an input module pair is selected by the controller, the input data is applied through the signal-conditioning electronics directly onto the 8-bit data bus. When an output module pair is selected by the controller, the data on the bus is loaded into storage latches on the output modules, where outputs are controlled until updated.

All opto-isolator power in the I/O modules is supplied through an indipendent power bus. This power is controlled by the controller such that in the event of a problem (lack-of-line power) the controller will first shut off the opto-isolator power. This forces all outputs off as part of the shut-down procedure. On start up, the opto-isolator power will remain off until the controller has established control over the outputs.

The height of an installed 8-module housing and duct is 32 inches. Additional room must be provided for wire runs. The height of an installed 4-module housing is 18 inches. Each I/O housing requires 5 inches in mounting surface width.

The I/O system will operate in standard NEMA cabinets and internal ambient air temperatures from 0 to 60° centigrade provided that nothing restricts the free flow of convection air currents.

Table VI-1 shows the signal conditioning module options. Input/Output Module terminal assignments are shown in Table VI-2.

Table VI-1. Signal Conditioning Module Options

Model	Type		Color Code
B550	conditions	115 VAC outputs	red
B551	conditions	115 VAC inputs	pink
B552	conditions	9-56 VDC outputs Universal DC Module -True High*	dark blue
B553	conditions	9-56 VDC inputs Universal DC Model -True High*	light blue
B554	conditions	220 VAC outputs	orange
B555	conditions	220 VAC inputs	melon
B556	conditions	5 VTTL outputs	violet
B557	conditions	5 VTTL inputs	light purple
B558	conditions	9-56 VDC outputs Universal DC Module -True Low*	turquoise
B559	conditions	9-56 VDC inputs Universal DC Module -True Low*	blue
B560	conditions	90-150 VDC outputs	blue
B561	conditions	90-150 VDC inputs	blue

* The term "True High" means that the controller sees the input as "True" (ON) when the input is "High" (+VDC). Using true high input module, the input device (outside the controller) should be wired to the +VDC source. The same terminology is used for outputs but in this case the output device (outside the controller) is wired to the -VDC (or grounded) since the switching (inside the module) is done on the "High" line of the source. The "True Low" modules are vice versa.

Table VI-2. Input/Output Module Terminal Assignments

Terminal	B550-115 VAC B554-220 VAC AC OUTPUTS	B551-115 VAC B555-220 VAC AC INPUTS	B552-True High B558-True Low DC OUTPUTS	B553-True High B559-True Low DC INPUTS	B556 TTL OUTPUTS	B557 TTL INPUTS	B560 120 VDC OUTPUTS	B561 120 VDC INPUTS
1	AC IN GROUP A	AC IN INPUT 1	DC IN (+) GROUP A	DC IN (+)	DC IN (+)	DC IN (+)	OUTPUT 1	DC IN (+) INPUT 1
2	AC RETURN GROUP A LAMP COMMON	AC RETURN INPUT 1	DC RETURN GROUP A	DC RETURN	DC RETURN	DC RETURN	RETURN 1	DC RETURN INPUT 1
3	OUTPUT 1	AC IN INPUT 2	OUTPUT 1	INPUT 1	OUTPUT 1	INPUT 1	OUTPUT 2	DC IN (+) INPUT 2
4	OUTPUT 2	AC RETURN INPUT 2	OUTPUT 2	INPUT 2	OUTPUT 2	INPUT 2	RETURN 2	DC RETURN INPUT 2
5	AC IN GROUP B	AC IN INPUT 3	DC IN (+) GROUP B	NOT USED	NOT USED	NOT USED	OUTPUT 3	DC IN (+) INPUT 3
6	AC RETURN GROUP B LAMP COMMON	AC RETURN INPUT 3	DC RETURN GROUP B	NOT USED	NOT USED	NOT USED	RETURN 3	DC RETURN INPUT 3
7	OUTPUT 3	AC IN INPUT 4	OUTPUT 3	INPUT 3	OUTPUT 3	INPUT 3	OUTPUT 4	DC IN (+) INPUT 4
8	OUTPUT 4	AC RETURN INPUT 4	OUTPUT 4	INPUT 4	OUTPUT 4	INPUT 4	RETURN 4	DC RETURN INPUT 4

6.1 DISCRETE I/O SYSTEM

The Discrete I/O System has the following major features:

- o 4 points per module.
- o Fits in an 8-inch deep NEMA cabinet.
- o Module easily replaceable without distrubing any wiring.
- o User wiring connections easily available at the front of the system.
- o Each user connection point will accept up to 2 #12 wires.
- o Active indicator (LED) on each point.
- o Output active indicators are on Load side.
- o Each output point is fused.
- o Each output point has an open fuse indicator.
- o AC output points turn on at zero-crossing.
- o Each DC input point thresholds at approximately one-half the supply voltage.
- o Each input point is filtered for spike rejection.
- o Each input and output point is optically isolated.
- o User Labeling surfaces are provided on the I/O housings.

6.1.1 MODULES

B550 115 VAC OUTPUT MODULE

The MODICON B550 115 VAC Output Module conditions the signals used internally in the controller to four independent 115 VAC outputs capable of driving solenoids, motor starters and other loads up to two amperes. The four output circuits in the module are divided into two groups. Each group, contains two output circuits and is fully isolated. This module can be referred to as an Isolated Output Module in a group of two points. Different 115 VAC sources can drive each group. Each module uses four triac devices to switch the loads of the user supplied VAC line.

Self contained damping networks and voltage limiting varistor suppress line voltage spikes and prevent false triggering. Each output circuit is provided with a fuse to protect its circuitry from overload current (Figure VI-1 and VI-2).

Electrical Characteristics:

Load Current:	
OFF Current:	5MA max.
ON Current:	2 amps continuous for each output (8 amps per module).

Recommended minimum Load:	10mA
ON Holding Current:	0.5mA
Inrush Load Current:	15 amps maximum for 10 ms. 5 amps maximum for 100 ms.
Fuse Rating:	5 amps normal blow (one fuse per output).
Load Voltage:	
Working Voltage:	80 VAC to 130 VAC continuous 40 to 70 Hz.
Transient Voltage:	150V max for 10 seconds. 200 V max for 1 cycle (varistor limited).
ON Voltage Drop:	Approximately 1 VAC at 2 amps current.
Common Mode Voltage:	Working 200 VAC, 1500 max for 10 ms.
Response Time:	OFF to ON 0.3 to 10 ms max. ON to OFF 0.3 to 8.3 ms max (at 60 Hz).
Output Status Indicator:	A neon lamp is provided for each output. The lamp will be ON when output is ON.
Fuse Indicator:	A neon lamp is provided for each output. The lamp will be ON when the fuse is blown.
Compatibility with input Modules:	The B550 is capable of interconnection with the MODICON B551 and B231 115 VAC Input Modules without the use of additional components.

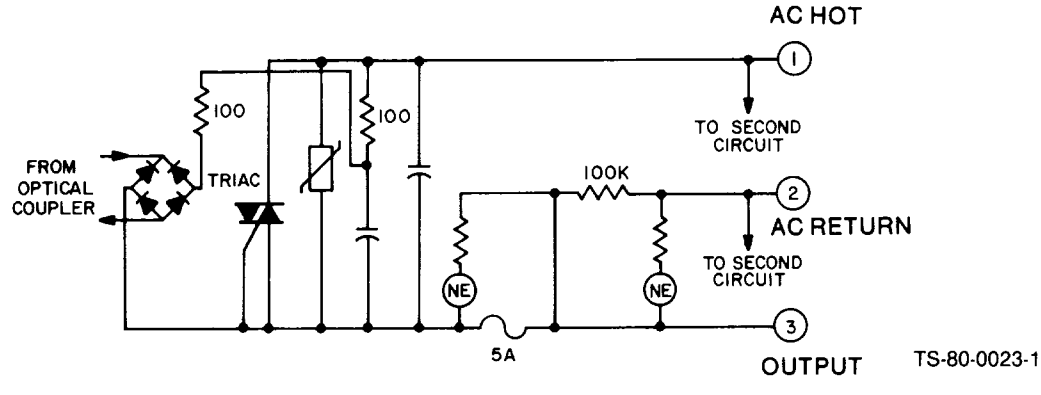


Figure VI-1. B550 115 VAC Output Module Simplified Schematic

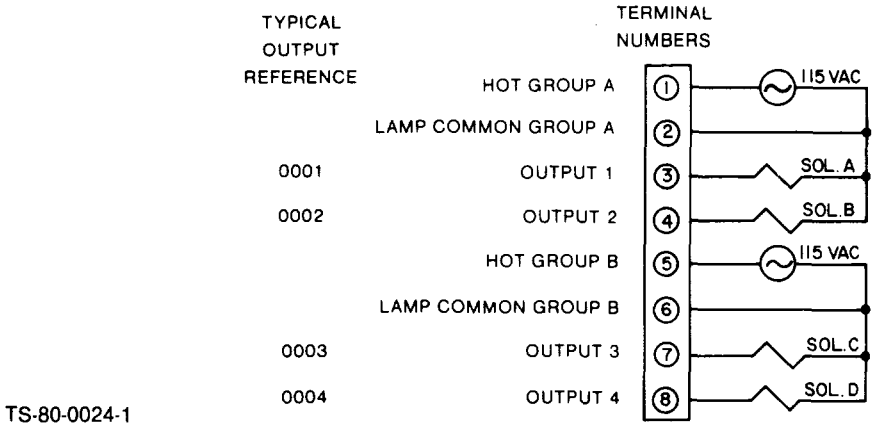


Figure VI-2. B550 115 VAC Output Modules Terminal Numbering and Connections

B551 115 VAC INPUT MODULE

The MODICON B551 115 VAC Input Module (Figure VI-3 and VI-4) contains four 115 VAC isolated inputs. Each input draws sufficient "wetting" current to inhibit the buildup on contaminants on the surface of silver contacts used in pushbuttons, limit switches, pressure switches, etc. The input signal requirements for each of the 4 inputs are as follows:

Electrical Characteristics:

ON Condition:	Input at high level. Input indicator ON (neon lamp). Controller input ON.
ON level:	Input voltage greater than 80 VAC and less than 130 VAC continuous. Source impedance less than 1K ohms. 40 to 70 Hz.
OFF Condition:	Input at low level or open circuit. Input indicator OFF (neon lamp). Controller input OFF.
OFF level:	Input voltage less than 48 VAC or less than 150 VAC with source impedance greater than 40K ohms. 40 to 70 Hz.

Switching Level:	Approximately 60 VAC.
Input Impedance:	Approximately 16K ohms at working frequency.
Input Current:	Approximately 8 mA at 115 VAC.
Common Mode Voltage:	200 VAC steady state (60 Hz), 1500V for 10 ms.
Maximum Input Voltage:	150 VAC for 10 seconds. 200 VAC for 1 cycle (16.7 ms. at 60Hz).
Response Time:	OFF to ON 10 ms. max. ON to OFF ms. max.
Compatibility with output modules:	The B551 is capable of interconnection with the MODICON B550 and B230 115 VAC Output Modules without the use of additional components.

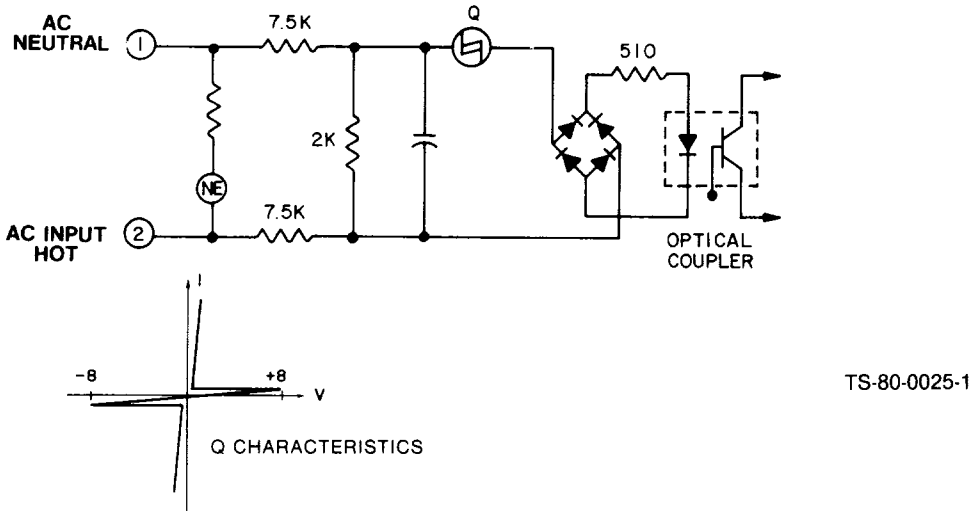


Figure VI-3. B551 115 VAC Input Module Simplified Schematic

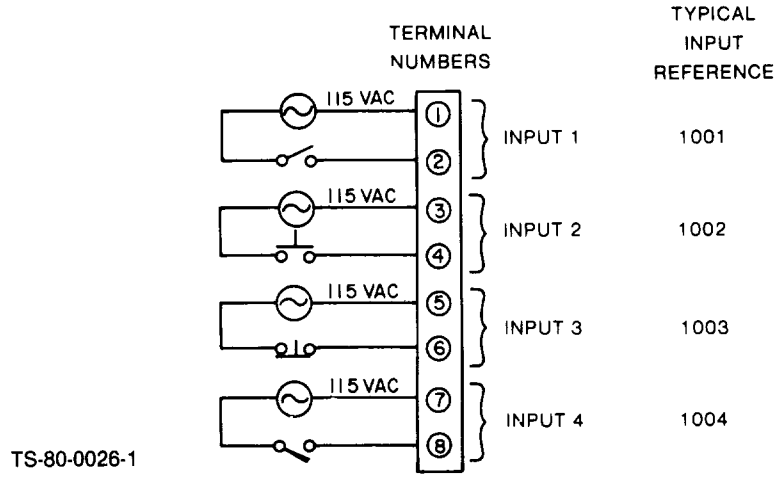


Figure VI-4. B551 115 VAC Input Module Terminal Numbering and Connections

B552 UNIVERSAL DC OUTPUT MODULE (TRUE HIGH)

The MODICON B552 Universal DC Output MOdule (True High) (Figures VI-5 and VI-6) converts the signals used internally in the controller to four independent DC outputs capable of driving relays, pilot lamps, motor starters, solenoids of any other load up to 2 amperes. The module uses transistor switches to control loads connected to the user DC source. The four output circuits are divided into two groups of two circuits each. Two different VDC sources can be used for each group.

The "True High" output module requires user load connection to the negative VDC source. The positive VDC is wired directly to the module since the "hot" line is switched by the module logic. For lamps common, the negative VDC is also wired directly to the module.

Self-contained clamp diodes suppress transient voltages when inductive loads are driven. Each output circuit is fused to protect its circuitry against overload currents. LED indicators are provided to indicate ON status for each output as well as separate LED's for blown fuse indication.

Electrical Characteristics:

Load Current:
OFF Current: 5 mA max.
Steady State ON Current: 2 amps per output (8 amps for four outputs).

Recommended Minimum Load:	10 mA.
Inrush Current:	7 amps max for 10 ms. 5 amps max for 100 ms. 5 amps, normal blow per each output.
Fuse Rating:	
Load Voltage:	
Working Voltage:	9 to 56 VDC (different sources can be used for each group to two outputs in one module).
Peak Voltage:	60 VDC max.
Output Voltage Drop:	1.2 VDC at 2 amps.
Bias Current:	Each source (two required per module) should provide the following current:

Source Voltage	Outputs OFF	Outputs ON
24 VDC	6 ma	26 ma
56 VDC	13 ma	32 ma

NOTE

If one source provides power to both pairs of outputs on a module, the above values should be doubled to obtain the correct load for that module.

Common Mode Voltage:	200 VAC steady state. 1500V for 10 ms.
Response Time:	OFF to ON 1 ms max.
Output Status Indicator:	A LED is provided for each output. The light is ON when the output is ON.
Fuse Indicator:	A LED is provided for each output. The LED will be ON when the fuse is blown.

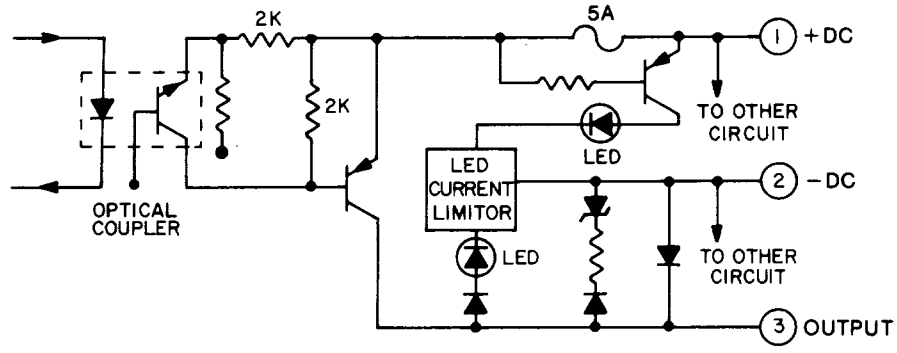


Figure VI-5. B552 Universal DC Output Module (True High) Simplified Schematic

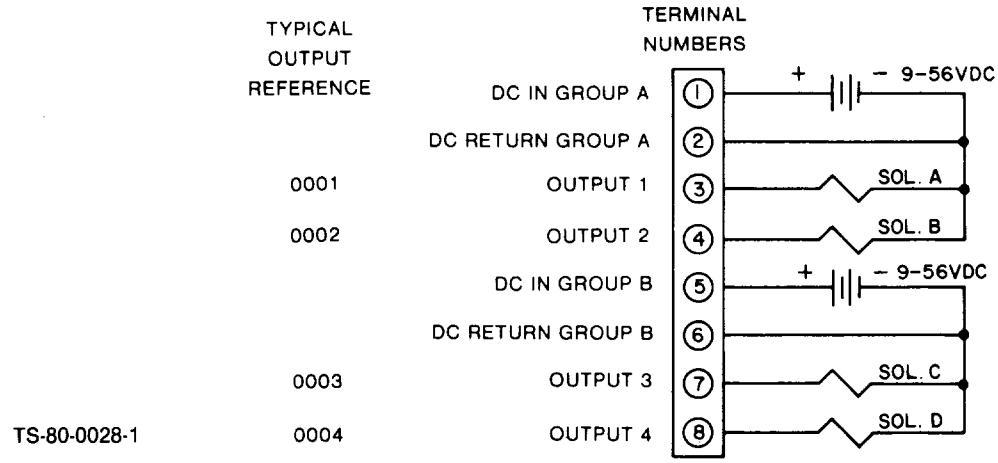


Figure VI-6. B552 Universal DC Output Module (True High) Terminal Numbering and Connections

B553 UNIVERSAL DC INPUT MODULE (TRUE HIGH)

The MODICON B553 Universal DC Input Module (True High) (Figures VI-7 and VI-8) conditions four independently useable DC input signals (sharing common source and "return") to the signals used internally in the controller. This module provides the capability of using discrete input voltages varying from 9 to 56 volts DC. The "True High" module requires the inputs to be wired to positive VDC since the module defines an ON condition (true) as "high" voltage level.

Electrical Characteristics:

Input signal requirements for each of the four inputs:

ON Condition:	Input "High" (short circuit to positive VDC). Input in "ON". Control input line "ON".
ON Level:	9 to 56 VDC reference to common (one source per module). Input is "ON" when greater than 60% of source voltage.
ON Current:	Approximately 0.75 mA at 24 VDC. Approximately 1.6 mA at 48 VDC.
OFF Condition:	Input "low" (short circuit to common or open circuit). Input indicator "OFF". Control input line "OFF".

OFF Level:	Less than 40% of VDC source.
Switching Level:	40-60% of the supply voltage.
Common Mode Voltage:	200 VAC steady state. 1500V for 10 ms.
Response Time:	OFF to ON 7 ms. max. ON to OFF 14 ms. max.
Input Status Indicator:	A LED is provided for each input. A LED is ON when input is ON.

Bias Current:

Source Voltage	Inputs OFF	Inputs ON
9 VDC	6 mA	25 mA
56 VDC	22 mA	60 mA

Compatability with output modules: The B553 is capable of interconnection with the B552 Universal DC Output Module (True High) without the use of additional components.

Protection: Polarity reversal of bias supply and operation with parallel unclamped inductive loads shall not cause circuit failure.

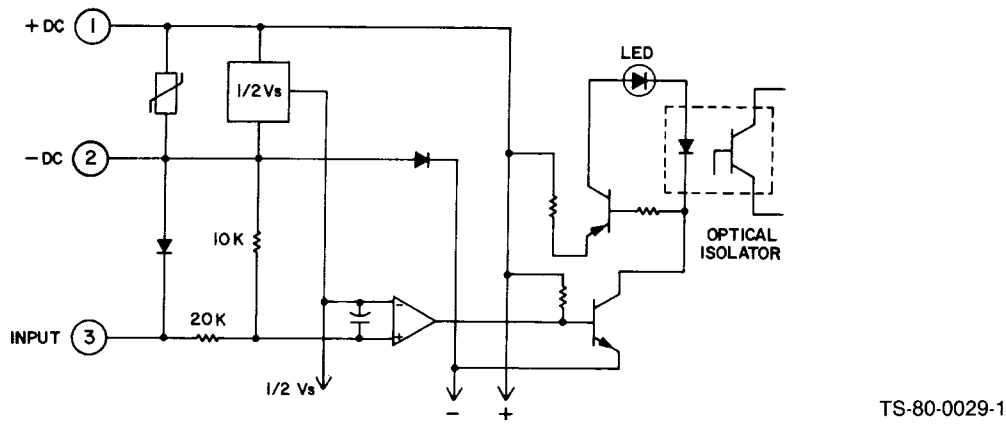


Figure VI-7. B553 Universal DC Input Module (True High) Simplified Schematic

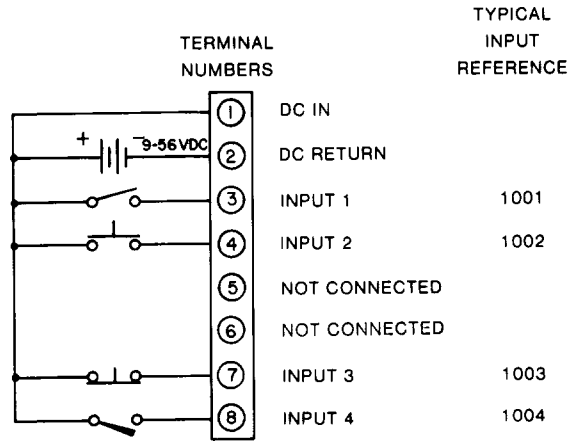


Figure VI-8. B553 Universal DC Input Module (True High) Terminal Numbering and Connections

B554 220 VAC OUTPUT MODULE

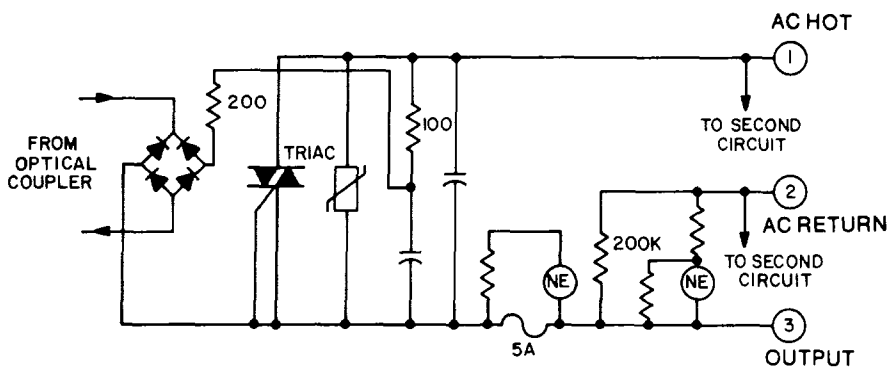
The MODICON B554 220 VAC Output Module (Figures VI-9 and VI-10) conditions the signals used internally in the controller to four independent 220 VAC outputs capable of driving solenoids, motor starters or other loads, up to two amperes each. The four output circuits in the module are divided into two groups. Each group containing two output circuits is fully isolated. This module can be referred to as an ISOLATED OUTPUT MODULE in a group of two points. Different 220 VAC sources can drive each group. Each module uses four triac devices to switch the loads of the user supplied VAC line.

Self contained damping networks and voltage limiting varistor suppress line voltage spikes and prevent false triggering. Each output is provided with a fuse to protect its circuitry from overload current. The following are the electrical characteristics of the B554 output module.

Electrical Characteristics:

Load Current:	
OFF Current:	5 mA max.
ON Current:	2 amps continuous (8 amps per module).
Recommended Minimum Load:	10 mA.
ON Holding Current:	0.5 mA.
Inrush Load Current:	15 amps for 10 ms. 5 amps for 100 ms.
Fuse Rating:	5 amps normal blow (one fuse per output).
Load Voltage:	

Working Voltage:	160 to 260 VAC. 40 to 70 Hz.
Transient Voltage:	300 VAC max. for 10 secs. 400 VAC max. for 1 cycle.
ON Voltage Drop:	Approximately 1 volt at 2 amps currrent.
Common Mode Voltage:	Working 400 VAC, 1500 volts max for 10 ms.
Response Time:	ON to OFF 0.3 to 8.3 ms. max. (at 60 Hz). OFF to ON 0.3 to 10 ms. max.
Output Status Indicator:	A neon lamp is provided for each output. The lamp will be ON when the output is ON.
Fuse Indicator:	A neon lamp is provided for each output. The lamp will be ON when the fuse is blown.
Compatibility with input modules:	The B554 is capable of interconnection with the MODICON B555 and B235 220 VAC Input Modules without the use of additional components.



TS-80-0031-1

Figure VI-9. B554 220 VAC Output Module Simplified Schematic

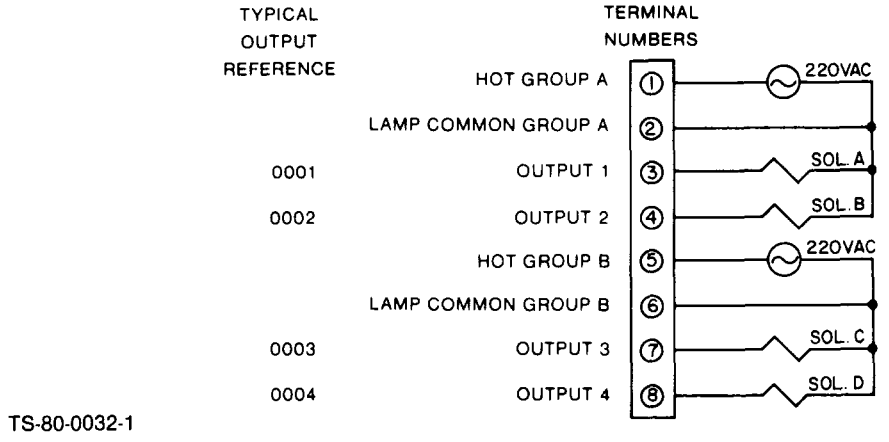


Figure VI-10. B554 220 VAC Output Module Terminal Numbering and Connections

B555 220 VAC INPUT MODULE

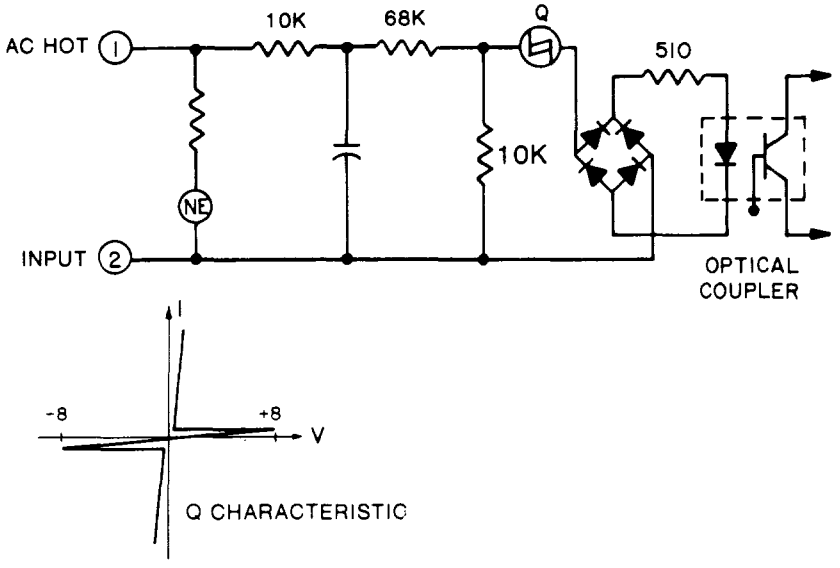
The MODICON B555 220 VAC Input Module (Figure VI-11 and VI-12) contains four 220 VAC isolated inputs. Each input draws sufficient "wetting" current to inhibit the buildup of contaminants on the surface of silver contacts used in pushbutton, limit switches, pressure switches, etc. The input signal requirements for each of the four inputs are as follows:

Electrical Characteristics:

ON Conditions:	Input at high level. Input indicator ON (neon lamp). Controller input ON.
ON Level:	140 to 260 VAC, source in series with impedance less than 1K ohm. 40 to 70 Hz.
OFF Condition:	Input at low level or open circuits. Input indicator OFF. Controller input OFF.
OFF Level:	Input voltage less than 90 VAC or less than 150 VAC with source impedance greater than 80K ohms.
Switching Level:	Approximately 120 VAC.
Input Impedance:	Approximately 32K ohms at working frequency.
Common Mode Voltage:	400 VAC steady state (60Hz) 1500 volts for 10 ms.
Response Time:	OFF to ON 10 ms. max. ON to OFF 20 ms. max.

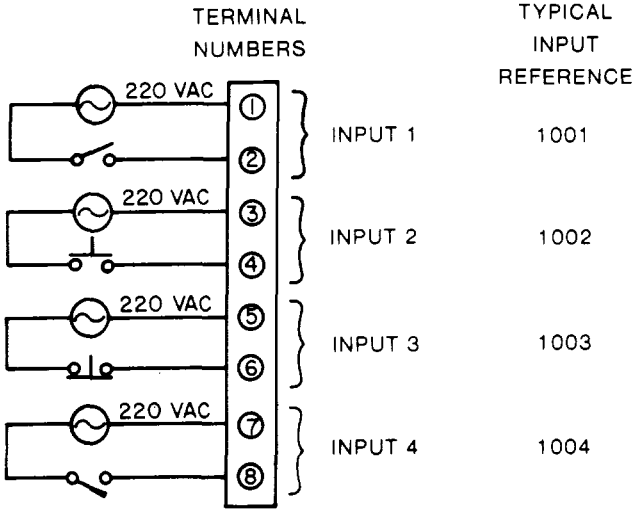
Compatibility with output modules:

The B555 is capable of interconnection with the MODICON B554 and B234 220 VAC Output Modules without the use of additional components.



TS-80-0033-1

Figure VI-11. B555 220 VAC Input Module Simplified Schematic



TS-80-0034-1

Figure VI-12. B555 220 VAC Input Module Terminal Numbering and Connections

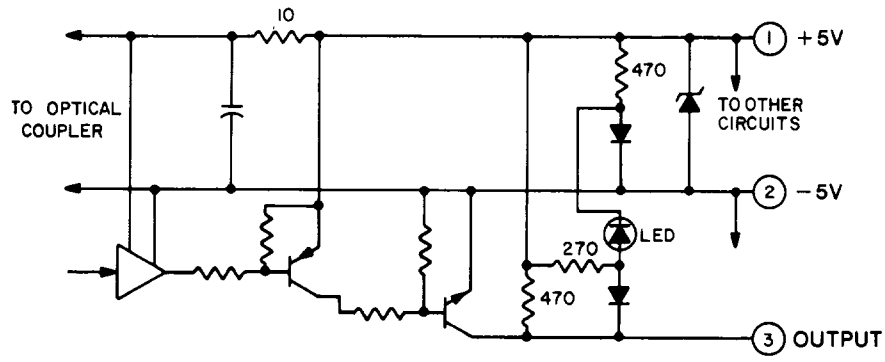
B556 VDC TTL OUTPUT MODULE

The MODICON B556 VDC TTL Output Module (Figure VI-13 and VI-14) conditions the signals used internally in the controller to four independent outputs capable of driving up to 75 mA of TTL or DTL loads. The module uses four transistor drives to control logic loads associated with an externally applied 5 VDC source.

Electrical Characteristics:

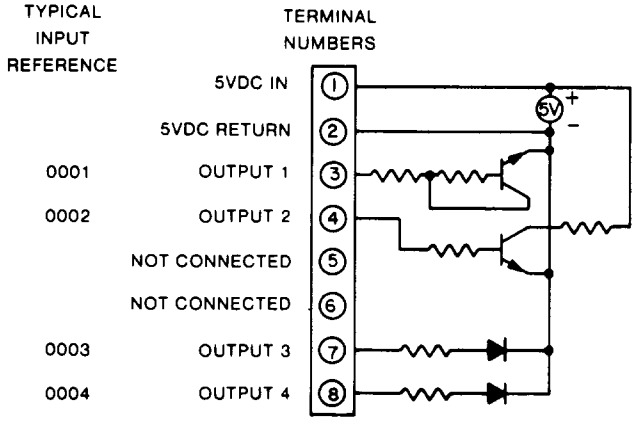
Logic One State:

Line output ON.
Output transistor OFF.
Output indicator ON.
Output voltage: 4.0V minimum at 1 mA current and + 5V supply at 4.75 VDC.



TS-80-0035-1

Figure VI-13. B556 VDC TTL Output Module Simplified Schematic



TS-80-0036-1

Figure VI-14. B556 VDC TTL Output Module Terminal Numbering and Connections

Logic Zero State:	Line output OFF. Output transistor ON. Output indicator OFF. Output voltage 0.4V max. at 75 mA. Rated current: 75mA continuous, 100 mA peak (10 ms., 20% duty cycle).
+ 5V Supply (Supplied by User):	Voltage: 5.0± 0.25 VDC. Current: 325 mA max. current (all outputs ON).
Common Mode Voltage:	200 VAC steady state max. (50/60 Hz). 1500 VDC for 10 ms.
Response Time:	OFF to ON 4 ms. max. ON to OFF 13 ms. max.
Output Status Indicator:	A LED is provided for each output. The light is ON when the Output is in logic one state.
Compatibility with input modules:	The B556 is capable of interconnection with the MODICON B557 and B237 Input Modules without the use of additional components.

B557 VDC TTL INPUT MODULE

THe MODICON B557 VDC TTL Input Module (Figures VI-15 and VI-16) conditions up to four independent +5 VDC input signals to the signals used internally by the controller.

Electrical Characteristics:

Input signal requirements for each of the four inputs:

Logic One State: Conditions:	Input "High" or open circuit. Input indicator ON. Controller input ON.
Level:	VIH = 2.0V minimum. II = 0.1 mA max. at VIH 5.5V: V source = 5.0V. Maximum input voltage + 8.0 volts. Maximum positive clamp current: 25 mA.

Logic Zero State:	
Conditions:	Input "low". Input indicator OFF. Controller input OFF.
Level:	VIL = 0.8V max. IIL = 1.1 mA max at V source = 5.25V and VIL = 0V. Max negative input voltage: -2 volts. Max negative clamp: 15 mA.
Common Mode Voltage:	200 VAC steady state max (50/60 Hz). 1500 for 10 ms.
+ 5V Supply (Supplied by User):	Voltage: 5.0 + 0.25 VDC. Current: 65 mA max.
Response Time:	OFF to ON 4 ms. max. ON to OFF 13 ms. max.
Input Status Indicator:	A LED is provided for each input. The light is ON when input is logic one state.
Compatibility with output modules:	The B557 is capable of interconnection with the MODICON B556 and B236 Output Modules without the use of additional components.

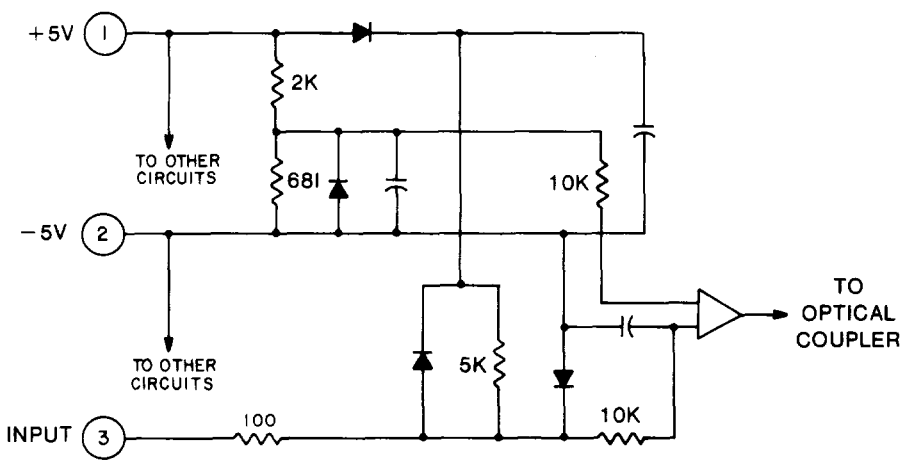


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Figure VI-15. B557 VDC-TTL Input Module Simplified Schematic

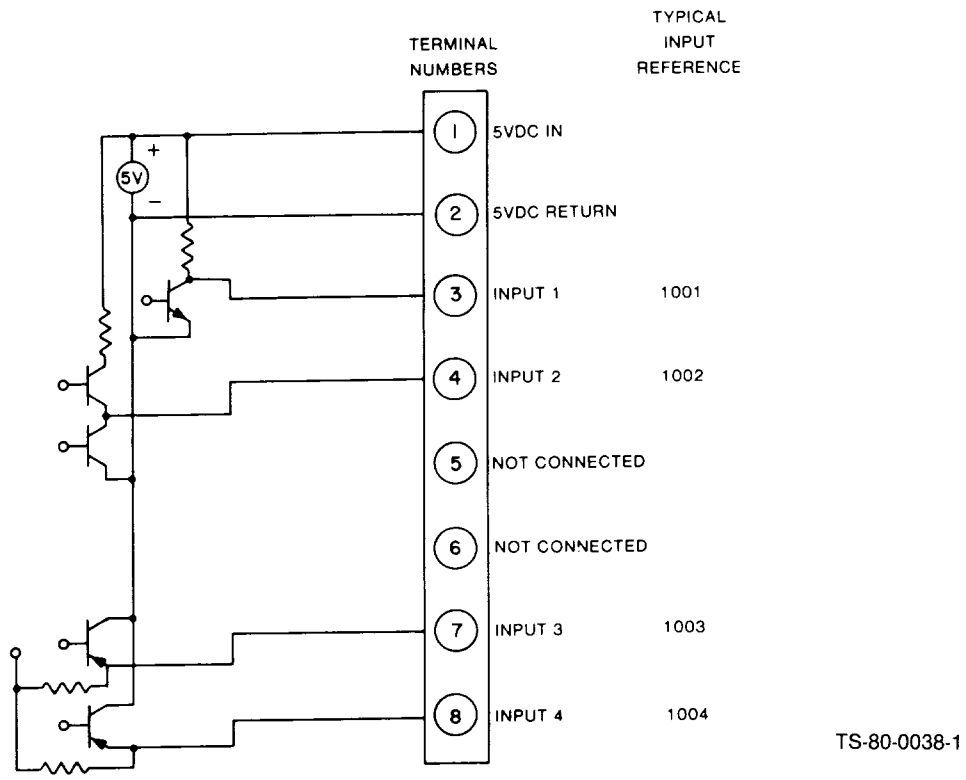


Figure VI-16. B557 VDC TTL Input Module Terminal Numbering and Connections

B558 UNIVERSAL DC OUTPUT MODULE (TRUE LOW)

The MODICON B558 Universal DC Output Module (True Low) (Figures VI-17 and VI-18) converts the signals used internally in the controller to four independent DC outputs capable of driving relays, pilot lamps, motor starters, solenoids or any other load up to two amps. The module uses transistors switches to control loads connected to the user DC source. The four output circuits are divided into two groups of two circuits each. The two groups are fully isolated and the module can be referred to as an ISOLATED OUTPUT MODULE in groups of two points.

The "True Low" output module requires user load connection to the positive VDC source. The negative VDC is wired directly to the module, since the "return" line is switched by the module logic. Note that for bias of the electronic circuits inside the module, the positive VDC is also wired directly to the module.

Self contained clamp diodes suppress transient voltages when inductive loads are driven. Each output circuit is fused

to prevent its circuitry in the case of overload currents. LED's are provided for each circuit to indicate blown fuses. Separate sets of LED's are provided to indicate ON status of each output.

Electrical Characteristics:

Load Current:	
OFF Current:	-5 mA max.
Steady State ON Current:	2 amperes max (8 amps per module).
Recommended Minimum Load:	10 mA.
Inrush Current:	7 amps max for 10 ms. 5 amps max for 100 ms. 5 amps, normal blow per each output.
Fuse Rating:	5 amps, normal blow per each output.
Load Voltage:	
Working Voltage:	9 to 56 VDC (different source can be used for each group of two outputs in one module).
Peak Voltage:	60 VDC max.
Output Voltage Drop:	1.5V max at 2 amps current.
Bias Current:	Each source (two required per module) should provide the following current:

Source Voltage	Outputs OFF	Outputs ON
24 VDC	6 mA	26 mA
56 VDC	13 mA	32 mA

NOTE

If one source provides power to both pairs of outputs on a module, the above values should be doubled to obtain current load for that module.

Common Mode Voltage:	200 VAC steady state. 1500 Volts for 10 ms.
Response Time:	OFF to ON - 1 ms. max. ON to OFF - 1 ms. max.
Output Status Indicator:	A LED is provided for each output. The light is ON when the output is ON.
Fuse Indicator:	A LED is provided for each output. The LED will be ON when the fuse is blown.

Compatibility with input modules:

The B558 is capable of interconnection with the MODICON B559 and B233 DC Input Modules without the use of additional components.

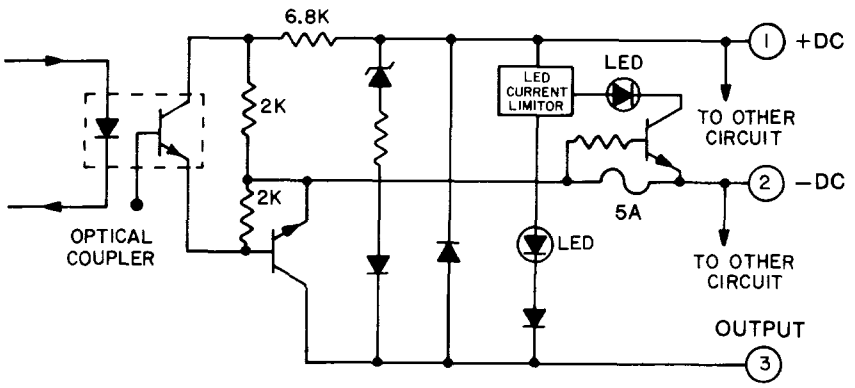


Figure VI-17. B558 Universal DC Output Module (True Low) Simplified Schematic

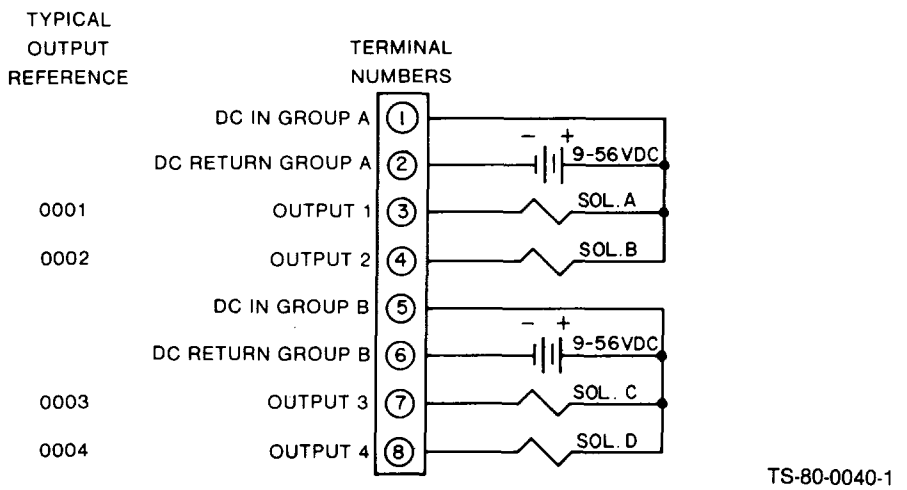


Figure VI-18. B558 Universal DC Output Module (True Low) Terminal Numbering and Connections

B559 UNIVERSAL DC INPUT MODULE (TRUE LOW)

The MODICON B559 Universal DC Input Module (True Low) (Figures VI-19 and VI-20) conditions four independently useable DC input signals (sharing common and "return") to the signals

used internally in the controller. This module provides the capability of using discrete input voltages varying from 9 to 56 VDC.

The "True Low" module requires the inputs to be wired to the negative line of the source since the logic defines "low" voltage level on an ON condition (true).

Electrical Characteristics:

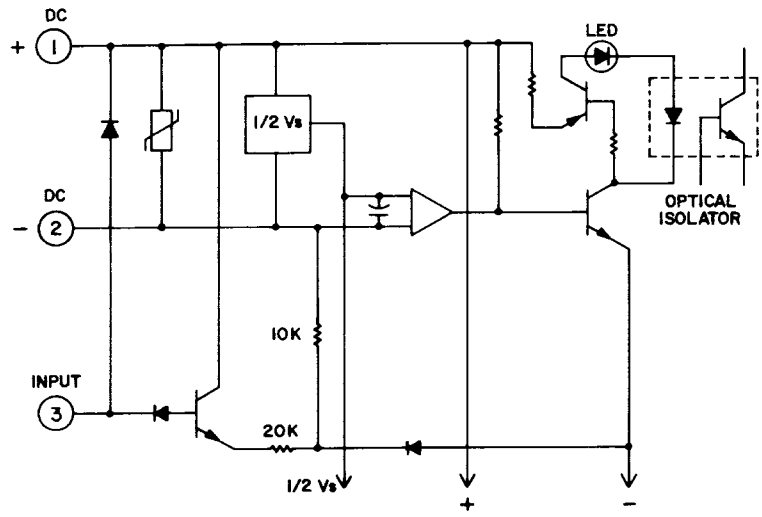
Input signal requirements for each of the four inputs:

ON Condition:	Input "Low" (short circuit to negative VDC). Input indicator ON. Control input line ON.
ON Level:	Source 9 to 56 VDC. Input ON when less than 40% of supply voltage.
ON Current:	Approximately 1.2 mA at 24 VDC source and input at zero volt.
OFF Condition:	Input "High" or open circuit. Input indicator OFF. Control input line OFF.
OFF Level:	Input greater than 60% of supply voltage.
Switching Level:	40 - 60% of supply voltage.
Common Mode Voltage:	200 VAC steady state. 1500V for 10 ms.
Response Time:	OFF to ON 7 ms. max. ON to OFF 14 ms. max.
Input Status Indicator:	A LED is provided for each input. The LED is ON when input is ON.

Bias Current:

Source Voltage	Inputs OFF	Inputs ON
9 VDC	8 mA	25 mA
56 VDC	30 mA	60 mA

Compatibility with output modules:	THe B559 is capable of interconnection with the B558 and B232 DC Output Modules without the use of additional components.
Protection:	Polarity reversal of bias supply and operation with parallel unclamped inductive loads shall not cause circuit failure.



TS-80-0041-1

Figure VI-19. B559 Universal DC Input Module (True Low) Simplified Schematic

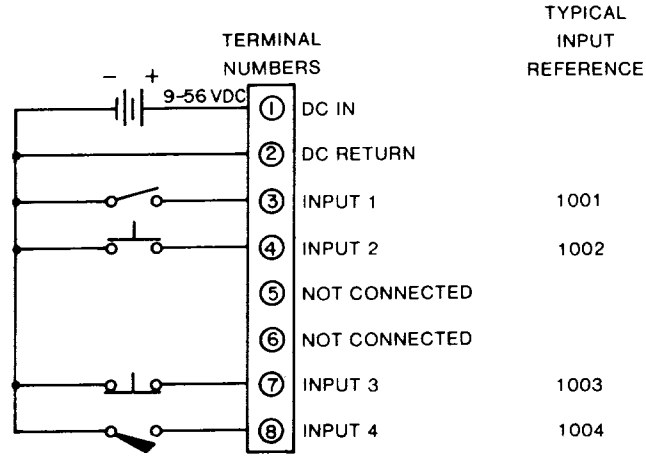


Figure VI-20. B559 Universal DC Input Modules (True Low) Terminal Numbering and Connections

B577 ANALOG INPUT MODULE

The MODICON B577 Analog Input Module is available in three options, each capable of servicing up to four analog signals. Model B577-005 is designed to handle 1-5 VDC signals, model B577-010 handles 0-10 VDC, and model B577-015 handles -10 to +10 VDC signals (factory established selection). Any analog input module can be addressed to one of four groups of four consecutive input registers. This selection is made by setting one of four switches on the rear of the module as follows:

Switch (Group A)	Input Registers
S1A	3001-3004
S2A	3009-3012
S3A	3017-3020
S4A	3025-3028

A second set of four switches allows specific input registers to be "Locked out" or not serviced by this module. Registers not serviced can be used by other properly addressed modules; if another module is not servicing them, these registers will contain zero at the CPU. The exact register effected by each of these four switches is also controlled by the module address as follows:

Switch (Group B)	S1A	S2A	S3A	S4A
S1B	3001	3009	3017	3025
S2B	3002	3010	3018	3026
S3B	3003	3011	3019	3027
S4B	3004	3012	3020	3028

Electrical Characteristics:

Input Voltage:	1-5 VDC (Model 005). 0-10 VDC (Model 010). -10 to + 10 VDC (Model 015).
Maximum Input Voltage:	220 VAC.
Common Mode Rejection:	-70 dB.
Cross Talk (between inputs):	-70 dB.
Input Impedence:	2 Mohms.
Frequency Response:	DC to 100 Hz (-2 dB points).
Setting Time (within 0.01% of final value):	10 msec.
Resolution:	1 bit in 1024.
Linearity Error:	Less than 0.05% of full scale.
Accuracy:	0.05% of full scale at 25°C. 0.25% of full scale at 0-65°C.
Temperature Coefficient:	
Offset and Linearity:	0.005% per °C of full scale.
Gain:	0.005% per °C of input voltage.
External Power Requirements:	15-30 VDC at 250 ma.
Isolation:	
Input to input:	1 mohm.
Input to Controller:	300 VAC continuous. 1500 V for 100 msec.
Input to External Power Supply:	500 VDC.

Each analog input will be converted and new data presented to the controller each scan. The numerical value supplied to the controller will vary linearily from 000 to 999 as the analog input signal varies from minimum to maximum. The following illustrates typical numerical values:

Voltage	- 005	- 010	- 015
- 10 VDC	000	000	000
- 5 VDC	000	000	250
0 VDC	000	000	500
1 VDC	000	100	550
2.5 VDC	500	250	625
5 VDC	999	500	750
10 VDC	999	999	999

Each B577 Analog Input Module incorporates an Active indicator. The Active LED will be ON as long as the CPU communicates to the module at least once each 100 msec. The external power supply is protected by a single 1/2 amp Pico fuse (MODICON Part No. 57-0024. Little Fuse number 276.500 or equal). Wiring to the B577 module is made via a 30-pin connector (MODICON Part No. 52-2109. Buchanan Part NO. PCB2B30A616798) supplied with the module. This connector can be removed for replacement of the module without disturbing field wiring; to facilitate removal of the module, a service loop of field wiring should be left. Connections (Figure VI-21) to this connector are as follows:

Circuit	+ Input	- Input	Shield
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12
(external Power 15-30VDC)	29	30	

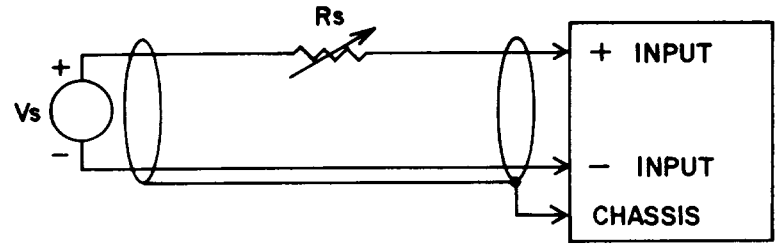


Figure VI-21. B577 Analog Input Module Typical Connections

6.2 REGISTER I/O DESCRIPTIONS

The following 500 Series Register I/O descriptions will be supplied later:

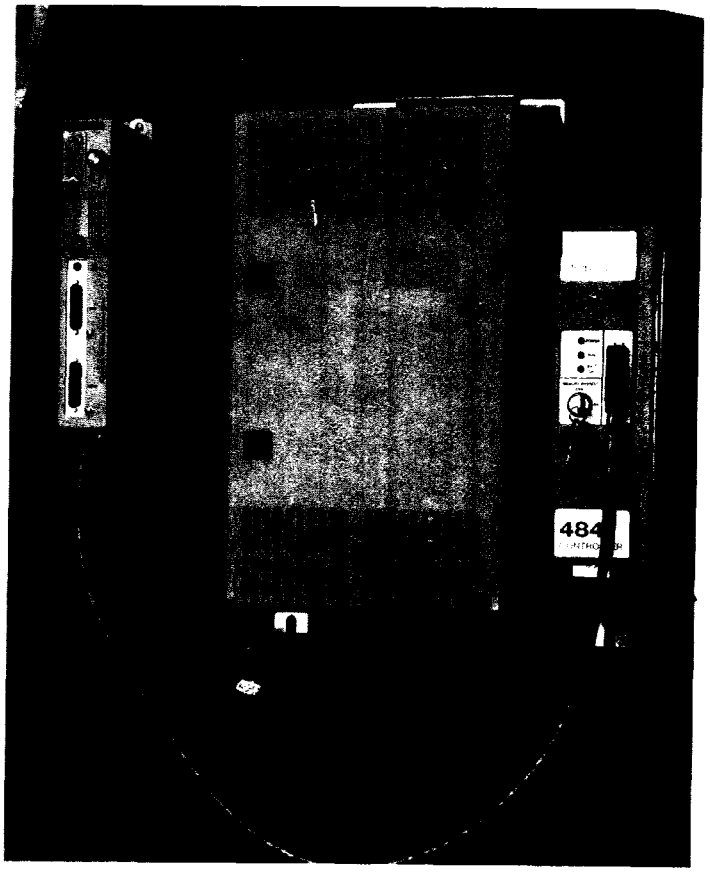
B579-001	Hi Speed Counter Module
B581-001	Absolute Encoder Input - Single-Ended Module
B583-001	Latched Int Safe Prox Sw Input Module
B585-001	Incremantal Encoder Input Module
B586-001	Ramping Prog. Stepper Drive Module
B587-001	Latched Prox Sw Input Module

SECTION VII

J470 ADAPTER

7.0 INTRODUCTION

The J470 Adapter (Figure VII-1) is a customer option which may be added to any 484 Controller at any time. The adapter is mounted adjacent to the controller mainframe. The three-foot cable plugs into the communication connector. This connector is usually used to talk to a programming device. Therefore, the J470 has two connectors: one is for the EIA device (computer) and the other for a programming panel. Simultaneous operation with both units is possible. However, when the EIA device is actively communicating, the programming panel stops for about a half second. During this lockout time, the programming panel displays a COMM BUSY message. It also stores requests made until the communication port is available. Power flow and screen displays freeze. The controller itself continues to operate during lockout time.



TS-80-0034-2

Figure VII-1. J470 Adapter

The user selects the EIA communication speed (baud rate), parity, and quantity of stop bits needed. Avaible baud rates are shown in Table VII-1.

Table VII-1. Setting of J470 Adapter Option Swps

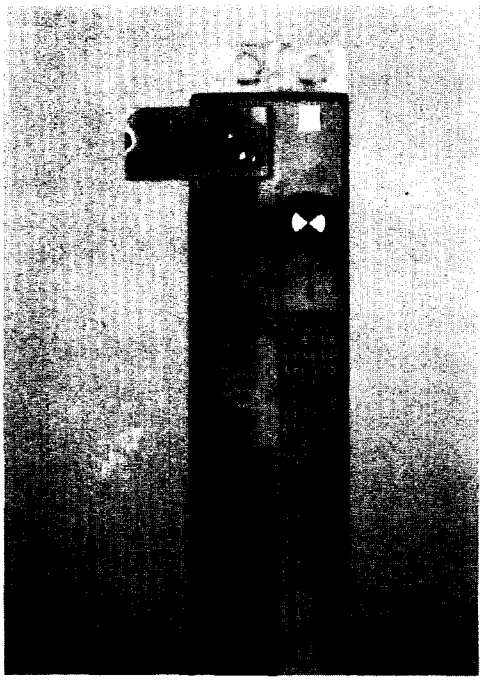
BAUD RATE	S1	S2	S3
9600	1	1	1
4800	0	1	1
2400	1	0	1
1200	1	1	0
300	0	0	0
200	0	0	1
150	1	0	0
110	0	1	0

STOP BITS - S4 (0 = two stop bits, 1 = one stop bit)

PARITY - S5, S6 as follows:
S5 Activates parity (0 = Inhibit, 1 = Enable)
S6 Selects parity (0 = Odd, 1 = Even)

NOTE

When shipped from factory, J470 Adapter will be set for: 9600 baud, no parity, one stop bit, and both ports active.



TS-80-0035-2

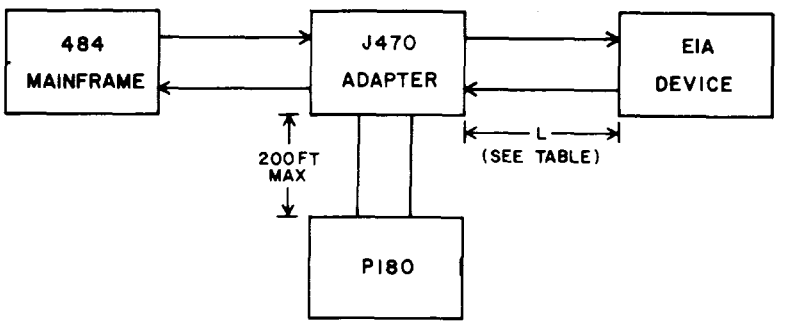
Figure VII-2. Option Selector on J470 Adapter

Shown in Figure VII-2 is a select switch that must be used to indicate device or devices are being used with the J470.

Any combination of baud rate, parity, or stop bits is allowed. The P180 Programming Panel always communicates at 9600 baud, even parity with one stop bit. Communications to a computer can be at any option selected by the user.

The J470 Adapter is also required to operate with L206 Universal Tape Loader and T158 Telephone interface. Thus, the 484 Controller can be simultaneously connected via the J470 Adapter to the P180 Programming Panel and one of the following:

Universal Tape Loader (Model L206)
Telephone Interface (Model T158)
EIA Compatible Computer



Device	Maximum Distance (L)	Maximum Baud Rate
L206	50'	9600
T158	100'	300
Computer W/O Adapters	50'	9600
Computer W/I642 Adapter	2000'	300
Computer W/I643 Adapter	1000'	9600

TS-80-0044-1

Figure VII-3. J470 Block Diagram, External Connections

Figure VII-3 is a block diagram of the various connections to the J470 Adapter and the distance limitations. Most computers are compatable of communicating at distances up to fifty feet (per EIA specification RS-232C); however, the J470 Adapter is capable of driving up to 1000 feet of cable (baud rates up to 9600) or 2000 feet with baud rates equal to or less than 300.

SECTION VIII

J471 I/O EXPANDER

8.0 INTRODUCTION

The J471 I/O Expander enables the 484 Programmable Controller to access an additional 256 discrete I/O points beyond the basic 256 discrete I/O points. All register devices may also be used on the extended I/O bus. Any MODICON model 484 Programmable Controller equipped with any enhanced executive software package may make use of the J471.

8.1 CONNECTIONS AND MOUNTING

The J471 I/O Expander is designed to be mounted on any flat vertical surface by the use of 4 EA 5/16" bolts. The J471 will attach to the remote end of any standard Now Bus duct, as well as the W514 flat cable and the W513 flexible shielded Now Bus extension cable. The Expanded Now Bus is then attached to the opposite side of the J471 chassis. Access to the Now Bus connectors on the J471 PC board is gained by loosening the two adjustible grip latches on the front cover and pulling the top of the front cover out and then down. The front cover is hinged at the bottom and also serves to house the power supply assembly (Figures VIII-1 and VIII-2). The expanded I/O is always connected to the right connector on the inside of the J471. Data from the 484 always comes into the left connector on the J471.

8.2 DIMENSIONS

The J471 is approximately 18" H x 11" W x 6.75" D (460.8 CM x 281.6 CM X 172.8 CM) and weighs 30 lbs (13.6 kilograms) (Figures VIII-3 and VIII-4).

8.3 ELECTRICAL CHARACTERISTICS

The J471 uses 250 ma at 12 VDC from the power supply of the 484 Controller. The + 5VDC I/O power from the 484 Controller is not used by the J471 to power any circuitry.

The J471 has an internal power supply that provides +12 VDC at 3.6 amps and + 5VDC at 4.5 amps (+5 I/O) to the Expanded Now Bus to power I/O devices. The power supply within the J471 contains undervoltage monitor circuitry that will shut off the +5 VI/O power to the Expanded Bus if the internal voltages fall to less the 90% of their nominal value, or if the +5 V I/O power from the 484 Controller is not present on the Now Bus.

The J471 is available with compatability to the following power sources:

	Voltage	Frequency	Current	Part No.
A.	117 VAC + 10%	60 HZ + 2.5 Hz	1 amp	J471-600
B.	110 VAC ∓ 10%	50 HZ ∓ 2.5 Hz	1 amp	J471-500
C.	220 VAC ∓ 10%	50 HZ ∓ 2.5 Hz	0.6 amp	J471-500

The J471-500 is set at the factory for 110 VAC 60 Hz. An internal jumper change will convert it to 220 VAC 50 Hz. Power input protection is provided by a 1-1/2 slow-blow fuse.

8.4 INDICATORS

On the front of the J471 are three indicator lights labled and defined as follows:

POWER: When on, this light indicates that the J471 power supply voltages are within 10% of normal and +5V I/O from the 484 is present on the Now Bus.

ACTIVE: When on, this light indicates that the J471 is producing discrete read strobes on the extended bus as commanded by the 484.

BUSY: When on, this light indicates that the BUSY line on the Now Bus is being pulled to the true state (low level) by the J471. This will happen if any device connected to the Extended Bus is busy or if the J471's power supply voltages are less than 90% of their nominal level.

8.5 ADDRESSING

Discrete I/O modules when used on the expanded I/O bus, occupy addresses 0129 to 0256 for output modules and 1129 to 1256 for input modules. When register modules are used on the expanded I/O bus, the addressing remains the same as it would be if the register modules were on the normal I/O bus. Table VIII-1 shows these listings.

Table VIII-1. Address Listings

Module Number (Top To Bottom)	Circuit Number	Expanded Housing Number							
		One		Two		Three		Four	
		Output	Input	Output	Input	Output	Input	Output	Input
1	1	0129	1129	0161	1161	0193	1193	0225	1225
	2	0130	1130	0162	1162	0194	1194	0226	1226
	3	0131	1131	0163	1163	0195	1195	0227	1227
	4	0132	1132	0164	1164	0196	1196	0228	1228
2	1	0133	1133	0165	1165	0197	1197	0229	1229
	2	0134	1134	0166	1166	0198	1198	0230	1230
	3	0135	1135	0167	1167	0199	1199	0231	1231
	4	0136	1136	0168	1168	0200	1200	0232	1232
3	1	0137	1137	0169	1169	0201	1201	0233	1233
	2	0138	1138	0170	1170	0202	1202	0234	1234
	3	0139	1139	0171	1171	0203	1203	0235	1235
	4	0140	1140	0172	1172	0204	1204	0236	1236
4	1	0141	1141	0173	1173	0205	1205	0237	1237
	2	0142	1142	0174	1174	0206	1206	0238	1238
	3	0143	1143	0175	1175	0207	1207	0239	1239
	4	0144	1144	0176	1176	0208	1208	0240	1240
5	1	0145	1145	0177	1177	0209	1209	0241	1241
	2	0146	1146	0178	1178	0210	1210	0242	1242
	3	0147	1147	0179	1179	0211	1211	0243	1243
	4	0148	1148	0180	1180	0212	1212	0244	1244
6	1	0149	1149	0181	1181	0213	1213	0245	1245
	2	0150	1150	0182	1182	0214	1214	0246	1246
	3	0151	1151	0183	1183	0215	1215	0247	1247
	4	0152	1152	0184	1184	0216	1216	0248	1248
7	1	0153	1153	0185	1185	0217	1217	0249	1249
	2	0154	1154	0186	1186	0218	1218	0250	1250
	3	0155	1155	0187	1187	0219	1219	0251	1251
	4	0156	1156	0188	1188	0220	1220	0252	1252
8	1	0157	1157	0189	1189	0221	1221	0253	1253
	2	0158	1158	0190	1190	0222	1222	0254	1254
	3	0159	1159	0191	1191	0223	1223	0255	1255
	4	0160	1160	0192	1192	0224	1224	0256	1256

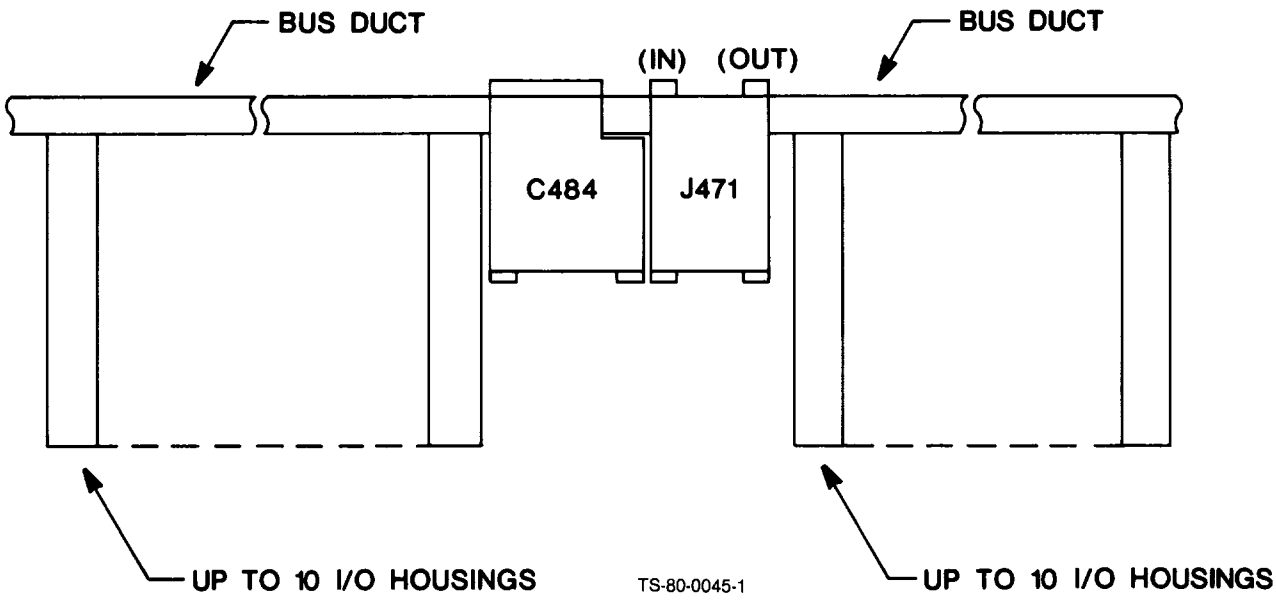
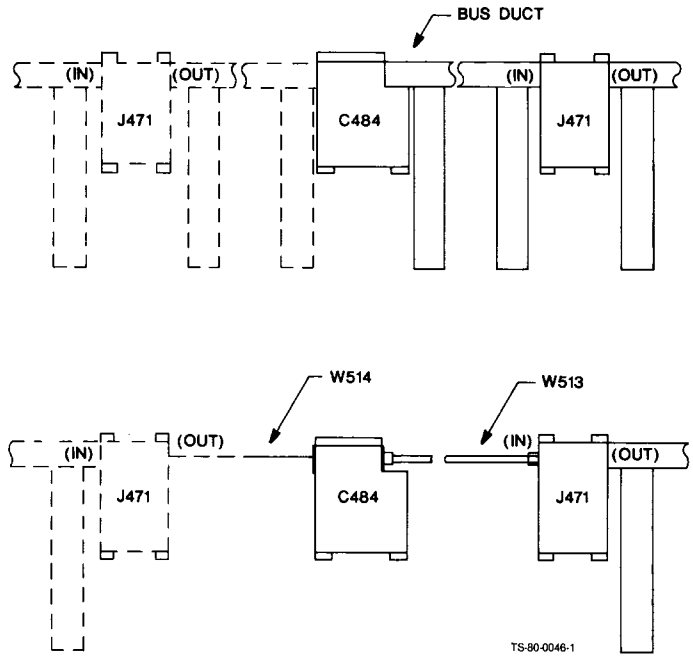


Figure VIII-1. J471 Block Diagram



NOTE

J471 may be mounted to either side of the C484. It may be attached by any one of the following cables: W513, W514, or W515.

Figure VIII-2. J471 Mounting

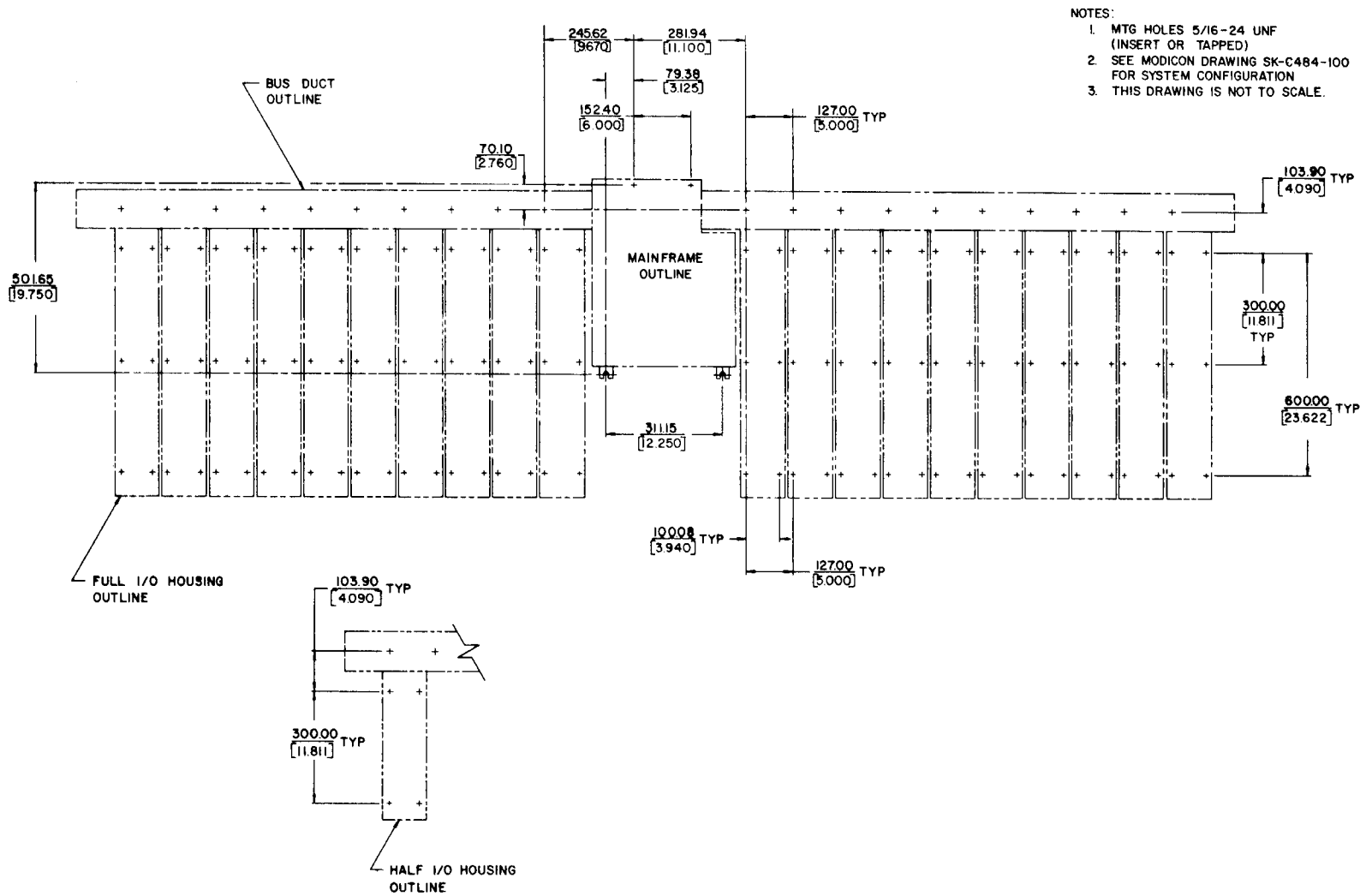
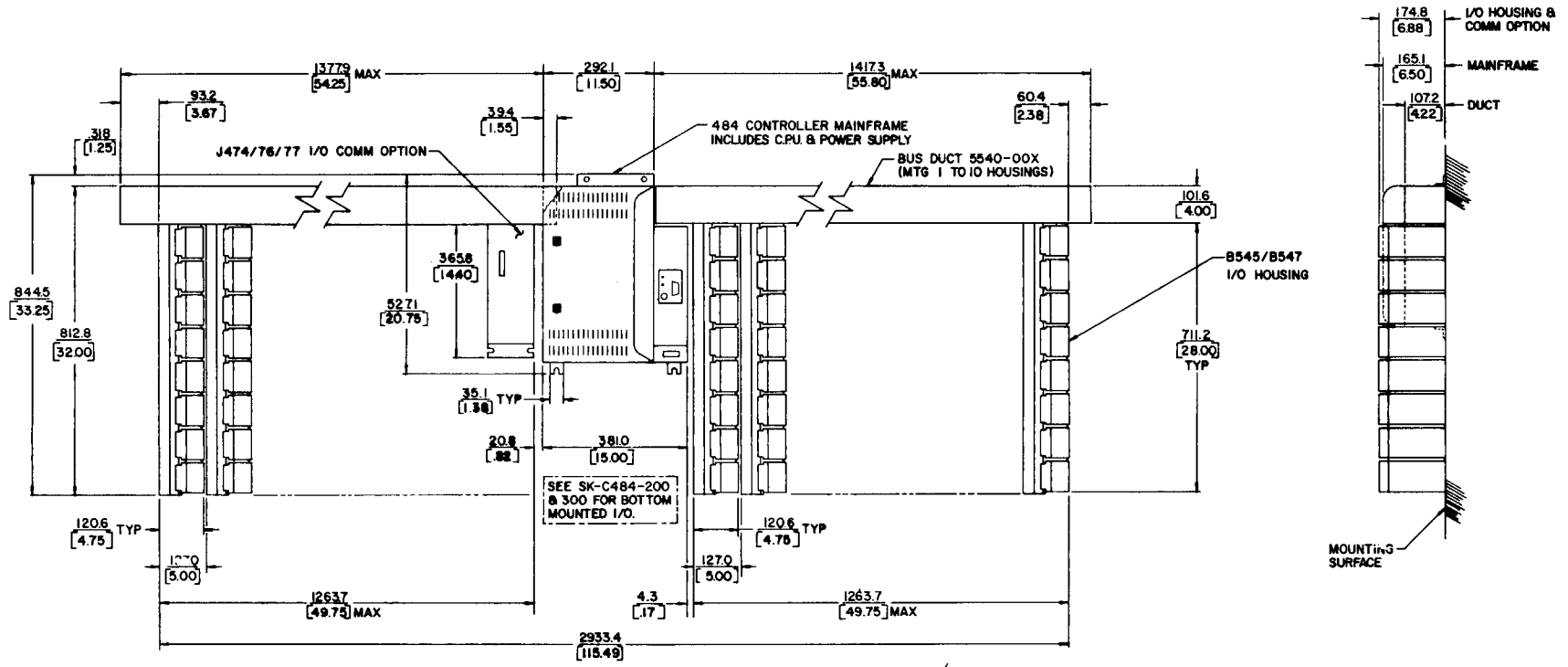


Figure VIII-3. J471 Installation

SK-C484-101



10 HOUSINGS	55.80 MAX	1417.3 MM
9 HOUSINGS		
8 HOUSINGS	45.80 MAX	1163.3 MM
7 HOUSINGS		
6 HOUSINGS	35.80 MAX	909.3 MM
5 HOUSINGS		
4 HOUSINGS	25.80 MAX	655.3 MM
3 HOUSINGS	20.80 MAX	528.3 MM
2 HOUSINGS	15.80 MAX	401.3 MM
BUS DUCT LENGTH		
TABLE I		

NOTES:
1. ALL DIMENSIONS ARE FOR REFERENCE INFORMATION ONLY.
2. SEE MODICON DRAWING SK-C484-101 FOR MOUNTING DIMENSIONS.
3. MAX I/O SYSTEM WITHOUT I/O EXPANDER IS 8 DISCRETE I/O HOUSINGS & 2 REGISTER I/O HOUSINGS.
4. THE COMM OPTIONS MUST BE MOUNTED IMMEDIATELY ADJACENT TO THE MAINFRAME ON LEFT, RIGHT OR BOTTOM. THEY OCCUPY THE SPACE OF A HALF HIGH I/O HOUSING.

SK-C484-100

Figure VIII-4. J471 Configuration

APPENDIX A

EXTERNAL CABLES

Cables	Description
W510-0XX	Bus cable for mounting I/O left or right from CPU or Expander. (XX = 2, 3, 4, 6, 8, 10 slots)
W511-002	Bus cable for mounting I/O to bottom of mainframe (2 slots).
W512-003	Bus cable for mounting I/O to bottom of mainframe in underduct (3 slots). Supplied with 5566-003.
W13-010 for J471	I/O extension cable (shielded) for mounting I/O or Expander up to 10 ft from CPU/Expander or bus cable attachment point. Only one length from mainframe and one length from Expander in system. (Available in 10-ft lengths only.)
AS-2183-0XX	Cable included with T152-611, 002, T158-611, 002. Required for T154-611, 002 484 compatibility. Standard length is 12 ft. Also available in 25, 50, and 75-foot lenghts.
AS-W180-XXX AS-W181-XXX AS-W182-XXX	Supplied with P180=0YZ in standard 8-foot length. Used to attach P180 to C484-XYZ or J470-X00. Also available in specified length up to 50 feet for direct attachment to C484-XYZ. Lengths up to 200 feet may be specified for attachment to J470-X00.
AS-W474-001	J474 Attachment cable supplied with J474.

GLOSSARY OF TERMS

GLOSSARY OF TERMS

ADDRESS SELECTOR	A switch on the top of each I/O Housing to establish housing address. Each switch contains four sections, one can be selected to establish address at housing 1 to 4.
ARITHMETIC	A type of logic used to add, subtract, multiply or divide two numerical values. Optional outputs detect addition overflow, comparisons (greater than, equal to, or less than), and illegal division.
BCD (Binary-Coded Decimal)	A system of numbers representing decimal digits (0-9) with four binary (ON/OFF) lines. BCD is a recognized industrial standard; BCD input (e.g., thumbwheels) and output (e.g., numerical displays) are readily available.
BINARY	A numerical system wherein values are represented only by numbers 1 and 0 (ON/OFF). This system is commonly employed in modern electronic hardware since circuits can be economically designed for ON/OFF status.
BIT	A single number whose value can be either a One or a Zero. Commonly represented in hardware by a small magnetic toroid device that can be either magnetized or not magnetized.
CHANNEL	A portion of the total I/O capability of the controller. Each channel represents 50% of the total available I/O.
CHECKSUM	An error detection code that sums all one bits of a group of data storage locations. Summing is done without carries from one column to another. The known result is stored; any variance from this result indicates data has been altered. Checksums can be prepared for any portion of logic memory, coil storage, or register content.

CMOS	Advanced semi-conductor memory that requires DC power to retain its content. However, the amount of DC power is very low when compared to other memory techniques, allowing relatively small batteries to maintain this memory for years without application of AC power.
CORE MEMORY	An electronic component used to store data magnetically for future utilization that is retentive upon power failure.
COUNTER	A type of logic that is used to simulate the operation of external counters.
CPU (Central Processor Unit)	See PROCESSOR.
DISABLE	The capability to disconnect a logic coil or a discrete input from its normal control, and force it ON or OFF.
DISCRETE	References that can be either ON or OFF; can be input, output, or internal references.
DOUBLE PRECISION	The technique of storing a single numerical value in two consecutive registers. Since each register can store up to three digits (maximum value 999), double-precision allows magnitudes of up to 999,999 to be stored.
DUMP	Recording the entire memory of a Controller onto disk by the Service Center. Generally accomplished by use of a Telephone Interface at the Controller.
ELEMENT	The basic building block of the 484 logic. An element can be a relay contact, horizontal shunt or open, fixed numerical value, register reference, or coil representation.
FORCE	The pushbutton on the P180 Programming Panel that can be used to change the state of a Disable reference. The reference will be changed OFF to ON or ON to OFF every time this pushbutton is depressed.

HEXADECIMAL	The numbering system that represents all possible statuses of four bits with sixteen unique digits (0-9 then A-F).
INPUT	A signal that provides information to the controller; can be either discrete input (pushbutton, relay contacts, limit switches, etc.) or numerical input (thumbwheel, external solid-state device, etc.).
I/O	Input/Output, the Controller connection to the "real world"; includes both discrete and register signals.
LATCH	The type of coil that is retentive upon power failure. Can be used similar to a latching relay. Normally coils are reset to OFF conditions upon power up; those coils selected by the user as latched (L) will not be altered and thus retain their previous condition (ON/OFF).
MAINFRAME	See PROCESSOR.
MEMORY PROTECT	The hardware capability to prevent a portion of the memory from being altered by an external device. This hardware feature is under keylock control.
MODULE	Hardware sub-assembly that can be easily replaced for maintenance purposes. If a failure occurs, the module is rapidly replaced to restore the control system with minimum downtime. The failed module (Processor, Power Supply, or I/O module) is then repaired at a later time.
NETWORK	A group of connected logic elements used to perform a specific function. A network can be from one element to a complete 10 x 7 matrix of elements (plus coils) as desired by the user.
NODE	Point on a ladder diagram that can receive power from left or provided power flow to right. This can be an input to a logic element (left side) or an output from a logic element (right side).

OUTPUT	A signal provided from the Controller to the "real world" can be either discrete output (solenoid valve, relay, motor starter, indicator lamp, etc.), or numerical output (e.g., display of values stored within the Controller).
PRESET	The limit established for a counter or timer function. The current count or time available from the register referred to in the lower element cannot exceed this limit. At the preset value, the logic output is energized.
PROCESSOR	The "brain" of the Controller system, wherein the customer's logic and executive is stored; all logic solving and decision making is performed by the Processor. Also called the CPU or mainframe.
RAM(Random-Access Memory)	A memory where individual bits are stored and accessed, in lieu of groups of bits as used for numerical storage.
REAL TIME	The actual time during which physical events take place.
REAL WORLD	The actual world within which physical events take place.
REFERENCE	Four-digit numbers used in the construction of the customer's logic. References can be either discrete (logic coils, inputs, or sequencer steps) or register (input or holding).
REGISTER	A location within the Controller allocated to the storage of numerical values (up to 999). All holding registers are retentive on power failure. There are three types of registers: input whose contents are controlled by the "real world" outside the Controller; holding registers whose contents are controlled from within the Controller; and output registers, which are special holding registers since their contents can also be provided to the "real world".

RELAY ELEMENT	A logic symbol used to simulate the effect of relays. Contacts can be normally open, normally closed, or transitional contacts.
REMOTE PRESET	The capability for placing the preset for a timer or counter line into a register and referring to that register in the upper element of the logic. The preset is no longer fixed since the contents of the register (and thus the preset) can be altered at any time.
RS-232C	Electronic Institute of America (EIA) standard for data communications, RC-232 type C. Data is provided at various rates, eight data bits per character.
RUN LIGHT	A LED indicator on the Processor that indicates, when lit, that the logic is being processed.
SCAN	The technique of examining or solving logic netowrks one at a time in their numerical order. After the last network is solved, the next scan begains at network one; logic is always solved in the fixed cyclic process.
SOLID-STATE	Circuitry designed using only integrated circuits, transistor, diodes, etc.; no electromechanical devices such as relays are utilized. High reliability is obtained with solid-state logic, which would be degraded by depending upon electromechanical devices.
TIMER	A logic element used to measure and record the time of an event or sequence of events. Timers can accumulate time in seconds, tenths of seconds, or hundredths of seconds.
TRAPPED (START/STOP)	The ability to stop a controller from scanning; can be exercised only from a computer or the P180 Programmer. The controller can still communicate to the computer but will have all outputs OFF.

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Document Part Number ML-C484-MTN Rev. B

Title 484 Programmable Controller Maint. Manual

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	Y	N
Are there any terms or concepts that are not defined clearly?	☐	☐

If so, what are they? _____

	Y	N
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