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GE Fanuc Automation

Programmable Control Products

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Series Six Installation andMaintenance

User's Manual

GEK-25361A *July 1982*

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WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, and temperatures that could cause personal injury exist in this equipment.

CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

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NOTE

Notes merely call attention to information that is especially significant in understanding and operating the equipment.

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Preface

This manual provides the reader with the information required to install and maintain the Series Six family of Programmable Controllers.

The Series Six family includes Central Processing Unit models 6000, 600, and 60 along with a flexible Input/Output (I/O) system and a Program Development Terminal for entering user created ladder diagram programs.

Chapter I provides a general description of the hardware used in a Series Six system. Sufficient information is provided to enable the user to plan, select and assemble a system suited to virtually any application.

Chapter II is a guide to the installation of a Series Six system. Included is a recommended sequence of installation, setting of switches requiring configuration in the field, connection of cables, and wiring of the I/O modules.

Chapter III provides the basic information needed to maintain a Series Six system. Included are guides to the troubleshooting and repair of the Program Development Terminal, Central Processing Unit and the Input/Output system. Replacement parts lists are provided for each part of the Series Six system.

The contents of this publication will be updated and added to as applicable in order to maintain a quality product consistent with the policies and practices of General Electric Company.

For informatiuon on programming a Series Six system, refer to GEK-25362, PROGRAMMING MANUAL FOR SERIES SIX PROGRAMMABLE CONTROLLERS.

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General Electric backs up its Series Six programmable control equipment with an exclusive one-year (up to 18 months if the customer resells or leases the equipment to a third party) warranty. Specific terms of the warranty can be obtained from your General Electric Sales Office.

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SECTION 1
INTRODUCTION

This manual contains a general description of the Series Six programmable controller, installation instructions and data for troubleshooting if system malfunctions should occur. For a detailed explanation of programming the Series Six, refer to the PROGRAMMING MANUAL FOR SERIES SIX PROGRAMMABLE CONTROLLERS, GEK-25362.

GENERAL OVERVIEW

The Series Six is a family of programmable controllers. Programmable controllers are general purpose microprocessor controls specifically designed for operation in harsh industrial environments. A programmable controller accepts data from input devices (switches, sensors, etc.), performs logical decisions determined by a program stored in memory, and provides output control for machines or processes. Figure 1 is a basic block diagram of the Series Six programmable controller.

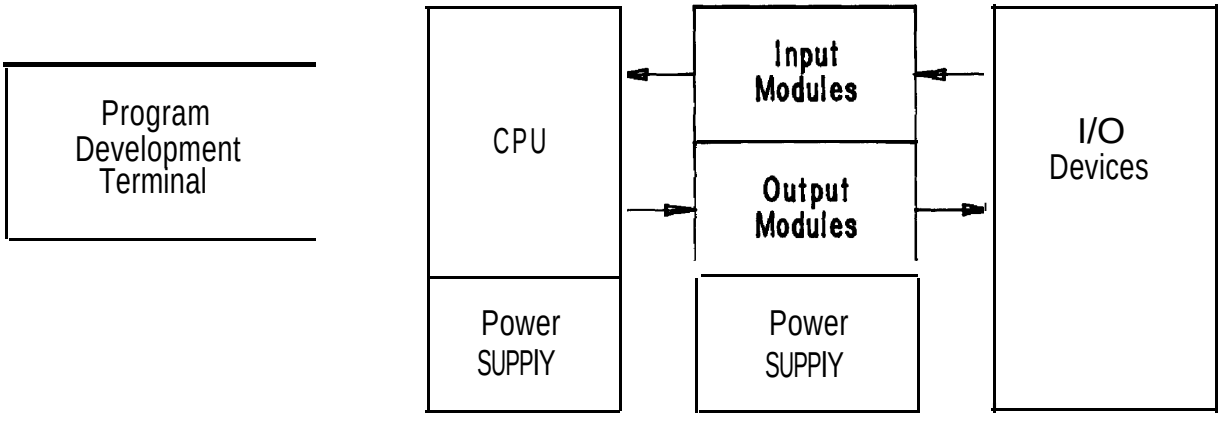


Figure 1.
BASIC BLOCK DIAGRAM OF SERIES SIX SYSTEM

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Programs are entered, edited, and monitored with the Program Development Terminal (PDT). Input data is evaluated, logic decisions are made based on the stored program, and appropriate outputs are driven by the Central Processing Unit (CPU). The Input/Output (I/O) modules convert electrical signals to logic levels for processing by the CPU and convert CPU signals to the proper electrical levels for control of user devices. The I/O modules also provide isolation for signals in the CPU from electrical noise in the typical factory environment.

The basic programming language used by the Series Six is relay ladder logic. This has been expanded to include (as an option) a powerful Extended Instruction Set which adds the capability of programming applications more complex than those requiring only relay, timing, and counting functions. Detailed information on programming the Series Six can be found in GEK-25362, PROGRAMMING MANUAL FOR SERIES SIX PROGRAMMABLE CONTROLLERS.

BASIC SYSTEM DESCRIPTION

The Series Six consists of 3 models which are the Model 60, Model 600 and Model 6000. The same Input/Output (I/O) system and Program Development Terminal are used by all 3 of the Series Six models.

The basic components of the Series Six are as follows:

1. Program Development Terminal (PDT)- Allows user programs to be entered into the system. May be used on-line or off-line.

2. Central Processing Unit (CPU) - Stores user programs and interfaces to input/output modules for solving logic and performing desired functions. Contains various control modules.

3. Input/Output modules (I/O) - Converts user signals to low-level voltages for processing by CPU and converts CPU signals to proper level for control of user devices. Also provides optical isolation from electrical noise.

4. I/O Devices - User-provided devices such as switches, pushbuttons, relays, motor starters, solenoids, etc.

By virtue of the family concept a number of common modules may be interchanged among the models. The models differ with respect to memory size, register capacity, I/O capacity, and options available. An important advantage of the family concept is that the spare parts inventory, training requirements, and documentation needs for large multiple model installations are held to a minimum. Figure 2 is the Series Six Model 60, Model 600, Model 6000 and the Program Development Terminal.

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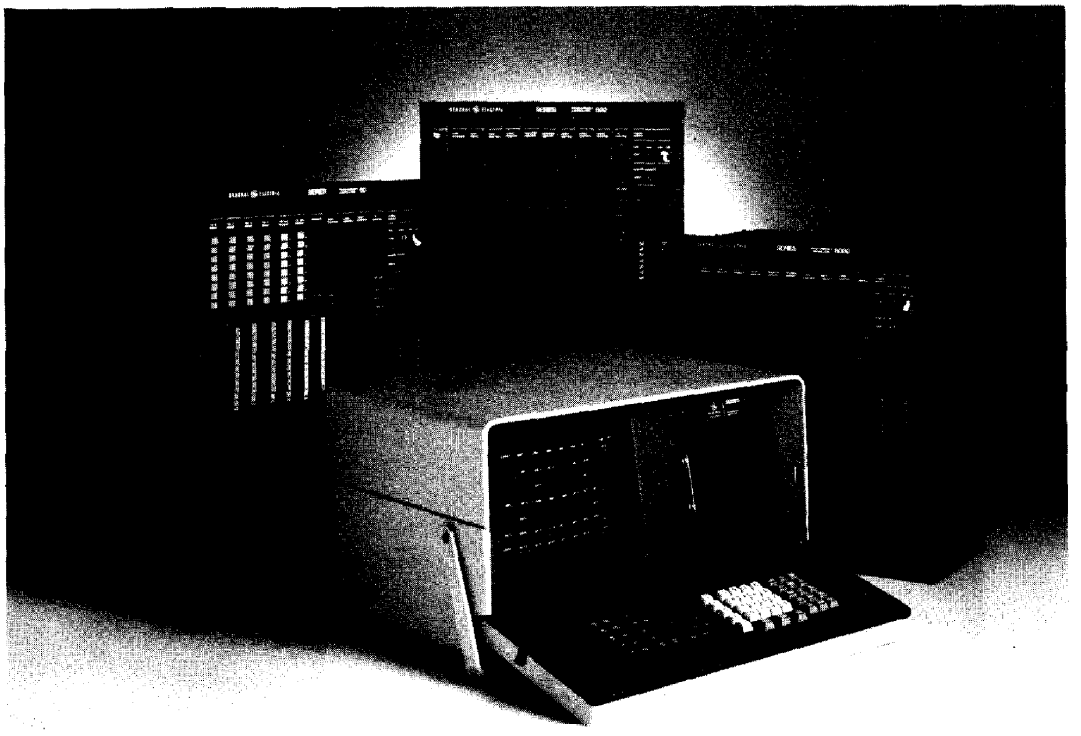


Figure 2.
SERIES SIX FAMILY

MEMORY SIZE

User program (Logic) memory can store up to 32,768 sixteen-bit words. Logic Memory consists of CMOS RAM (Random Access Memory) backed up by a Lithium-Manganese Dioxide battery. In addition to the Logic Memory modules the Model 600 and 6000 have a Register Memory module, which contains 1024 sixteen-bit registers, and an Internal Memory module. The Model 60 has a combined memory module which includes logic memory (either 2K or 4K sixteen-bit words), register memory consisting of either 256 or 1024 sixteen-bit registers and internal memory circuits.

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MODELS

Model 6000 is the top of the line and has the greatest capacity for control, processing functions and options available. This is followed in order of capacity by the Models 600 and 60. The Models 60 and 600 are upward compatible which means that any Model 60 program can run on the Model 600 or 6000 and any Model 600 program can run on the Model 6000.

OPTIONAL DEVICES

Optional devices are available for use with all 3 Models of the Series Six. These optional devices are the Data Processor Unit, and a Portable tape loader.

The Series Six Data Processor is a microprocessor-based unit designed to perform functions which are too time consuming or require too much memory for the CPU to perform efficiently. For a detailed description of the Data Processor, see Section 3.

PORTABLE TAPE UNIT

A Portable Tape Unit is available which is interfaced to the CPU through the Communication Control module. This is a portable unit which allows fast loading of programs into the CPU. The tape unit operates at a selectable baud rate and allows a 32K x 16-bit program to be loaded in less than three minutes. The Portable Tape Unit is highly reliable and is compatible with the tape unit in the Program Development Terminal.

COMPARISON

A comparison of the functions and features available for the Series Six is shown in Table I. The functions and features will be explained in detail in later paragraphs or sections of this manual.

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Features	Model 6000	Model 600	Model 60
Program Memory Type	CMOS-RAM with Battery Backup	CMOS-RAM with Battery Backup	CMOS-RAM with Battery Backup
Maximum Program Memory Size (16-Bit Words)	32K	8K	4K
Register Storage (16-Bit Words)	1024	1024	256 (2K Model) 1024 (4K Model)
Interrupts	Yes*	Yes*	Yes”
Data Processor: Integrated 16-Bit Microcomputer (Internally interfaced to programmable controller CPU)	Yes*	Yes*	Yes”
Networking: Multiple CPU Communication (High Speed, Serial)	Yes”	Yes*	Yes*
Maximum I/O Address Capacity	4000	2000	5 12 (2K Model) 2000 (4K Model)
Remote I/O: Parallel 2000 feet, Serial 10,000 feet, greater with modems.	Yes	Yes	Yes
Functions:	Relay Contact Logic Timing (01, .I, 1 .O second increment) Counting (up and down) Latch 16-Bit Logic Operations Bit Manipulation Multi-bit shifting 4-Function Arithmetic Indexing Circular List Handling MCR/SKIP function 3-Mode (PID) Control Message Generation (Reports) Data-Base Handling Analog I/O High Speed Positioning Control		
Peripheral Devices	Program Development Terminal, Tape Unit		

*Optional

Table 1.
SERIES SIX FEATURES AND FUNCTIONS

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PHYSICAL DESCRIPTION

Table 2 lists the general physical and electrical characteristics of the Series Six.

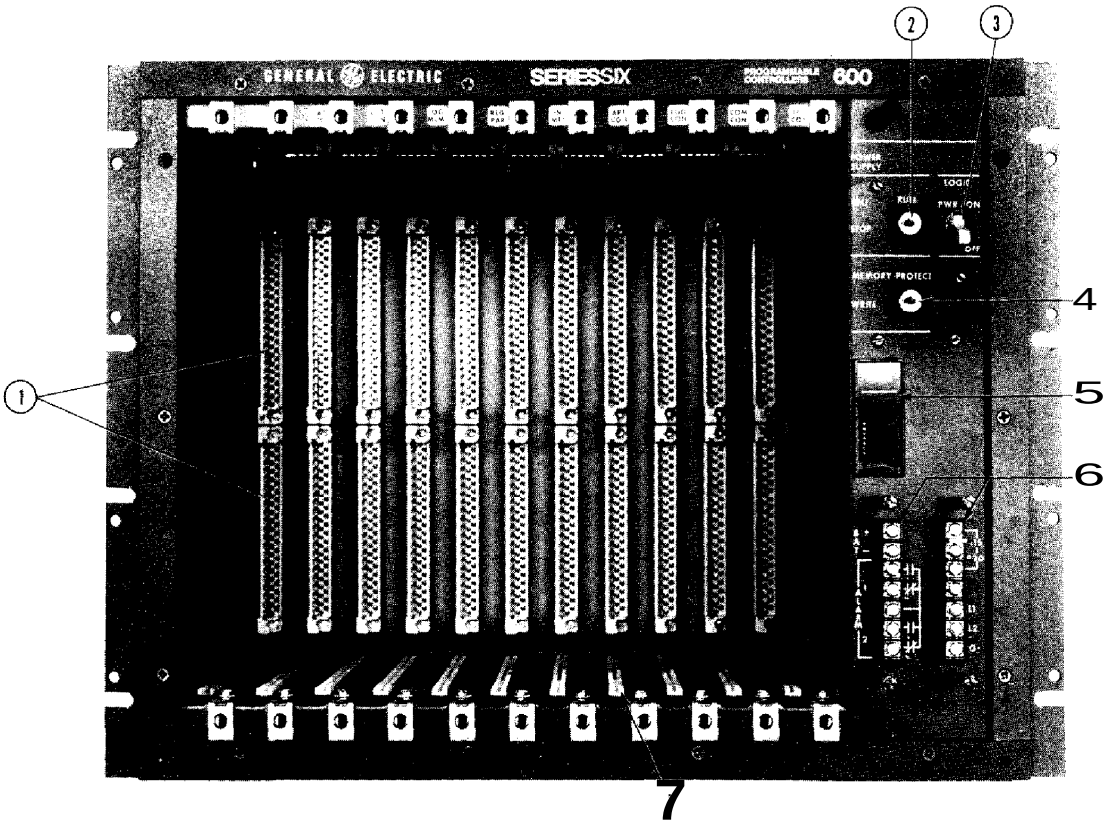
Physical and Electrical Characteristics	
Operating Temperature:	0-60°C (32-140 deg F at outside of rack
Humidity:	5-95% (Non-condensing)
Required Power:	115VACor230VAC +/-15%
	47-63Hz
	Maximum 250 Volt-amps
Dimensions (Outside Measurement):	
Rack Mount:	19.0 x 14 x 10.3 (inches) 483 x 356 x 261 (millimeters)
Panel Mount:	20.0 x 14 x 10.3 (inches) 508 x 356 x 261 (millimeters)
Weights:	CPU rack 45 lbs. (21 kg) with all slots filled
	I/O rack 45 lbs. (21 kg) with all slots filled
	Program Development Terminal 57 lbs. (25 kg)

Table 2.
PHYSICAL AND ELECTRICAL CHARACTERISTICS

Enclosure

All Models of the Series Six family are mounted in the same size enclosure (rack). See Figure 3. This universal rack provides a professional appearance and eases some of the problems associated with installation; specifically, the need for multiple mounting schemes because of various sizes of enclosure. The rack is a standard 19 inch (483 millimeters) rack or panel mount enclosure.

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1. 41-Pin Backplane Connectors, Two per Slot
2. CPU RUN/STOP Keyswitch
3. Logic Power Switch/Circuit Breaker
4. Memory Protect Keyswitch
5. DC Power OK Indicator
6. Terminal Block - AC Input Connections, Alarm Connections and External Memory Back-up Battery
7. Cardguide - One per Slot

Figure 3.
UNIVERSAL RACK FOR SERIES SIX CPU AND DPU

The area available in the rack allows for vertical mounting of 11 modules and a power supply. The modules slide into the enclosure on cardguides and require an insertion force of 25 Ibs. (1 1.3 kg) for I/O modules and 50 Ibs. (22.7 kg) for CPU modules. A card extraction/insertion tool is included with each system as an aid for insertion and extraction of modules.

MODULES

Each module consists of 2 parts: the faceplate and the logic board. All printed-circuit boards are mounted vertically in the rack with 11 card or module slots available plus a slot for the power supply. After each module is inserted into its slot the faceplate is secured to the enclosure by 2 quarter-turn thumb screws, one at the top and one at the bottom of the faceplate. The faceplate for each of the I/O, CPU or Communications Interface modules is 12.46 inches high x 1.175 inches wide (316.5 x 29.85 millimeters). The faceplate on the power supply module is 12.46 inches high x 2.67 inches wide (316.5 x 67.8 millimeters). See Figure 4. The cover is engraved with the module name as an identifier. Most of the CPU modules have a plastic cover centered on the module with legends for indicator LED's (Light Emitting Diodes). The LED's indicate the state of various status or error conditions in the system.

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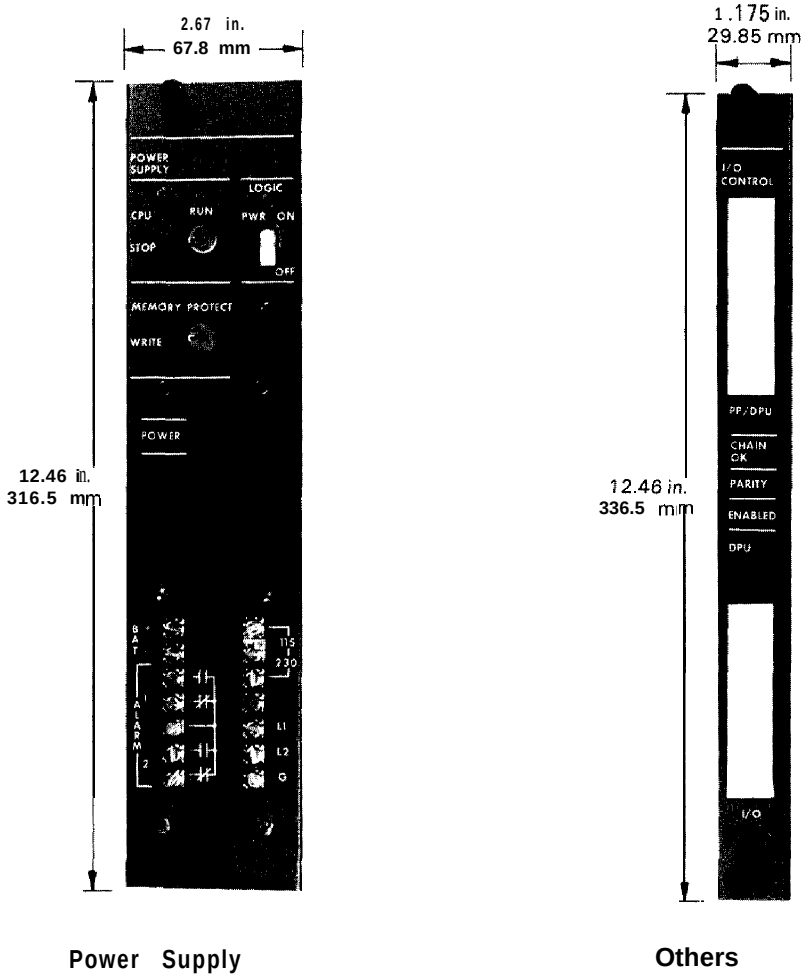


Figure 4.
SERIES SIX FACEPLATES

BACKPLANE

The CPU and DPU rack backplane consists of two 41-pin connectors for each slot that are connected by wire-wrapping. Common signals connected between each connector of the backplane form a bus.

I/O STRUCTURE

The I/O structure allows flexibility to the user in that I/O modules can easily be interchanged between I/O Racks. Available modules are listed in Table 3.

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INPUT MODULES	OUTPUT MODULES
8-Circuit Modules 12V AC/DC 24-48V AC/DC 115V AC/DC 230V AC/DC	8-Circuit Modules (2 amps) 12V DC Sink or Source 24V DC Sink or Source 48V DC Sink or Source 115VAC 230V AC
32-Circuit Modules 5V TTL 10-50V DC	32-Circuit Modules (1/4 amp) 5V TTL 10-50 V DC
8-Circuit Analog Modules (12 bit A/D conversion) 0-10VDC 4 to 20 mA/1 to 5V DC -IOto+IOVDC	4-Circuit Analog Modules (12 bit D/A conversion) 0-10V DC 4-20 mA -10 to +IOV DC
8 Interrupt Circuits	6-Circuit Module (2 amps) Reed Relay
8-Circuit Thermocouple Type J Type K Type S Type T	6-Circuit Module (3 amps) Isolated 115V AC Isolated 230V AC
SYSTEM INTERFACE MODULES	
Local Interface I/O Receiver I/O Transmitter	Remote Interface Remote I/O Receiver Remote I/O Driver

Table 3.
I/O MODULES

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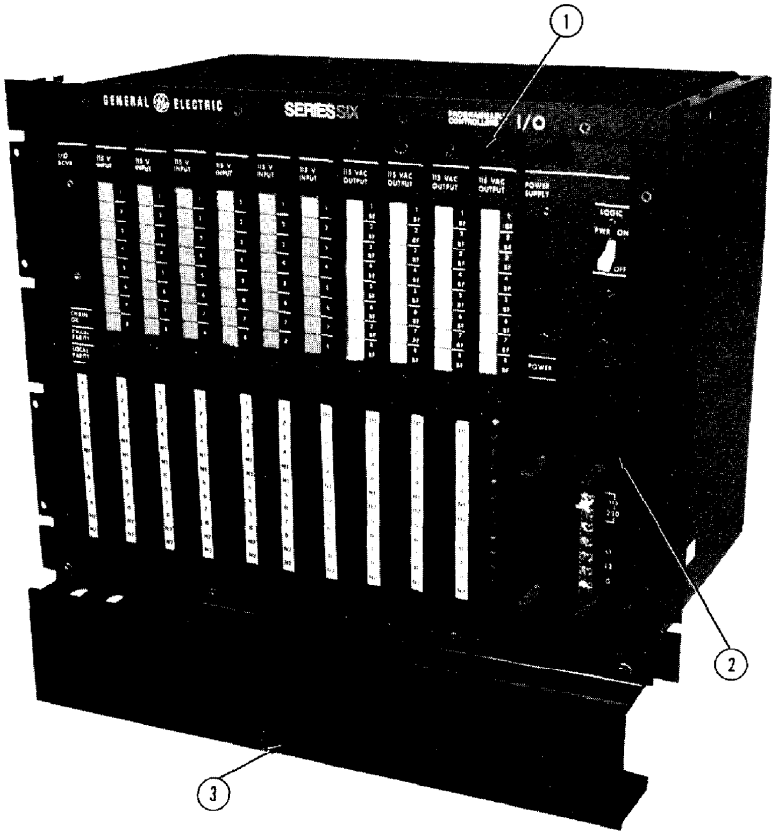
An I/O rack can be located up to 2000 feet (with no more than 500 feet between links) from the CPU when using I/O communications originating at a parallel I/O transmitter (IOT). Using a serial communication channel an I/O rack can be located up to 10,000 feet from a Remote I/O Driver. (Greater distances when using an RS-232 modem link).

A more detailed explanation of the I/O structure is provided in Section 5, Input/Output System

I/O Rack

The I/O rack is the same as the CPU rack in physical size and structure. See page 1-6 for details. One 41 pin connector is provided for each slot.

Wiring from input or output devices is made by connection to box lug terminals located on the Faceplate of each I/O module. At the bottom of each I/O rack is a wire trough or tray for running field wiring to and from the I/O connectors. Indicators are provided on each I/O module for status indication. Figure 5 illustrates a typical I/O rack showing location of indicators and the wiring tray.



1. I/O Module Slots 11 Per Rack
2. I/O Power Supply (Standard Model)
3. Wiring Tray

Figure 5.
INPUT/OUTPUT RACK WITH WIRING TRAY

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PROGRAMMING

The Series Six uses the familiar ladder diagram approach. The instruction set contains the commonly used functions such as open and closed contacts, relay coils, timers, counters, latches, and one-shots. Additional instruction capability is provided in mnemonic form.

The user's ladder diagram program is stored in the logic memory of the CPU. Instructions in the program may reference the status table, or register memory.

The status table is composed of the input and output tables. In mnemonic instructions that reference the status table, such as Ri/O (Move Register to I/O table), the desired table (input or output) must be specified.

A basic or extended instruction set is offered for programming the Series Six CPU's, For detailed programming information, refer to the Series Six Programming Manual, GEK-25362.

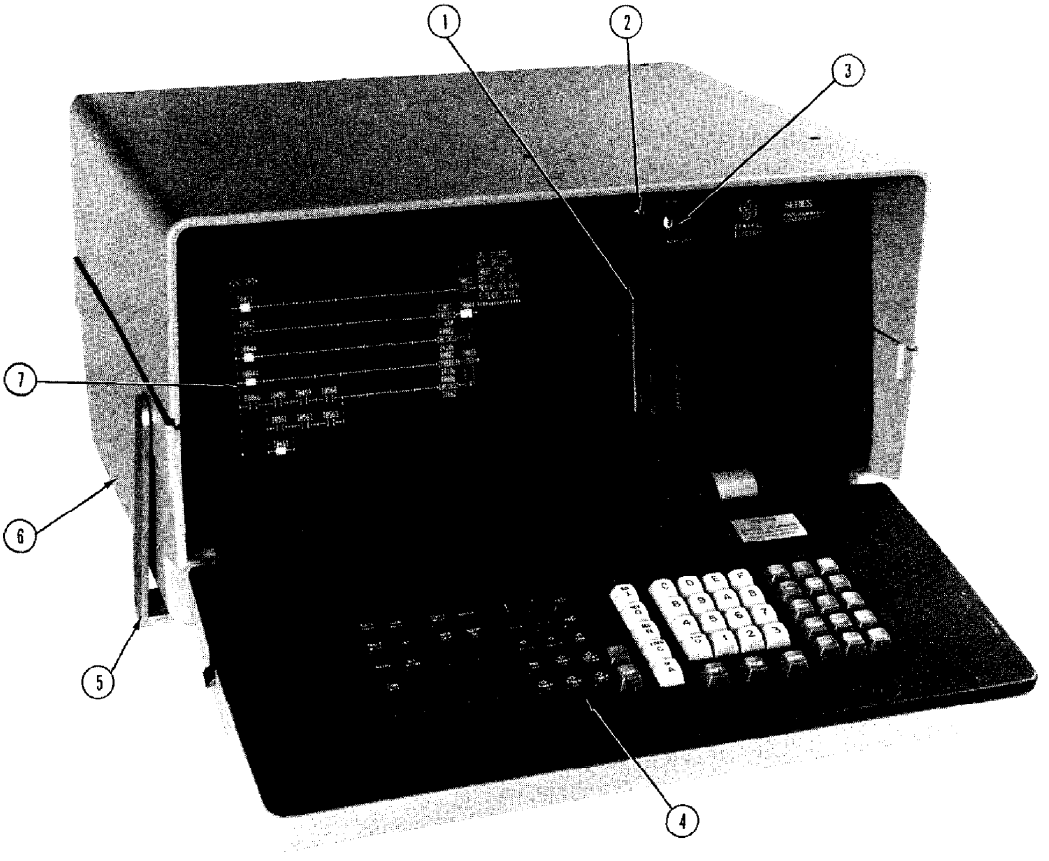
PROGRAM DEVELOPMENT TERMINAL

The Program Development Terminal (PDT) used with the Series Six family of programmable controllers is a transportable microprocessor-based CRT terminal. The terminal gives the user the ability to create, edit, and store ladder diagrams. See Figure 6.

Programs can be created and entered directly into the CPU or they can be created and stored on tape without the necessity of having the PDT connected to the CPU. With the PDT connected to the CPU, the user can load programs, monitor program operation, start and stop the CPU, and control operation of the system.

A convenient feature of the Series Six Program Development Terminal is that it may be plugged into an I/O rack that is distant from the CPU, thereby allowing the user to be near the device being controlled.

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1. Tape Unit (Optional)
2. Power Switch
3. Keyswitch
4. Keyboard
5. Handle
6. Foam Enclosure
7. CRT Display

Figure 6.
PROGRAM DEVELOPMENT TERMINAL

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SECTION 2
Hardware Description of the Central Processing Unit

This section contains a hardware description of the Central Processing Unit for the Series Six programmable controllers.

Since the CPU for the Model 6000 and 600 are functionally identical, the description of the CPU given for the 6000 applies with some exceptions to the 600. These exceptions are described under "Model 600 CPU", page l-35. The differences in the Model 60 are described on page 1-37.

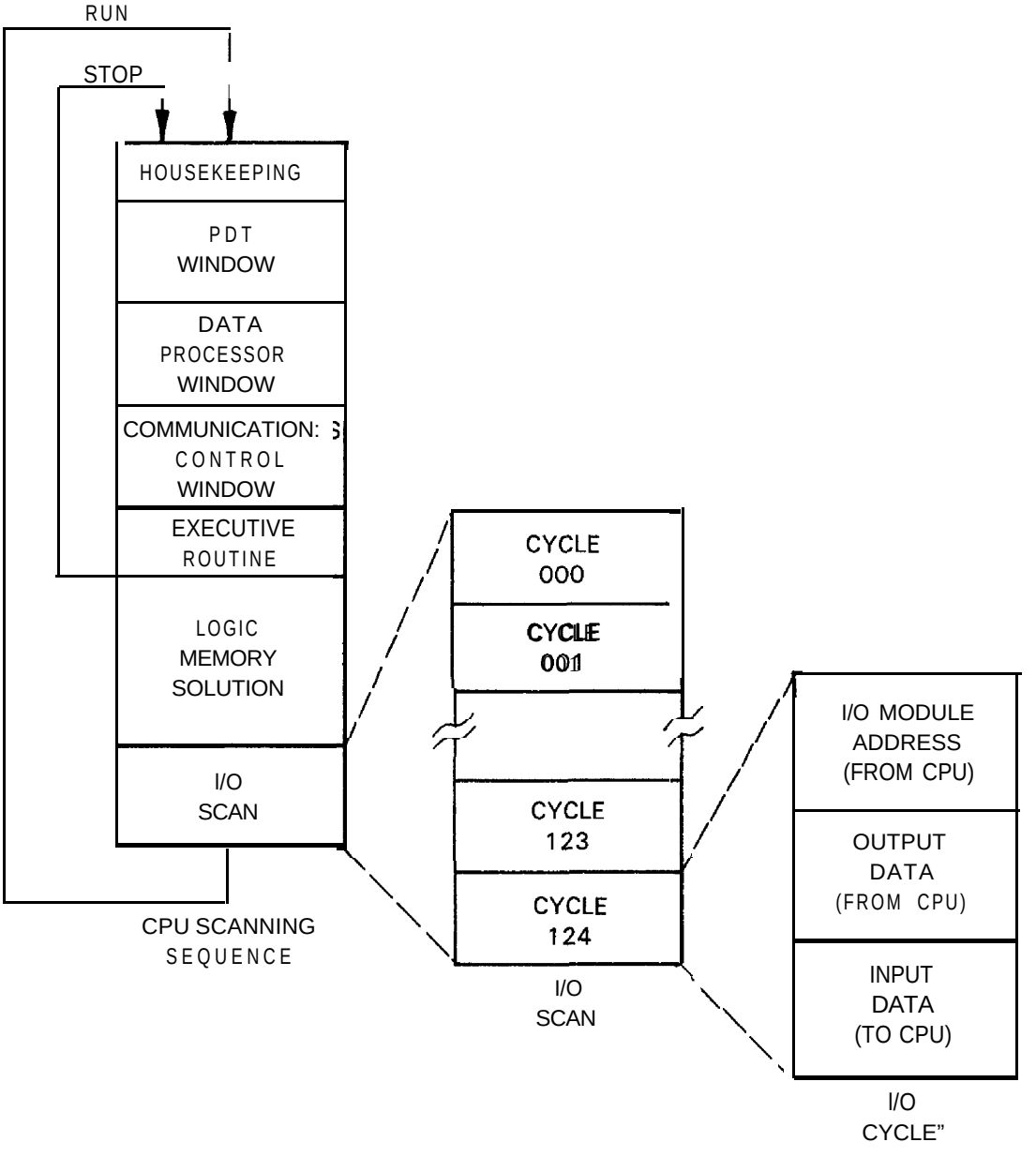
The primary purpose of the CPU is to perform all logic solving and decision making operations as defined by the user's program that has been entered into the programmable controller. In addition the CPU contains various memory circuitry for storing the user's program, for storing various tables necessary for bit status and data manipulation, and for storing the firmware (program instructions) that tells the programmable controller how to perform its operations.

The Series Six Programmable Controller performs its function by continually scanning the various logic circuits in the CPU. Scanning is a technique whereby various logic bits are checked for their current state and certain decisions are made based on those states. Lines of logic are examined and solved one at a time in numerical sequence (from the first to the last). The scan time is variable dependent on the program.

The scan determines what the states of the I/O's should be by examining the user's program. The CPU then drives the appropriate outputs as determined by the program. Figure 7 illustrates the sequence of the scanning technique used by the Series Six, detailing the I/O scan.

Each Model of the Series Six CPU is mounted in a universal rack which is a standard 19 inch rack or panel mount that is described on page l-6.

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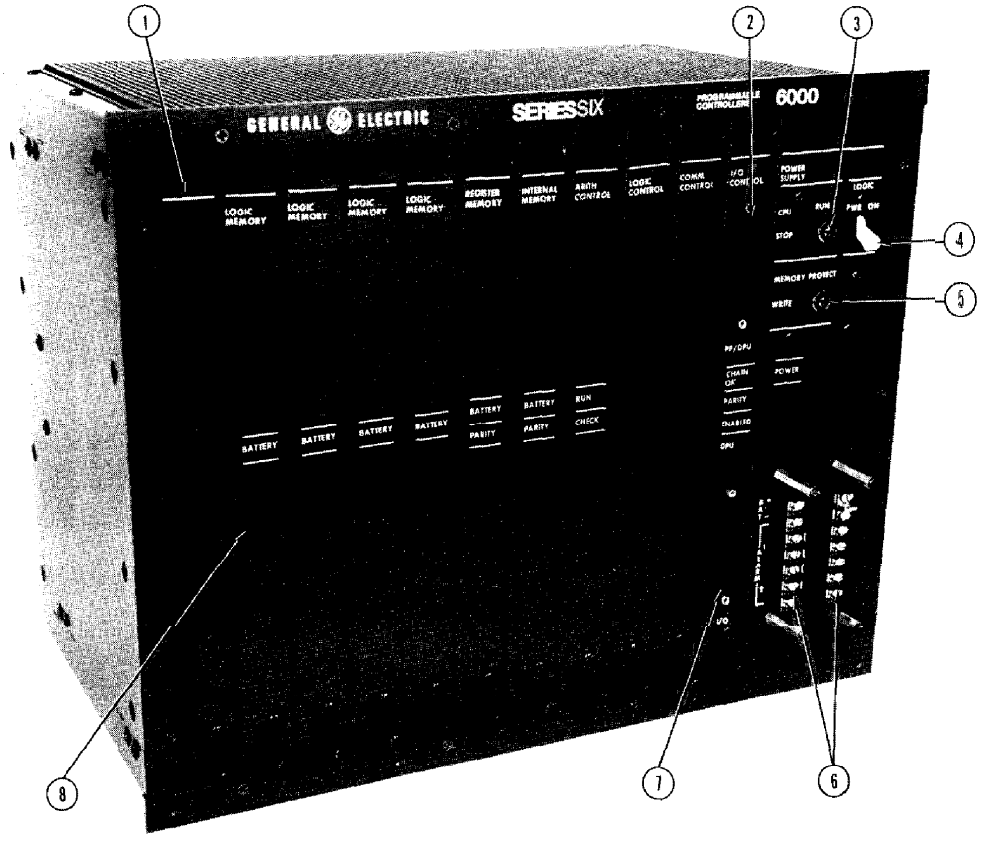
*The I/O cycle occurs 125 times during each I/O scan, once for each of the 125 possible I/O addresses. Each address references 8 inputs and 8 outputs.

Figure 7.
SCAN SEQUENCE

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MODEL 6000 CPU

The Model 6000 is the most powerful CPU in the Series Six family. A user program containing as many as 32,768 (32K) sixteen-bit words can be stored in the logic memory of the Model 6000. A photograph of the Model 6000 CPU is shown in Figure 8. Module locations are indicated along with associated hardware.



1. Auxiliary I/O Option If Selected
2. Program Development Terminal or Data Processor Connector
3. CPU Run/Stop Keyswitch
4. Logic Power Switch/Circuit Breaker
5. Memory Protect/Write Switch
6. Terminal Strips
   - Auxiliary External Battery Connection
   - Alarm No. 1
   - Alarm No. 2
   - AC Power Connection
7. Connector to Main I/O Chain
8. LED Status Indicators

Figure 8.
MODEL 6000 CPU

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Options for Model 6000 CPU

The optional Auxiliary I/O module which interfaces the CPU to the Series Six Auxiliary I/O System allows an additional 1000 inputs and 1000 outputs. Another option offered with the Model 6000 is the Data Processor. The Data Processor is a microprocessor-based unit capable of performing functions which are too time consuming or require too much memory for the CPU to perform efficiently.

CPU POWER SUPPLY

The Series Six CPU power supply is self-contained on one assembly.

AC power input is made through connection to a terminal board located on the front panel, 115 or 230V AC input voltage may be used as required.

Three voltages are provided: +5V DC, + 12V DC, and -12V DC. In addition, system control signals are generated by the power supply.

Input power is turned on or off with a circuit breaker located on the front panel. An LED provides visual indication that the power supply is turned on and all operating DC voltages are within tolerance.

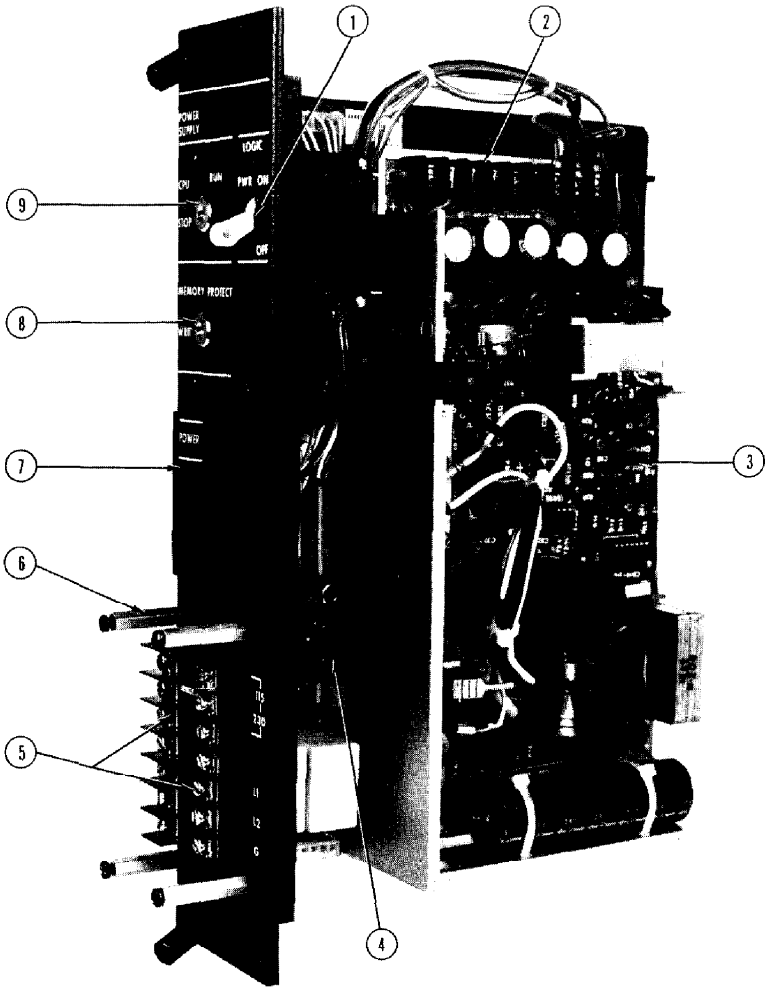
Terminal strips on the front panel also provide 2 sets of alarm contacts and connection for an external battery for use as an external backup for CMOS RAM memory.

Two key switches are on the front panel, a CPU Run/Stop switch and a Memory Protect switch.

The terminal strips have a cover supplied as a safety precaution.

Figure 9 is the Series Six CPU power supply with a view of the front panel and the electronics.

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1. Logic Power Switch/Circuit Breaker
2. Terminal Block, Connections to Rack Backplane
3. Power Supply Board
4. Auxiliary Circuit Board
5. Terminal Block (AC Input, Alarm Contacts, Auxiliary Battery)
6. Standoffs (4) for Terminal Block Covers
7. DC Power OK Indicator
8. Memory Protect/Write Keyswitch
9. CPU RUN/STOP Switch

Figure 9.
SERIES SIX CPU POWER SUPPLY

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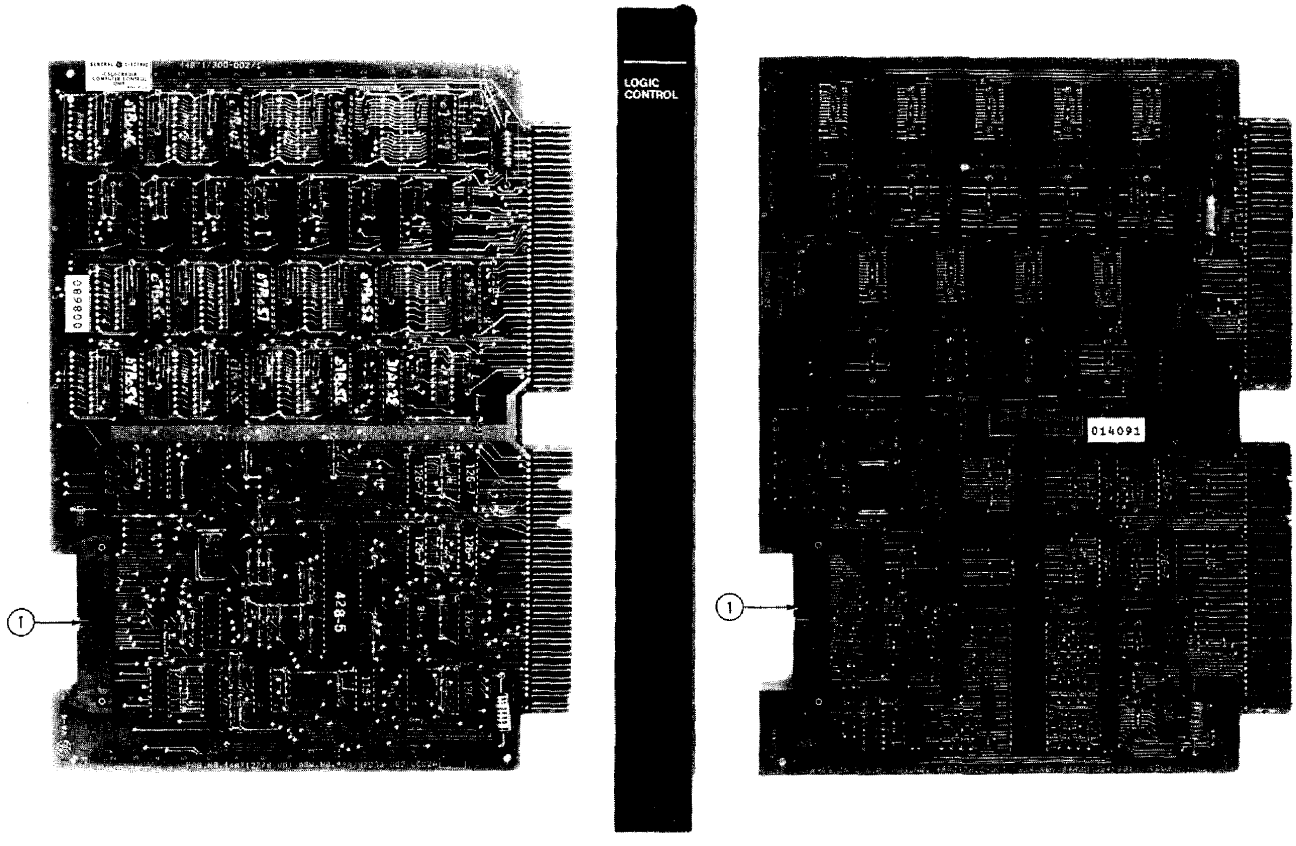
LOGIC CONTROL

The Logic Control module contains circuitry for generation of signals, which provide control to all of the other CPU modules. The circuitry includes an Am2910 microprogram controller and 512 or 2048 words by eighty-eight bit PROMs for microprogram storage. Figure 10 is a view of the Logic Control module showing the faceplate and the Logic Control circuitry. Two versions of the Logic Control module are available, the difference being the program entered into them. One (Part Number IC600CB501A) is programmed for the Basic Functions, the other (Part Number IC600CB502A) is programmed for the Extended Functions. A connector on the bottom front edge of the module allows interfacing to the Arithmetic Control Module. The ribbon cable connecting the two modules must be in place for proper system operation.

NOTE

Attempting to operate the system without the ribbon cable connected between an Arithmetic Control module and a Logic Control module will cause the CPU to operate unpredictably.

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BASIC

EXTENDED

1. Connector For interface To Arithmetic Control Module

Figure 10.
LOGIC CONTROL MODULE

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ARITHMETIC CONTROL

The Arithmetic Control (See Figure 11) module contains circuitry which performs arithmetic and logical operations on data and address lines. The time base for the timer functions in the CPU are derived from a 3.2 MHz clock on this module.

The Series Six CPU has 4 hardware registers located on the Arithmetic Control board. The continuity and buffer registers are each one bit wide. The accumulate and preset registers are sixteen bits wide. The registers are operated on internally by the CPU and are not accessible by the user.

The logic for performing these operations is a sixteen-bit Arithmetic Logic Unit. The ALU is made up of 4 Am2903 bit slice microprocessors.

The Am2903 is a 4-bit expandable bipolar microprocessor slice. The Am2903 is especially useful in arithmetic oriented processors, and in addition, provides a special set of instructions which eases the implementation of multiplication, division, and other time consuming operations.

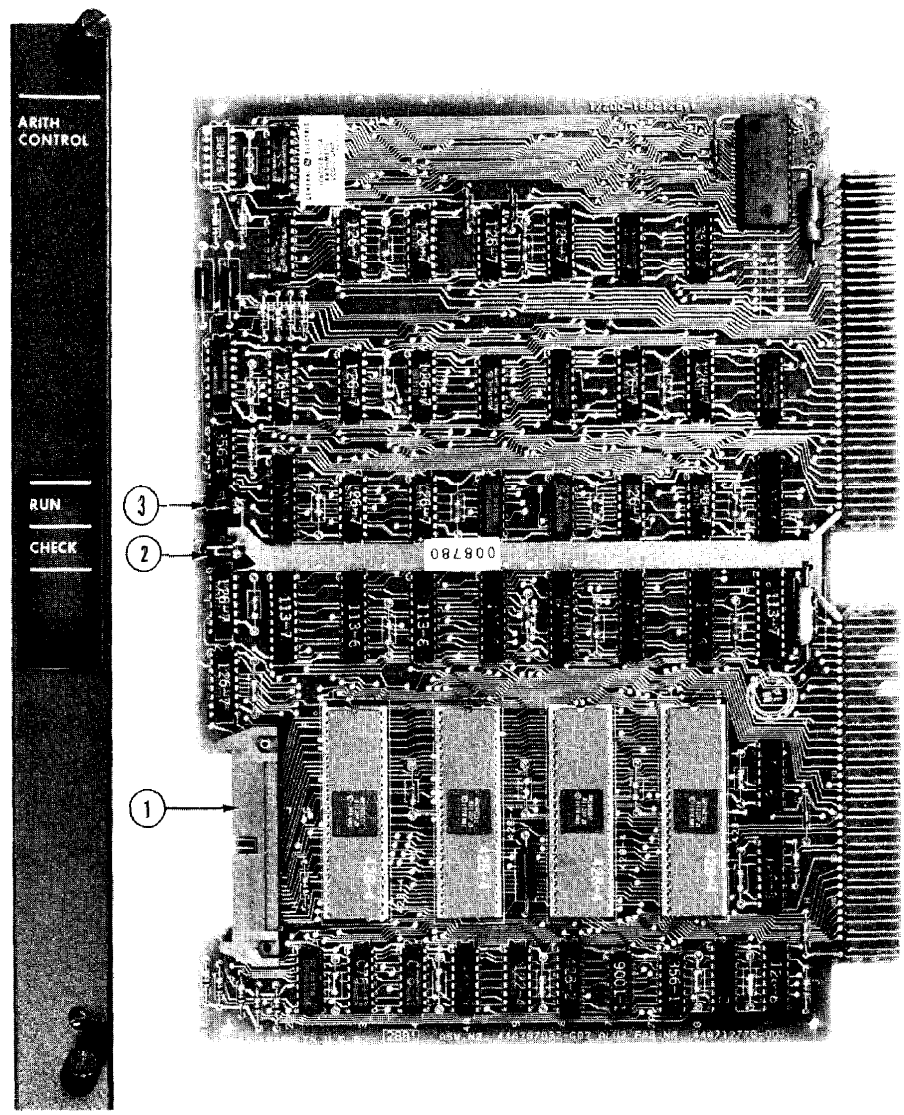
The faceplate has 2 LED indicators: Run and Check. The executive routine in the sweep execution sequence contains a self-test routine which is executed once per sweep. If several conditions are met (normal) the CHECK LED remains on. If the CPU fails the test, if the clock stops, or if anything interrupts the sweep for more than 200 milliseconds the LED goes out. The 200 milliseconds is generated by a retriggerable one-shot and is the watchdog timer for the Series Six.

The RUN light when on indicates that the CPU execution sequence is proceeding normally, the self-test has passed and the I/O scan is completed at least once every 200 milliseconds.

NOTE

The watchdog timer interval is 200 msec ± 50 msec.

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1. Connector for interfacing to Logic Control
2. CHECK Light
3. RUN Light

Figure 11.
ARITHMETIC CONTROL MODULE

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I/O CONTROL

The I/O Control module interfaces the CPU's bus to the main I/O bus which allows up to 1000 inputs and 1000 outputs.

Logic on the module which performs the interfacing includes command, status, port select, and data latches, a status multiplexer, and control and timing circuits.

This module also provides interrupt circuitry and control for the Auxiliary I/O module and the Communications Control module.

Two 37-pin connectors are accessible on the faceplate of the I/O Control module. The top connector is for connection to either the Program Development Terminal or the optional Data Processor Unit. The bottom connector interfaces the CPU to the primary I/O chain.

Four LED indicators are provided on the front panel of the I/O Control module. From top to bottom they are:

LED	DEFINITION
CHAIN OK	On when all I/O stations in the primary chain have normal continuity and have received good output parity.
PARITY	On when input data parity is okay.
ENABLED	On when the CPU is in the normal Run mode with outputs enabled.
DPU	On when the optional Data Processor Unit is connected and is operating.

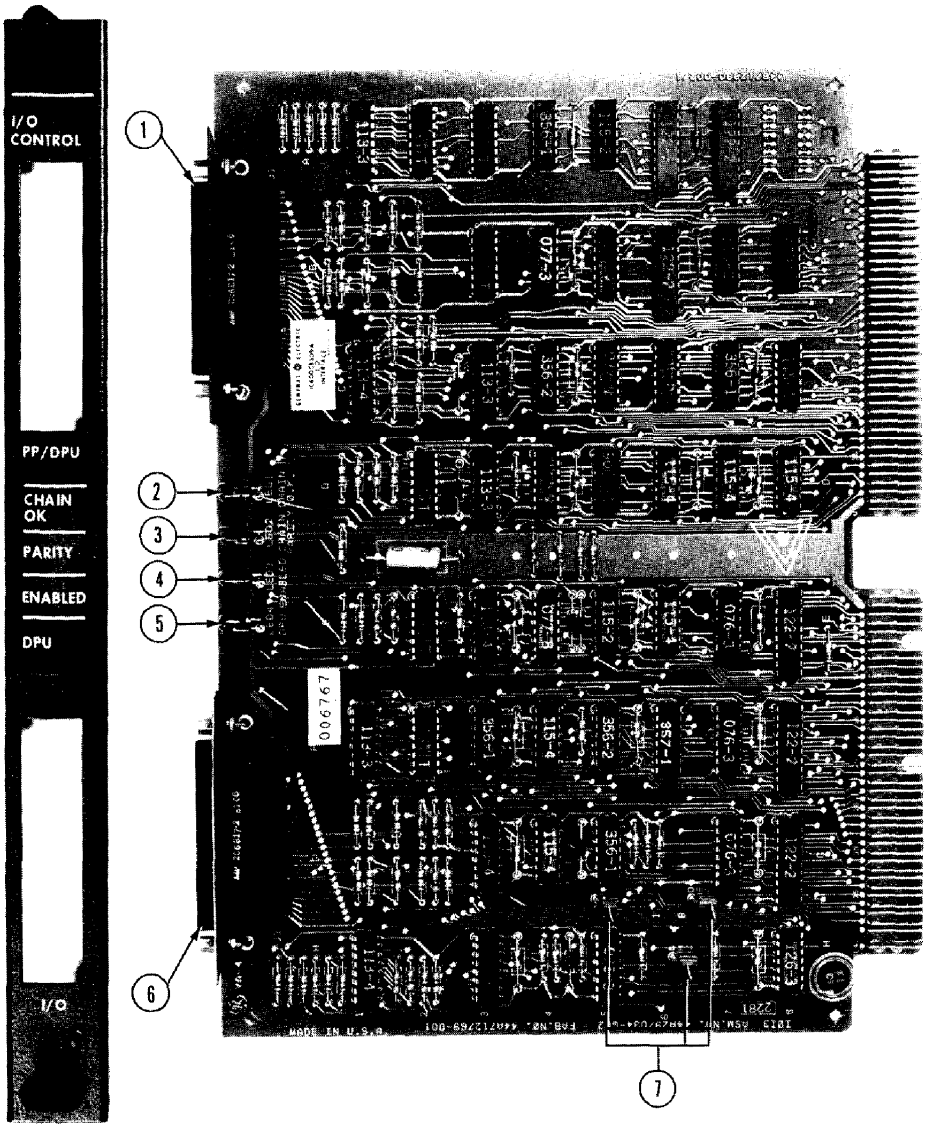
Figure 12 is the I/O Control module and its faceplate showing connectors and LED indicators.

NOTE

If an I/O chain is not connected to the I/O Control module a jumper plug (supplied with each CPU) should be connected to the lower connector to terminate the I/O chain signals.

Three jumpers are provided on the board to allow selection of board options. The 3 options are Data Processor Present, Data Processor Interrupt Enable, and Communications Control Interrupt Enable.

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1. Connector to PDT or DPU
2. CHAIN OK Light
3. PARITY Light
4. ENABLED Light
5. DPU Light
6. Connector to main I/O chain
7. Jumpers for selectable board options

Figure 12.
I/O CONTROL MODULE

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MEMORY

The type of memory as well as the internal memory, register memory, and logic memory modules are described below. Also described are memory protection, visual status of backup battery, memory addressing and memory allocations.

CMOS

CMOS-RAM is an integrated circuit memory that is desirable in that it uses very low power. CMOS-RAM memory is available in either 2K, 4K or 8K words of memory. Since CMOS-RAM memory is volatile (loses contents of memory with no power) a Lithium-Manganese Dioxide battery located on the memory module protects the memory contents when power fails or is turned off. This battery provides approximately six months of data protection. When power is applied to the CPU, an LED indicator lights if the battery condition is normal. The normal, fully-charged voltage of a Lithium battery is 2.95V @ 1.75 amp-hours. Lithium batteries are not rechargeable. The battery indicator LED provides 3 states. If the battery voltage is normal, the LED is on. If the battery voltage is low (between 2.55V and 2.75V), the LED flashes. The CPU will run if the battery voltage gets low. If the CPU stops, it can be restarted. If the battery voltage drops below 2.55V, the LED turns off. If the CPU is stopped it cannot be restarted.

INTERNAL MEMORY

The Internal Memory Module Logic is made up of various tables stored in CMOS-RAM with Lithium battery back-up. The RAM's are 256 x 8-bit words each.

The following tables are stored in the Internal Memory module.

TABLE	FUNCTION
Status	Stores bits which represent the status (ON or OFF) of all of the 1000 inputs and 1000 outputs available on the I/O main chain.
Override	The status of overridden input or output bits is stored here. An overridden bit in the status table will not be changed when the CPU reads inputs or solves outputs.
Transition	The logic state of the inputs to counters and one-shots is stored in this table.

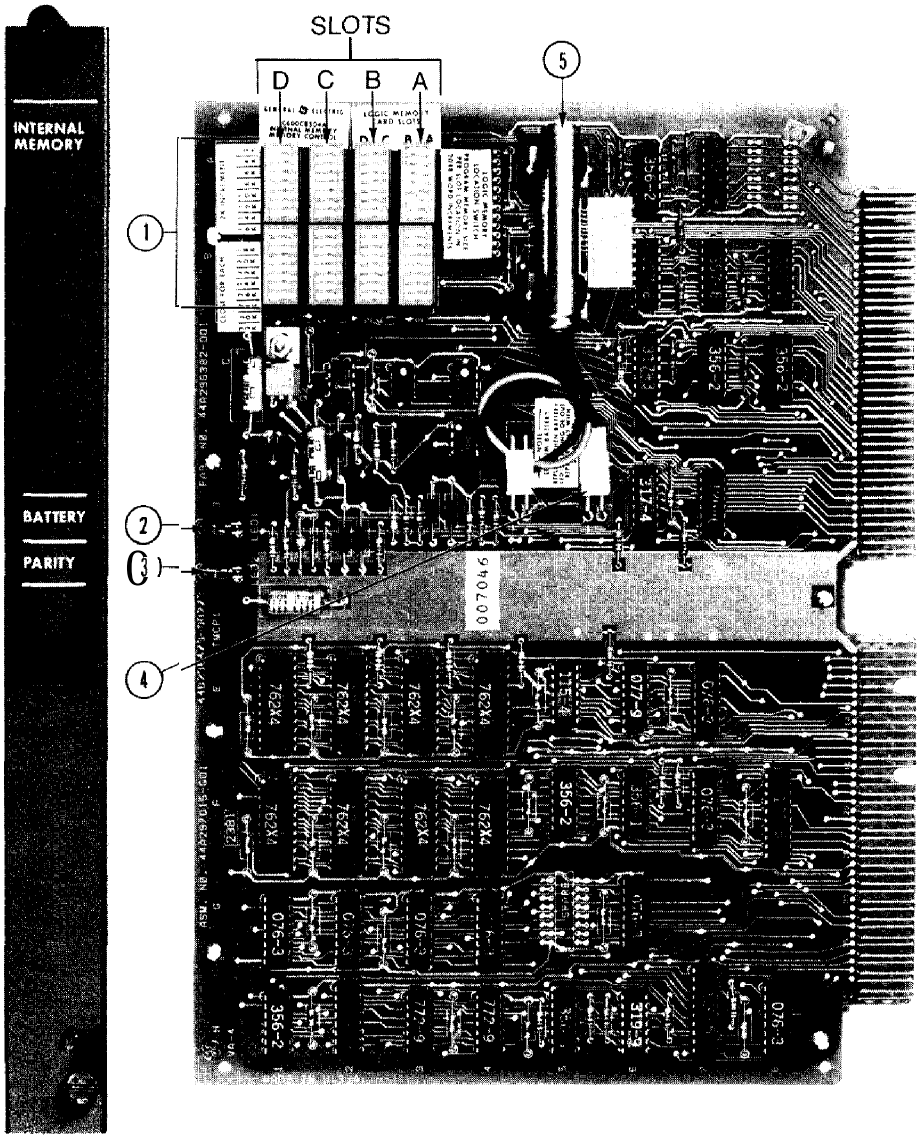
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In addition the Scratch Pad memory is stored in the Internal Memory module. The Scratch Pad contains miscellaneous data pertaining to CPU operation.

SCRATCH PAD ITEM	DEFINITION
CPU ID	Number assigned to the CPU if there is more than one CPU in a system.
MEMORY SIZE	Number of words of logic memory in the CPU.
CPU STATUS	Current operating status of the CPU, either run enabled, run disabled or stop.
INSTRUCTION SET	Selected instruction set, basic or extended. Also shows version of software in the PDT and CPU.
REGISTER MEMORY	Number of words of register memory in the CPU, either 256 or 1024.
WORDS USED	Number of words of memory in user program.
NUMBER OF SUBROUTINES	Number of subroutines used in the user program.
CPU FLAGS	Type of CPU error and location.

The Internal Memory module has 2 LED indicators viewed through the faceplate. One of the LED's (BATTERY) displays the status of the Lithium back-up battery for the CMOS-RAM memory. The other LED (PARITY) shows that Logic Memory parity errors exist. Figure 13 is a photograph of the Internal Memory module.

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1. Programming Switches For Memory Size/Slot Location
2. Battery Status Light
3. Parity Light
4. Battery Connectors
5. Lithium-Manganese Dioxide Battery

Figure 13.
INTERNAL MEMORY MODULE

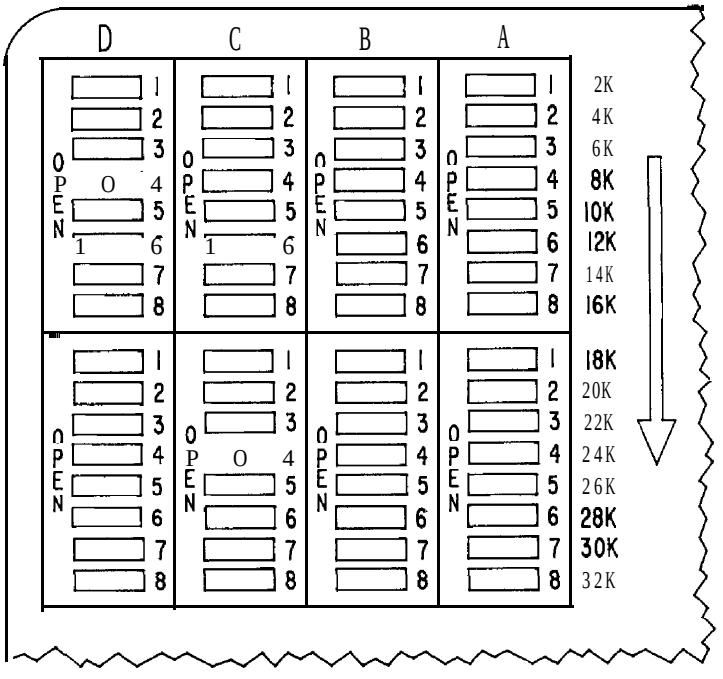
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Memory Addressing and Memory Map Allocation

The CPU must be told how much logic memory is to be used for proper addressing and memory map allocation. This function is performed by a group of 8 DIP (Dual-In-line-Package) switches located on the Internal Memory module.

There are 4 slots available for Logic Memory modules in a Model 6000. Each slot has 2 DIP switches (which correspond to these slots) located on this module. In the CPU, the slot to the left of the Register Memory is slot A, the next one is slot B, etc. (for the purpose of memory size addressing).

A switch is closed for each 2K of memory in each board slot. Each CPU must have the DIP switches set for the proper memory configuration. If memory is added to a system, the switches will have to be reconfigured to the proper settings. Chapter 2, Section 1 of the Installation and Maintenance Manual, GEK-25361A will further detail the switch settings.



LOGIC MEMORY SIZE/LOCATION DIP SWITCHES

WARNING

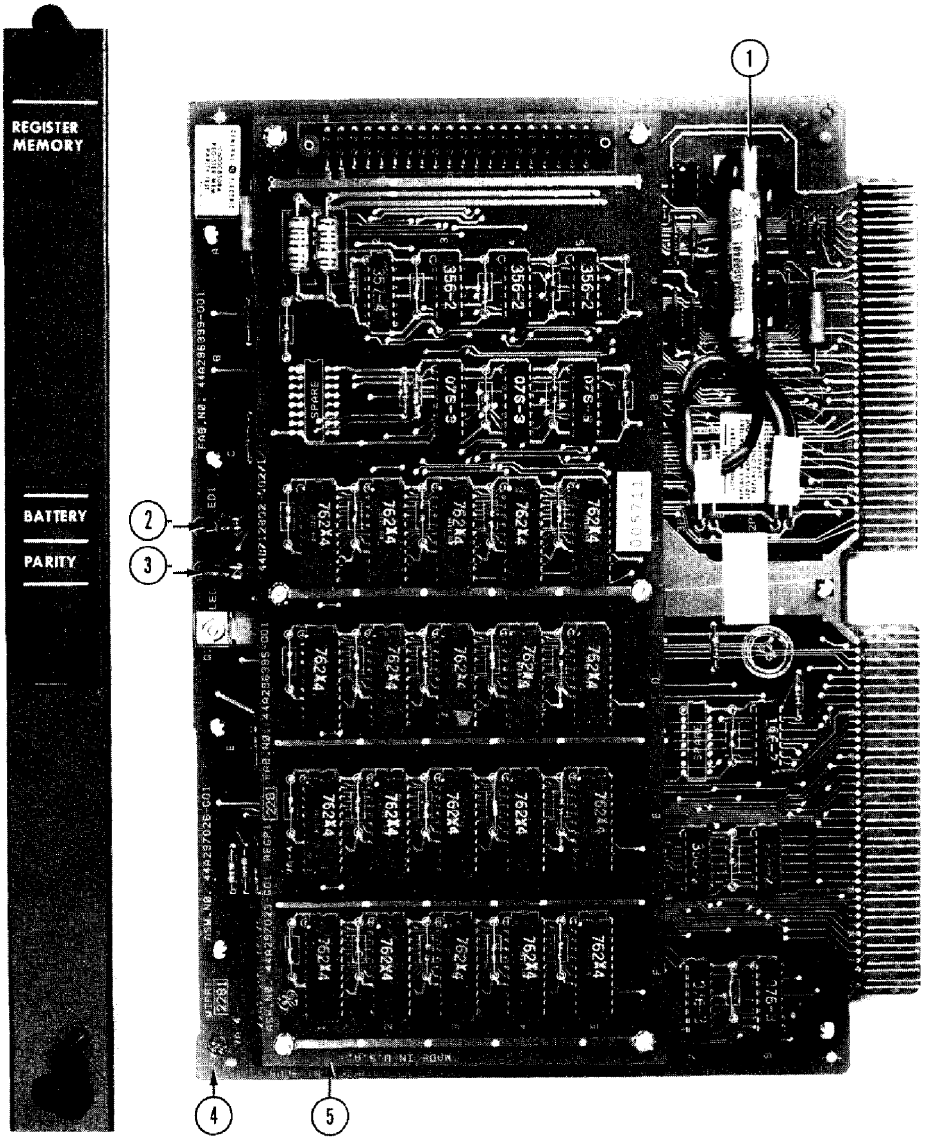
Do not change the settings of the programming switches on the Internal Memory module with a program already loaded into the logic memory system. Failure to observe this **WARNING** will cause the user program to run out of sequence and could result in damage to plant equipment and/or injury to personnel.

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REGISTER MEMORY

The Register Memory module is comprised of a Mother board which contains memory parity generation and checking functions and a Daughter board that contains 1024 sixteen-bit registers (storage locations) in CMOS-RAM with Lithium battery back-up. The registers are used for bit manipulation by certain mnemonic functions. The lower 128 words of the Register Memory are used as a storage location for the Auxiliary I/O status table. Data bus transfer logic is also generated on this board.

The Register Memory module has 2 LED indicators which are viewed through the lens on the faceplate. One of the LED's is the status indicator (BATTERY) for the Lithium back-up battery. The other LED (PARITY) indicates a table or register memory parity error. If a table memory parity error is detected, a bit is set in an error register and the LED goes out. Figure 14 is a photograph of the Register Memory module showing its circuitry and the faceplate.



I. Lithium Manganese Dioxide Battery
2. Battery Status Light
3. Parity Light
4. Mother Board
5. Daughter Board

Figure 14.
REGISTER MEMORY MODULE

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LOGIC MEMORY

The Logic Memory module (Figure 17) contains the CMOS-RAM semiconductor devices used to store the user ladder diagram program. This memory is available in modules containing either 2K, 4K or 8K words. The basic word is 2 bytes (16 bits) plus 2 parity bits (1 parity bit for each byte). The basic word is illustrated below in Figure 15. Parity error detection is standard in the Series Six. Parity is used to check the validity of the data contained in each word. Parity check is performed automatically by the CPU. Note that parity error detection is not standard in the Model 60.

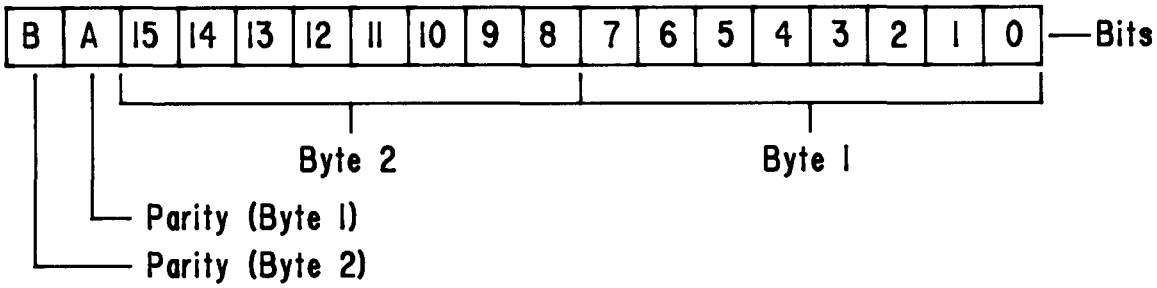


Figure 15.
BASIC WORD STRUCTURE

CMOS-RAM memory modules require a Lithium-Manganese back-up battery installed on each module for retention of memory under power down conditions since this type of memory is volatile.

The Model 6000 CPU must have at least one memory module and can have a maximum of four modules. This allows a memory capacity of 2K to 32K words in 2K increments. It should be noted that it is physically impossible to have 30K of memory. The 4 slots to the left of the Register Memory module are reserved for installation of Logic Memory modules. These 4 slots are referenced A, B, C and D for ease of explanation. See Figure 16. It is recommended that the 4 slots are filled from right to left, beginning with slot A.

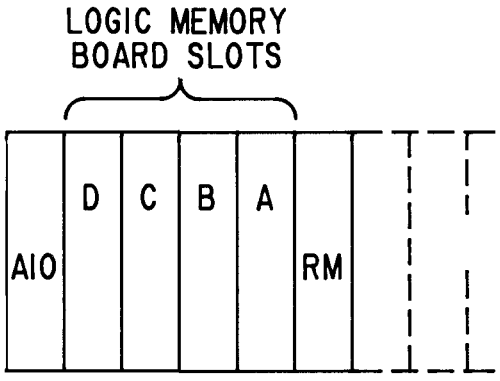


Figure 16.
MODEL 6000 LOGIC MEMORY SLOT REFERENCE

When installing or removing a memory module it is recommended that you use the extraction/insertion tool to install or remove the module. This tool is furnished with each Series Six CPU.

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CAUTION

Relatively small amounts of excess charge can cause very intense electrostatic fields in metal-oxide-semiconductor (MOS) devices, damaging their gate structure. When the board covers are removed, avoid handling the circuit board under conditions favoring the build-up of static electricity. Failure to observe this **CAUTION** could result in the destruction of the CMOS-RAM devices in this module.

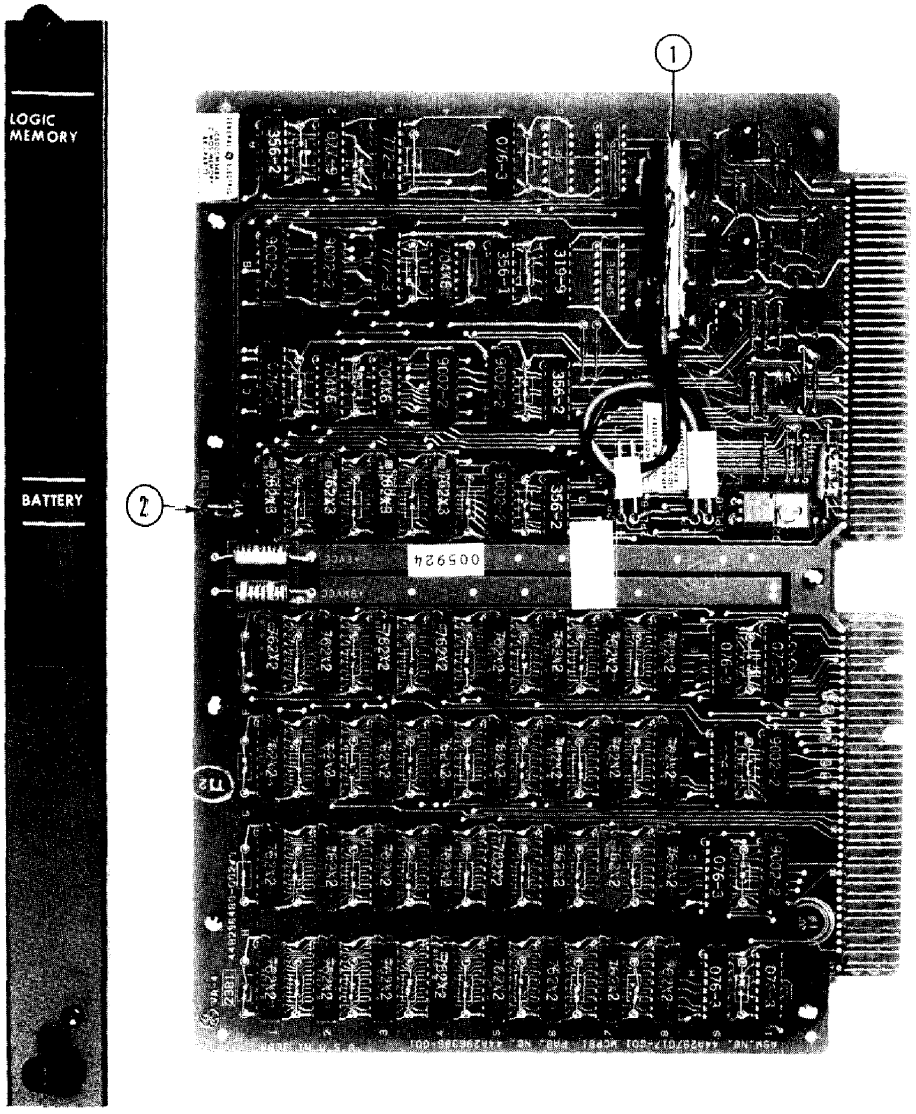
With the board covers in place, it is unlikely that normal handling of this module will cause any damage.

The board covers provided with each Logic Memory module are a non-conductive material. These boards are provided for protection of the CMOS-RAM devices.

CAUTION

Do not allow the bottom of the module to come into contact with a conductive (metal} surface when the board covers are removed. Failure to observe this **CAUTION** could result in the discharge of the non-rechargeable Lithium battery and the loss of memory contents.

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1. Lithium Manganese Dioxide Battery
2. Battery Status Light

Figure 17.
LOGIC MEMORY (8K)

Memory Protection

A two-position key switch (located on the power supply) is provided for protecting logic and override memory that has been written into. The two positions are MEMORY PROTECT and WRITE. In the WRITE position, the user can write into memory, and programs can be entered or changed. In the MEMORY PROTECT position, memory cannot be written into, thereby protecting any user program that has been previously entered. Once a program has been entered it is advisable to switch the key to the MEMORY PROTECT position.

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Visual Status of Backup Battery

There is one LED indicator viewed through the faceplate window on each memory module. This indicator BATTERY is a visual status of the Lithium backup battery located on each module. Battery status is described below.

STATUS	DESCRIPTION
ON	Lithium battery is normal. Memory contents are saved on power loss.
FLASHING	Battery low: CPU continues running and will restart if stopped. The battery should be replaced before it fails.
OFF	Battery Failed (Voltage too low or no voltage). CPU continues running, will not restart if stopped. Memory contents will be lost if power is turned off or lost. Battery should be replaced.

AUXILIARY I/O

The Auxiliary 1/O (Figure 18) module contains circuitry for interfacing an Auxiliary I/O chain to the CPU bus in a Model 6000 CPU. This module allows a second I/O system with the same structural features as the primary I/O system to be connected to the CPU. The Auxiliary I/O system is functionally identical to the primary I/O system except that the Auxiliary inputs and outputs cannot be overridden. The Auxiliary I/O system allows an additional 1000 inputs and 1000 outputs, thereby allowing the Model 6000 a total of 4000 I/O points. The auxiliary I/O status tables are physically stored in registers 1 to 128. Registers 1 to 64 are the auxiliary output tables and registers 65 to 128 are the auxiliary input tables.

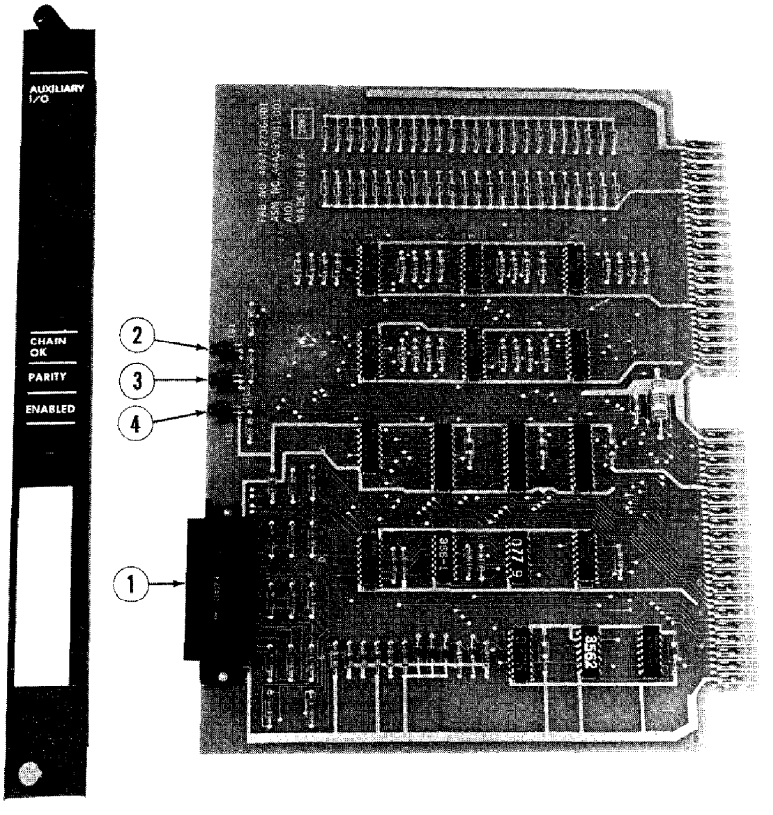
The Extended CPU instruction set must be present in order to access the Auxiliary chain I/O modules; The Auxiliary I/O module interfaces internally to the I/O Control module for control signals.

There is one 37-pin connector located on the bottom front edge of the Auxiliary I/O module. This connector provides a physical connection to the Auxiliary I/O chain.

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There are 3 LED indicators which are viewed through the window on the face- plate. The LED's and their functions are as shown below.

INDICATOR	DEFINITION
CHAIN OK	On when all I/O stations in the Auxiliary !/O chain have continuity and power and have received good output-data parity.
PARITY	On when good input data parity has been received from the Auxiliary I/O chain during the I/O scan.
ENABLED	On when outputs are enabled. The CPU is operating in the RUN ENABLED mode.



1. D-Type 37-Pin Connector to Auxiliary I/O Chain.
   Connects to l/O Receiver module in nearest I/O rack in auxiliary chain.
2. CHAIN OK Light
3. PARITY Light
4. ENABLED Light

Figure 18.
AUXILIARY I/O MODULE

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COMMUNICATIONS CONTROL

The Communications Control module, which is an option with any model of the Series Six provides a serial interface to the CPU. A Portable Tape Unit and a high speed data highway can communicate with the CPU through the Communications Control module. This interface allows an external intelligent device such as a computer to communicate with a Series Six Programmable Controller.

Two connectors are provided for connection to the module. The connectors are mounted at the bottom of the module. The upper connector is a 25-pin D-type and is configured to accept a device using either an RS-232, RS-422 or 20mA current loop interface. The baud rate of the low speed port is jumper selectable (See Chapter 2, Installation).

The lower connector is a 9-pin D-type and can accept a device using either an RS-232 or an RS-422 interface. The baud rate of the high speed port is the same speed as the low speed port.

There are 4 LED indicator lights which are viewed through the faceplate lens. The LED's and their functions are as listed in the following table.

INDICATOR	DESCRIPTION
BOARD OK	On - Board diagnostic has passed the self-check test and is operating properly. Flashing - Configuration jumper(s) in wrong position. Off - Indicates a hardware failure.
MATCH OK	On - (Tape Mode) Instruction set for tape data and CPU is compatible. A good compare has been made. Off - An attempt has been made to write to an illegal address in the CPU or tape does not compare to CPU contents. The data on tape has exceeded the capacity of the CPU memory or CPU and tape incompatibility because of instruction set differences.
DATA OK	On - (Serial Link) Message received correctly. Off - Data incorrect because of parity, overrun or framing errors, bad data block or the Serial Link has timed out.
TAPE OK	On - (Tape Mode) Data stream normal. Off - Data stream interruption caused by parity, framing or overrun errors, unsuccessful tape comparison or timeout on tape link.

Table 4.
COMMUNICATIONS CONTROL STATUS INDICATORS

There are 2 switches located at the top of the module. These are used to initiate operation during the reading from or writing to external tape units. A tape and CPU data compare mode is also initiated by a switch action.

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MODEL 600 CPU

The Model 600 CPU is functionally identical to the Model 6000, however, the Logic Memory and I/O capacity is not as great. An important feature is that a Data Processor Unit can be contained in the same rack.

Logic Memory is allocated one slot to contain one Logic Memory module, thereby allowing the CPU user program capacity in 16-bit words to be 2K, 4K, or 8K of CMOS-RAM. The Logic Memory programming switches on the Internal Memory module must be programmed for slot A.

Parity error detection is standard as on the Model 6000. The register memory is standard which allows 1024 sixteen-bit registers.

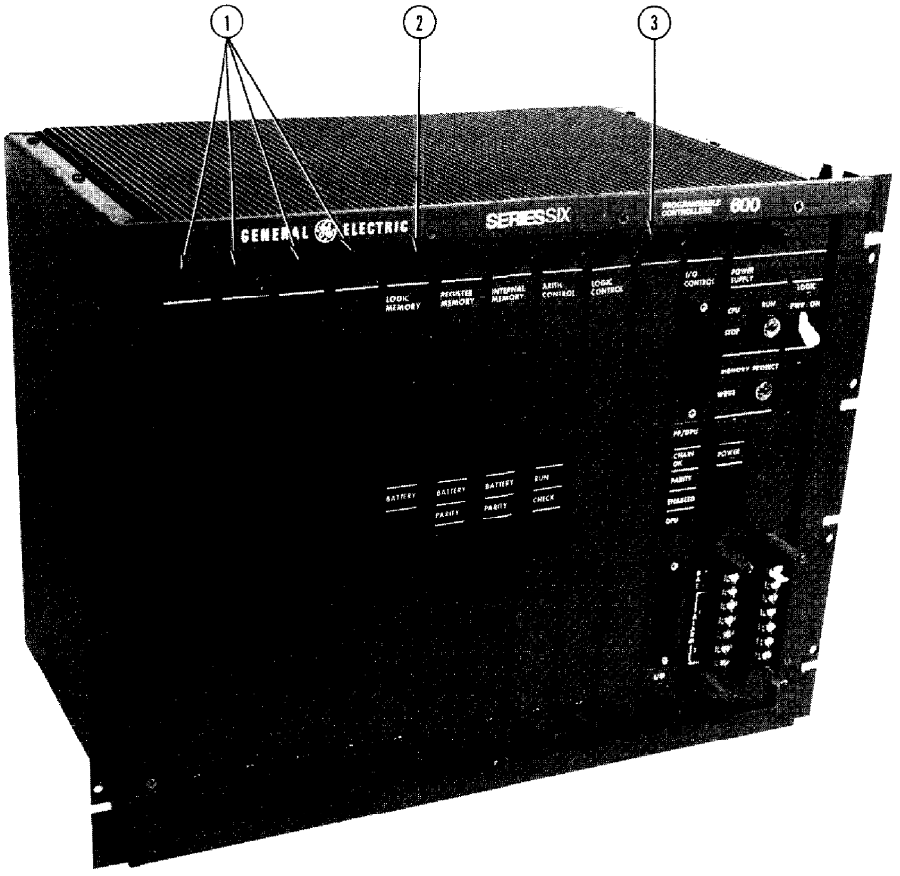
The optional Auxiliary I/O module cannot be used on the Model 600 CPU. The I/O Control module is identical to the I/O Control module used in the Model 6000 CPU. Therefore the I/O system can have up to 1000 inputs and 1000 outputs.

Since only one Logic Memory module can be used and the Auxiliary I/O module is not available as an option for the Model 600, 4 slots are available for the optional Data Processor. The Model 600 CPU is the only model of the Series Six family that allows the Data Processor option to be installed in the CPU rack. The Data Processor option for the Models 6000 and 60 is mounted in its own universal rack with power supply. The Data Processor option is more fully described in Section 7. If data storage requirements exceed the capacity of the Data Storage module, the Model 600 CPU should be interfaced to a Data Processor in its own rack.

The Communications Control module is available as an option which allows the CPU to connect to an external Minicartridge Tape Unit and the Data Highway.

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Figure 19 is the Model 600 CPU which shows the modules available and their locations.



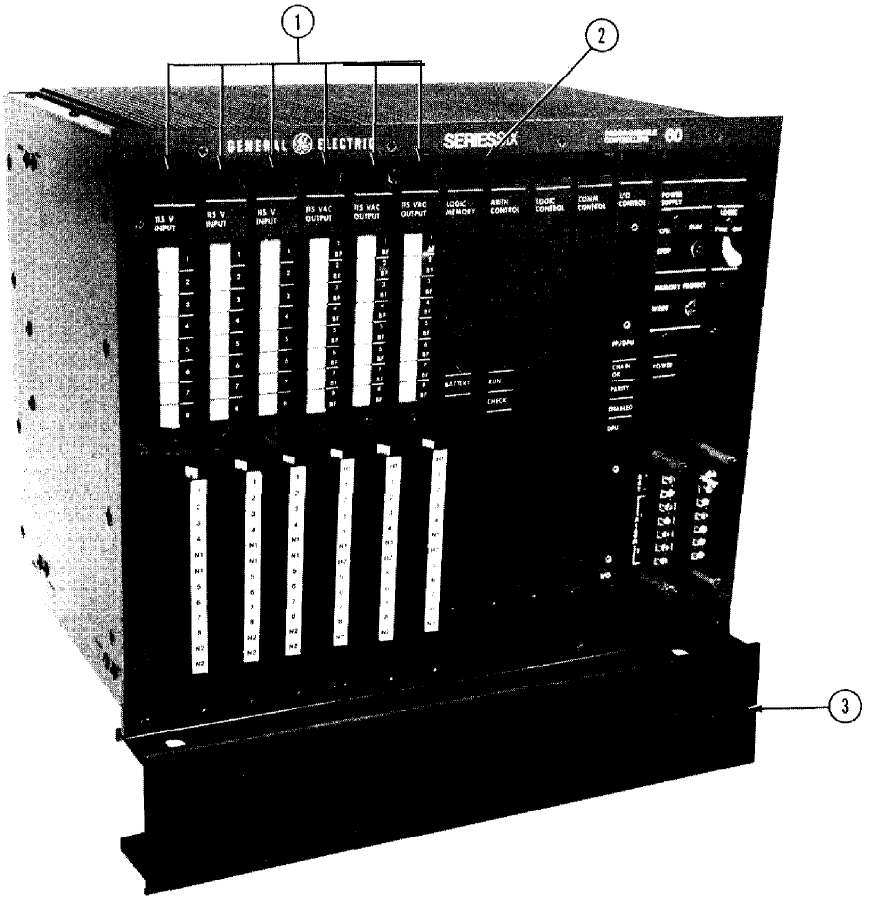
1. Data Processor Option Slots
2. Logic Memory 8K Maximum
3. Communications Control Option

Figure 19.
MODEL 600 CPU

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MODEL 60 CPU

For applications not requiring a large quantity of I/O the Model 60 (Figure 20) is a self-contained PC system which combines the CPU and up to 6 I/O modules in the same standard 11-slot Series Six rack. Power Supply, Logic Control, Arithmetic Control and the optional Communications Control modules are identical to those used in the Models 6000 and 600.



1. I/O Modules 192 I/O Points Maximum (6 Modules)
2. Combined Memories (Internal, Register, Logic)
3. Tray for Field Wiring

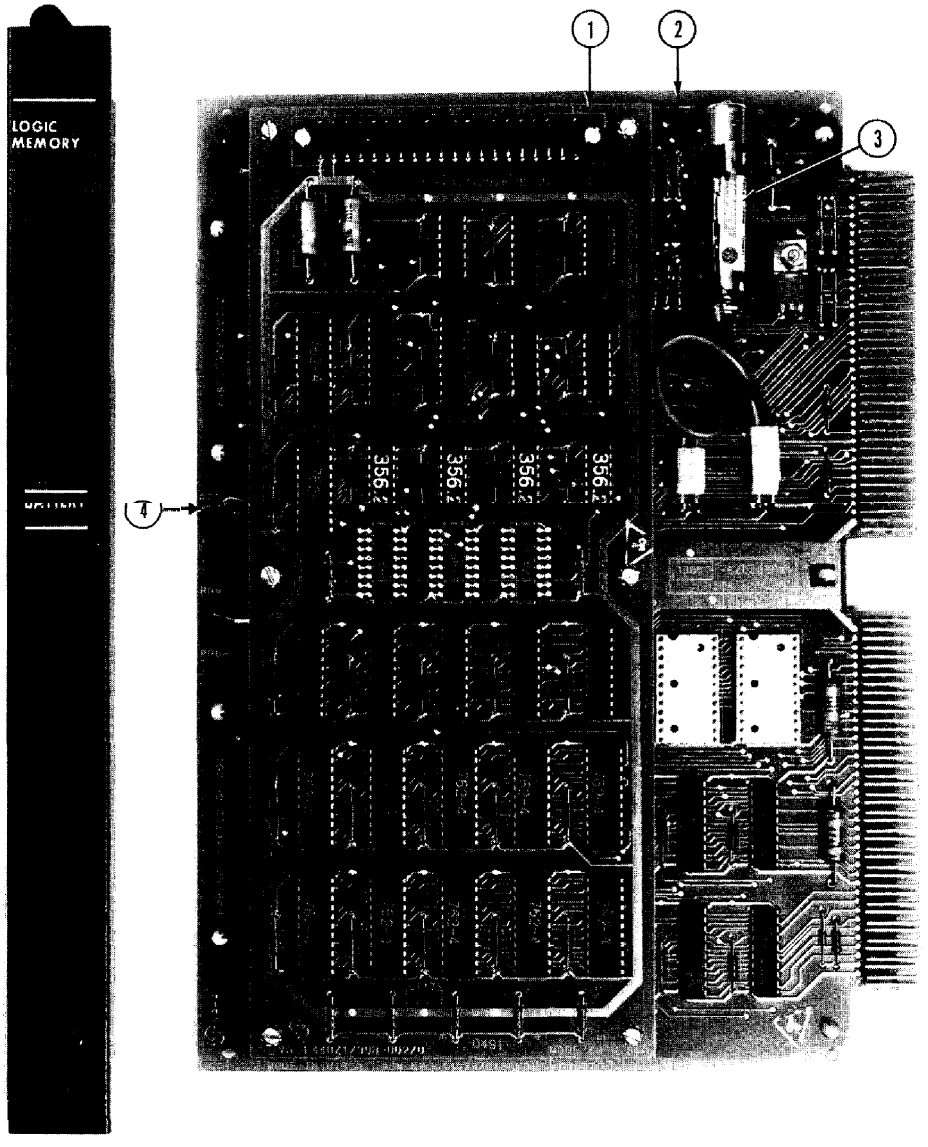
Figure 20.
MODEL 60 CPU

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The Memory module (Figure 21) combines the functions of the Logic Memory, Register Memory, and Internal Memory modules used in Models 6000 and 600. The user memory available in the Model 60 is either 2K or 4K of 16-bit words. Maximum register Memory capacity is either 256 or 1024 sixteen-bit words. The Register Memory is standard in the Model 60.

NOTE

The Memory module used in the Model 60 is not compatible with the Logic Memory modules used in the Models 6000 and 600.



1. Daughter Board
2. Mother Board
3. Lithium Manganese Dioxide battery
4. Battery Status Light

Figure 21.
COMBINED MEMORY MODULE FOR MODEL 60 CPU

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By combining the 3 memories into one module, and with no Auxiliary I/O module offered, the Model 60 has 6 slots available for I/O modules within the CPU rack. For applications requiring no more than 192 I/O points the Model 60 is a complete system within one rack.

The I/O Control module connects the Model 60 CPU to an I/O system having a maximum of 256 inputs and 256 outputs (2K Model) or 1000 inputs and 1000 outputs (4K Model). The 6 I/O modules which can be located in the CPU rack will allow 192 inputs or 192 outputs or a combination of inputs and outputs up to a total of 192. The I/O modules selected must not exceed 100 units of load (See Chapter 2 for details). If more than 6 I/O modules or 192 I/O points are required for a particular application, additional I/O racks must be used.

The optional Communications Control module is offered with the Model 60. This allows the Model 60 to be interfaced to the Minicartridge Tape Unit and the Data Highway.

If the Data Processor option is used with the Model 60 it is located in a separate rack with its own power supply. The Data Processor Option will connect by cable to a port (connector) on the I/O Control module.

NOTE

In order for the Model 60 to function properly using only the I/O modules contained within its rack, a terminator plug (supplied with each CPU) must be connected to the I/O connector (lower connector) on the I/O Control module.

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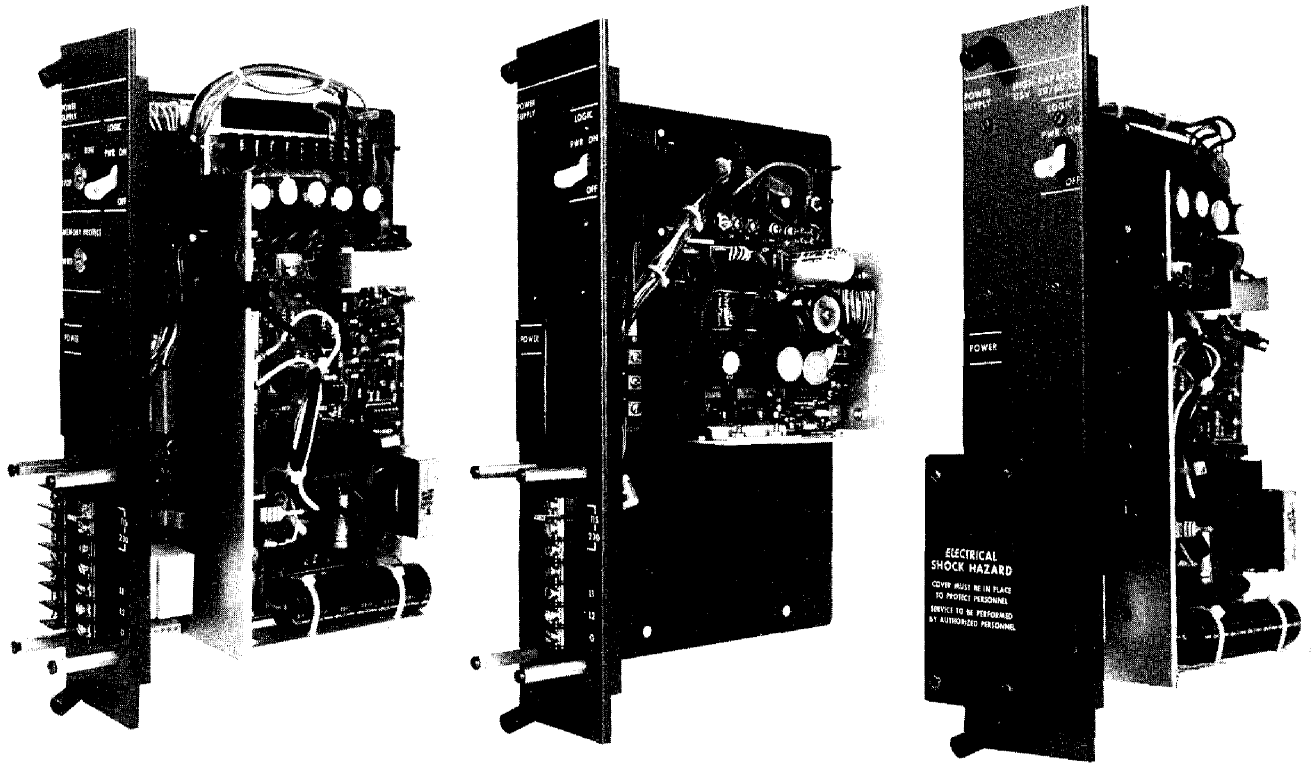
SECTION 3
POWER SUPPLY

The power supply used in the Series Six family of programmable controllers is a multiple output, switching, regulated supply with its electronic circuitry completely self-contained on one assembly. The power supply assembly is attached to a faceplate which has various hardware mounted on it. Two variations of the power supply are used by the Series Six; one is mounted in the CPU rack, DPU rack, and the PDT, the second is mounted in the I/O rack. The I/O version is available in either a standard or a high-capacity model, dependent on the load placed on the supply by the I/O modules. The I/O power supplies are described in Section 4 of this chapter. Table 5 lists the electrical and environmental characteristics of the power supplies. Figure 22 shows the three variations of the power supply.

ELECTRICAL CHARACTERISTICS	
Input Voltage	95-130VAC 190-260V AC
Input Frequency	47-63 Hz
Output Voltages	+5V DC +/-2%, 16.5A CPU/DPU/PDT + 12V DC +/-5%, 1.5A CPU/DPU/PDT - 12V DC +/-5%1 .OA CPU/DPU/PDT
Standard I/O Rack	+5V DC +/-2%, 6.1A
High Capacity I/O Rack	+5V DC +/-2%, 16.5A + 12V DC +/-2%, 1.5A -12VDC +/-2%, 1.0A
Noise & Ripple	2% pp maximum
Overvoltage Protection	6.2V +/-0.5V (+5V DC Output)
Overcurrent Protection	All outputs
GENERAL CHARACTERISTICS	
Temperature Range	0°C to 60°C (Operating), Outside of Rack -20°C to 85°C (Storage)
Relative Humidity	5% to 95% (Non-Condensing)
Altitude	maximum (Operating) 50,000 ft. (Storage)

Table 5.
POWER SUPPLY ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

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A
CPU Power Supply

B
Standard I/O
Power Supply

C
High-Capacity
I/O Power Supply

Figure 22.
SERIES SIX POWER SUPPLIES

MOUNTING

The power supply slides into the rack on cardguides as do all modules mounted in the Series Six racks. The power supply module is held secure in the rack by 2 quarter-turn thumb screws, one at the top of the panel and one at the bottom. Mounting of the power supply is at the far right side of the rack as viewed from the front.

LOGIC POWER SWITCH

A circuit breaker is mounted on the front panel for switching the AC input power on or off. With the circuit breaker in the ON position, a POWER OK LED indicator turns on when all DC voltages have reached their specified operating range. The LED is viewed through the translucent lens on the front panel.

Ref. 81-PC-35
81-PC-48
82-PC-9

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AC INPUT

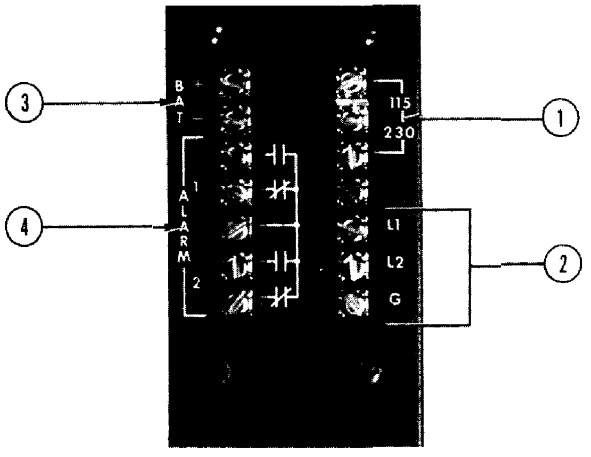
Two sources of AC input voltage may be used, either 115V AC or 230V AC . AC input to the power supply circuitry is provided by connection to screw down terminals on a terminal block mounted on the front panel. Only dual voltage models are jumper selectable.

KEY SWITCH

The CPU power supply has two key switches mounted on the front panel. Both are two-position. One of the switches functions as a CPU RUN/STOP switch, the other is a MEMORY PROTECT/WRITE switch. The keys for these switches are interchangeable.

TERMINAL BLOCK

The CPU power supply has two terminal blocks each having seven screw down terminals. Figure 23 shows the power supply front panel with connections to each of the terminals indicated. The I/O power supply connections are described in Section 4, INPUT/OUTPUT SYSTEM.



1. Jumper For Selection of Either 115VAC or 230V AC (On Dual Voltage Models)
2. AC Input, 115/230V AC
3. Auxiliary Back-Up Battery, 6-28V DC
4. Connections To External Alarms
   Alarm 1 (Advisory)
   Alarm 2 (CPU Stops Scanning)

Figure 23.
CPU POWER SUPPLY FRONT PANEL

In addition to the AC input connections on the terminal blocks several other connections are provided. Connections are provided for 2 sets of isolated alarm contacts for external visual or audible alarms which indicate status or error conditions in the CPU or its associated I/O chain. The alarm relay contacts are internal to the power supply.

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Contacts are also provided for connecting an auxiliary battery of 6 to 28V DC for use as an external memory back-up.

CAUTION

If a memory auxiliary battery is used, the circuit connecting it to the Power Supply module should be isolated from the rest of the system.

TERMINAL BLOCK COVER

A cover is provided for attachment to the terminal blocks. The cover provides a safety precaution against accidental shorting of terminals and is a safeguard against shock to the user or maintenance personnel. The terminal block cover attaches to four stand-offs mounted on the front panel.

WARNING

Extreme care must be taken when making connections to the terminal boards; 115V AC or 230V AC may be present.

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OUTPUTS

The Series Six CPU power supply provides DC outputs of +5V DC, +12V DC and -12V DC. In addition system control signals are generated for use throughout the CPU. DC voltages are hard wired to the backplane. Logic signals are distributed through a connector. Figure 24 is a block diagram of the CPU power supply. The block diagram shows connections to the terminal blocks, DC voltages available and system control signals to and from the power supply.

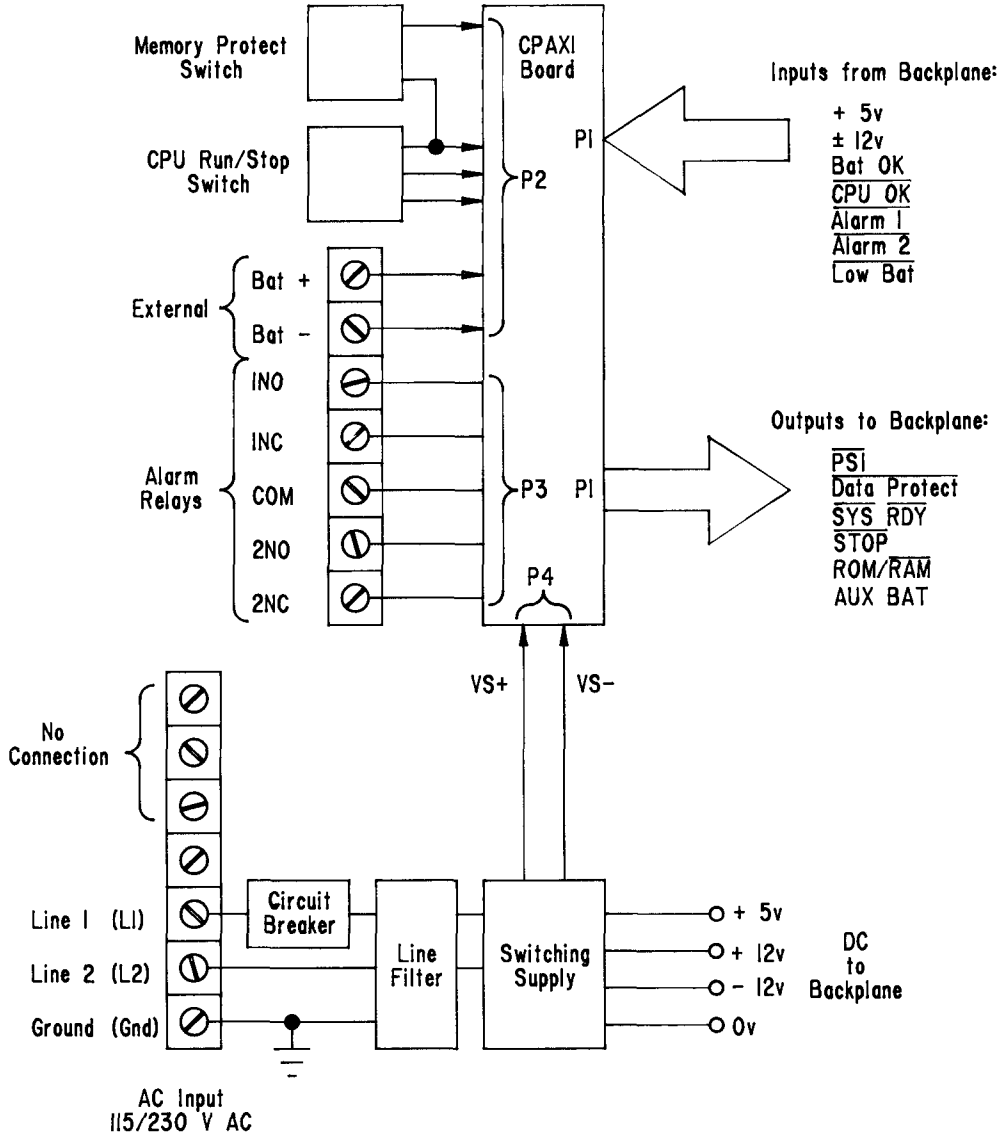


Figure 24.
CPU POWER SUPPLY BLOCK DIAGRAM

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AUXILIARY CIRCUIT BOARD

An auxiliary circuit board (CPAX1) is mounted in the CPU power supply module. Figure 23 shows the internal connections to this board, Figure 25 is a block diagram of the auxiliary circuit board.

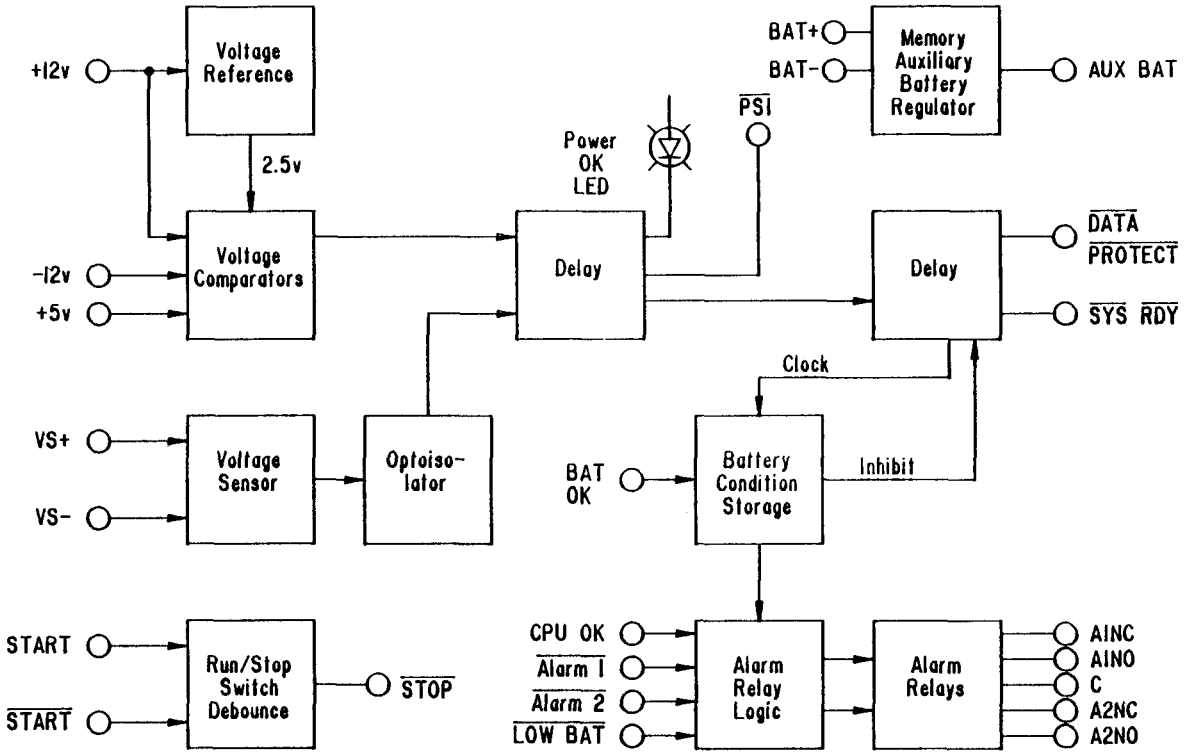


Figure 25.
AUXILIARY CIRCUIT BLOCK DIAGRAM

The auxiliary circuit board performs several functions which are summarized below.

- Senses the levels of the +5V, +12V and -12V supplies in the CPU rack and provides 3 outputs: PSI, SYS RDY and Data Protect.
- Provides switch debouncing for the front panel CPU Run/Stop switch.
- Provides control logic and relay isolation for the 2 user alarm signals.
- Provides voltage regulation for a user-supplied memory auxiliary back-up battery (6-28V DC).

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ALARM RELAY

The alarm relay logic is located on the CPAXl board. Various system problems cause the alarm relay outputs to switch. The alarm relay outputs are rated at 115V AC or 28V DC, 1 amp resistive load. Alarm no. 1 causes the CPU status to be set to stop. Alarm no. 2 causes an error indication to be recorded, but the CPU status in most cases does not stop. Table 6 lists some of the problems that can cause the alarm relay outputs to switch.

<table>
<tr><th>ALARM NO. 1 (MAJOR)</th><th>ALARM NO. 2 (ADVISORY)</th></tr>
<tr><td>CPU or I/O parity error</td><td>Voltage of any memory battery drops too low.</td></tr>
<tr><td>CPU self-test failure.</td><td rowspan="3">CPU OR I/O power supply turned Off.</td></tr>
<tr><td>CPU watchdog timer timed out.</td></tr>
<tr><td>Any memory backup battery dead when power turned on.</td></tr>
<tr><td>Any CPU or l/O power supply voltage out of tolerance.</td><td rowspan="3">Communications Control or Data Processor error (fault jumpers in or out of circuit).</td></tr>
<tr><td>CPU power supply turned off.</td></tr>
<tr><td>Communications Control or Data Processor error (fault jumpers in circuit).</td></tr>
</table>

Table 6.
ALARM CONDITIONS

CAUTION

User devices connected to each set of alarm terminals should present a resistive load drawing no more than 1 amp of current at 1 15V AC or 28V DC. Failure to observe this **CAUTION** may result in damage to the CPAXI circuit board in the power supply.

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SECTION 4
INPUT/OUTPUT SYSTEM

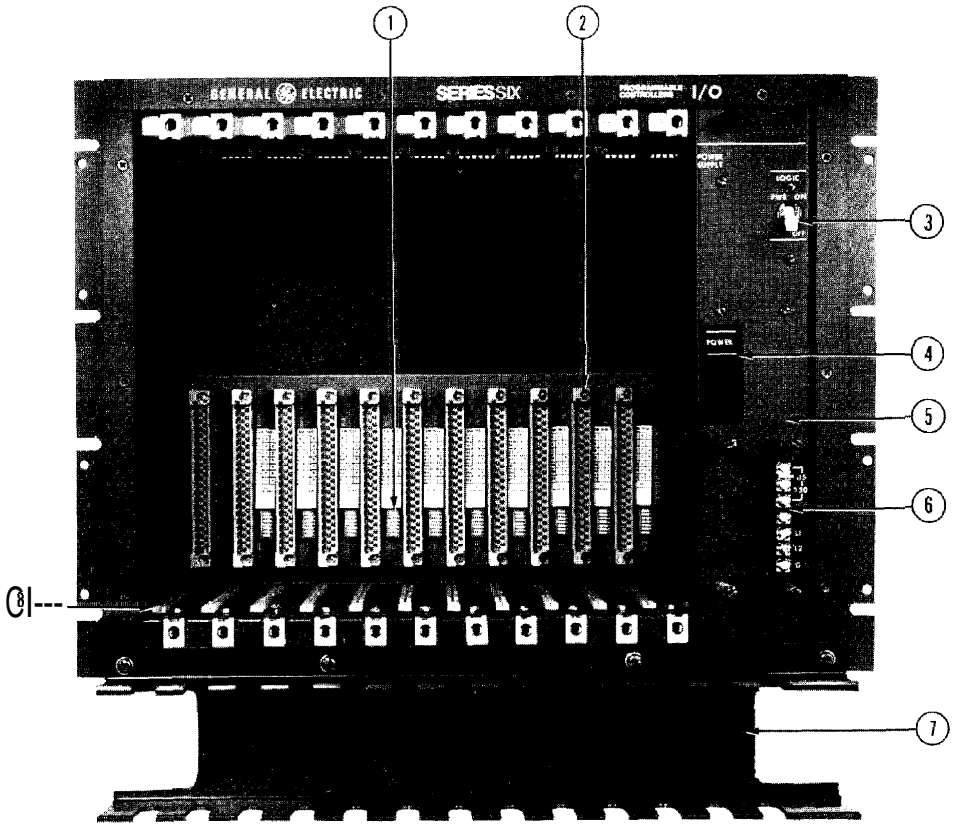
This section describes the Input/Output (I/O) system used by the Series Six family of programmable controllers. The I/O system is common to all models of the Series Six family. I/O racks and modules can be interchanged between systems using the Model 60, Model 600 or the Model 6000. As indicated in Table 1, Section 1, the maximum number of I/O points available with the Models 6000, 600, and 60 respectively are 4000, 2000 and 2000. The Model 60 is the only model in the Series Six family that accommodates both the CPU and I/O modules in the same rack. A maximum of 6 I/O modules (192 I/O points maximum) can be self-contained in the Model 60. Modules, according to type, are available that will allow 4,6,8 or 32 Inputs or Outputs.

The I/O rack is the same universal rack as the one used with the Series Six CPU's and is described in Section 1 of this chapter.

I/O RACK

All I/O modules are housed in an I/O rack (See Figure 26). An I/O rack uses the same mechanical packaging as a CPU or DPU and can be mounted in a standard 19 inch (483 mm) rack or panel. Each rack contains a power supply, either standard or high-capacity depending on the I/O load to be contained in the rack. In addition to the power supply, each rack has slots for eleven I/O modules.

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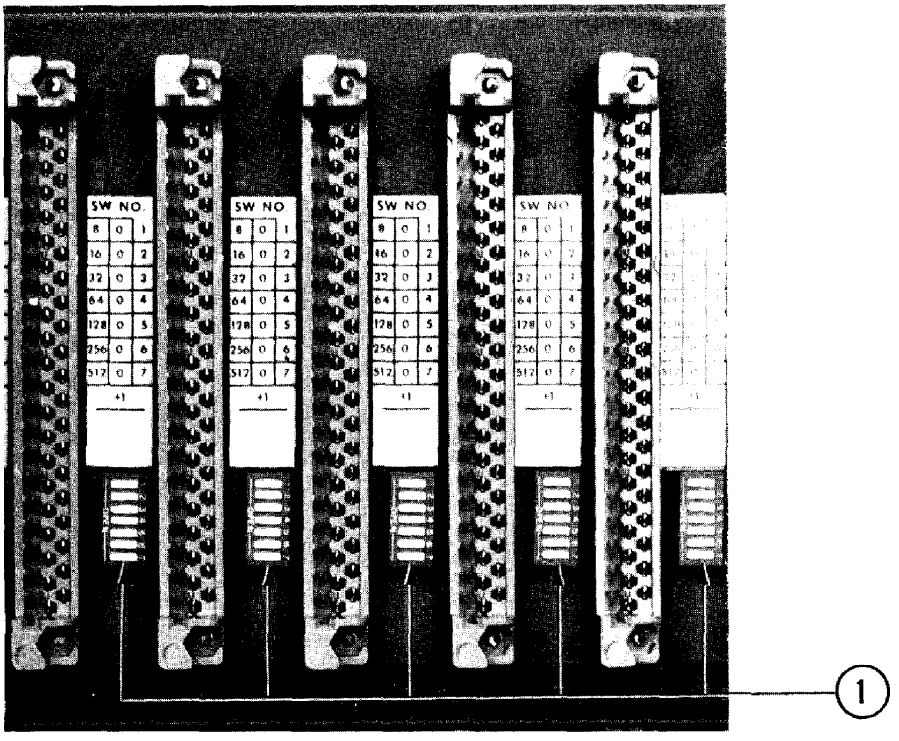
1. 7 Position DIP Switch (10 Per Rack)
2. 41 -Pin Connector (1 1 Per Rack)
3. Logic Power On/Off Circuit Breaker
4. Power On Indicator
5. l/O Power Supply
6. Terminal Board
   1 15V/23OV AC Input Selected By Jumper
7. Tray For Containing Field Wiring
8. Cardguide (1 1 Per Rack)

Figure 26.
I/O RACK

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I/O POINT ADDRESSING

Each I/O slot (except the left-most slot) has a seven segment DIP switch physically located on the back-plane adjacent to each slot (See Figure 27). These switches are used to assign a unique address for each Input or Output module placed in that slot. An Input or Output module can be placed in any of the ten addressable slots. Programming of these switches is accomplished by setting each position of a DIP switch either to the open or closed position. To set a switch to the OPEN position, depress the switch to the left. Each DIP switch setting allows the selection of a starting I/O point number and either 8, 16, or 32 consecutive I/O points. The number of I/O points is determined by the type of I/O module. Figure 28 is a chart indicating the DIP switch settings for 8 circuit modules Modules requiring selection of more than eight I/O points have a similar chart showing the switch settings included in the module descriptions later *in* this section. It should be noted that each address can be used two times, once for an input module and once for an Output module.



I. Seven Segment DIP Switches, IO In Each I/O Rack

Figure 27.
I/O ADDRESS SWITCHES

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I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1	I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1	I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1
1-8								337-344		X		X		X		673-680	X		X		X		
9-16							X	345-352		X		X		X	X	681-688	X		X		X		X
17-24						X		353-360		X		X	X			689-696	X		X		X	X	
25-32						X	X	361-368		X		X	X		X	697-704	X		X		X	X	X
33-40					X			369-376		X		X	X	X		705-712	X		X	X			
41-48					X		X	377-384		X		X	X	X	X	713-720	X		X	X			X
49-56					X	X		385-392		X	X					721-728	X		X	X		X	
57-64					X	X	X	393-400		X	X				X	729-736	X		X	X		X	X
65-72				X				401-408		X	X			X		737-744	X		X	X	X		
73-80				X			X	409-416		X	X			X	X	745-752	X		X	X	X		X
81-88				X		X		417-424		X	X		X			753-760	X		X	X	X	X	
89-96				X		X	X	425-432		X	X		X		X	761-768	X		X	X	X	X	X
97-104				X	X			433-440		X	X		X	X		769-776	X	X					
105-112				X	X		X	441-448		X	X		X	X	X	777-784	X	X					X
113-120				X	X	X		449-456		X	X	X				785-792	X	X				X	
121-128				X	X	X	X	457-464		X	X	X			X	793-800	X	X				X	X
129-136			X					465-472		X	X	X		X		801-808	X	X			X		
137-144			X				X	473-480		X	X	X		X	X	809-816	X	X			X		X
145-152			X			X		481-488		X	X	X	X			817-824	X	X			X	X	
153-160			X			X	X	489-496		X	X	X	X		X	825-832	X	X			X	X	X
161-168			X		X			497-504		X	X	X	X	X		833-840	X	X		X			
169-176			X		X		X	505-512		X	X	X	X	X	X	841-848	X	X		X			X
177-184			X		X	X		513-520	X							849-856	X	X		X		X	
185-192			X		X	X	X	521-528	X						X	857-864	X	X		X		X	X
193-200			X	X				529-536	X					X		865-872	X	X		X	X		
201-208			X	X			X	537-544	X					X	X	873-880	X	X		X	X		X
209-216			X	X		X		545-552	X				X			881-888	X	X		X	X	X	
217-224			X	X		X	X	553-560	X				X		X	889-896	X	X		X	X	X	X
225-232			X	X	X			561-568	X				X	X		897-904	X	X	X				
233-240			X	X	X		X	569-576	X				X	X	X	905-912	X	X	X				X
241-248			X	X	X	X		577-584	X			X				913-920	X	X	X			X	
249-256			X	X	X	X	X	585-592	X			X			X	921-928	X	X	X			X	X
257-264		X						593-600	X			X		X		929-936	X	X	X		X		
265-272		X					X	601-608	X			X		X	X	937-944	X	X	X		X		X
273-280		X				X		609-616	X			X	X			945-952	X	X	X		X	X	
281-288		X				X	X	617-624	X			X	X		X	953-960	X	X	X		X	X	X
289-296		X			X			625-632	X			X	X	X		961-968	X	X	X	X			
297-304		X			X		X	633-640	X			X	X	X	X	969-976	X	X	X	X			X
305-312		X			X	X		641-648	X		X					977-984	X	X	X	X		X	
313-320		X			X	X	X	649-656	X		X				X	985-992	X	X	X	X		X	X
321-328		X		X				657-664	X		X			X		993-1000	X	X	X	X	X		
329-336		X		X			X	665-672	X		X			X	X								

[X] = Switch in OPEN Position (Depressed to the Left)

DIP SWITCH SETTINGS FOR I/O POINT SELECTION

Figure 28.
DIP SWITCH SETTINGS FOR I/O POINT SELECTION
FOR EIGHT-CIRCUIT MODULES

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I/O RACK INTERCONNECTION

i/O racks are interconnected in a system by using combinations of I/O Receivers, I/O Transmitters, Remote I/O Drivers or Remote I/O Receivers depending on the grouping and location of the racks. Racks are grouped together in either a CPU station, a Local I/O station or a Remote i/O station depending on their physical location and distance from the CPU and from other I/O racks. Each of the i/O communication modules and stations are described in detail later in this section.

Each I/O rack requires a receiver which isolates the I/O data cable from the backplane bus and performs error checking. A receiver does not require an address and is normally inserted in the left slot; however, a receiver can be placed in any I/O slot. Two connectors are mounted on each receiver, the top one is for incoming data and the bottom one is used to forward data to a receiver in the next rack of an I/O chain. This method of linking i/O racks together in a station is referred to as a daisy chain. A group of i/O racks in a daisy chain can have no more than 50 feet (15 meters) separating the first rack from the last and there can be a maximum of ten I/O racks in the chain.

The last rack in a daisy chain requires termination of the I/O signals. The bottom connector on the last i/O Receiver is not used for I/O signal connection, thereby allowing a PDT to be connected to the last rack in a CPU station or a Local i/O station.

I/O racks separated by no more than 500 feet (150 meters) can be connected by use of an I/O Transmitter, through a 16 pair cable to an I/O Receiver in the first I/O rack of a chain of no more than ten racks. A total of four Local I/O stations can be connected in this manner; however, the last I/O Receiver can be no more than 2000 cable feet (600 meters) from the originating CPU.

A remote I/O system allows I/O racks to be located up to ‘lO,OOO feet (3 km) from any rack in a CPU station or a Local I/O station by direct cable connection. A Remote I/O Driver placed in a slot in a CPU station or Local station is connected through a two twisted pair serial cable to a Remote i/O Receiver placed in the left slot of a remote station. Any number of Remote I/O Drivers and Remote i/O Receivers can be used in a system. Up to 248 inputs and 248 outputs can be used in a Remote I/O station.

Additionally a CPU station or Local station can be connected to a remote station at distances greater than 10,000 feet (3 Km) by using a communications link consisting of RS-232 modems.

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I/O POWER SUPPLY

The I/O power supply module will accept either 1 15V AC or 230V AC (jumper selectable). The AC input voltage is routed through a terminal block on the front panel to a circuit breaker (LOGIC POWER ON/OFF switch), then through a line filter to the switching power supply. Figure 29 is a block diagram of the I/O power supply. The standard rack power supply AC input is jumper selectable, the high-capacity is available in either a 1 15V or 230V AC version.

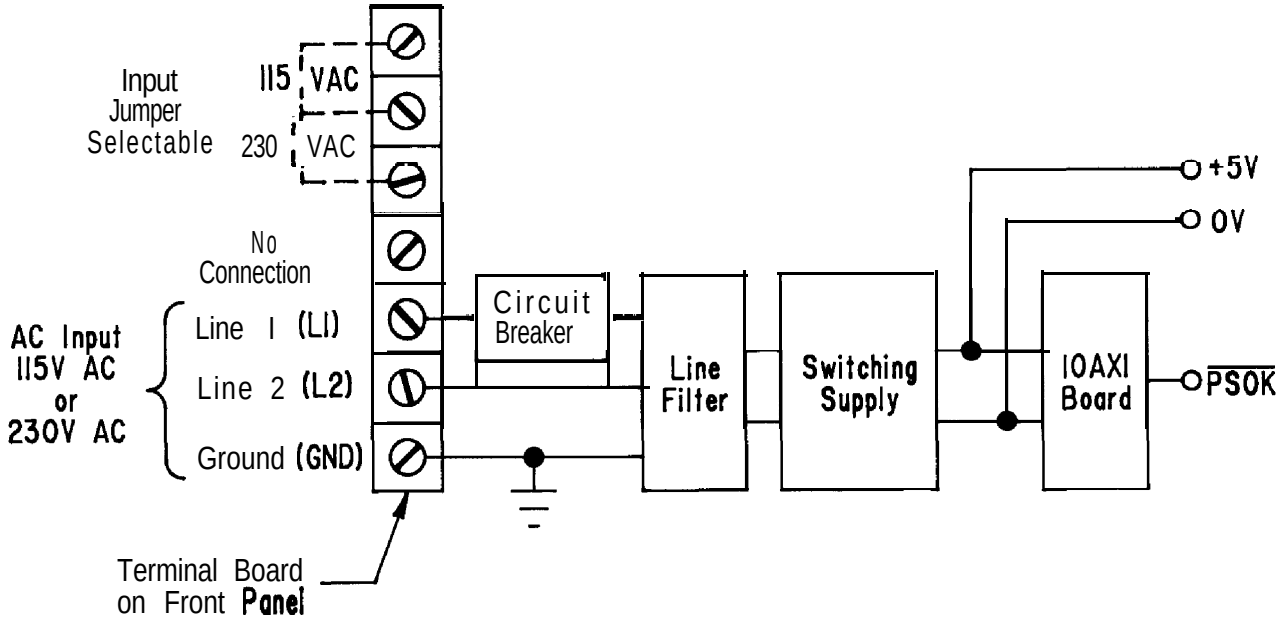


Figure 29.
I/O POWER SUPPLY BLOCK DIAGRAM

outputs

Two versions of the I/O power supply are available, dependent on the I/O load to be used in a rack. Chapter 2, INSTALLATION describes how to determine the I/O load in a rack. Voltage provided to the I/O rack is +5V DC at 6.1 amps (standard rack) or +5V DC at 16.5 amps, + 12V DC at 1.5 amps and -12V DC at 1 .O amp (high-capacity rack).

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Auxiliary Circuit Board

An auxiliary circuit board is mounted in the I/O power supply module. The auxiliary circuit board (IOAXI) senses the +5V DC output to determine if it is within its normal operating range. A protection signal PSOK is generated if the +5V is within its specified limits. The PSOK signal is normally at OV when the power supply is on and +5V is within its normal limits. When the power supply is turned off or the +5V drops below 4.75V, PSOK switches high, which provides a power fail signal to the CPU.

CAUTION

When connecting an AC power source to an I/O rack, ensure that all AC input connections are identical on each of the terminal blocks on each rack. Do no cross Line 1 (LI) and Line 2 (L2). A difference in potential may result which can cause damage to equipment.

MODULES

Each I/O module uses one physical I/O slot in an I/O rack and can be placed anywhere in the I/O structure. A module can be placed anywhere in an I/O rack except the left most slot which is reserved for communication modules. Modules have either 4, 6, 8 or 32 input or output circuits according to type.

Module Hardware Features

Each module consists of two parts: a printed circuit board and a terminal assembly. The printed circuit board contains the electronic circuitry which interfaces a CPU to Input/Output devices and provides isolation from electrical noise. The printed circuit board plugs into a slot in an I/O rack and the terminal assembly attaches to the front edge of the printed circuit board. The terminal assembly is mounted on a faceplate. Each faceplate contains various legends depending on the type of module.

The discrete 8 circuit modules have a markable lens surface for custom visual indication of input or output wiring. The lens is on the upper half of the faceplate and is numbered 1 through 8, top to bottom. The numbers correspond to input or output circuitry on the printed circuit board.

The terminal strips mounted on the faceplates have box lug terminals for ease of connection to field wiring. Each box lug terminal is electrically rated at 10 amps. Each I/O rack has a tray mounted on the bottom front for the purpose of running field wiring from external devices to and from the box lug terminals.

Modules are color coded for convenience and as a visual safety feature. The color scheme is shown below in Table 7. Note that the higher voltage modules are a bright color. Colors used range progressively from blue for low voltage modules to white for the highest voltage modules.

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The terminal assembly has a dual keying system to prevent the accidental connection of the terminal assembly to a circuit card that is not compatible with the field wiring on the terminals. This feature is helpful in troubleshooting in that if a circuit card fails it can only be replaced with the same type of card since the keying system will only allow that type of card to be connected to the terminal assembly.

VOLTAGE AC/DC	COLOR
230V Input	White
230V Output	Red
115V Input	Orange
1 15v output	Yellow
Low V Input	Green
Low v output	Blue

Table 7.
I/O MODULE COLOR CODE

Module Electrical Features

Discrete I/O modules have 8 input or output circuits per board. All input or output circuits are isolated from the control (logic) circuitry by optically-coupled isolation devices (OCI). The OCI couples the 2 circuits together by transmission of light energy from a sender (LED) to a receiver (photo-transistor). Each I/O module is isolated in 2 groups of 4 circuits each.

High-Density modules have either 32 input or 32 output circuits per module. Optical isolation is provided between logic circuitry and user input or output connections. Connections are provided for user power supply wiring on the bottom terminals of each High-Density module.

Analog Input modules have 8 circuits per module and Analog Output modules have 4 circuits per module.

Isolated AC Output modules provide 6 output circuits and the Reed Relay Output modules also provide 6 output circuits.

Specifications and features of the various types of modules are more fully described in the discussion of each individual module.

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Connections To I/O Modules

Connections are made to the I/O modules by inserting wiring from field devices into box lug terminals. These lugs will accept one No. 12 AWG wire or two No. 14 AWG wires on discrete modules or one No. 14 AWG wire on Analog and High-Density modules. Wiring connections conform to UL standard 230 C.

WARNING

When the Logic Power switch is turned off on an I/O or CPU rack, potentially dangerous voltages may remain at the box lug terminal connections on I/O modules. These voltages are user supplied and are controlled externally from the CPU or I/O racks. Operators and maintenance personnel should exercise extreme care when working with the I/O modules to prevent personal injury.

AC/DC 8 Circuit Input Modules

Eight circuit discrete AC/DC modules are available in the ranges shown in Table 8.

MODULE	ON RANGE	OFF RANGE	ON DELAY	OFF DELAY	INPUT LOADING
12V Input (AC/DC)	10-20v	0-4v	10-20 ms	20-50 ms	1 KΩ (7.0 mA @ 12V)
24-48V Input (AC/DC)	20-60V	0 - 8 V	10-20 ms	20-50 ms	3 K Ω (6.3 mA @24V)
115V input (AC/DC)	90 - 130v	0-30v	10-20 ms	20-50 ms	20 KΩ (5.5 mA @ 115V)
230V Input (AC/DC)	180-260V	0-50V	10-20 ms	20-50 ms	39 K Ω (5.8 mA @23OV)
Power Requirements	5V DC, 104 mA maximum. Supplied by I/O power supply. Power for Input devices must be supplied by the user.				
Operating Temperature" O to 60°C (32° to 140°F) at outside of rack.					
Storage Temperature* -20° to +80°C (-4° to +176°F)					
Humidity* 5% - 95% (non-condensing)					

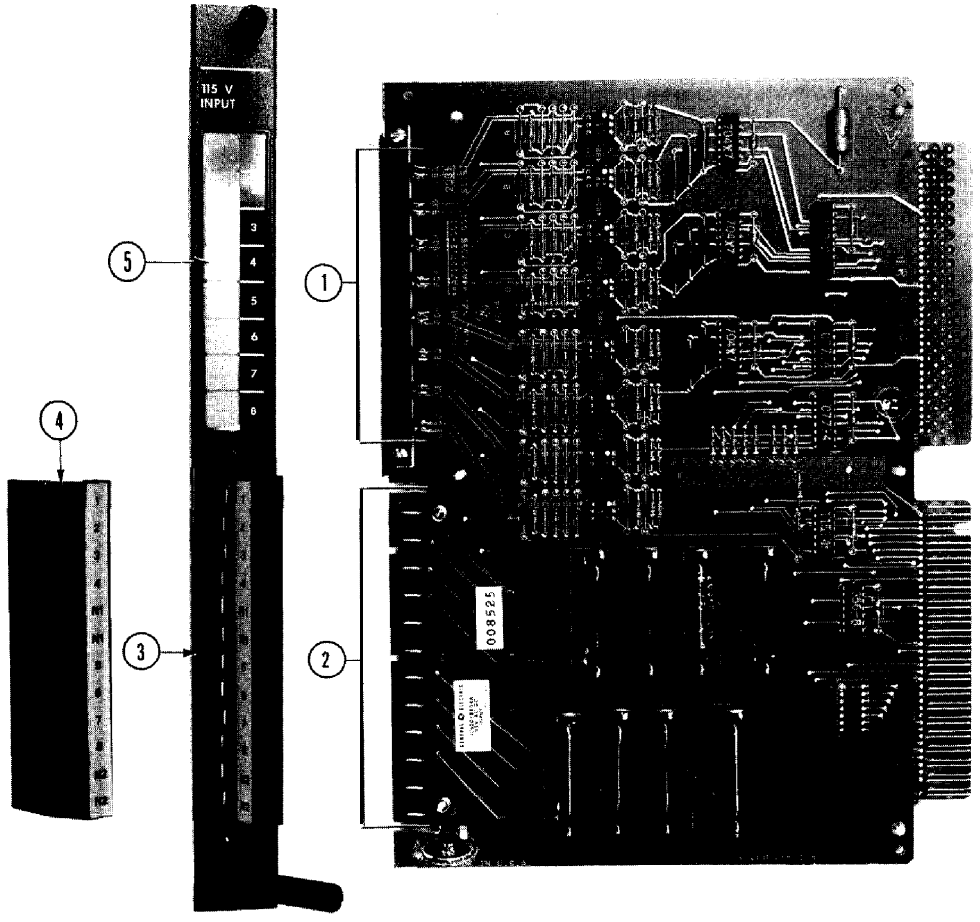
"These specifications are common to all I/O modules.

Table 8.
SPECIFICATIONS, DISCRETE INPUT MODULES

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Each module contains 8 isolated input circuits. AC or DC voltages in the ranges shown in the table can be input to the modules. Each input circuit has a high impedance Schmitt trigger which improves the life of the circuitry. Maximum turn-on voltage is 78% of the nominal input voltage and turn-off is 20% of the **nominal** voltage. Each input circuit also contains an opto-isolator, a rectifier to detect an AC input or a DC input of either polarity, and a filter to provide immunity against various noise signals.

An LED is provided for each circuit which indicates an input ON condition. Figure 30 is a 115V Input module that indicates features common to each of the 8 circuit discrete modules. An Input module can be inserted in any slot of an I/O rack (except the left most slot) or in an I/O slot in a Model 60 CPU.



1. Input "ON" Lights
2. Circuit Board Terminal Block
3. Box Lug Terminals For Field Wiring
4. Terminal Cover
5. Markable Lens Surface

Figure 30.
INPUT MODULE

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The starting I/O point for each module is selected by setting the seven segment DIP switch on the back-plane adjacent to the I/O slot in which the module is inserted. The starting I/O point establishes a starting reference for eight consecutive I/O points reserved for that module by setting the DIP switch. Refer to Figure 28 or the Installation section of this manual for instructions on setting the DIP switches.

Input connections for field wiring are arranged in two groups of four inputs each with two neutral con-- nections in each group. Detailed installation instructions can be found in Chapter 2.

High-Density Input Modules

The High-Density Input module provides 32 input circuits on one module and allows the user a choice of two modes of operation, either 5V TTL or IO-50V DC. This module provides an optically isolated inter-. face between the backplane I/O bus and user digital circuitry (TTL mode) or input devices (I0-50V DC mode). Table 9 is a list of specifications for this module.

	TTL MODE	10-50V DC MODE
Power Requirements	+5V DC, 200 mA maximum. Supplied by I/O rack power supply.	
User Supplied Voltage Ripple Current	 5 ± 0.25V DC < 100 mV 200 mA plus 7 mA per input point used	 I0-50V DC < 1 .ov 200 mA plus 7 0 mA per input point used
Input Requirements On State Off State	 Vin < 0.8V Vin > 2.0V	 Vin < 40% of supply voltage Vin > 50% of supply voltage
	NOTE For proper operation in the On state, each user input device must be able to sink 7 mA of current in the TTL mode, or 10 mA in the IO-50V mode. In the Off state, negligible current is drawn through each input terminal.	
Response Time	7ms	7ms

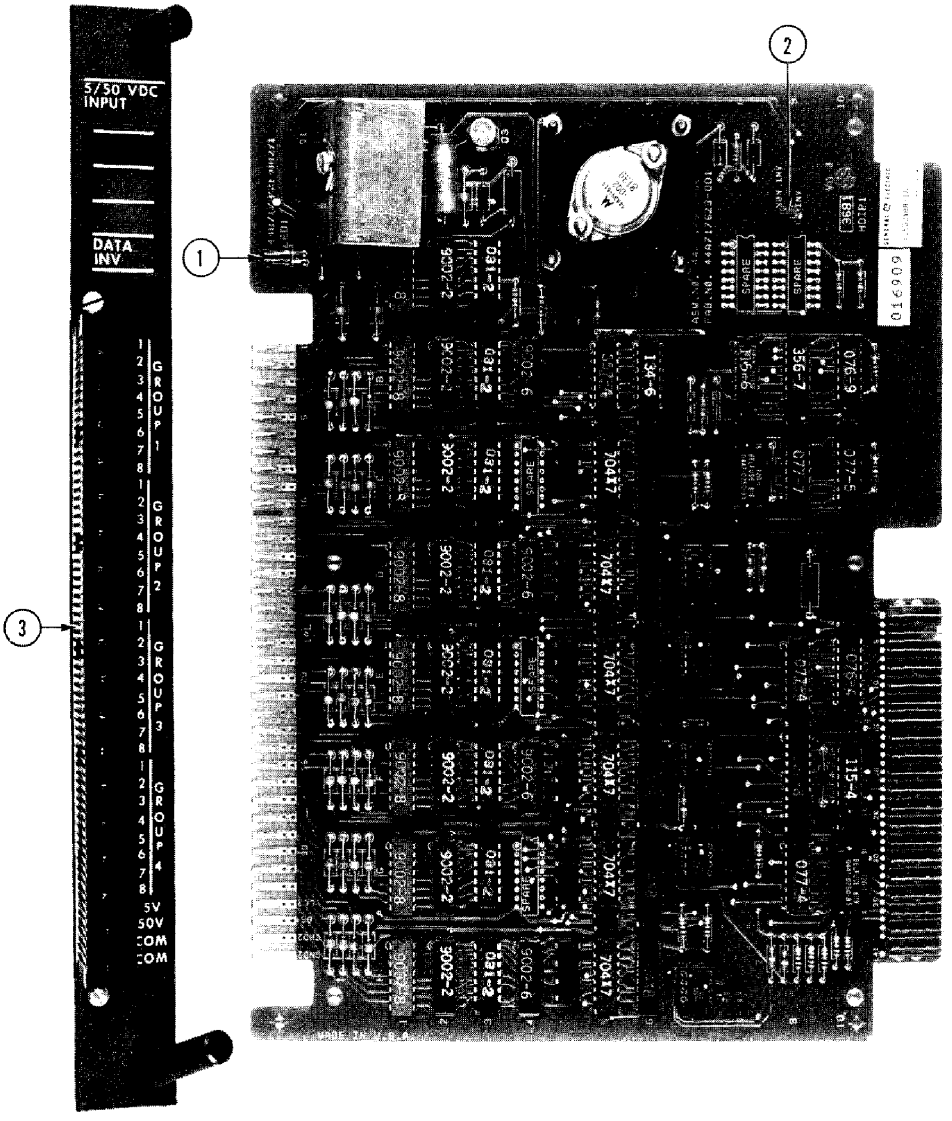
Table 9.
SPECIFICATIONS, HIGH-DENSITY INPUT

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The 32 inputs available on this module are arranged in four groups with eight inputs in each group. A single group is read by the CPU during an I/O cycle. All 32 inputs (four groups) are read in four consecutive I/O cycles. A user supplied power source is connected to either the 5V (TTL mode) or 50V (I0-50V DC mode) and COM terminals as required. Further details for installation of this module can be found in Chapter 2 of this manual.

By connecting a jumper plug on the circuit board to the proper terminals, the user can select whether the data sent to the CPU is inverted (complemented) or non-inverted. An LED viewed on the faceplate provides a visual indication of the selected mode. Figure 31 shows the High-Density Input module, including features described above.

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1 DATA INVert Light
On: The module is in the Inverting mode.
Off: The module is in the Non-Inverting mode.

2 NON-INV/INV Jumper
A,B Connected:Sets module to the Non-Inverting mode.

B,C ConnectedSets module to the Inverting mode.

3 User Connector 8lock

NOTE

In early versions of this module, the sense of the DATA INVert light is the reverse of the (le-scription above, i.e., the light is On in the Nc In-Inverting mode.

Figure 31.
HIGH-DENSITY INPUT MODULE

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The starting I/O point number for a High-Density Input module is selected by setting the seven segment DIP switch on the backplane adjacent to the I/O slot containing the module. When a DIP switch is configured according to the chart in Figure 32, a group of 32 consecutive I/O points is reserved for that module beginning with the selected I/O point.

INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X	X	X	X	X
321-352		X		X		673-704	X		X		X		(NOT USED)				

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 32.
DIP SWITCH SETTINGS FOR HIGH-DENSITY MODULES

Analog Input Modules

The Analog Input module is availabe in three versions: unipolar, bipolar and current. Ranges available for each version are shown below. The 4 → 20 mA range can also be configured to read voltages in the range of +1 → +5V by a change of front panel connections. Each of the three versions has been assigned a separate part number and should be ordered as such.

Module Type	Range
Unipolar	0 → +10V
Bipolar	-10 → +10V
Current	4 → 20 mA (+1 → +5V)

Table 10.
ANALOG INPUT MODULE RANGES

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Each of the above modules functions as an analog-to-digital (A/D) converter for signals applied to each of its eight input channels. The sampled value of the input level is converted to a l2-bit binary number which provides a resolution of 1 part in 4096. This number, along with binary information which gives various operating conditions and the number of the channel being read, is sent to the Input Status Table in the CPU.

Specifications for the Analog Input module are as listed in Table 11.

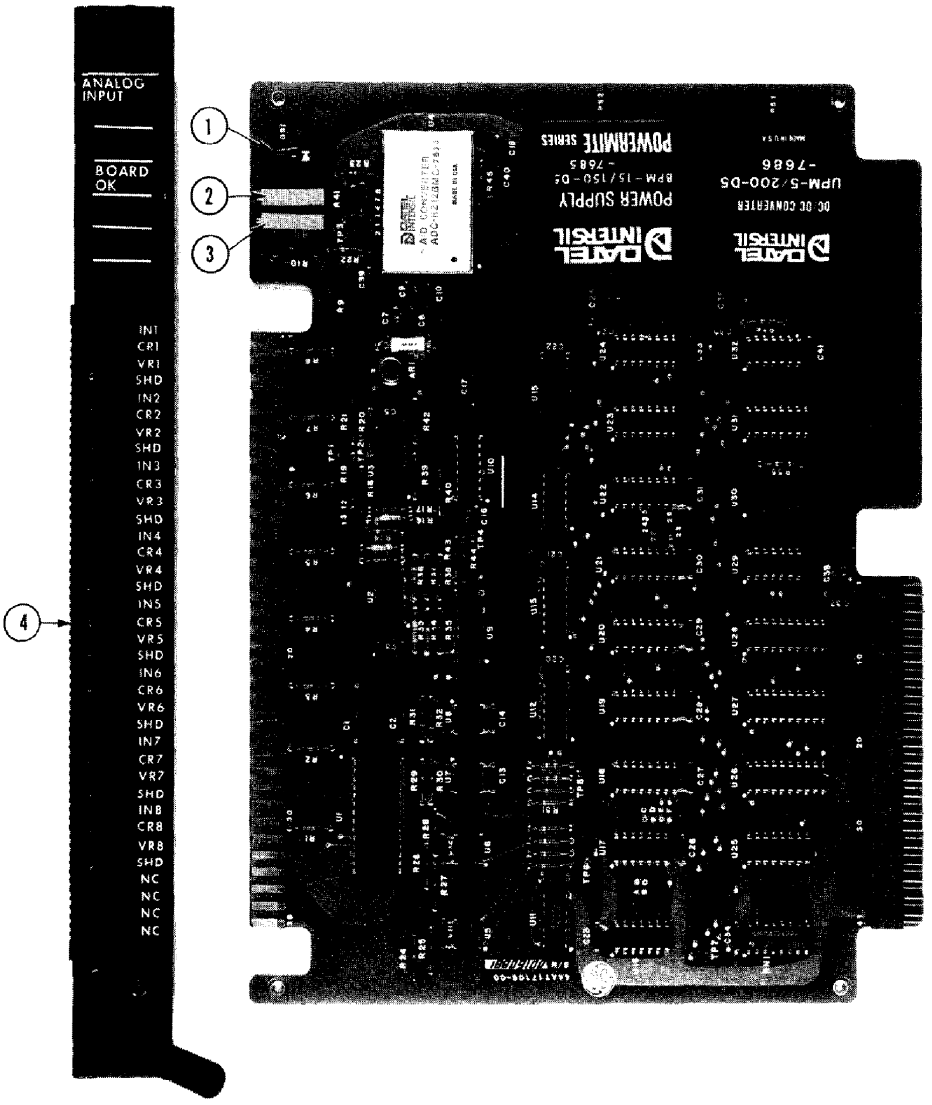
Power Requirements	5V DC, 1.5A - Supplied by I/O Rack Power Supply. User must supply analog input voltage or current levels.
Input Overvoltage	Protection provided for input voltages up to 30V.
Input 8ias Currents	200 pA at +25°C maximum 8 nA at +70°C maximum
Input Impedance	100 M Ω Typical
Input Capacitance	< 1 0pF for OFF channel < 1 00pF for ON channel
Common Mode Rejection (Noise Immunity)	> 60 dB, DC to 1 kHz
Cross Talk	> 74dBat 1 kHz
Resolution	12 Binary Bits (1 part in 4096)
Accuracy	> ± 0.025% of Full Scale at 250C
Temperature Coefficient Linearity Gain Offset	 < 6ppm of Full Scale per °C < 18ppm of Full Scale per °C < 1Oppm of Full Scale per °C

Table 11.
ANALOG INPUT SPECIFICATIONS

Each module contains an eight-to-one analog multiplexer, A/D circuitry, opto-isolation circuitry, an address decoder, and data bus drivers. Circuitry is also provided for detection of open-wire, overrange and underrange conditions. One LED indicator viewed on the faceplate displays module status. Figure 33 is an Analog Input module showing various features of the module.

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Four connections are provided for each channel on the user connector block mounted on the faceplate. The input wiring is configured according to the type of module. An illustration is provided in Chapter 2 showing typical user input connections.



1 BOARD OK Light:
The LED is Off if there is an A/D converter malfunction, an I/O rack power supply problem, or the CPU is in the Stop or the Run Disabled mode. It is also Off if the module has not been read since one of these conditions existed, or since power has been applied.

2 R12: Offset Pot, (All Channels)

3 Rl 1: Gain Pot, (All Channels)

4 User Connector Block

Figure 33.
ANALOG INPUT MODULE

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An Analog Input module can be installed in any slot in an I/O rack (except the left most slot) or in one of the six I/O slots in a model 60 CPU rack. Before the module is installed, the seven segment DIP switch on the backplane adjacent to the selected I/O slot should be configured to select the starting I/O point number for the module. A group of 32 consecutive I/O points are selected by setting the DIP switch. Figure 34 shows the DIP switch settings for an Analog Input module. Further installation procedures for this module can be found in Chapter 2.

INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X	X	X	X	X
321-352		X		X		673-704	X		X		X		(NOT USED)				

X = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 34.
DIP SWITCH SETTINGS FOR ANALOG INPUT MODULES

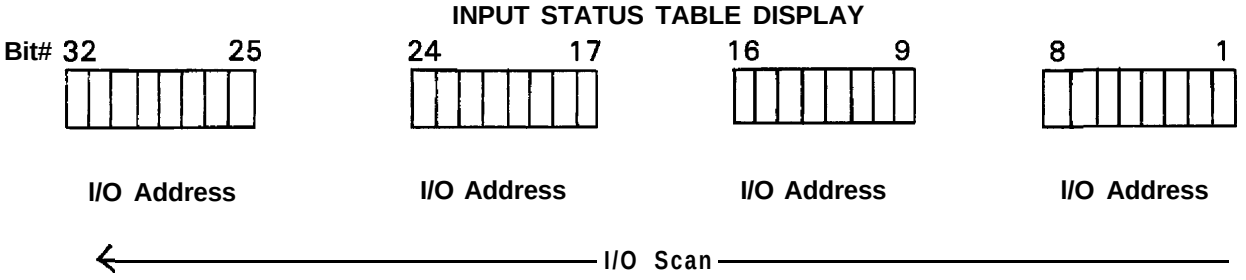
Four consecutive I/O addresses are required to read all 32 bits of information associated with each channel; a single channel is normally read during each sweep. Usually, all eight channels are read in sequence during consecutive sweeps: the first channel read (terminals IN1, CR1, VR1) has channel number "0"; the eighth channel read (terminals IN8, CR8, VR8) has channel number "7". The sequence then begins again. The channel number is incremented by the module each time a channel is read.

The data read corresponds to the input voltage or current detected on the present channel immediately after the previous channel was read. (The A/D conversion time is approximately 25 microseconds.)

Using the CPU Extended Functions, the user can choose to read repeatedly the same channel at a much faster rate than the normal I/O scan rate.

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The 32 bits corresponding to the group of 32 inputs reserved for each module are read into the Input Status Table in the sequence as shown below.



The significance of each of the bits is defined in the table below. Bit 1 corresponds to the lowest input number in the group of 32 inputs reserved for the module, while Bit 32 corresponds to the highest number in the group. For example, if DIP switch No. 5 is set OPEN and all the others are in the closed position (refer to Figure 34), then Inputs 129 to 160 in the CPU Input Status Table, as well as in the user program, would correspond to Bits 1 to 32 in the digital data format definition.

BIT	DEFINITION
Bits l-8	Channel Number: 8-bit binary number giving the number of the channel (0 → 7) being read. It consists of three significant bits (bits l-3) and five leading zeroes (bits 4-8).
Bits 9-l 6	Status Byte
Bit 9	Valid Data: HIGH if the Board OK Light is On; LOW if the light is Off.
Bit IO	Not Used
Bit 1 1	Open Wire: HIGH if input circuit is open (< 0.4V) on channel being read, with the 4 → 20 mA/+l → 5V module; LOW otherwise. Should be ignored with the 0 → +10V and -10 → + 10V modules.
Bit 12	Sign: HIGH with negative input to the -10 → + 10V module; LOW with positive input. Other modules same as bit 28.

Table 12.
DIGITAL DATA FORMAT

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BIT	DEFINITION
Bit 13	Board OK: HIGH if both +5V and +15V power supply levels are OK; LOW otherwise.
Bit 14	Underrange: HIGH if input level is at or below the low end of the module range; LOW otherwise. (Data will saturate at minimum reading.)
Bit 15	Overrange: HIGH if input level is at or above the high end of the module range; LOW otherwise. (Data will saturate at maximum reading.)
Bit 16	Heartbeat: Changes state when the reading of a channel is complete.
Bits 17-24	Data: Eight least significant of the twelve bits of data. Bit No. 17 is the least significant bit (LSB).
Bits 25-32	Data: Four most significant of the twelve bits of data (bits 25-281, plus four bits of sign extension (bits 29-32). Bit No. 28 is the most significant bit (MSB). The sign extension bits all have the same value as the Sign bit (bit No. 12) and bit 28.

Table 12. (Continued)
DIGITAL DATA FORMAT

The 12 bits of data and the sign extension make up a 16-bit binary number which is in straight binary form for positive data, or 2's-complement form for negative data. For the bipolar (-10 → + 10V) module, bit No. 28 functions as a sign bit.

The 2's-complement form of a binary number is found by inverting (complementing) all bits and then adding one. For example, the decimal number 770 can be expressed as the 'l6-bit binary number 0000001 'I 0000001 0. To find the 2's-complement form: first invert, giving 11 1 1 1 10011 11 1 101; then add one to this, giving 11 1 1 11001 11 'I 1 1 10. This would be a representation of the decimal number -770.

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It is recommended that calibration of the Analog Input module be performed every 90 days at normal operating temperature. Calibration procedures are detailed in Chapter 3 of this manual.

NOTE

The Analog Input module will function properly only when used with CPUs with the following serial numbers:

Model 60 CPU: Cl 88 -8135 -0130, and higher.

Model 600 CPU: Cl 88 -8138 -0100, and higher.

Model 6000 CPU: Cl 88 -8138 -6000, and higher.

If your CPU has a serial number lower than that listed, contact the PC Product Service Specialist at (804) 978-5624 for assistance.

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Interrupt Input Module

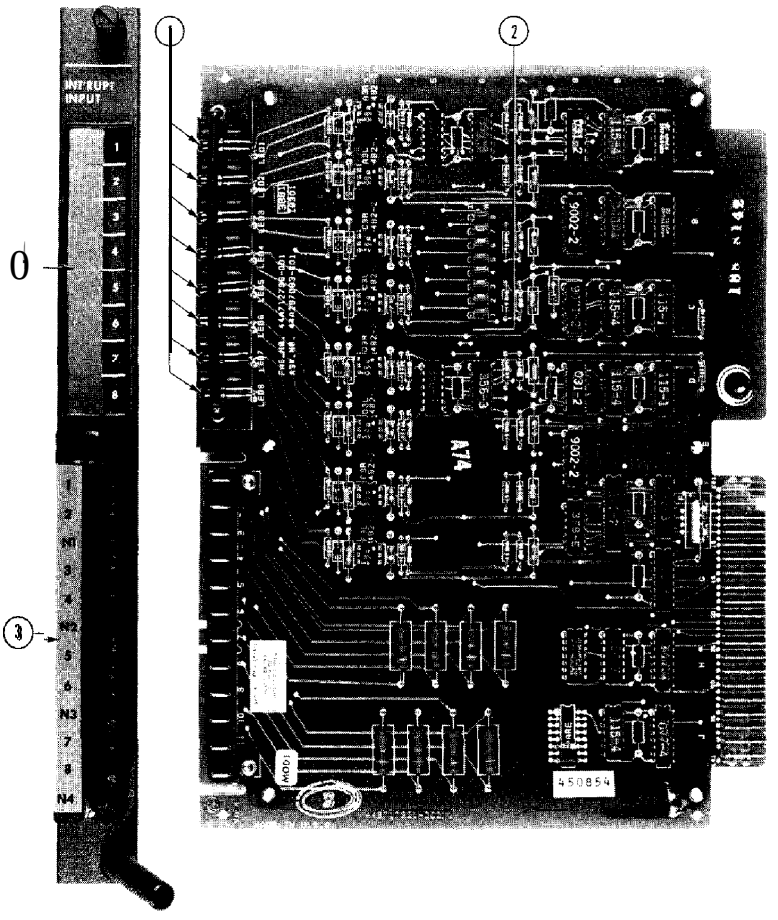
The Interrupt Input module provides a method of initiating a subroutine in the user program that is stored in the CPU memory. A signal to an Interrupt Input module is generated by a user device. The required voltage level of the interrupt signal from a user device is 10 to 30V DC. An interrupt input to the CPU can occur on either a positive or on a negative transition of the interrupt signal. The transition, either an ON/OFF or OFF/ON edge trigger is jumper selectable by positioning a jumper plug on the proper terminals on the circuit board. Figure 35 is an interrupt module. Specifications for the Interrupt Input module are as listed in Table 13.

Power Requirements	5V DC, 225 mA maximum Supplied by I/O Rack power supply.
User Power Source	10-30V DC
Interrupt OFF Condition	3V DC
Interrupt ON Condition	10VDC
Card Filtering OFF-ON Delay	300μs - maximum
ON-OFF Delay	8ms - minimum 10ms - typical 12ms - maximum

Table 13.
SPECIFICATIONS, INTERRUPT INPUT

Eight interrupts are available on each module. A maximum of two interrupt modules can be used in a system, one in the main I/O chain and one in the auxiliary I/O chain, thereby allowing a total of sixteen interrupt inputs in a system. An I/O starting point number does not need to be set on the DIP switch on the backplane adjacent to the I/O slot containing an Interrupt Input module since the number is fixed (hard wired on the circuit board) at I1001 to I1008 on the main I/O chain and AI1001 to AI1008 on the auxiliary I/O chain

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1. LED 1 to LED 8: LED numbers correspond to interrupt input numbers. Active LED (ON) indicates current flow through the input circuit.
2. Jumper 1 to Jumper 8: Jumper numbers correspond to interrupt input numbers. Jumper at "N" terminal causes corresponding interrupt input to respond to rising edge. Jumper at "I" terminal causes corresponding interrupt input to respond to falling edge.
3. User Connector Block
4. Markable Lens Surface

Figure 35.
INTERRUPT INPUT MODULE

The interrupt modules can be used in a Model 60 CPU, a CPU station or a Local I/O station. They can not be used in a Remote I/O station located at the distant end of a serial link. The Extended Function Set must be selected in order to use an Interrupt Input module.

The eight interrupt input connections on a module are arranged in four groups of two isolated inputs each. The eight inputs on the main I/O chain Interrupt module correspond to subroutines 1 through 8 and the eight inputs on the auxiliary I/O chain Interrupt module correspond to subroutines 9 through 16.

When the CPU is initially powered up or set to the RUN mode, the CPU clears the Interrupt Input modules. Thereafter, any interrupts which occur will be latched on the appropriate interrupt module. A signal will also be sent to the CPU alerting it that an interrupt has occurred. The CPU will read the interrupt module and place the state of each interrupt in the input status table. The CPU will then execute the subroutine associated with the highest priority (interrupt 1, 2, 3, etc. in order) interrupt one time, then the next one in sequential order. When all of the interrupts that were read have been serviced, the CPU resumes operation at the point where it was interrupted.

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AC Output Module

AC Output modules are available in either a 115V AC or 230V AC version. The outputs are capable of driving 5 mA to 2 amps. The module contains comparator circuitry to determine when the module is being addressed and a register to store the output data before presenting it to the output drivers. Each output has overvoltage protection and is protected from inadvertent turn-on. The eight output drivers each use a triac as a switching device to connect the corresponding output terminal to the high side of the user power source when that output is in the ON state. Each output circuit is fused and has a neon lamp blown fuse indicator which is viewed through the translucent lens on the faceplate. There is also a neon lamp to indicate an output ON condition. Specifications for the AC Output module are shown in Table 17.

Module	User Supplied Voltage	ON Delay	OFF Delay	Output Current(ON)		Leakage (OFF)
				Minimum	Maximum	
115VAC	90-130VAC	< 1 .Oms	≤1/2 cycle	5 m A	2A	1.7mA@ 115V
230V AC	180-260VAC	< 1 .Oms	<I/2 cycle	5 m A	2A	1 .O mA @ 230V
Power Requirement: 5V DC, 535 mA maximum. Supplied by I/O power supply. ON-State Voltage Drop: I.5V typical, 2.5V maximum. Inrush Current: I2A for 33ms (maximum). Fuse Rating: 3A						

Table 17.
SPECIFICATIONS, AC OUTPUT MODULES

A protection circuit automatically disables the entire group of eight output drivers in the event of an I/O chain or CPU failure. The outputs are arranged in two groups of four with each group sharing a common power source. Refer to Figure 38.

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The significance of each of the bits is defined in the following table. Bit 1 corresponds to the lowest input number in the group of 32 inputs, while Bit 32 corresponds to the highest number in the group. For example, if DIP switch No, 6 is set OPEN and all the others are in the closed position (refer to Figure 37), then Inputs 257 to 288 in the CPU input Status Table, as well as in the user program, would correspond to Bits 1 to 32 in the data format definition.

BIT	DEFINITION
1-3	Channel number: 3-bit binary number giving number of channel (0 → 7) being read.
4-8	Not Used
9	Valid Data: HIGH if the data is valid; LOW if the data is invalid.
10	Not Used
11	Open Thermocouple: HIGH if the input circuit is open (< 0.4V) on the channel being read; LOW otherwise.
12	Sign: Bit is 1 if temperature is negative; 0 if positive.
13	Board OK: HIGH if DC power supply levels are OK; LOW otherwise.
14	Underrange: HIGH if input level is at or below the low end of the module range; LOW otherwise.
15	Overrange: HIGH if input level is at or above the high end of the module range; LOW otherwise.
16	Heartbeat: Changes state when reading of a channel is complete.
17-28	Data: 12 bits of temperature data.
29-32	Sign Extension: Four bits of sign extension for 2's complement format; they are zeros in sign plus magnitude format.

Table 16.
DIGITAL DATA FORMAT

The twelve bits of data and the sign extension make up a 16-bit binary number which can be a signed magnitude or a 2's complement number (for negative data). The 2's complement form of a binary number is found by inverting (complementing) all bits and then adding one.

It is recommended that calibration of the Thermocouple Input module be performed every 180 days at normal operating temperatures. Calibration procedures are detailed in Chapter 3 of this manual. A calibration connector is available for ease of connecting a voltage meter and a voltage source.

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A Thermocouple Input module can be installed in any I/O slot in a model 60 CPU rack or in any slot in an I/O rack (except the left most slot). Before the module is installed, the seven segment DIP switch on the backplane adjacent to the selected I/O slot should be configured to select the starting I/O point number for that module. This will cause a group of 32 consecutive bits in the appropriate Input Status Table to be specified for the module. Figure 37 shows the DIP switch settings that can be selected for a Thermocouple Input module.

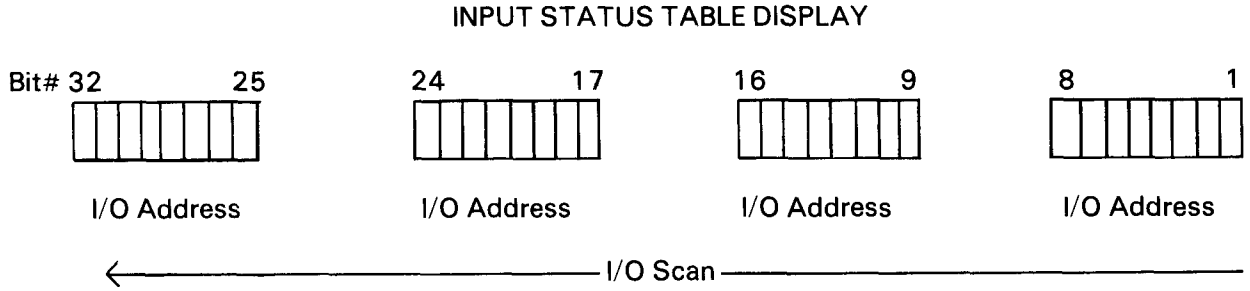
INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X X X X X (NOT USED)				
321-352		X		X		673-704	X		X		X						

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 37.
DIP SWITCH SETTINGS FOR THERMOCOUPLE INPUT MODULES

Four consecutive I/O addresses are required to transfer all 32 bits of information to the CPU for each channel read. Data from a single Thermocouple channel will normally be transferred with each I/O sweep. Usually all eight channels are read and transferred in sequence during consecutive I/O sweeps. The module will automatically index to the next channel as each channel is read. This action is independent of the input sampling rate. The CPU can strobe this module every 80 μsec for up to eight sweeps, it then must allow the module to return to its data sampling routine for 20 msec before reading the input points again.

The 32 bits corresponding to the group of 32 inputs specified for each module are transferred into the appropriate Input Status Table in the sequence shown below.



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Power Requirements	5V DC, 1.7A maximum. Supplied by I/O Rack Power Supply	
Input Voltage Levels Type J Type K Type S Type T	 -8.096 to +42.922 millivolts -6.061 to +49.988 millivolts 0.000 to +18.698 millivolts -6.250 to +20.869 millivolts	
Sample Rate	66.4 msec/input. Provides a conversion rate of 15 per second. (Conversion rate can be changed-jumper selectable)	
Resolution	12 Binary Bits (1 part in 4096)	
Accuracy Type J Type K Type S Type T	Temperature Drift, Max. ± .1°C/°C ± .3°C/°C ± .3°C/°C ± .1°C/°C	Time Drift, Max. ± .10°C/month ± .15°C/month ± .15°C/month ± .10°C/month

Table 15.
THERMOCOUPLE INPUT SPECIFICATIONS

Each module contains two four-channel, isolated thermocouple conditioners, a microprocessor with EPROM memory for linearization, address decoding logic and data bus drivers. Circuitry is also provided for open thermocouple detection, and for protection of overrange and underrange conditions. One LED indicator viewed through the faceplate lens provides a visual indication of module status.

The format for data to be transferred to the CPU is jumper selectable and can be either signed magnitude or 2's complement. Temperature readings are sampled for a period of 66.4 msec/input. The average value of a 12-bit sample is then linearized and converted to a temperature reading. At 66.4 msec/input, the module will sample the same point every 532 msec. This equates to a conversion rate of 15 per second. Alternate conversion rates for both 50 and 60Hz systems can be selected by repositioning of jumper plugs on the printed circuit board. Instructions on reconfiguring of any jumpers on this module can be found in Chapter 2 of this manual.

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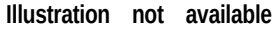


Figure 36.
THERMOCOUPLE INPUT MODULE

Accuracy of temperature measurement is assured through a Cold Junction Sensing module connected directly to the terminals on the Thermocouple module faceplate. This module connects to internal logic and provides an automatic offset to the effect of ambient air temperature at the point where the thermocouple wires are connected to the Thermocouple module faceplate terminals. Specifications for the Thermocouple Input modules are listed in Table 15.

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Thermocouple Input Module

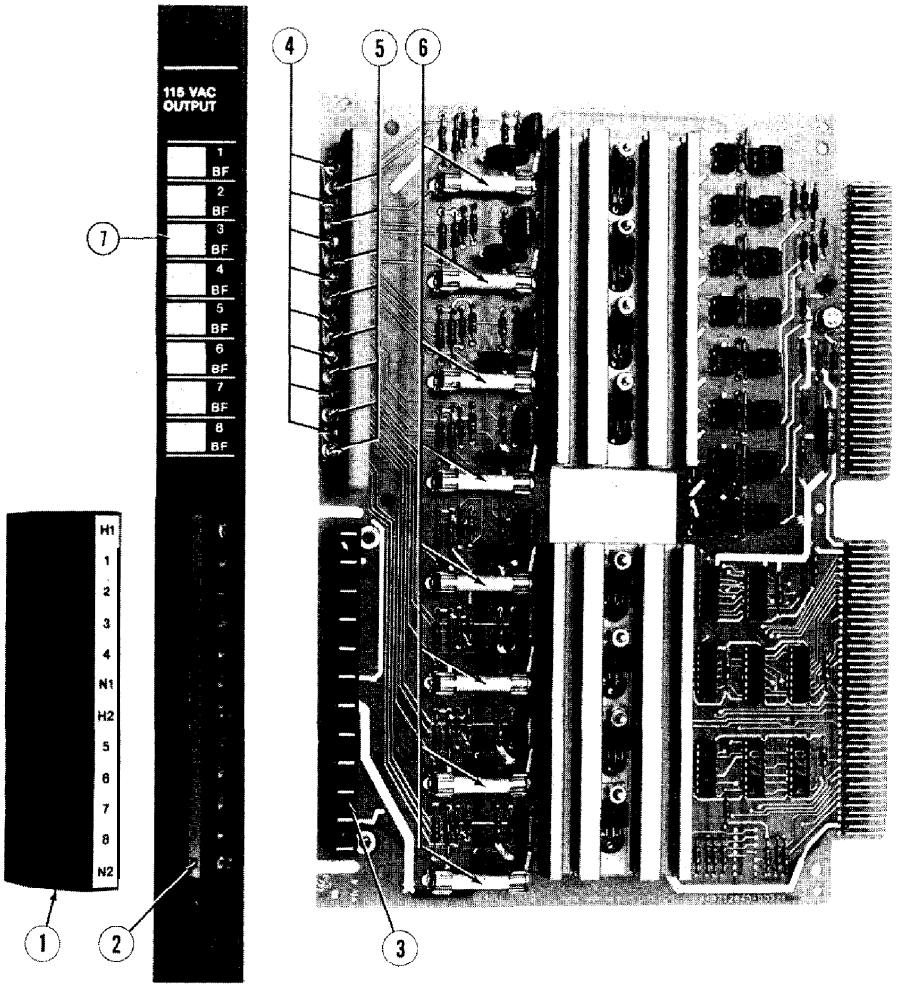
The Thermocouple Input (see Figure 36) module is available in four versions, types J, K, S, and T each having a different range of temperature measurement. Temperature ranges for each of these modules is listed below in Table 14.

TYPE	DEGREES CENTIGRADE (°C)	DEGREES FAHRENHEIT (°F)
J	-210 to 760°C, ± 1.3°	-346 to 1400°F, ± 2.43°
K	-212 to 1232°C, ± 1.4°	-350 to 2250°F, ± 2.52°
S	0 to 1768°C, ± 3.5°	32 to 3200°F, ± 6.3°
T	-270 to 400°C, ± 1.3°	-454 to 752°F, ± 2.43°

Table 14.
TEMPERATURE RANGES FOR THERMOCOUPLE INPUT MODULES

Each of the four types of modules functions as an analog-to-digital (A/D) converter for signals on each of its eight input channels. The sampled value of the input level is converted to a 12-bit binary number which is linearized over its usable range and then converted to either °C or °F. This temperature value is sent, along with binary information that gives various operating conditions and the number of the channel being read to the Input Status Table in the CPU.

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1. Terminal Cover
2. User Terminal Block
3. Circuit Board Terminal Block, Mates With User Terminal Block
4. Output "ON" Lights (l-8)
5. BF (Blown Fuse) Lights (l-8)
6. Fuses, 3A (One Per Circuit)
7. Markable Lens Surface

Figure 38.
AC OUTPUT MODULE

An AC Output module can be installed in any slot in an I/O rack (except the left slot) or in an I/O slot in a Model 60 CPU. Before installing the module the I/O starting point number for the group of eight outputs should be established by setting the seven segment DIP switch on the backplane adjacent to the selected I/O slot. Refer to Figure 28 or the Installation chapter in this manual for instructions on setting the DIP switches. Instructions for connecting field wiring to the terminals on this module can also be found in Chapter 2 (Installation).

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Isolated AC Output Module

The Isolated AC Output module is available in either a 115V AC or 230V AC version. Each module provides six isolated outputs; i.e. each output circuit can use a separate power source. The modules are capable of driving 10 mA to 3 amps. The module contains comparator circuitry for decoding the addresses presented to the module from the I/O bus, thereby determining when the module is being addressed. Output data is stored in a register on the module before being presented to the output drivers.

Each output has overvoltage protection and is also protected from inadvertent turn-on. Each of the six output drivers uses a triac as a switching device which connects the corresponding output terminal to the high side of the user power source when that output is turned ON. An LED indicator is present in each circuit to indicate when the circuit is in the ON state. Each output circuit is fused and has a neon lamp blown fuse indicator as a visual indication of a blown fuse condition. Both the LED (output On) and the neon lamp (blown fuse) indicators are visible through the translucent lens on the faceplate. Specifications for the Isolated AC Output modules are listed in Table 18.

Module	User Supplied Voltage	ON Delay	OFF Delay	Output Current(ON)		Leakage (OFF)
				Minimum	Maximum	
115V AC	90-130V AC	$<1/2$ cycle	$\leq 1/2$ cycle	10 mA	4A@40°C	4.0 mA maximum
230V AC	180-260V AC	$<1/2$ cycle	$\leq 1/2$ cycle	10 mA① 30 mA②	4A@40°C	4.0 mA maximum

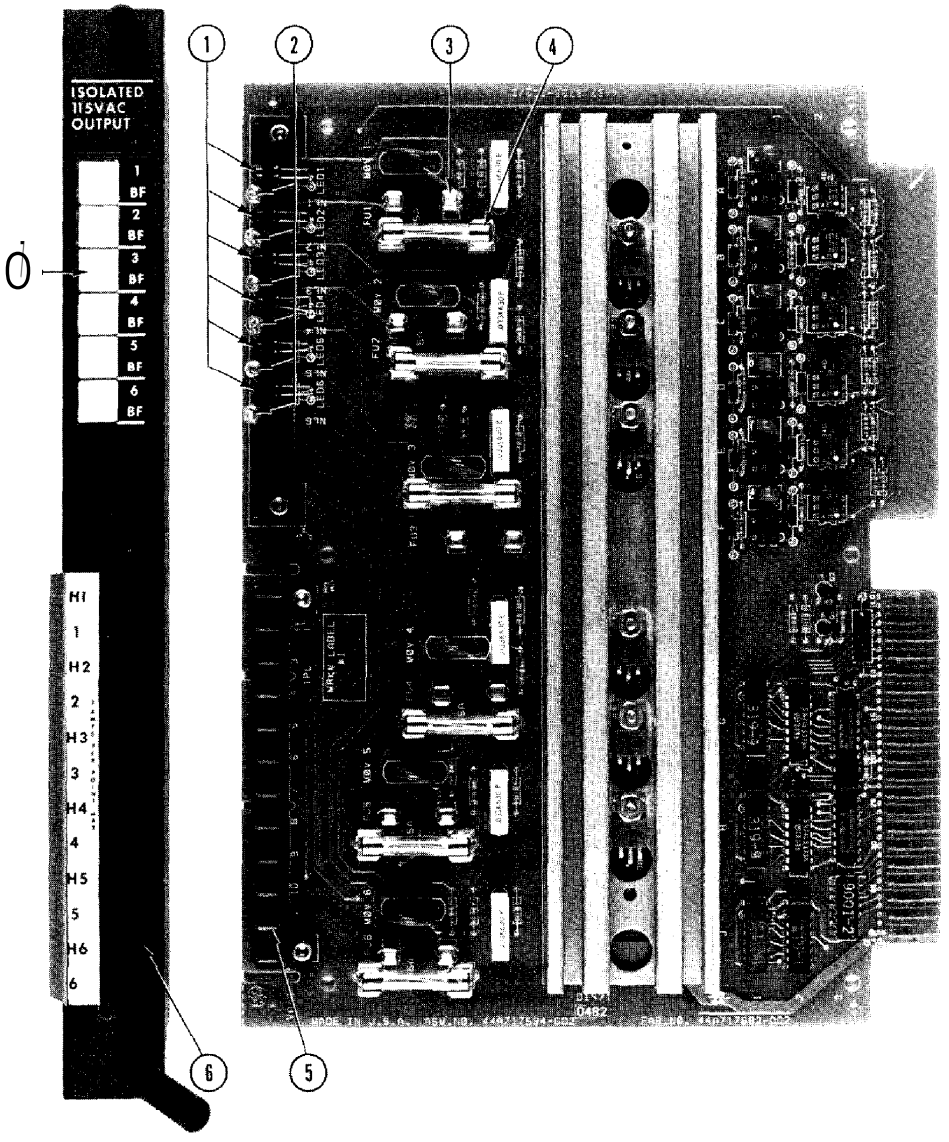
① With resistive load. ② With inductive load.
Power Requirement: 5V DC, 460 mA maximum. Supplied by I/O power supply.
On-state Voltage Drop: 1.2V typical, 2.2V maximum.
Inrush Current: 20A for 33ms (maximum).
Fuse Rating: 5A

Table 18.
SPECIFICATIONS, ISOLATED AC OUTPUT MODULES

A protection circuit automatically disables all six output drivers in the event of a CPU or I/O chain failure. Each output has two connections, H1-H6 is the high side of the user power source and O1-O6 is the output connection to the corresponding load for each circuit. Each terminal can accommodate up to one No. 12 AWG or two No. 14 AWG wires. Figure 39 is an Isolated AC Output module indicating the described features.

As an added convenience, fuse clips are provided on the module for both American (1/4" x 1 1/4") and European (5mm x 20mm) style fuses.

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1. Output "ON" Lights (I -6)
2. BF (Blown Fuse) Lights (I -6)
3. European Fuse Clip (6)
4. Fuse, 5A, (6)
5. Circuit Board Terminal Block
6. User Terminal Block
7. Markable Lens Surface

Figure 39.
ISOLATED AC OUTPUT MODULE

An Isolated AC Output module can be installed in any slot in an I/O rack (except the left slot) or in an I/O slot in a Model 60 CPU. Before installing the module the I/O starting point number for that module should be selected by setting the seven segment~DIP switch on the backplane adjacent to the selected I/O slot. An Isolated AC Output module will respond to the first six output points in the selected group. Refer to Figure 28 or the Installation chapter in this manual for instructions on setting the DIP switches. Instructions for connecting field wiring to the terminals on this module are also found in Chapter 2 (Installation).

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DC Output Modules

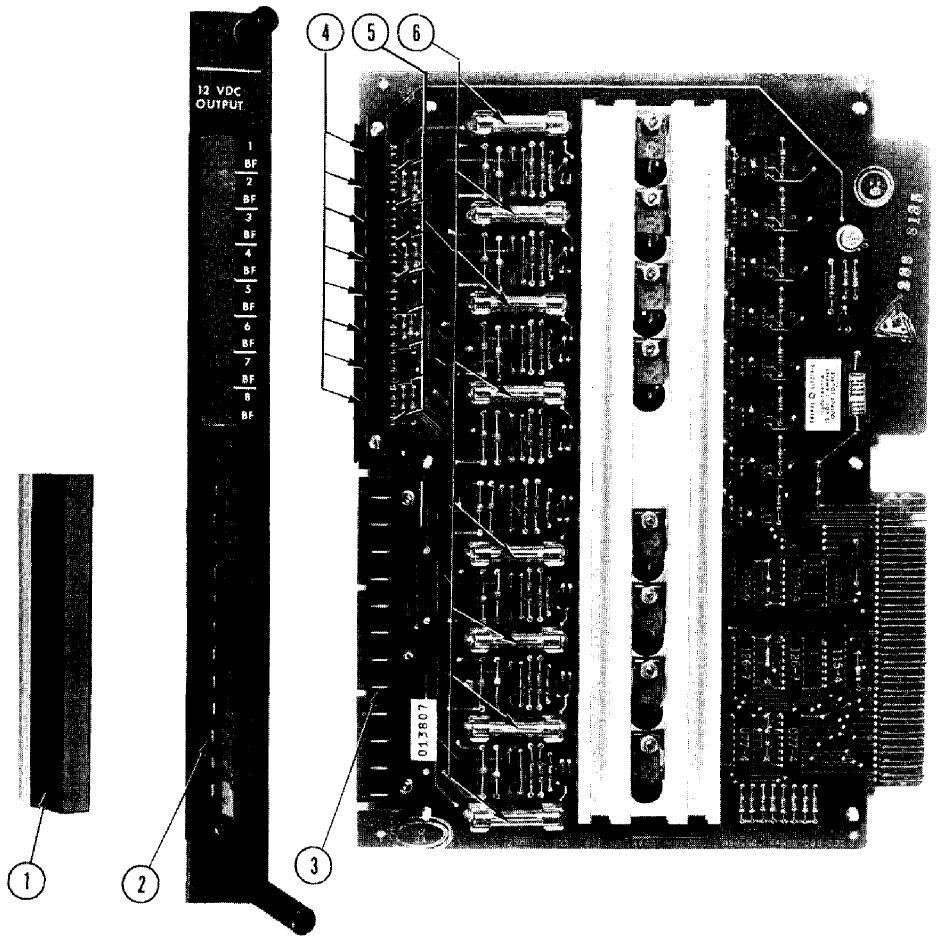
The discrete 8-point DC Output module is available in three voltage ranges. The module for each voltage range is available in either a sink or a source version. Each module has eight outputs arranged in two groups of four outputs. Each group shares a common power source and has a high (positive) and a neutral (negative) terminal. Table 19 lists the specifications for the DC Output modules.

Module	User Supplied Voltage	Response Time	ON-State Voltage Drop	output Current (ON)	Leakage (OFF)	Inrush Current
12VDC Sink/ Source	9-2OV DC	1 ms maximum	1.75v maximum	0-2A	5mA@ 60°C maximum	7 A maximum
24V DC Sink/ Source	19-40V DC	1 ms maximum	1.75v maximum	0-2 A	5mA@ 60°C maximum	7 A maximum
48V DC Sink/ Source	38-55V DC	1 ms maximum	1.75v maximum	0-2 A	5mA@ 600C maximum	7 A maximum
Power Requirements: 5V DC, 400 mA maximum. Supplied by I/O power supply. Fuse Rating: 3A						

Table 19.
SPECIFICATIONS, DC OUTPUT MODULES

Each of the eight outputs on a module are capable of either sinking or sourcing up to two amperes. All output stages have overvoltage protection and are fused. Two LED indicators associated with each output are provided. The top LED is an indication of the state (ON/OFF) of the output and the second LED functions as a blown fuse indicator. Each output (I-8) has both LEDs which are viewed through the module faceplate lens. Figure 40 is a DC Output module showing features common to each of the modules.

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1. Terminal Cover
2. User Terminal Block
3. Circuit Board Terminal Block
4. Output "ON" Lights (I-8)
5. BF (Blown Fuse) Lights (I-8)
6. Output Circuit Fuses, 3A, Normal Blow (AGC 3)

Figure 40.
DC OUTPUT MODULE, TYPICAL

The module contains comparator circuitry to determine when the module is being addressed and an **on** board register for storing data before presenting that data to the output stages. Each of the eight output drivers uses a Darlington transistor as a switching device.

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Two types of output amplifiers are used on the DC Output modules, a sink version and a source version. With the source module, when an output is in the ON state, the Output terminal is pulled up towards the voltage of the positive side of the user power source. With the sink module, an Output terminal is pulled down toward the negative side of the user power source when the corresponding output is ON.

A circuit is provided that disables all of the outputs in the event of an I/O power supply, I/O chain, or CPU failure. This prevents improper operation which could damage equipment or cause injury to an operator.

A DC Output module can be installed in an I/O rack or in an I/O slot in a Model 60 CPU rack. Before installing the module the seven segment DIP switch on the backplane adjacent to the selected I/O slot should be configured to establish the I/O starting point number for the group of 8 outputs on the module. Refer to Figure 28 or Chapter 2 of this manual for instructions on setting the DIP switches. Instructions for connecting field wiring to a DC Output module can also be found in Chapter 2.

High-Density Output Modules

The High-Density Output modules provide 32 output circuits on each module and are available as either a 5V TTL or a I0-50V DC module. Both modules provide an optically isolated interface between the backplane I/O bus and user digital circuitry (5V TTL module) or discrete loads (I0-50V DC module). Table 20 lists the specifications for both modules.

	5V TTL Module	10-50V DC Module
Power Requirements	+5V DC, 200 mA maximum. Supplied by I/O rack power supply.	
User Supplied Voltage Ripple Current	 5 ± 0.25V DC < 100 mV 400 mA plus 5 mA per output ,point used	 I0-50V DC < 5v 350 mA plus 10 mA per output point used
Output Capabilities ON State (Output Low: Module acts as Current Sink) OFF State (Output High: Module acts as Current Source)	 50 mA 1mA	 250 mA Output Floats
Response Time	30 μs maximum	30 μs maximum
Fuse	3 A (Normal Blow)	1 A (Normal Blow)

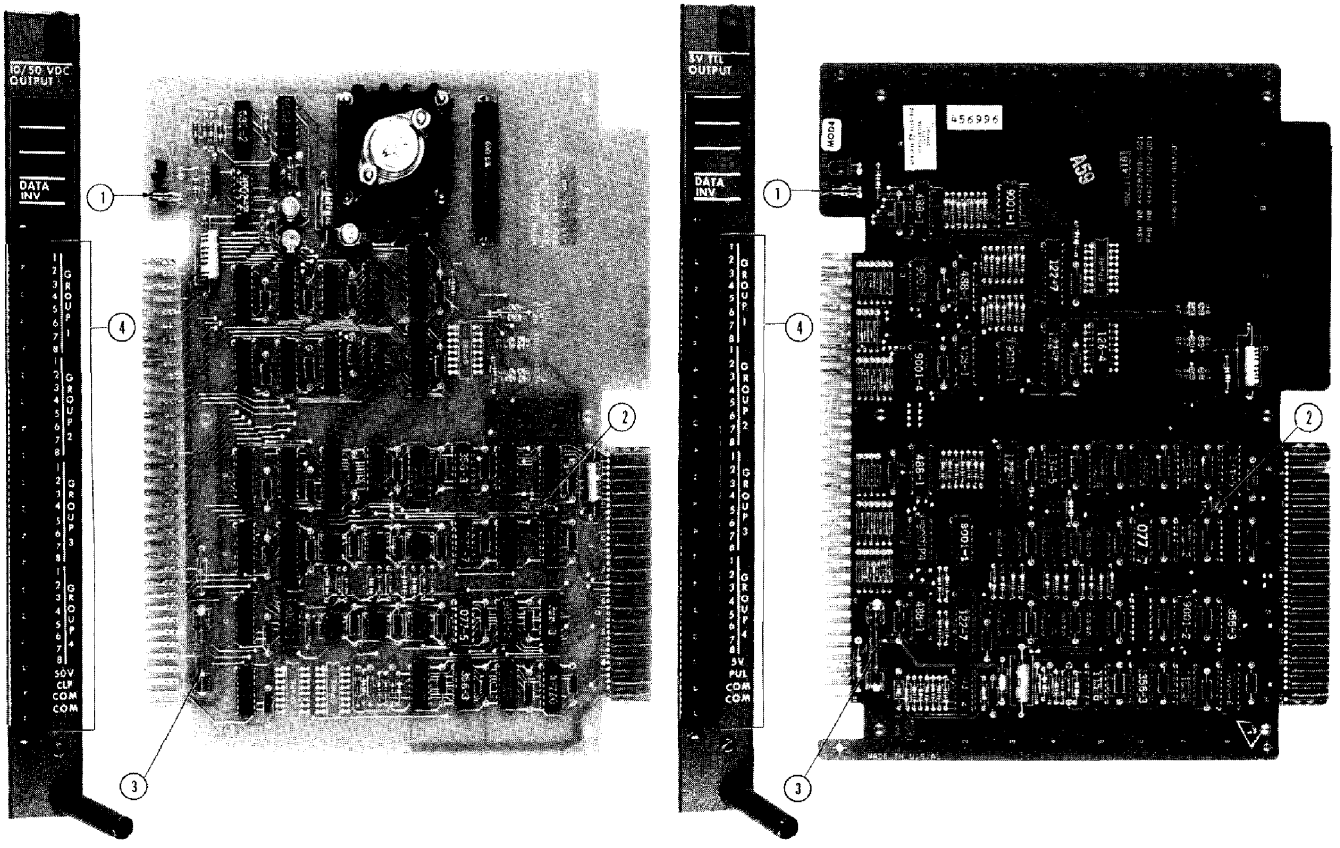
Table 20.
SPECIFICATIONS, HIGH-DENSITY OUTPUT

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The 32 outputs on this module are arranged in four groups with eight outputs in each group. A single group is read by the CPU during an I/O cycle. All 32 outputs (four groups) are read in four consecutive I/O cycles. A user supplied power source is connected to either the 5V (TTL module) or 5OV (IO-50V DC module) and COM terminals as required.

By connecting a jumper plug on the circuit board to the proper terminals, the user can select whether the data sent to the CPU is inverted (complemented) or non-inverted. An LED viewed on the faceplate provides a visual indication of the selected mode. See Figure 41.

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10/5OV DC

5V TTL

1 DATA INVert Light
On: The module is in the Inverting mode.
Off: The module is in the Non-Inverting mode.

2 NON-INV/INV Jumper
A,B Connected: module to the Inverting mode
B,C Connected: Sets module to the Non-Inverting mode.

3 Fuse
TTL Module: 3A, normal blow
IO-50V Module: 1 A, normal blow

4 User Connector Block

NOTE

In early versions of this module, the sense of the DATA INVert light is the reverse of the description above, i.e., the light is On in the Non-Inverting mode.

Figure 41.
HIGH-DENSITY OUTPUT MODULE

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NOTE

When using a High-Density Output module to drive a High-Density Input module, both modules should be configured in the same mode, either Inverting or Non-Inverting. Following this procedure will ensure that the bit values sent from the Output Status Table to the Input Status Table are not inverted.

The On state of an output point results when a "1" is in the Output Status Table with the module in the Non-Inverting mode. Conversely, an Off state exists with a "0" in the Output Status Table.

On the 10-50V module, an output terminal in the On state is virtually at the same voltage as the module common (COM) terminals. An output terminal in the Off state floats.

A TTL module operates with negative logic; i.e., a "1" in the Output Status Table causes the corresponding output voltage to go low. To use positive logic, the module should be configured to operate in the Inverting mode.

A High-Density Output module can be installed in an I/O rack or in an I/O slot in a Model 60 CPU. Before installing the module, the starting I/O point for that module should be selected by setting the seven segment DIP switch on the backplane adjacent to the I/O slot which will contain the module. Setting the DIP switches according to the chart in Figure 42 will reserve a group of 32 consecutive I/O points for that module beginning with the selected I/O point.

INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X X X X X (NOT USED)				
321-352		X		X		673-704	X		X		X						

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 42.
DIP SWITCH SETTINGS

Installation procedures for High-Density modules, including field wiring to the box lug terminals on the user connector block can be found in Chapter 2 of this manual.

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Analog Output Modules

The Analog Output module is available in three versions: unipolar, bipolar and current. Ranges for each version are shown in Table 2 1.

Module Type	Range
Unipolar	0 → +10V
Bipolar	-10-+10v
Current	4 → 20 mA

Table 21.
ANALOG OUTPUT MODULE RANGES

Each module has 4 output channels and provides conversion from 12 data bits. An Analog Output module receives from the CPU, twelve bits of binary output data and a binary number indicating which channel is to be accessed. The module functions as a digital-to-analog (D/A) converter and delivers the correct output voltage or current to the designated channel. Conversion from 12 data bits provides a resolution of 1 part in 4096.

Specifications for the Analog Output module are as shown in Table 22.

Power Requirements	**5V DC, 1.5A - Supplied by I/O Rack Power Supply.**
User Supplied 4 → 20 mA Module only (Optional)	**I8-42V DC, Regulated @ 100 mA (Can be common for all Channels or for individual channels).**
Output Current (On voltage ranges)	± 5 mA
Output Load Capacitance	**750 pF maximum.**
Cross Talk	**Offset of channel change from + full scale to - Full Scale is < 0.005%.**
Accuracy Resolution Linearity	 **12 Binary Bits (1 part in 4096)** **± 0.012% of Full Scale.**
Noise (Current Loop)	**< 1 uA rms, DC to 10 KHz.**
Total Output Drift @ 0 Volts out	10 ppm of Full Scale per °C, Typical 30 ppm of Full Scale per °C, Maximum
Total Output Drift @ Full Scale	20 ppm of Full Scale per °C, Typical

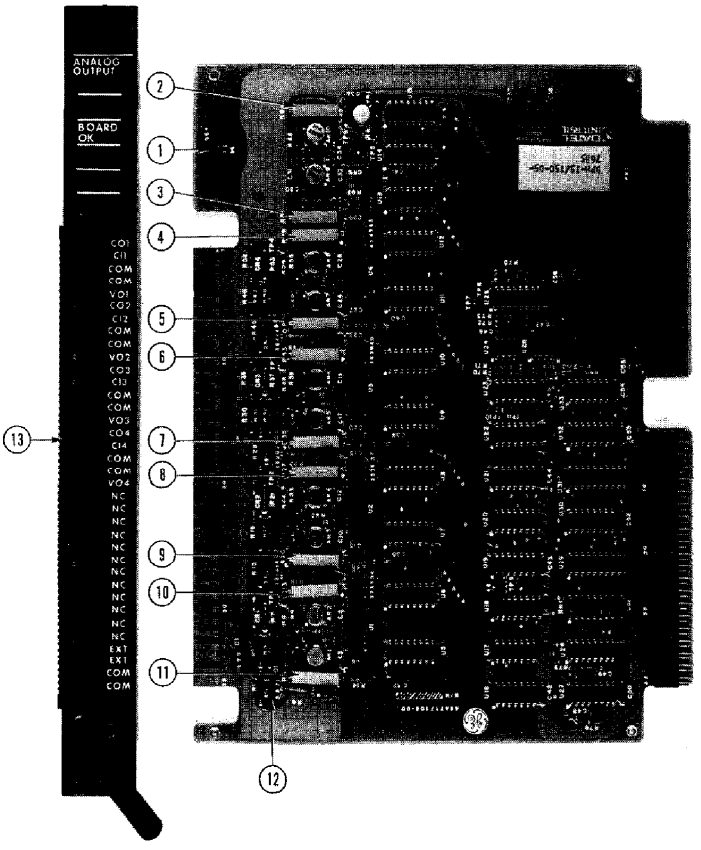
Table 22.
ANALOG OUTPUT SPECIFICATIONS

Each module contains an address decoder to determine when the module is being addressed, opto-isolation circuitry, D/A and output amplifier circuitry. On the unipolar and bipolar voltage output modules, an internal power converter (DC/DC converter) delivers output levels that are isolated from the **I/O bus. On the current output module, output power can be derived from this converter or an external** power source can be provided by the user, thereby reducing the load on the I/O rack power supply. One LED indicator displays the status of the module.

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A jumper must be set on the current output module. If the internal loop supply is used to power the outputs the circuit board jumper (refer to Figure 43) should connect pins 1 and 2. If a common external source that provides a regulated +18V to +42V DC @ 100 mA is used, the jumper should connect pins 2 and 3. During operation, there is a significant voltage drop across the output devices; i.e., between the low side of the load and the low side of the source.

Five connections are provided on the user connector block for each of the four output channels. Field wiring is configured at these terminals according to the type of module. Detailed installation and wiring instructions are provided in Chapter 2.



1. BOARD OK Light
2. R69, Factory Set Pot
3. R61, Factory Set Pot
4. R59, Gain Pot, Channel No. 0
5. R51, Offset Pot, Channel No. 0
6. R43, Gain Pot, Channel No. 1
7. R35, Offset Pot, Channel No. 1
8. R27, Gain Pot, Channel No. 2
9. R20, Offset Pot, Channel No. 2
10. RI 3, Gain Pot, Channel No. 3
11. R6, Offset Pot, Channel No. 3
12. Jumper to Select Internal Loop Supply/Common External Source
13. User Connector Block

NOTE

Pots R69 and R61 are set at the factory and should not be adjusted. If the settings are accidentally changed, contact the GE PC Service Center at (804) 978-5747 for assistance.

Figure 43.
ANALOG OUTPUT MODULE

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An Analog Output module can be installed in an I/O rack or in one of the six I/O slots in a Model 60 CPU. Before the module is installed the seven segment DIP switch on the backplane adjacent to the selected I/O slot should be configured to select the starting I/O point number for the module. A group of 16 consecutive I/O points are reserved for the module by setting the DIP switch. Figure 44 shows the DIP switch settings for an Analog Output module.

INPUT NUMBER	DIP SWITCH POSITION						INPUT NUMBER	DIP SWITCH POSITION						INPUT NUMBER	DIP SWITCH POSITION					
	7	6	5	4	3	2		7	6	5	4	3	2		7	6	5	4	3	2
1-16							353-368		X		X	X		705-720	X		X	X		
17-32						X	369-384		X		X	X	X	721-736	X		X	X		X
33-48					X		385-400		X	X				737-752	X		X	X	X	
49-64					X	X	401-416		X	X			X	753-768	X		X	X	X	X
65-80				X			417-432		X	X		X		769-784	X	X				
81-96				X		X	433-448		X	X		X	X	785-800	X	X				X
97-112				X	X		449-464		X	X	X			801-816	X	X				X
113-128				X	X	X	465-480		X	X	X		X	817-832	X	X			X	X
129-144			X				481-496		X	X	X	X		833-848	X	X		X		
145-160			X			X	497-512		X	X	X	X	X	849-864	X	X		X		X
161-176			X		X		513-528	X						865-880	X	X		X	X	
177-192			X		X	X	529-544	X					X	881-896	X	X		X	X	X
193-208			X	X			545-560	X				X		897-912	X	X	X			
209-224			X	X		X	561-576	X				X	X	913-928	X	X	X			X
225-240			X	X	X		577-592	X			X			929-944	X	X	X		X	
241-256			X	X	X	X	593-608	X			X		X	945-960	X	X	X		X	X
257-272		X					609-624	X			X	X		961-976	X	X	X	X		
273-288		X				X	625-640	X			X	X	X	977-992	X	X	X	X		X
289-304		X				X	641-656	X		X				993-1008	X	X	X	X	X	
305-320		X			X	X	657-672	X		X			X	1009-1024	X	X	X	X	X	X
321-336		X		X			673-688	X		X		X			(Not Used)					
337-352		X		X		X	689-704	X		X		X	X							

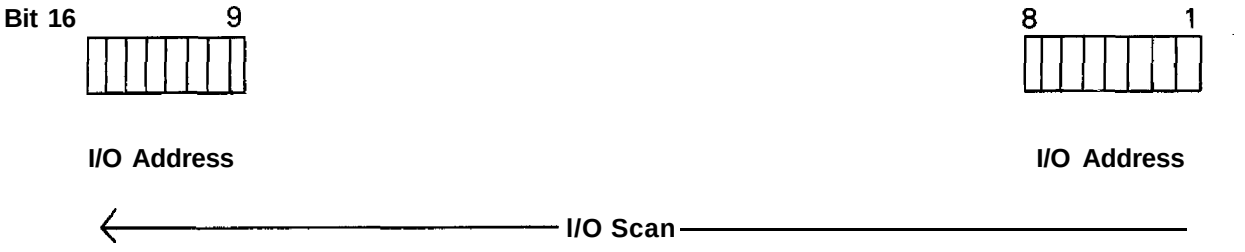
X = Switch in OPEN Position (Depressed to the Left)
Switch #1 Should be in CLOSED Position

Figure 44.
DIP SWITCH SETTINGS FOR ANALOG OUTPUT MODULES

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Two consecutive I/O addresses (16 I/O points) are required to write all 16 bits of information associated with each channel. A single channel is normally accessed during each sweep. The channel number is determined by the CPU under control of the user program. The information in the Output Status Table is accessed during the f/O scan as shown below.

OUTPUT STATUS TABLE DISPLAY



Bit 1 corresponds to the lowest output number in the group of 16 outputs reserved for the module, while Bit 16 corresponds to the highest output number in the group. For example if DIP switches 2 and 6 are set OPEN and all others are in the closed position (see Figure 44) then Outputs 273 to 288 in the CPU Output Status Table, and in the user program would correspond to Bits 1 to 16 in the Digital Data Format description. The significance of each of the bits is defined in Table 23.

Bit	Definition	Bit	Definition
Bits l-8	Data: Eight least significant of the twelve bits of data. Bit 1 is the least significant bit (LSB).	Bits 13-14	Channel Number: 2-bit binary number which determines the number of the channel (0→3) being written. Bit 14 is the MSB.
Bits 9-I 2	Data: Four most significant of the twelve bits of data. Bit 12 is the most significant bit. For the bipolar (-10→+10V) module, Bit 12 functions as a sign bit.	Bits 15-16	Not used: (May be in either a HIGH *or* LOW state.)

Table 23.
DIGITAL DATA FORMAT

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The twelve bits of data should be in straight binary form for positive output values, or in 2's-complement form for negative values.

The 2's-complement form of a binary number is found by inverting (complementing) all bits and then adding one. For example, the decimal number 770 can be expressed as the 16-bit binary number 0000001 100000010. To find the 2's-complement form: first invert, giving 1 1 1 1 1 1001 1 1 1 1 101; then add one to this, giving 1 111 1 1001 1 11 1 1 10. This would be a representation of the decimal number -770.

Each channel on the module can be set independently for an output range of either 0→+1 OV, -1 0→+1OV, or 4-20 mA by configuring jumpers on the printed circuit board. Refer to the Installation section (Chapter 2) of this manual for instructions on configuration of the jumpers.

It is recommended that calibration of the Analog Input Module be performed every 90 days at normal operating temperature. Calibration procedures are detailed in Chapter 2 of this manual.

NOTE

The Analog Output module will function properly only when used with CPUs with the following serial numbers:

Model 60 CPU: CI 88-8135-0130, and higher.

Model 600 CPU: CI 88-8138-0100, and higher.

Model 6000 CPU: CI 88-8138-6000, and higher.

If your CPU has a serial number lower than that listed, contact the PC Product Service Specialist at (804) 978-5624 for assistance.

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Reed Relay Output Module

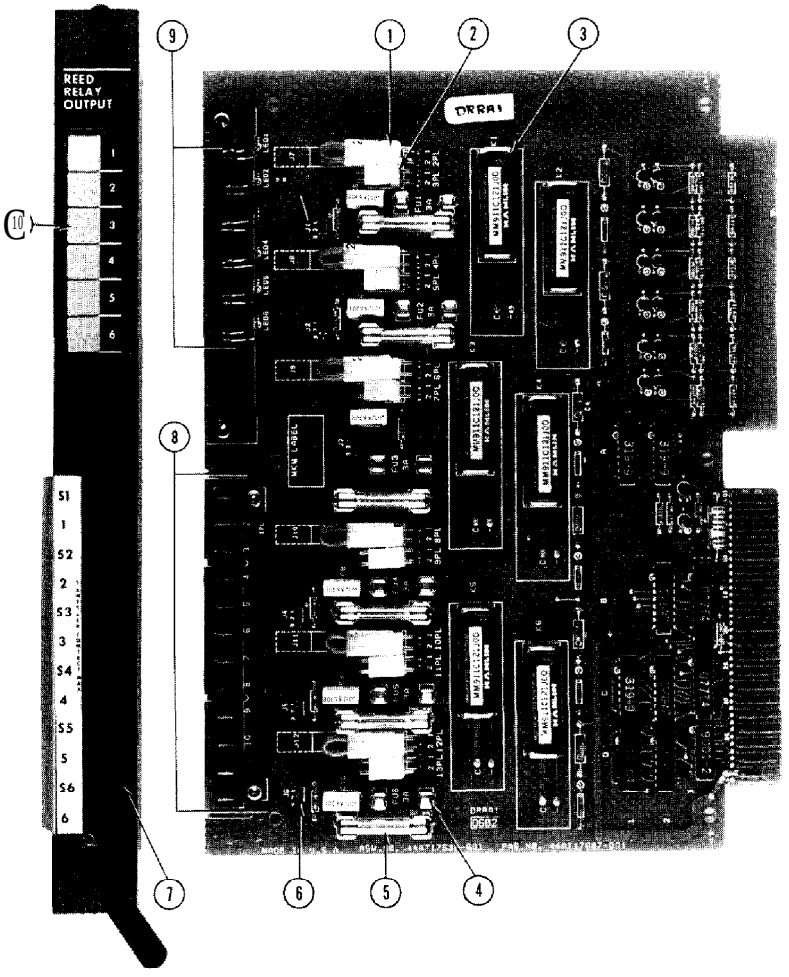
The Reed Relay Output Module provides six form C, mercury-wetted outputs. This module can be used to switch loads with voltages up to 250V AC/DC at 2 amps. Each of the outputs is individually fused and has an LED indicator that turns on when the corresponding reed relay coil is energized. Table 24 is a list of specifications for this module.

Contact Type	**Form C, Normally Open (N.O.) or Normally Closed (N.C.) - Jumper Selectable**
Power Requirements	+5V DC, 1 .OA maximum. Supplied by I/O rack power supply.
User Supplied Voltage Current Voltage Drop Power	 250V AC/DC maximum 2A continuous, 2A inrush .4V @ 2A 100 VA maximum
ON Delay OFF Delay	2 msec 3 msec
Contact Resistance	50 millohms maximum
Contact Life	100,000,000 (10^8) operations, with contact protection
Contact Protection	RC network (68 Ω, .012 μf) Jumper selectable for in or out of circuit.
Fuse Rating	3A

Table 24.
SPECIFICATIONS, REED RELAY MODULE

Each circuit has a jumper plug to allow selection of the de-energized state of the relay in that circuit to have either normally open (N.O.) or normally closed (N.C.) contacts. A second jumper in each circuit allows removal of the RC protection circuit across each output. Removal of this jumper plug which is in series with the RC circuit allows for the operation of low level analog and instrumentation signals where arc suppression is not a factor during normal operation. Fuse clips are provided for both American **(I/4" x 1 I/4") and European (5mm x 20mm) style fuses. Figure 45 is a Reed Relay Output module with the** described features indicated.

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1. Jumpers: 2,4,6,8,10, 12 PL - Select Normally Open Contacts
2. Jumpers: 3,5,7,9,11 ,13 PL - Select Normally Closed Contacts
3. Kl to K6, Mercury Wetted Contact Reed Relays
4. Fuse Clip, European Style Fuses (6)
5. Fuse, 3A Normal Blow (6)
6. Jumpers (Jl -J6) for Selection of Contact Protection RC Network to be In or Out of Circuit
7. User Terminal Block
8. Circuit Board Terminal Block
9. LED 1 to LED 6, On when Relay Coil Energized
IO. Markable Lens Surface

Figure 45.
REED RELAY OUTPUT MODULE

A Reed Relay Output module can be installed in any slot in an I/O rack (except the left slot) or in an I/O slot in a Model 60 CPU. Before installing the module the I/O starting point number for that module should be selected by setting the seven segment DIP switch on the backplane adjacent to the selected I/O slot. A Reed Relay Output module, since it has six outputs, will respond to the first six output points in the selected group. Refer to Figure 28 or Chapter 2 of this manual for instructions on setting the DIP switches.

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Each circuit has two output connections for user field wiring. One side of each load to be controlled by this module connects to the appropriate output terminal, 1 through 6. The other side of the load is connected through the power source to terminals SI through S6. Each terminal will accommodate up to one No. 12 AWG or two No. 14 AWG wires. Further instructions for installation of this module can be found in Chapter 2 of this manual.

I/O SYSTEM CONFIGURATION

A Series Six I/O system can be configured by using 3 types of interconnected I/O groupings of racks. An I/O system is compatible with all 3 models of Series Six CPU's. The 3 systems (stations) are described in this section. I/O racks are connected by interface modules in the CPU or I/O racks. Interfacing is through the parallel bus channel using a 16-pair shielded cable for the CPU I/O station and the Local I/O station. Interfacing to the Remote I/O station is through a serial communication channel using a 2-pair shielded cable or an RS-232 modem link. The number of I/O racks and modules in a system is determined by the number of I/O points supported by the model of Series Six CPU used in a system. Each I/O rack contains a power supply, an interface module and up to 10 additional modules. The station configuration will be explained in more detail in the illustrations of each I/O station in this section.

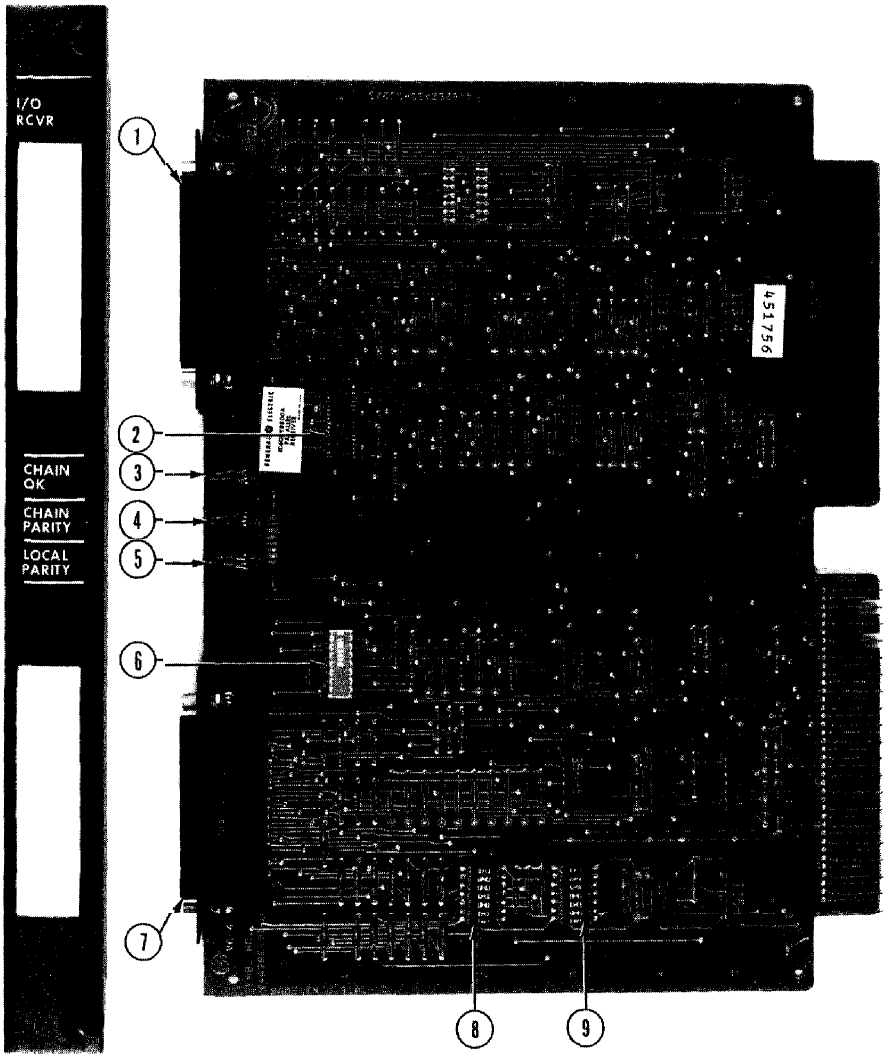
I/O SYSTEM COMMUNICATION MODULES

The I/O system communication modules connecting I/O racks to the CPU and I/O racks to I/O racks are described in this section.

I/O RECEIVER

The function of the I/O Receiver (Figure 46) is to interface the I/O chain parallel bus to the I/O modules in an I/O rack. I/O racks are connected in a station (grouping of I/O racks) by linking I/O Receivers together through a 16-pair twisted cable. No more than 10 racks can be connected in a station. A linking of racks in this configuration is referred to as a daisy chain. The total cable length in a daisy chain from the I/O Control module in a CPU station or the originating I/O Receiver in a Local I/O station can be no more than 50 feet (15 meters).

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1. Connector to Upstream I/O Receiver, I/O Transmitter, I/O Control or Remote I/O Receiver Module
2. Socket, Location C1. Contains a DIP Shunt when used for I/O Chain Signal Termination
3. CHAIN OK Light
4. CHAIN PARITY Light
5. LOCAL PARITY Light
6. Socket, Location D1. Contains Jumper Pack for Continuation of I/O Chain Signals or DIP Shunt for I/O Chain Signal Termination
7. Connector to Downstream I/O Receiver Module
8. Socket, Location F2
9. Socket, Location F3

} Storage of DIP Shunts or Jumper Pack when not used

Figure 46.
I/O RECEIVER

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The I/O Receiver module receives signals through the parallel bus link, modifies the signals to update the status of inputs and outputs, then relays those signals to the next rack in a chain. Racks can be connected when they are more than 50 feet (15 meters) from a CPU by connecting an I/O Receiver in the first rack of the distant grouping to an I/O Transmitter through a 16-pair twisted cable on the parallel bus. The length of this cable can not exceed 500 feet (150 meters). This distant grouping of racks at the end of a parallel bus cable is referred to as a Local I/O station. Again, up to 10 I/O racks can be daisy-chained in a Local I/O station with no more than 50 feet (15 meters) of cable separating the first and the last rack. The maximum distance an I/O Receiver can be located from the originating I/O Control or Auxiliary I/O Control module is 2000 cable feet (600 meters). In a Remote I/O station, an I/O Receiver is used when connecting racks on the daisy chain in the station if more than one I/O rack is required in the station.

An I/O Receiver can be installed in any I/O rack except the first I/O rack in a Remote I/O station. This module is normally installed in the left most slot of an I/O rack; however, it could be inserted into any I/O slot in an I/O rack if required.

I/O Chain Signal Continuation Or Termination

Before installation of an I/O Receiver in an I/O rack, it should be determined if the module is to be in the last rack of an I/O station daisy chain or in a rack within the chain. An I/O Receiver as received from the factory is configured to continue the I/O chain signals through the module toward the next I/O Receiver in the chain. (See Figure 47). If the module is to be the last I/O Receiver in the daisy chain a jumper pack must be removed from its socket at location D1 and DIP shunts inserted into the sockets at locations C1 and D1. When installed in these locations, the DIP shunts will cause the I/O chain signals to terminate.

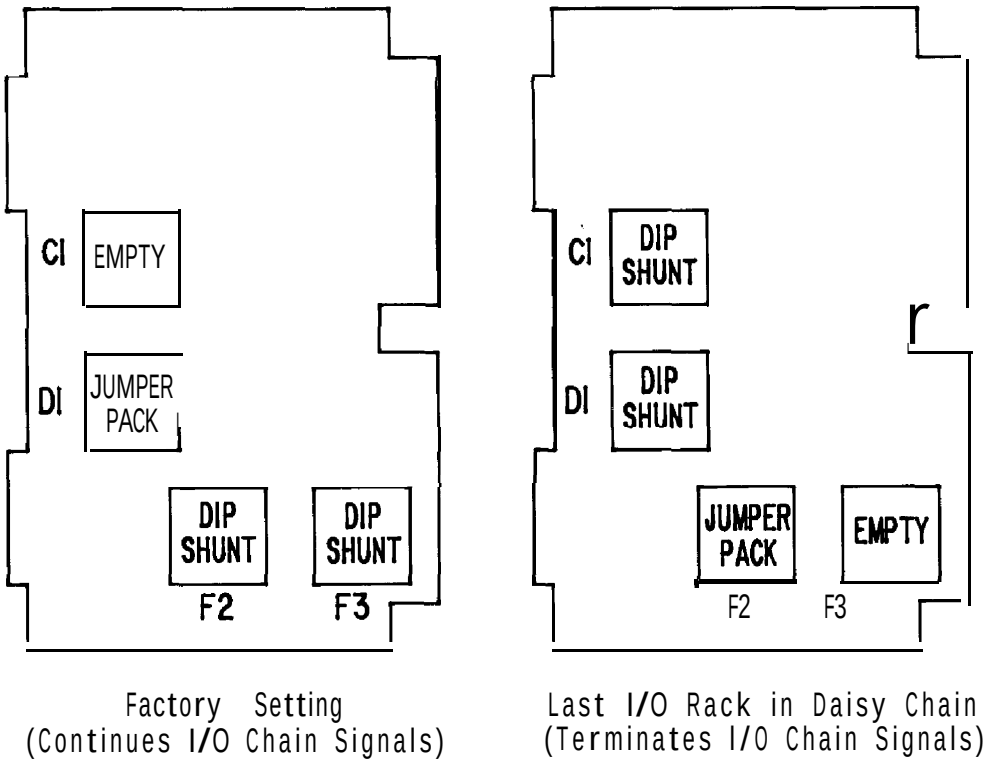


Figure 47.
1/0 RECEIVER DIP SHUNT/JUMPER PACK CONFIGURATION

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If an I/O Receiver should be removed from the last rack in a daisy chain and moved to a rack upstream, the jumper pack and DIP shunts must be reconfigured to continue the I/O chain signals. Conversely, if an I/O Receiver is moved from a rack within the chain to the last rack in the chain, the jumper pack and DIP shunts must be reconfigured to terminate the I/O chain signals.

When a jumper pack is not inserted in location D1 or the DIP shunts are not installed in locations Cl and D1 they should be inserted in spare sockets located at the bottom of the printed circuit board. These spare sockets are in board locations F2 and F3.

Connectors

Two 37 pin D-type connectors are mounted on the front edge of the module. The bottom connector connects to downstream I/O racks. The top connector connects to the next upstream I/O rack, to an I/O Transmitter at the opposite end of a parallel bus cable, or to an I/O Control module in a CPU rack.

Indicators

There are three edge-mounted LEDs which provide a visual status of various fault indications on the I/O chain. The LEDs are viewed through the lens on the faceplate. Table 25 defines the status indicated by each LED.

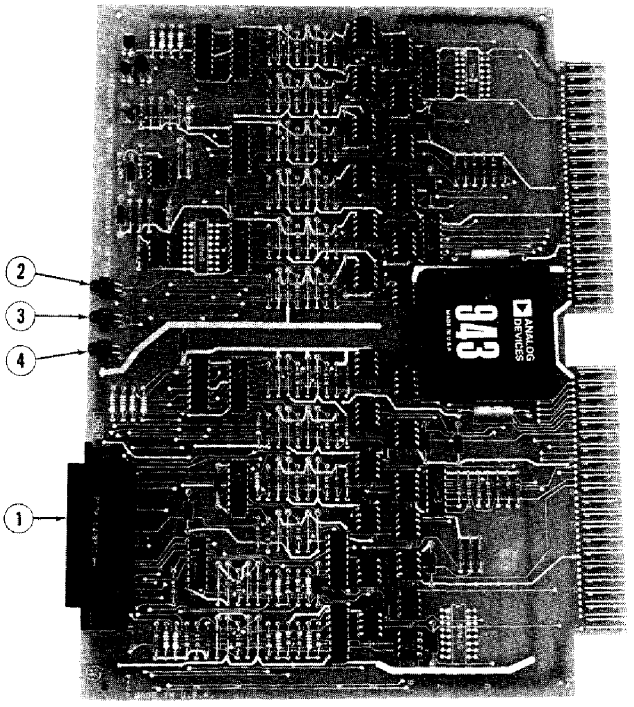
INDICATOR	DEFINITION
CHAtN OK	ON when station power is present, continuity is present and all stations downstream are OK.
CHAIN PARITY	ON when all downstream stations have received good parity.
LOCAL PARITY	ON when the l/O Receiver has received good output parity.

Table 25.
I/O RECEIVER STATUS INDICATORS

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I/O TRANSMITTER

The I/O Transmitter module (Figure 48) is used to provide an interface between the rack backplane signals and the i/O bus to a downstream Local I/O station. An l/O Transmitter should be used to interface to a Local I/O station if I/O racks are required beyond the capacity of a CPU station (10 I/O racks), an existing Local I/O station or a model 60 CPU. Any number of I/O Transmitters can be installed in a rack as long as the I/O load for the rack and the distance limitations are not exceeded. An l/O Transmitter can be installed in a Remote I/O station and linked to additional I/O Transmitters up to 2000 feet (600 meters), thereby extending the Remote I/O capability by that distance. Each I/O Transmitter link cannot exceed 500 feet (150 meters). It should be noted that no more than four I/O Transmitter links can be used with the 2000 foot limitation on the parallel I/O chain.



1. Connector to I/O Receiver Module in Downstream I/O Station
2. CHAIN OK Light
3. CHAIN PARITY Light
4. ISOLATED POWER Light

Figure 48.
l/O TRANSMITTER

The I/O Transmitter translates the l/O rack backplane signals into isolated, balanced signals at a level suitable for transmission up to 500 feet (150 meters) and with sufficient power to drive up to **10 I/O** Receivers. Optocouplers on the module isolate signals passing through the module and a DC to DC converter provides a +5V DC isolated supply voltage to those circuits connected to the parallel l/O bus. This method of isolation ensures that all Local I/O stations are electrically isolated from each other and from the CPU station.

An l/O Transmitter can be installed in any card slot in an l/O rack except the left most slot which is normally reserved for an I/O Receiver. The seven-segment DIP switch on the backplane adjacent to the selected slot for the module does not need to be set since it does not affect the operation of the module. An l/O Transmitter does not require an I/O address.

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Status Indicators

A monitor circuit checks the output level of the isolated +5V DC supply. If the output is not within its specified tolerance, the monitor circuit causes the I/O Transmitter to shut down. An LED indicator is on when the voltage is within tolerance. In addition, there are LED indicators for CHAIN OK and CHAIN PARITY status. Table 26 defines the status information provided by the indicators.

INDICATOR	DEFINITION
CHAIN OK	ON when station power is OK and continuity is present to all downstream stations.
CHAIN PARITY	ON when output parity is OK at all downstream stations,
ISOLATED POWER	ON when the output voltage of the +5V DC isolated power supply is within tolerance.

Table 26.
I/O TRANSMITTER STATUS INDICATORS

Connector

One 37 pin D-type connector is mounted on the bottom front edge of the circuit board. A 16-pair parallel cable plugged into this connector in a model 60 CPU, a CPU station or a Local I/O station connects to the first I/O Receiver in a Local I/O station at a distance not to exceed 500 feet (150 meters).

REMOTE I/O SYSTEM

The Remote I/O system allows a Series Six system to have an I/O capability that extends beyond the limit of the 2000 feet (600 meters) maximum distance allowed with the parallel I/O bus. A Remote I/O system can be located a maximum of 10,000 feet (3 Kilometers) from a model 60 CPU, a CPU station, or a Local I/O station when using a two twisted-pair serial cable. In addition a Remote I/O system can be transmitted over voice grade telephone lines through RS-232 or RS-422 compatible modems to a location a great distance from the originating I/O station.

System Connection

A Remote I/O system consists of a Remote I/O Driver, a two twisted-pair serial cable or modems and a Remote I/O Receiver. The Remote I/O Driver is installed in a model 60 CPU, a CPU station or a Local I/O station. The Remote I/O Driver is then connected by cable or a modem link to a Remote I/O Receiver in the first slot of the first I/O rack of a Remote I/O station. If the Remote I/O Driver and Remote I/O Receiver are to communicate by connection to modems, the Remote Receiver module must be installed in a High-Capacity I/O rack and the Remote Driver must be in either a High-Capacity I/O rack or a model 60 CPU, since a 12V DC source must be available to conform to RS-232 specifications. Figure 49 illustrates the two methods of system configuration described above.

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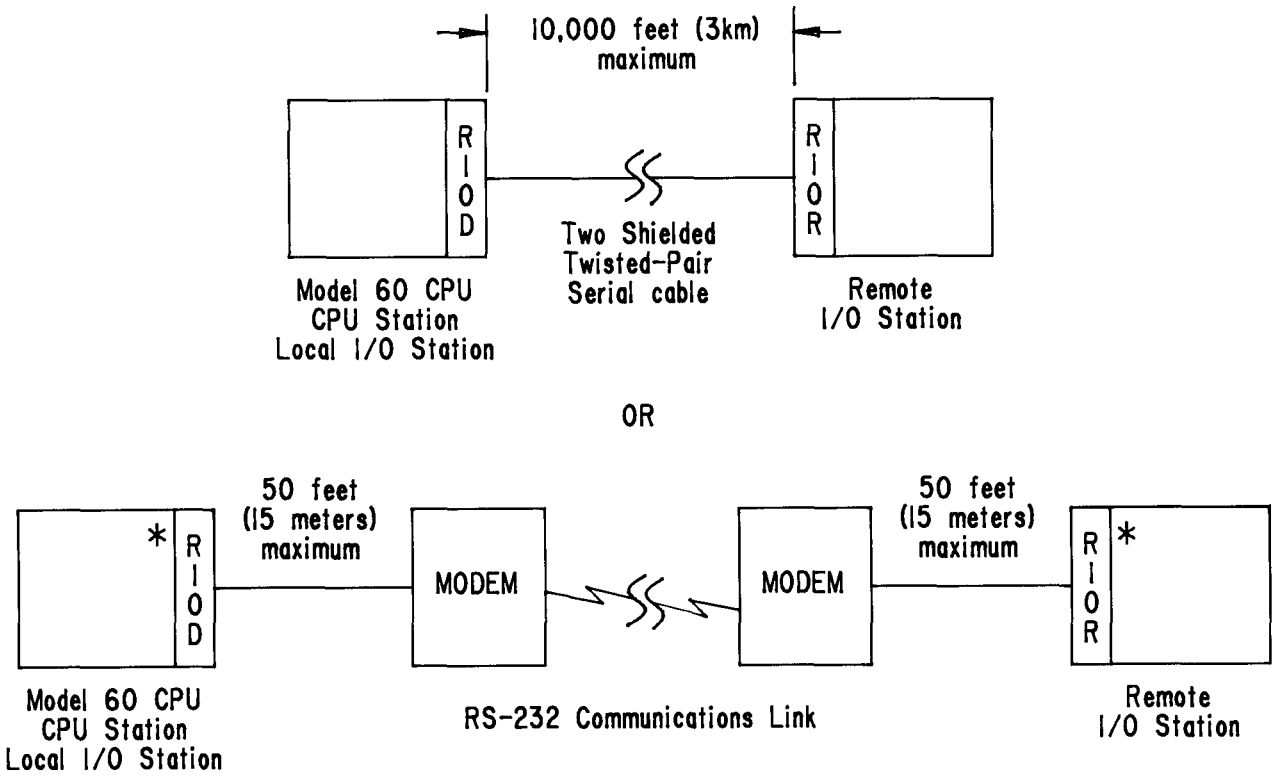


Figure 49.
CONNECTION TO A REMOTE I/O SYSTEM

The response time of a Remote I/O system is slightly delayed because of the distance when using up to the 10,000 foot (3Km) maximum cable length. The response time is delayed further when connection to the Remote I/O is made through the communications link using modems. Part of the delay in response time is due to the fact that the Remote I/O Driver stores output and input data and provides this data when needed to the Remote I/O Receiver and the CPU. This store and forward technique results in a one sweep delay.

NOTE

A one sweep delay for inputs can be avoided if a DO I/O instruction is executed for the Remote I/O prior to executing any logic using remote inputs.

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System Response

System response times to the Remote I/O for each of the valid baud rates are summarized in Table 27. The times as listed are approximate maximum response times and may vary slightly from system to system. These response times are due to hardware considerations related to communications between a Remote I/O Driver and a Remote I/O Receiver (component tolerance, cable length, etc.).

Quantity of I/O in Block	BAUD RATE							
	110	300	1200	2400	9600	19.2K	57.6K	
120 I/O								
Output Delay	6 sec.	2 sec.	.5 sec.	.25 sec.	70 ms	40 ms	20 ms	(1)
Input Delay	10 sec.	4 sec.	.9 sec.	.5 sec.	.1 sec.	60 ms	25 ms	(2)
248 I/O								
Output Delay	11 sec.	4 sec.	1 sec.	.5 sec.	.14 sec.	75 ms	30 ms	(1)
Input Delay	18 sec.	6.5 sec.	1.6 sec.	.9 sec.	.2 sec.	.1 sec.	46 ms	(2)

(1) + 1 sweep for all baud rates
(2) + 2 sweeps for all baud rates

Table 27.
SYSTEM RESPONSE TIMES TO REMOTE I/O

Remote I/O Addressing

A Remote I/O system normally responds to a block of 128 inputs and 128 outputs or 256 inputs and 256 outputs. However, eight inputs and eight outputs are used by the Remote I/O Driver for system status information, thus allowing a total of either 120 inputs and outputs or 248 inputs and outputs. The block of either 120 I/O or 248 I/O is selected by positioning of a jumper on the Remote I/O Driver module.

The unique I/O points (addresses) for each module in a Remote I/O station are selected by setting the seven segment DIP switch on the backplane adjacent to each slot in the I/O rack. However; all I/O points selected must be within the block selected for the Remote I/O station. The I/O points in a remote system must be within one of the blocks as listed in Table 28.

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120 Inputs and 120 outputs	248 Inputs and 248 Outputs
I-128 129-256 257-384 385-512 513-640 641-768 769-896 897-1000 ①	I-256 257-512 513-768 769-1000 ②

① This block selected allows 96 inputs and 96 outputs.

② This block selected allows 224 inputs and 224 outputs.

Table 28.
I/O POINT RANGES AVAILABLE IN REMOTE I/O STATIONS

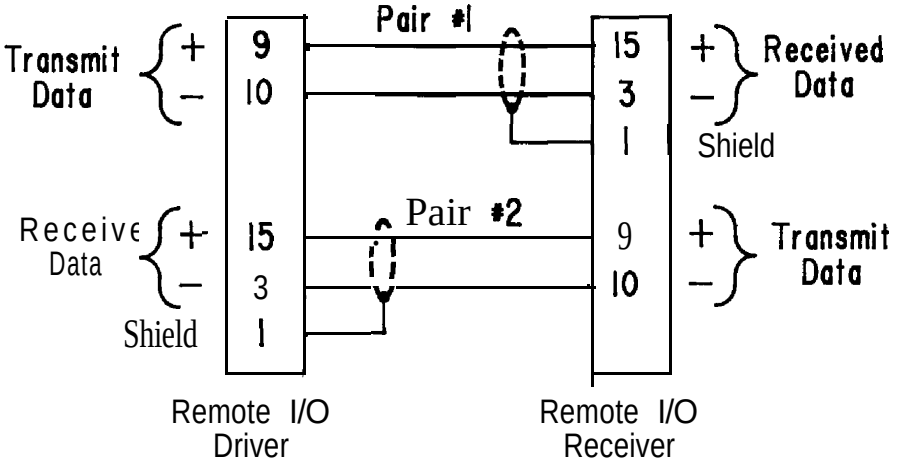
The address selected for the Remote I/O Driver can fall anywhere within the range of I/O points in a block. All I/O modules in a Remote I/O station (including the Remote I/O Driver) must have switches 5,6 and 7 (120 I/O) or 6 and 7 (248 I/O) set the same. By doing this all modules in a Remote station are thus tied to that particular Remote I/O Driver. More than one Remote I/O station can be programmed to the same I/O block; however, each Remote Driver must have its own unique address. Each Input module must also have a unique address, output module addresses can be duplicated. Unused I/O points in a Remote I/O station can be used by another Remote I/O station, a Local I/O station, a CPU station or a model 60 I/O slot.

For additional information on selection of I/O points in a Remote I/O station refer to Chapter 2, Installation, of this manual.

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Cable Wiring

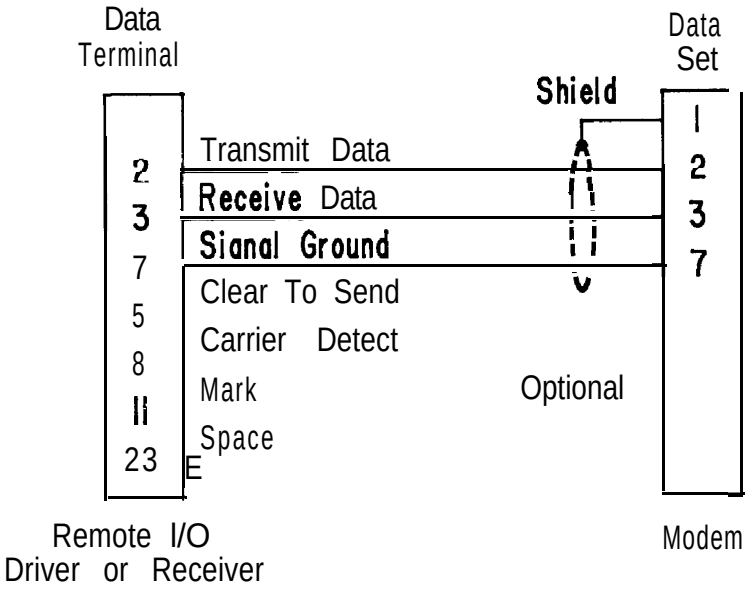
Wiring connections required for use with the remote I/O modules are shown in Figures 50 and 5 1. Two methods of connection are shown. Figure 50 shows two twisted pairs, Figure 51 shows wiring for connection using RS-232 modems. Note that both the Remote I/O Driver and Remote I/O Receiver are configured as Data Terminal devices when connection is by RS-232 modems.



CABLE SPECIFICATIONS
Length, Maximum - 10,000 feet (3 kilometers) Two Individual Shielded, Twisted Pairs 22 AWG, Minimum 15 pf/foot, Maximum Cable Type - National Electric Cable Co. 22P1 SLCBT or equivalent Connector (Driver and Receiver End) - D-Subminiature Type, Cannon DBC25P with 207908-7 Hood or Equivalent connector and hood.

Figure 50.
REMOTE I/O CONNECTION USING TWISTED PAIR CABLE

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CABLE SPECIFICATIONS
Length, Maximum - 50 Feet (15 Meters)
Overall Shield
24 AWG, Minimum
Connector, Driver or Receiver End - D-Subminiature Type, Cannon DBC25P with 207908-7 Hood or Equivalent
Connector, Modem - User selected

Figure 5 1.
REMOTE I/0 CONNECTION USING RS-232 MODEMS

If connection is to be by the RS-232 method, control signals are available if required by the RS-232 device. Jumpers would need to be changed to configure both the Remote Driver and Receiver to recognize these signals. If RS-232 outputs (such as Request to Send) are expected. RS-232 MARK and SPACE signals are available for use as required.

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Printed Circuit Board Jumpers

There are several printed circuit board jumper plugs which must be properly configured for operation of a Remote I/O system. Jumper plugs are located on both the Remote I/O Driver and the Remote I/O Receiver. Factory configuration of these jumpers is set for the following options.

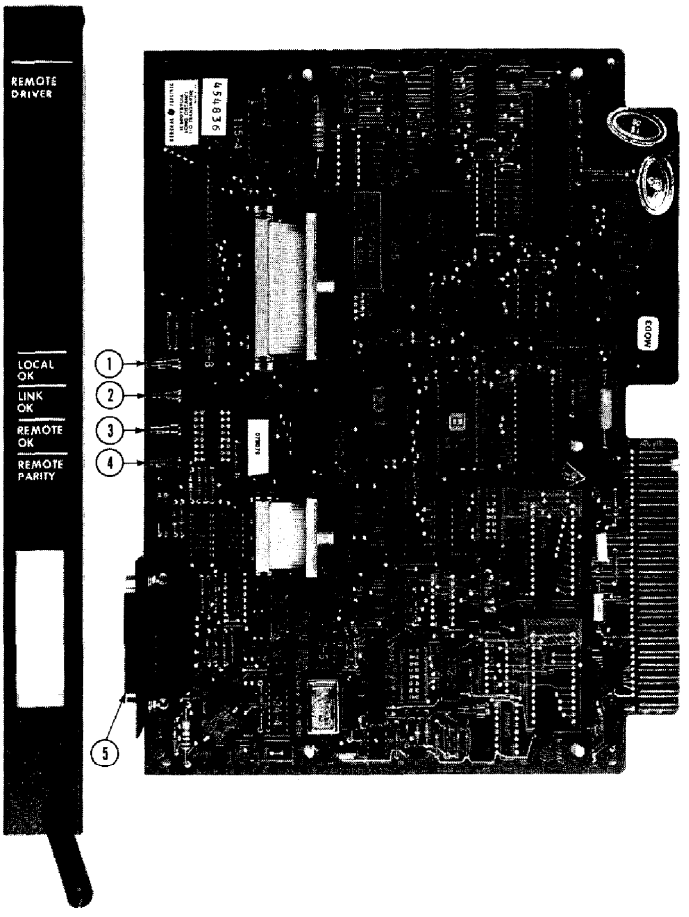
- 120 Inputs and 120 Outputs
- Connection up to 10,000 feet (3Km) using two twisted pair serial cable
- Baud rate - 57.6Kb
- Halt CPU on communications failure or Remote I/O parity error.
- Turn all outputs off on communications failure
- Odd serial parity

If a block of 248 Inputs and 248 Outputs, or the Remote I/O system is to be linked with RS-232 compatible modems, or any of the other options are to be changed, the printed circuit board jumper plugs must be reconfigured. A table listing all jumpers which can be configured by the user can be found in Chapter 2.

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REMOTE I/O DRIVER

The Remote I/O Driver module (Figure 52) provides control and data signals to a Remote I/O station. Circuitry on this module converts output data from parallel to serial and input data from serial to parallel. Specifically, a Remote I/O Driver connects the I/O structure in a model 60 CPU, a CPU station or a Local I/O station to a Remote I/O station through a serial communications channel by direct connection with a two twisted pair cable or a communications link using RS-232 compatible modems. Using the two twisted pair cable, the Remote l/O station can be located up to a maximum of 10,000 feet (3 kilometers) from the Remote l/Q Driver. A communications link using modems allows connection over a much greater distance. An I/O Transmitter located in a rack in the Remote I/O station can be the first of a link of up to four 500 foot (150 meters) links using I/O Transmitters, thereby extending the remote capability an additional 2000 feet (600 meters).



1. LOCAL OK Light
2. LINK OK Light
3. REMOTE OK Light
4. REMOTE PARITY Light
5. Connector to Remote I/O Receiver in a Remote System

NOTE

For Location of Option Jumpers, Refer to Chapter 2, Figure 18

Figure 52.
REMOTE l/O DRIVER MODULE

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The Remote I/O Driver has circuitry sufficient to drive up to 248 Inputs and 248 Outputs. A Remote I/O Driver module can be installed in any unused I/O slot in a CPU station, a Local I/O station or a model 60 CPU (except the left most slot in an I/O rack which is reserved for a Receiver module). If connection to the Remote I/O station is to be made through a modem link, the Remote I/O Driver must be installed in a High-Capacity I/O rack. This is necessary since the RS-232 specification requires +12 and -12V DC for operation.

Addressing

As described previously, a block of addresses for the Remote I/O station is established by setting the seven segment DIP switch adjacent to the slot selected for the Remote I/O Driver. For a block of 120 I/O, switches 5, 6, and 7 are set to select the block and for 248 I/O, switches 6 and 7 are set to select the block of l/O addresses. All I/O modules in the Remote I/O station connected to a Remote I/O Driver must then have the corresponding DIP switch segments set in the same configuration as the Remote I/O Driver. In all cases switches 1 to 4 or 1 to 5 (in addition to 5, 6, 7 or 6, 7) are configured to set a unique address for each module in the Remote l/O station; i.e. l-8, 249-256, 673-680, etc.

A unique I/O reference (address) must also be set for the Remote l/O Driver and can be the first of any group of eight consecutive valid l/O references within the selected block. The eight input references provide status information which can be monitored on the Program Development Terminal by observation of the Input Status Table. The eight output references are for future use. Table 29 lists the information provided by these inputs. In the table, l/O references 0297-0304 are used as an example. As viewed in the Status Table, a "1" indicates that the input is on and a “0” indicates that the input is off.

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input #	I/O Reference	Information Provided
1	10297	Input toggles every time new input data is transferred to the CPU.
2	10298	Reserved
3	10299	Reserved
4	10300	Remote Parity 0 = Parity error in Remote I/O station. 1 = Remote parity good.
5	10301	Remote OK 0 = Fault in Remote System (Power supply failure, parity error, etc.) 1 = Normal operation, Remote I/O OK.
6	10302	Link OK 0 = Error detected with communications between Remote I/O Driver/Receiver. 1 = Communication link good.
7	10303	Local OK 0 = Fault in Remote I/O Driver module. 1 = Remote I/O Driver operation normal.
8	10304	Heartbeat This input cycles from 0 to 1 0/1 /0/1, with each I/O scan when Remote I/O is operating normally. If any input status (4-7) is set to zero, cycling stops and the status will contain the last valid data received (0 or I).

Table 29.
REMOTE I/O DRIVER INPUT STATUS INFORMATION

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Status Indicators

There are four LED status indicators viewed through the faceplate lens. The four LEDs display the same status information as that indicated by the state of fnputs 4-7 listed **in** Table 29. These indicators and their meanings are listed below in table 30 in the same order as they appear on the module faceplate.

Indicator	Deflnmon
LOCAL OK	ON - Remote l/O Driver module operating normally. OFF - Fault in Remote I/O Driver.
LINK OK	ON - Communications link between this module and Remote Receiver good. OFF - Communications error between this module and Remote Receiver.
REMOTE OK	ON - Remote system is operating normally. OFF - Fault exists in Remote l/O system. (Power supply failure, cable loose, module not seated properly, etc.)
REMOTE PARITY	ON - Remote system has no parity errors, operation normal. OFF - Parity error detected in Remote I/O system, CPU will stop unless option jumper on this module set for CPU to RUN when error detected.

Table 30.
REMOTE I/O DRIVER INDICATOR STATUS

Option Jumpers

Several jumpers located on this module are used for configuration of various options necessary for proper system and module operation. Table 31 lists the factory and alternate settings for the Remote I/O Driver options.

Options	Factory Setting	Optional Setting
Block Size	120 Inputs and 120 outputs	248 Inputs and 248 Outputs
Baud Rate	57.6 Kb	User Selected
Serial Parity	Yes/Odd	Yes/Even or No
Communications Failure - CPU Status	STOP CPU	Allow CPU to RUN
Remote I/O Parity Error	STOP CPU	Allow CPU to RUN
Communications Link	Two Twisted Pair To 10,000 feet (3 Km)	RS-232 Modem Link

Table 31.
REMOTE l/O DRIVER OPTIONS

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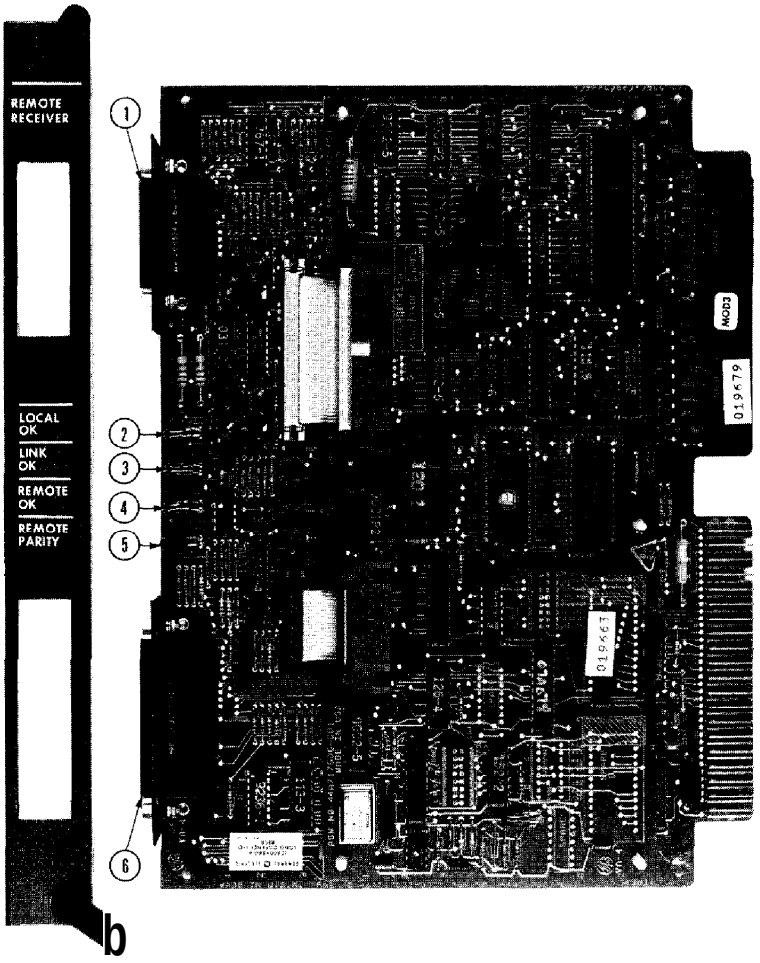
Instructions for reconfiguring circuit board jumpers to change any of the options can be found in the Installation chapter of this manual. The options listed in the table are those most necessary for proper system operation. Other jumpers on the board are available for RS-232 operation if required. In addition, several jumpers are factory set and are for future expansion or production testing. These jumpers should not be altered.

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REMOTE I/O RECEIVER

The Remote I/O Receiver module (Figure 53) is the interface to the serial communications link for a Remote I/O station. It is physically located in the first rack in a Remote I/O station, normally in the left most slot since the Remote I/O Receiver does not require an I/O address (no DIP switch on backplane adjacent to the leftmost slot).

A Remote I/O Receiver connected to a Remote I/O Driver (located in a model 60 CPU, CPU station, or a Local I/O station) through a two twisted pair cable can be installed in any I/O rack. If connection to the Remote I/O station is to be through a communications link using RS-232 compatible modems, then the Remote I/O Receiver must be installed in a High-Capacity I/O rack.



1. Connector From Remote I/O Driver Module in Upstream Local I/O System
2. LOCAL OK Light
3. LINK OK Light
4. REMOTE OK Light
5. REMOTE PARITY Light
6. Connector to Downstream I/O Receiver Module

NOTE

For Location of Option Jumpers, Refer to Chapter 2, Figure 19

Figure 53.
REMOTE I/O RECEIVER MODULE

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Circuitry on this module converts output data from serial to parallel and converts input data from a parallel to a serial format. The Remote I/O Receiver also isolates the serial data cable from the backplane bus and provides error checking circuitry. If more than one I/O rack is required in a Remote I/O station, the additional racks are daisy chained to the Remote I/O Receiver through I/O Receivers.

Connectors

A Remote I/O Receiver has two edge mounted D-type connectors. The top connector (25 pin) connects to a Remote I/O Driver at the opposite end of the serial communications link using a two twisted pair cable or to a modem located no more than 50 feet (I 5 meters) from the Remote I/O Receiver.

The lower connector (37 pin) provides a connection through a 16-pair parallel bus cable to an I/O Receiver module located in the next downstream rack in a Remote I/O station. If no connection is to be made to the lower connector, the I/O chain signals must be terminated. This is done by reconfiguring three jumper plugs on the printed circuit board which performs the same function as reconfiguring the jumper pack and DIP shunts on an I/O Receiver module.

Status Indicators

The Remote l/O Receiver has four LED indicators visable through the faceplate lens. The legends on the faceplate lens are the same as those on the Remote I/O Driver. Table 32 defines the status provided by these indicators.

INDICATOR	DEFINITION
LOCAL OK	ON - Remote l/O Driver module operating normally. OFF - Communications failure or Addressing Difference between Local and Remote.
LINK OK	ON - Communications link between this module and Remote I/O Driver established and valid. OFF - Communications failure between this module and Remote f/O Driver.
REMOTE OK	ON - Remote system is operating normally. OFF - Fault in Remote I/O system. (Illegal address block, loose connection, power supply failure)
REMOTE PARITY	ON - Remote system operating normally with no parity errors. OFF - Parity error detected in Remote I/O system.

Table 32.
REMOTE I/O RECEIVER INDICATOR STATUS

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Option Jumpers

There are several circuit board jumpers on this module which are used for option selection and I/O chain signal termination. Jumpers are factory set prior to shipment and must agree with the Remote I/O Driver to which it is to be connected. Table 33 lists the factory settings and alternate settings for the Remote I/O Receiver options.

Options	Factory Setting	Optional Setting
Baud Rate	57.6 Kb	User Selected
Parity	Yes/Odd	Yes/Even or No
Communications Failure - Remote I/O	Turn All Outputs Off	Hold All Outputs at Last State
I/O Chain Signals	I/O Chain Signals have continuity through this module.	Terminate I/O Chain Signals at This Module

Table 33.
REMOTE I/O RECEIVER OPTIONS

Instructions for reconfiguring any of the circuit board jumpers to change options can be found in the Installation chapter of this manual. Other jumper options are required when selecting the RS-232 option and are listed in the Installation chapter. In addition, other jumpers are for future expansion or production testing and should not be altered.

CPU I/O STATION

The CPU I/O station, Figure 54, consists of a Series Six CPU with up to 10 I/O racks. The racks are daisy chained on the parallel I/O bus (to the I/O Control module) with the last I/O rack located physically no more than 50 feet from the CPU.

Each I/O rack in the chain includes a Power Supply module (standard or high-capacity), an I/O Receiver module and up to 10 additional modules. The modules in the I/O rack are determined by the system configuration required. The modules can be a combination of the following modules: Input modules, Output modules, I/O Transmitter module and Remote I/O Driver module. Each I/O rack must have one, (and only one) I/O Receiver.

If more than IO I/O racks are required in a system, one or any of the I/O racks in the CPU station may contain any combination of I/O Transmitter or Remote I/O Driver modules for connection to additional I/O racks.

A Program Development Terminal can be plugged into the CPU or the last I/O rack in a CPU I/O station or a Local I/O station.

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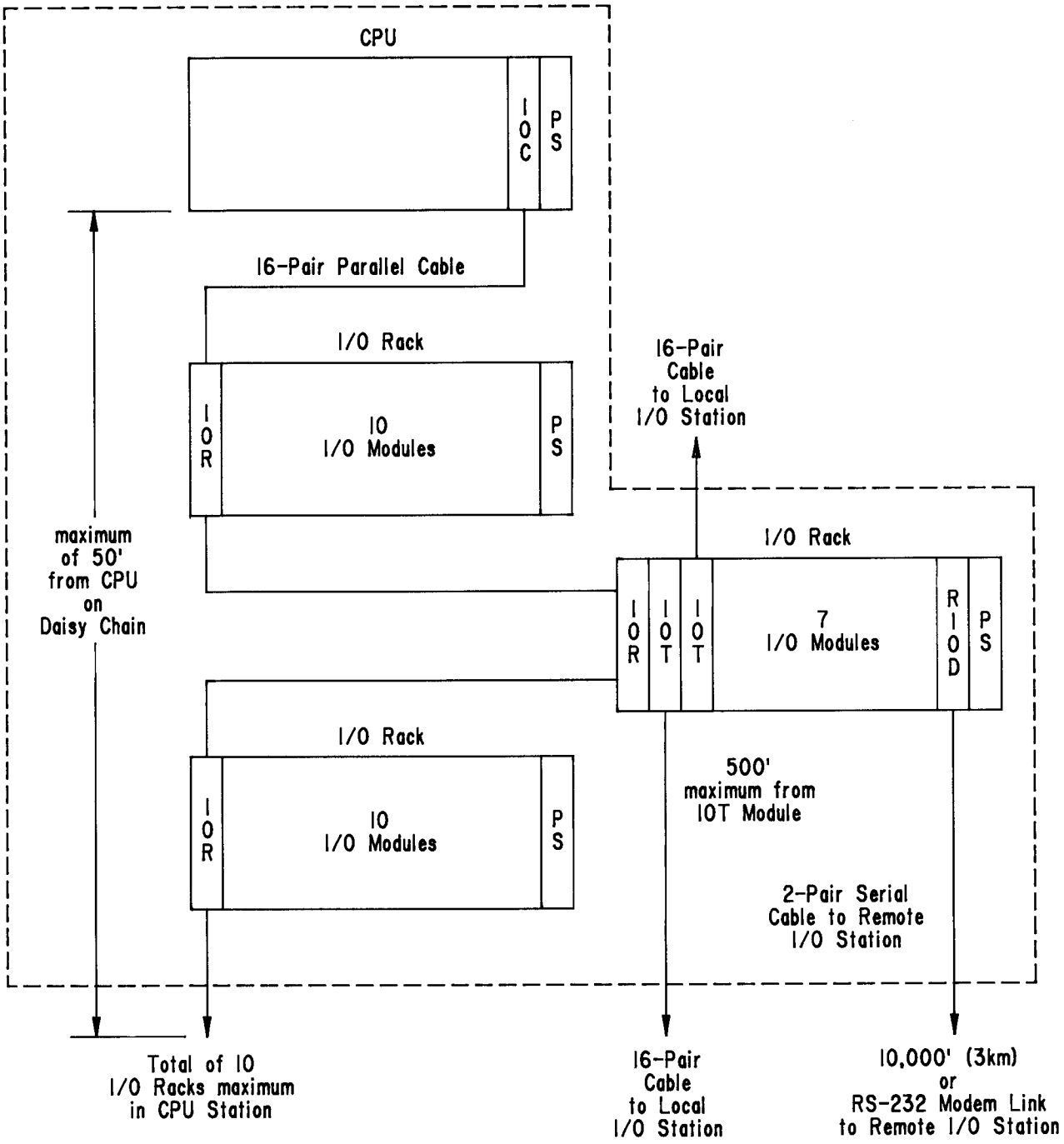


Figure 54.
CPU I/O STATION

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LOCAL I/O STATION

A Local I/O station can have up to 10 I/O racks daisy chained through the parallel bus channel. No more than 50 feet of cable can separate the first and last rack in a Local I/O station. A Local I/O station is linked to a Model 60 CPU, a CPU I/O station or another Local I/O station through the parallel bus. The interface is from an I/O Transmitter module to an I/O Receiver module. An I/O Receiver module may be located a maximum of 500 feet from the I/O Transmitter module. The last Local I/O station in a chain can be a maximum of 2000 feet (four I/O Transmitter links) from the originating I/O Control or Auxiliary I/O module in the CPU station.

A Program Development Terminal can be plugged into any Local I/O station. This scheme allows the Program Development Terminal to be located up to 2000 feet from the CPU.

Figure 55 illustrates the allowable configurations for a Local I/O station.

Each I/O rack in the Local I/O station can have the same configuration of modules as the I/O racks in a CPU station.

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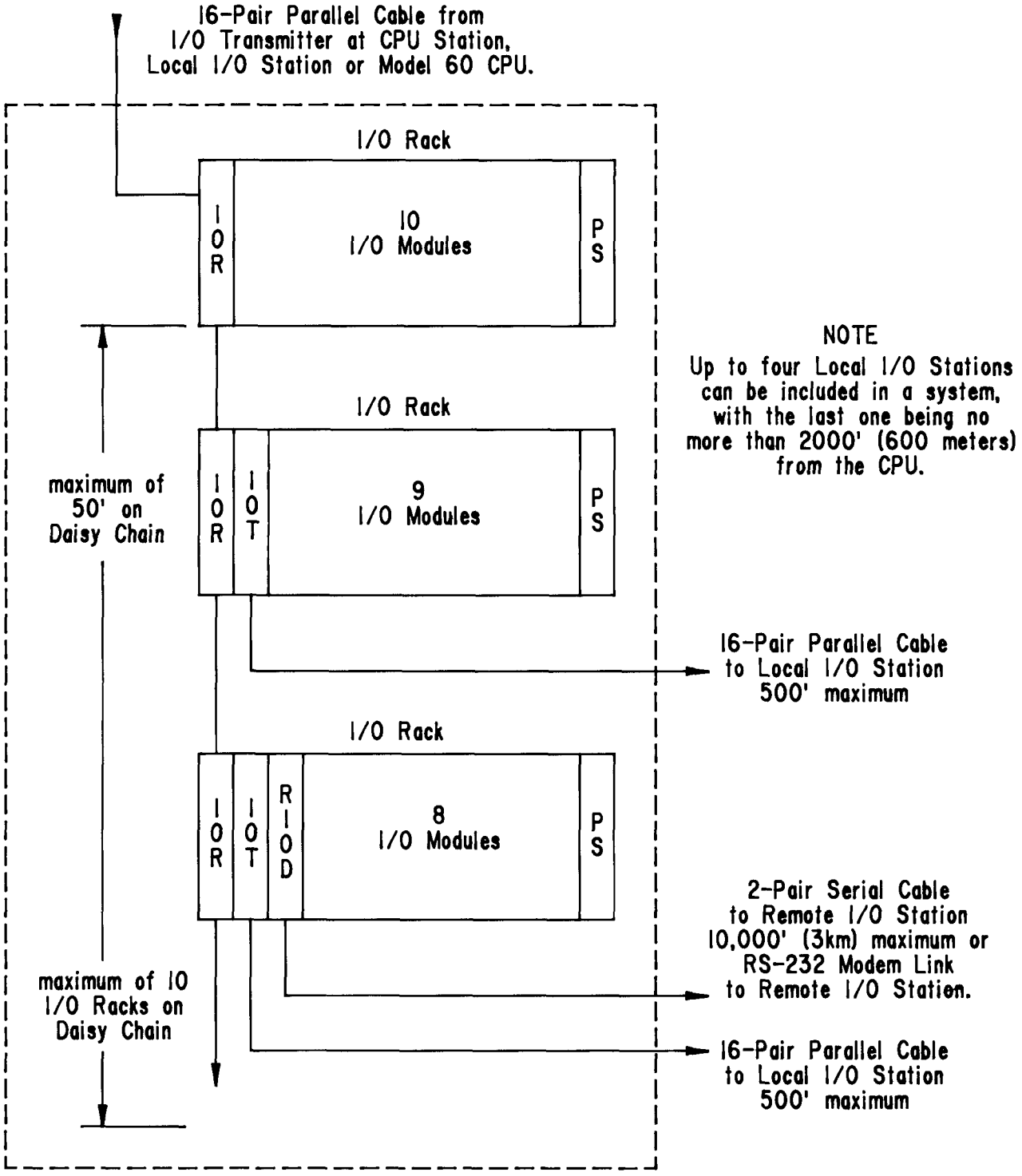


Figure 55.
LOCAL I/O STATION

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REMOTE I/O STATION

A Remote I/O station (see figure 56) consists of I/O racks connected in a daisy chain through the parallel I/O bus. A combination of I/O modules with a total of either 120 inputs and 120 outputs or 248 inputs and 248 outputs (jumper selectable) can be used in a Remote I/O station. The first and last rack in a Remote I/O station daisy chain can be separated by no more than 50 feet (15 meters) of cable.

In addition to the racks on the daisy chain an I/O Transmitter located in a rack in the Remote I/O station can be the first in a link of I/O Transmitters connecting to additional groupings of racks. An I/O Transmitter can be connected to the first rack in a group of racks by a 16 pair parallel cable with a length up to 500 feet (150 meters). Up to four links can be connected in this manner, thereby extending the Remote I/O station an additional 2000 feet (600 meters).

NOTE

The total number or I/O points assigned to a Remote I/O station (either 120/120 I/O or 248/248 I/O) cannot be exceeded regardless of the rack configuration.

The Remote I/O station connects to an upstream I/O rack in either a CPU station or Local I/O station or to an I/O slot in a model 60 CPU. The connection is made through a serial communication channel by a two twisted pair shielded cable or through an RS-232 compatible modem link. The communications module in the model 60, the CPU station or Local I/O station is a Remote I/O Driver while the communications module in the Remote I/O station is a Remote I/O Receiver.

The serial communications link to the Remote I/O station can be up to 10,000 feet (3 Km) using a two twisted pair cable. Using an RS-232 modem link, the distance between local and remote I/O is virtually unlimited.

NOTE

A Remote I/O Driver module cannot be installed in a Remote I/O station. A Program Development Terminal cannot be connected to a Remote I/O station.

Figure 56 illustrates a possible configuration for a Remote I/O station. The illustration shows how a Remote I/O station can be extended an additional 2000 feet (600 meters) by using I/O Transmitters to connect additional racks to the parallel bus.

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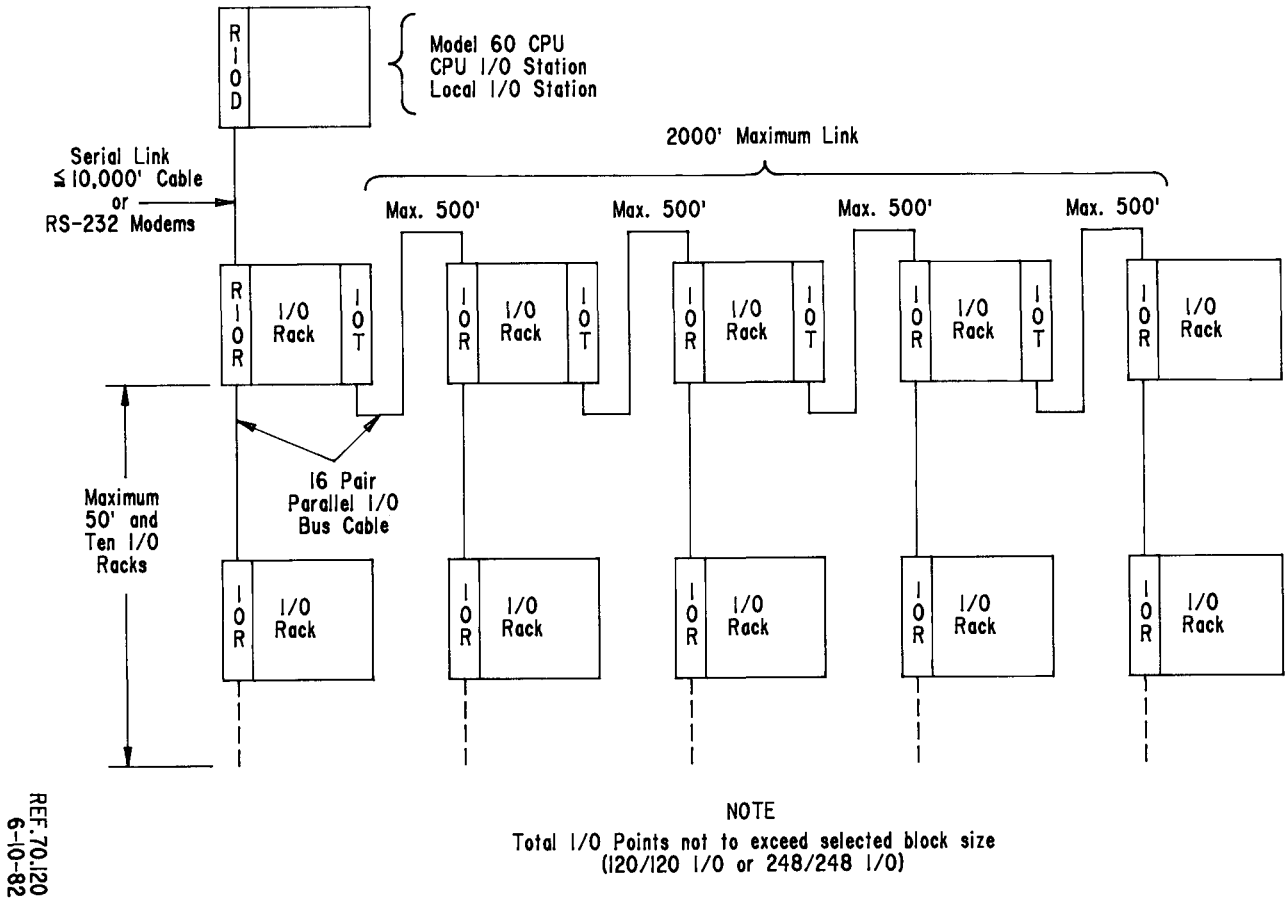


Figure 56.
REMOTE I/O STATION CONFIGURATION

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AUXILIARY I/O SYSTEM

The Auxiliary I/O system is available only with the Model 6000 CPU. If a Model 6000 CPU has an Auxiliary I/O module, an I/O system identical to the main I/O system can be originated at the CPU. The structure of the Auxiliary I/O system allows the Model 6000 CPU to accept an additional 1000 inputs and 1000 outputs. The total I/O capacity of the Model 6000 CPU with the Auxiliary I/O system is 2000 inputs and 2000 outputs.

All information pertaining to use of Input and Output modules, Interfacing modules, cable type and distance allowed between racks and stations is applicable when configuring the Auxiliary I/O system with the exception that inputs and outputs cannot be overridden.

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SECTION 5

PROGRAM DEVELOPMENT TERMINAL

This section provides an introduction to the Program Development Terminal (PDT). See figure 57. For a detailed description of the operation of the Program Development Terminal refer to GEK-25362, Programming Manual For Series Six Programmable Controllers. This section will give the user a familiarity with the hardware features and uses of the terminal.

PROGRAM DEVELOPMENT TERMINAL FUNCTIONS

The Program Develoment Terminal allows the user to create, modify and monitor programs for the Series Six family of programmable controllers. Programs are written in free-format ladder diagram form. The Program Development Terminal also provides a means of monitoring and overriding inputs and outputs. An interface to a printer is provided to allow the printing of ladder diagrams and cross-reference tables. Programs can also be loaded or stored by means of an optional built-in Minicartridge Tape Unit or by interfacing through the external tape port to an external portable tape loader.

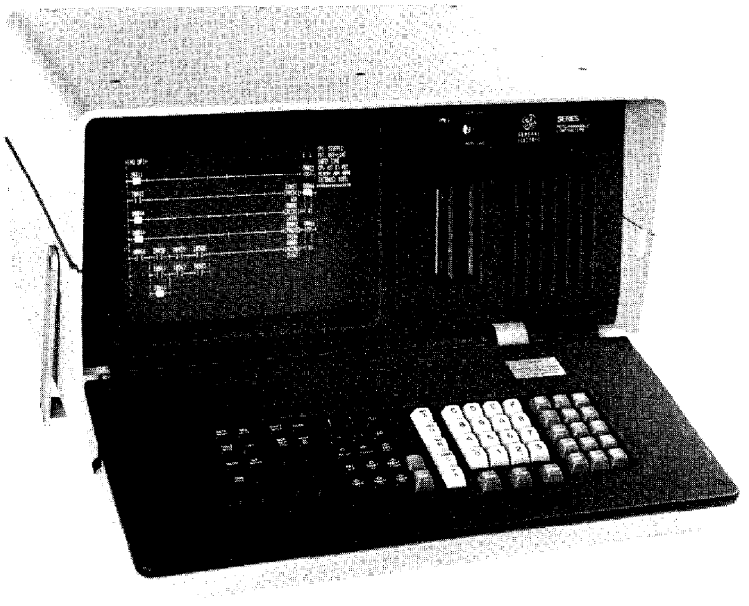


Figure 57.
PROGRAM DEVELOPMENT TERMINAL

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ENCLOSURE

The enclosure for the Program Development Terminal is made of structural foam for strength and durability. Dimensions of the unit with the keyboard closed are 12.5 x 21.5 x 16.5 inches (317.5 x 546.1 x 419.1 mm). The unit weighs 57 pounds (26kg). A carrying handle is provided for convenience as an aid to transporting the unit. See Figure 58.

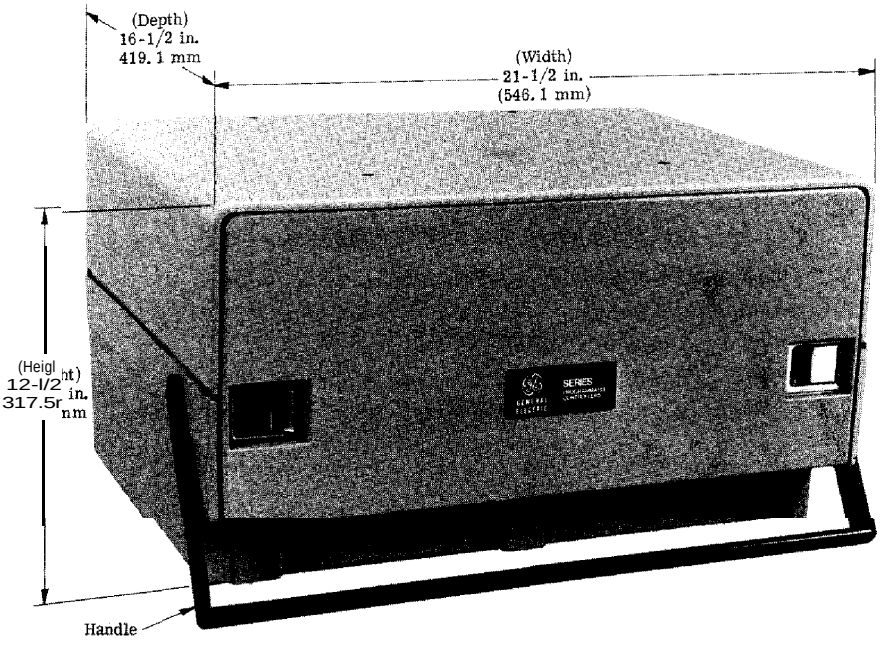


Figure 58.
PROGRAM DEVELOPMENT TERMINAL ENCLOSURE

KEYBOARD

The Program Development Terminal incorporates a keyboard assembly which folds out from the enclosure. With the unit resting on its back, the keyboard will open to a position which allows operation from an upright position. The keyboard extends 8 1/4 inch, (209.55mm). When the terminal is setting on its base, the keyboard folds down to an angle that is comfortable for data entry. The keyboard folds up into the terminal for storage and transportation, thus protecting the unit in a secure, rugged enclosure.

A molded ridge around the edge of the keyboard protects against damage to the keys if the handle should be in the way when the keyboard is closed.

The pushbuttons are reliable solid-state modules with good tactile feel and travel which helps greatly in speed and ease of data entry and reduction of operator fatigue.

Keys are grouped and color coded by function. The color coded keys provide a quick reference for the operator when entering programs. The key tops are two-shot injection molded. By use of this method of molding the legend color goes all the way through the key and will not rub off. Figure 59 is an illustration of the keyboard layout.

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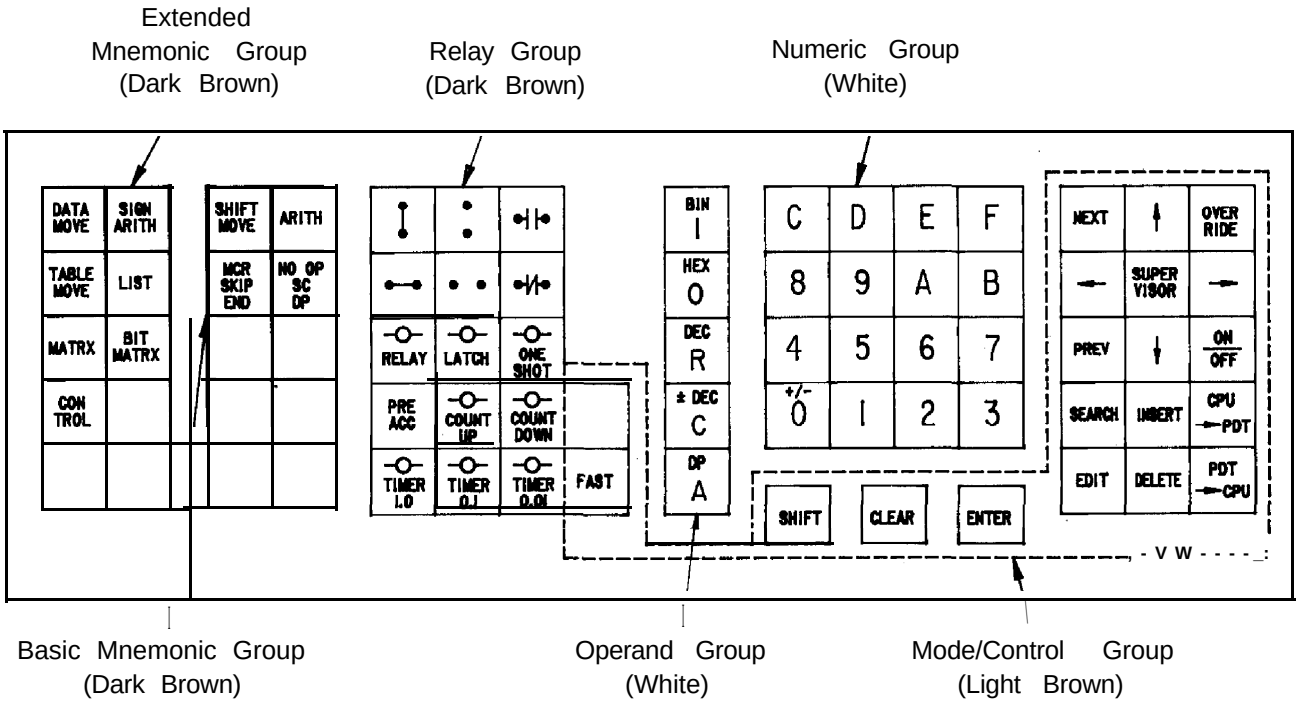


figure 59.
KEYBOARD LAYOUT

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CABLE STORAGE

A storage compartment is provided to secure all cables necessary for operation of the PDT. Molded-in cable wraps are provided to allow the AC power and PDT-to-CPU cables to be neatly stored. A hinged panel folds up to enclose the cables for transporting and storage. Additionally the compartment contains a panel with connectors for external devices (e.g. printer, Minicartridge Tape Unit, composite video monitor), a fuse and a CRT brightness control.

CRT DISPLAY

The CRT has a 12 inch (304.8mm) diagonal measure screen with an anti-glare faceplate for good visibility under adverse lighting conditions. The characters are displayed on the screen in a 5 x 7 dot matrix. A brightness control allows adjustment to various ambient lighting conditions.

TAPE UNIT

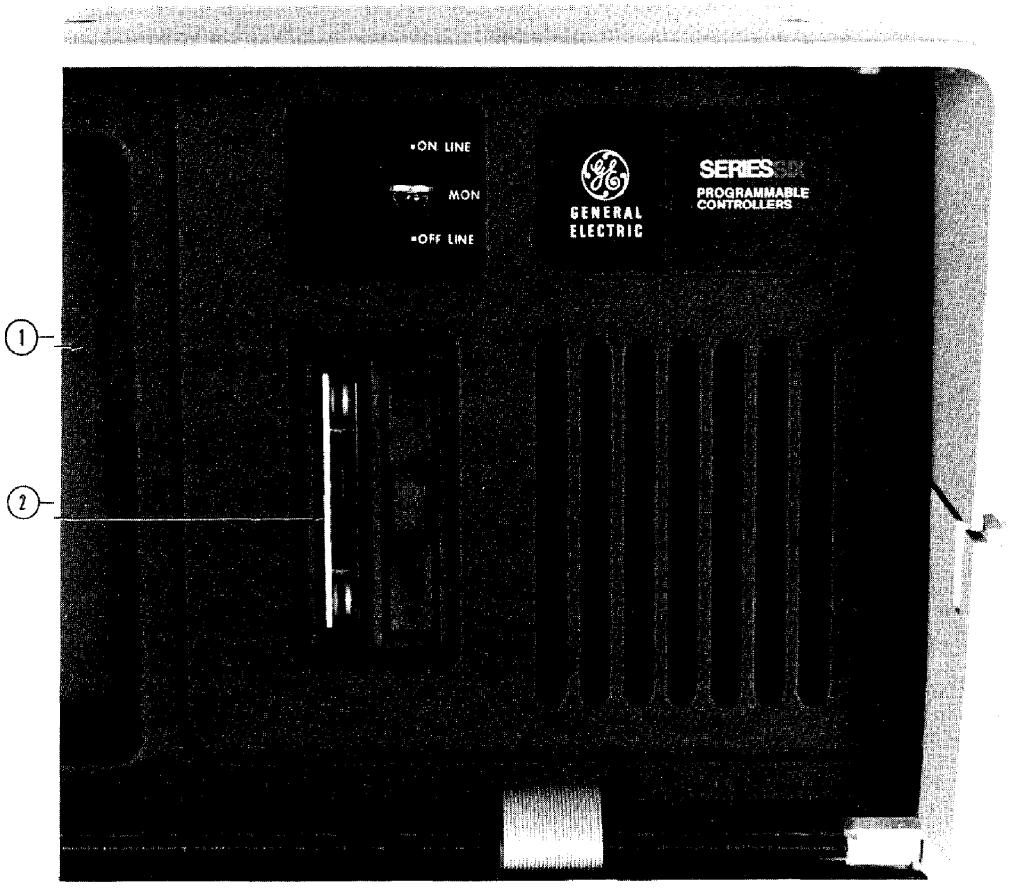
An optional built-in tape unit allows the user to read in programs or to write a program to tape. The tape unit uses the 3M DC100A minicartridge. Data is transferred between the PDT and the tape unit in a parallel mode of operation. This mode of operation allows a 32K program to be read or written on a single cartridge in less than three minutes. See Figure 60.

TAPE SPECIFICATIONS

The DC1 OOA Data Cartridge is a highly reliable bi-directional tape medium of shirt pocket size. The DC1 OOA contains 140 feet (42.7m) of 0.150 inch. (3.81 mm) tape in a package measuring 2.4 x 3.2 x 0.5 inches (6.1 x 8.1 x 1.2 cm). Complete specifications are shown below.

Tape Speed	0 to 90 inches per second (0 to 2.29m per second)
Tape	Employs computer grade magnetic tape. 140 feet (42.7 m) of usable storage
Tape Position Sensing	Holes are provided in tape for BOT Load Point, Early Warning and EOT Sensing.
File Protect	Manually operated sliding tab provides file protect capability.
Temperature	32°F to 122°F (0°C to +50°C)
Humidity	20% to 80% non-condensing
Construction	High-impact plastic cover over heavy gauge metal base plate. No deck components penetrate the cartridge shell.
Size	2.415 x 3.188 x 0.470 inches (6.12 x 8.10 x 1 .119 cm)
Weight	2 ounces (56.7 gm)

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1. CRT
2. Built-In Tape Unit (Optional)

Figure 60.
OPTIONAL BUILT-IN TAPE UNIT AND SWITCHES

POWER SWITCH

Power input to the Program Development Terminal is controlled by an illuminated rocker switch. When the top of the switch is depressed, AC power is applied to the unit and the light in the switch turns on to indicate the presence of power.

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KEYSWITCH

A three position, key-operated switch (key removable in the Monitor position) allows for 3 operating modes: Monitor, On-Line, and Off-Line. In the Monitor mode, the Program Development Terminal can read data from the CPU but cannot write data to it. All tables (input, output, and override), registers and Scratch Pad memory are updated automatically to reflect the status of the CPU.

The On-Line mode allows the user to read data from the CPU and to write data to the CPU. Status tables, register memory, and Scratch Pad memory are updated automatically to reflect the status of the CPU. In the On-Line mode, certain single word changes can be made to the CPU while it is running.

A main difference between the Off-Line and On-Line modes is that in the Off-Line mode, tables and registers are updated by a command (not automatically) and single word changes while the CPU is running are not permitted. With the Program Development Terminal in the Off-Line mode, programs can be created (which can be dumped to tape) without the necessity of having a CPU present.

CONNECTION TO I/O CHAIN

The Series Six Program Development Terminal can be plugged into the last I/O Receiver in a CPU Station or a Local I/O Station. This allows the user to connect the Program Development Terminal to an I/O rack distant from the CPU. All the features of, the Program Development Terminal can be used to debug programs or diagnose faults for troubleshooting while being close to the device being controlled.

The only noticeable effect in having the Program Development Terminal distant from the CPU is that communication between devices becomes slightly slower with increasing distance due to propagation delays.

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SECTION 6
SYSTEM CONFIGURATION

Configuration of a system using the Series Six family of CPU's and I/O system has been simplified by the universal rack. Mounting hole dimensions and layout allow for ease of mounting in a standard 19 inch rack or in a panel. The mounting scheme should be determined by taking into consideration the surrounding environment, allowable space, etc. See Figure 61 for layout and dimensions of mounting holes. For detailed installation instructions, refer to Chapter 2.

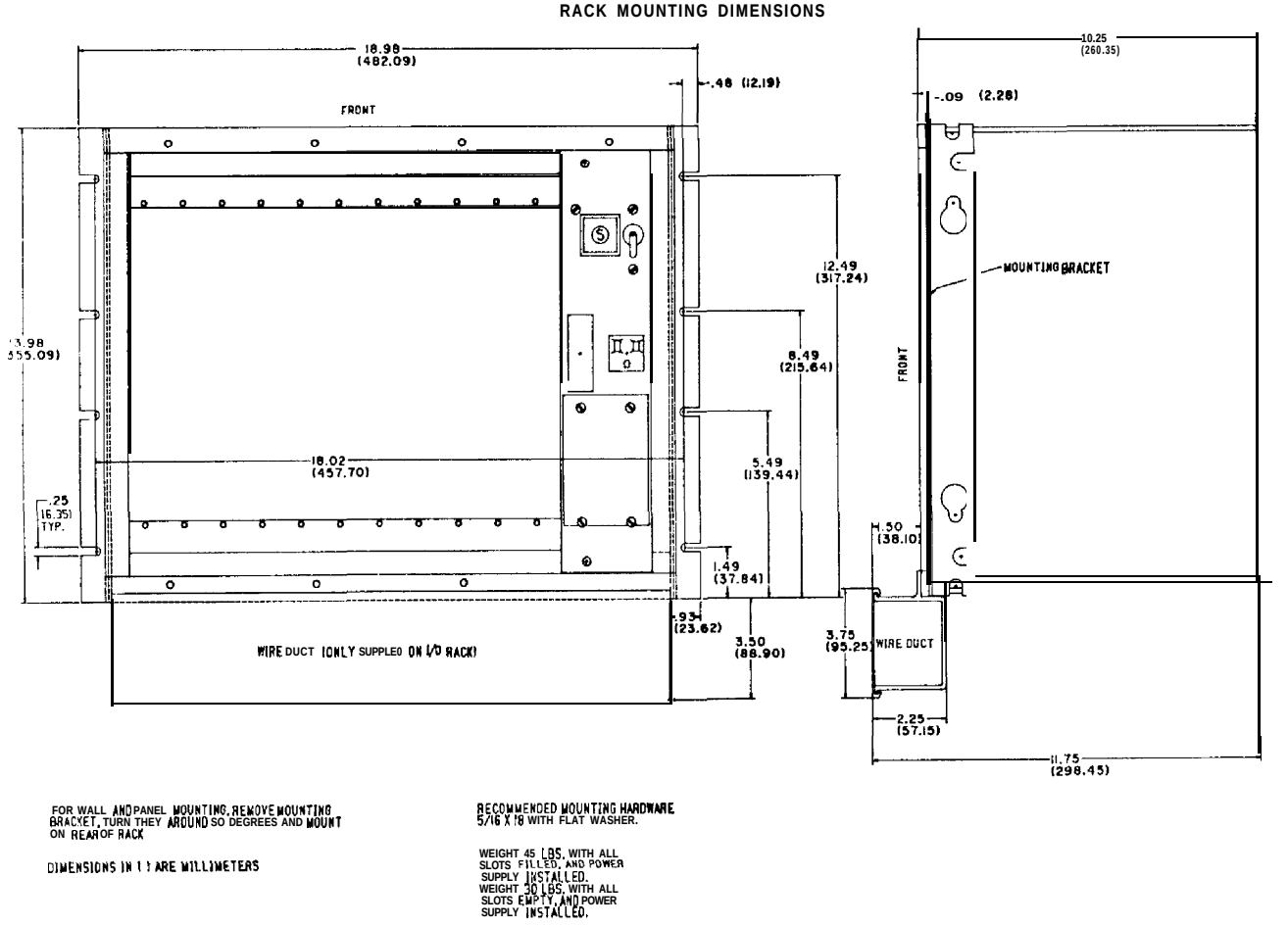


Figure 61.
UNIVERSAL RACK MOUNTING

Ref. 44C716406 Sh. 2

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HARDWARE REQUIREMENTS

A system consists of a CPU rack and I/O racks each containing their own power supply. For a system requiring a Model 600 CPU or a Model 6000 CPU, the I/O modules will be contained in a separate rack or racks, The Model 60, if no more than 192 I/O points are required, can be completely contained in one rack. The proper length cables for interconnection of CPU rack to I/O rack or I/O rack to I/O rack must be determined and be available for initial system check-out and installation. Standard I/O cables are available for interconnection on the parallel I/O bus in standard lengths ranging from 2 to 500 feet (.6 to 150 meters). Remote I/O requires a cable with two twisted shielded pairs for direct connection to 10,000 feet (3Km) and is normally user supplied. If connection to the Remote I/O is to be by RS-232 compatible modems, a cable of no more than 50 feet (15 meters) is required to connect the modems on each end of the serial link. Cabling must be provided by the user from external devices to be controlled to the I/O modules.

POWER REQUIREMENTS

Power Supply Input		
115VAC, +15%		
47-63 Hz —		
700 mA maximum (Standard I/O Rack)		
2.OA maximum (CPU, DPU, High-Capacity I/O Rack)		
230V AC, ± 15%		
47-63 Hz		
350 mA maximum (Standard I/O Rack)		
1 .O A maximum (CPU, DPU, High-Capacity I/O Rack)		
Power Supply Output		
+5V DC, 16.5 A maximum	}	CPU, DPU and High-Capacity I/O Rack
+12V DC, 1.5 A maximum	}	
-12V DC, 1.0 A maximum	}	
+5V DC, 6.1 A maximum (Standard I/O Rack)		

Table 34.
POWER REQUIREMENTS FOR CPU, DPU, AND I/O RACKS

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INITIAL SYSTEM CHECKOUT

It is recommended that an initial basic system checkout be performed before the system is configured, mounted, cables run and wiring of external devices to the I/O modules is made. The following list of items to be checked is intended as a guide to the user.

Visual

Verify that all racks, modules and cables conform to the system configuration as ordered.

Record model and serial number. If you have to communicate with the General Electric Co. regarding any problems, this information must be given to them.

Check for physical damage during shipment. If any damage is noted, notify the carrier immediately. You should also call the Programmable Control Product Service Specialist in Charlottesville, Virginia, at (804) 978-5624. A Customer Service representative will give you further instructions at this time.

Each Input or Output module has a seven position DIP switch mounted on the I/O rack backplane adjacent to its respective slot in a rack. Select and configure the proper I/O module starting point at this time.

When modules are mounted in the CPU and/or I/O racks, be sure they are seated properly and that the quarter-turn thumb screws securing the faceplates to the rack are tight.

If modules have been shipped separate from the racks, install them in the proper slots and attach their respective faceplates.

Electrical

Ensure that the AC power source is within the stated specifications. Provide isolated circuits to minimize any problems with line interference. Isolated AC circuits are recommended when using microprocessor controlled equipment because of the negative effects that noise or line spikes may have on operation of the equipment.

Connect 115 or 230V AC to the proper screw connections on the CPU power supply. Depress the Logic Power On/Off switch to the ON position. Ensure that the Power ON LED comes on. If it is okay turn the power off.

WARNING

Voltage is present (115 or 230V AC) on the power supply terminal board which could be hazardous and may cause personal injury if care is no-i taken.

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Connect the Program Development Terminal to the CPU with the cable provided. Connect the AC power plug to either 115V AC or 230V AC as required.

Refer to the Series Six Programming Manual, GEK-25362, page 2.5 for start-up instructions.

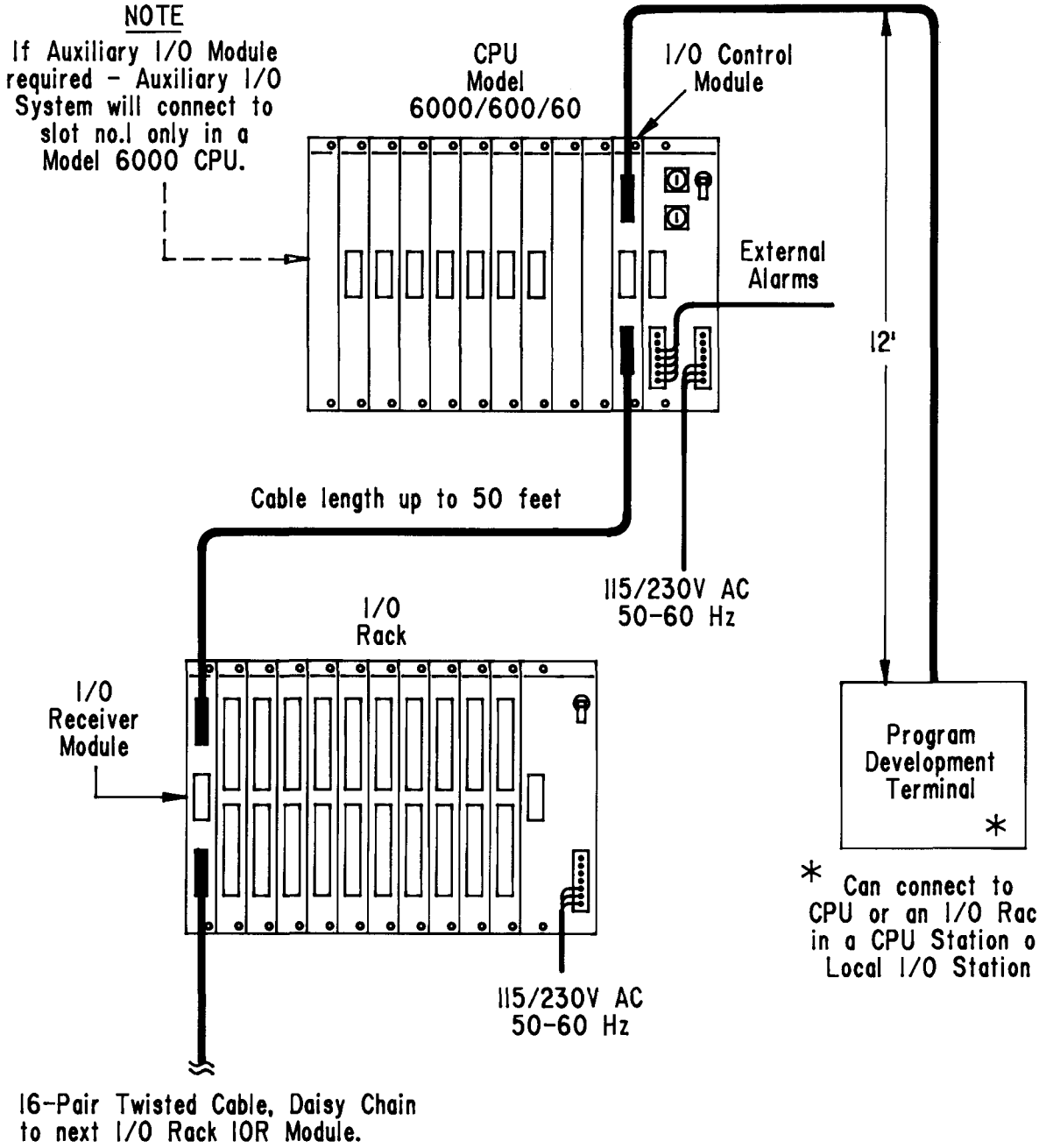
If all of the above checks are completed satisfactorily, the system is ready to be configured and I/O modules wired to their respective input and output devices.

If any problems are encountered during any of the above steps and they are not readily solved, contact the Programmable Control Service Center at (804) 978-5747 in Charlottesville, Virginia. A Customer Service representative will take the proper course of action to solve your problem.

CPU-TO-I/O RACK CONFIGURATION

The CPU and I/O racks should be mounted in a rack or panel as required. Connect 115 or 230V AC to the proper terminals on the respective power supplies. If audible or visual alarms are required for various system malfunctions, connect them to the proper terminals located on the terminal board on front of the CPU power supply. Run cables between the CPU and I/O rack or racks as required. Run interconnecting wiring between external devices and I/O modules, and make the proper connections. Then connect the Program Development Terminal. Now you can apply power, enter a program and system check the input and output modules. See Figure 62.

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NOTE:
10 Racks maximum on Daisy Chain.
Last rack may be no more than 50ft. from the CPU in a CPU Station.

Figure 62.
CPU-TO-I/O RACK CONFIGURATION

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I/O RACK-TO-I/O RACK CONFIGURATION

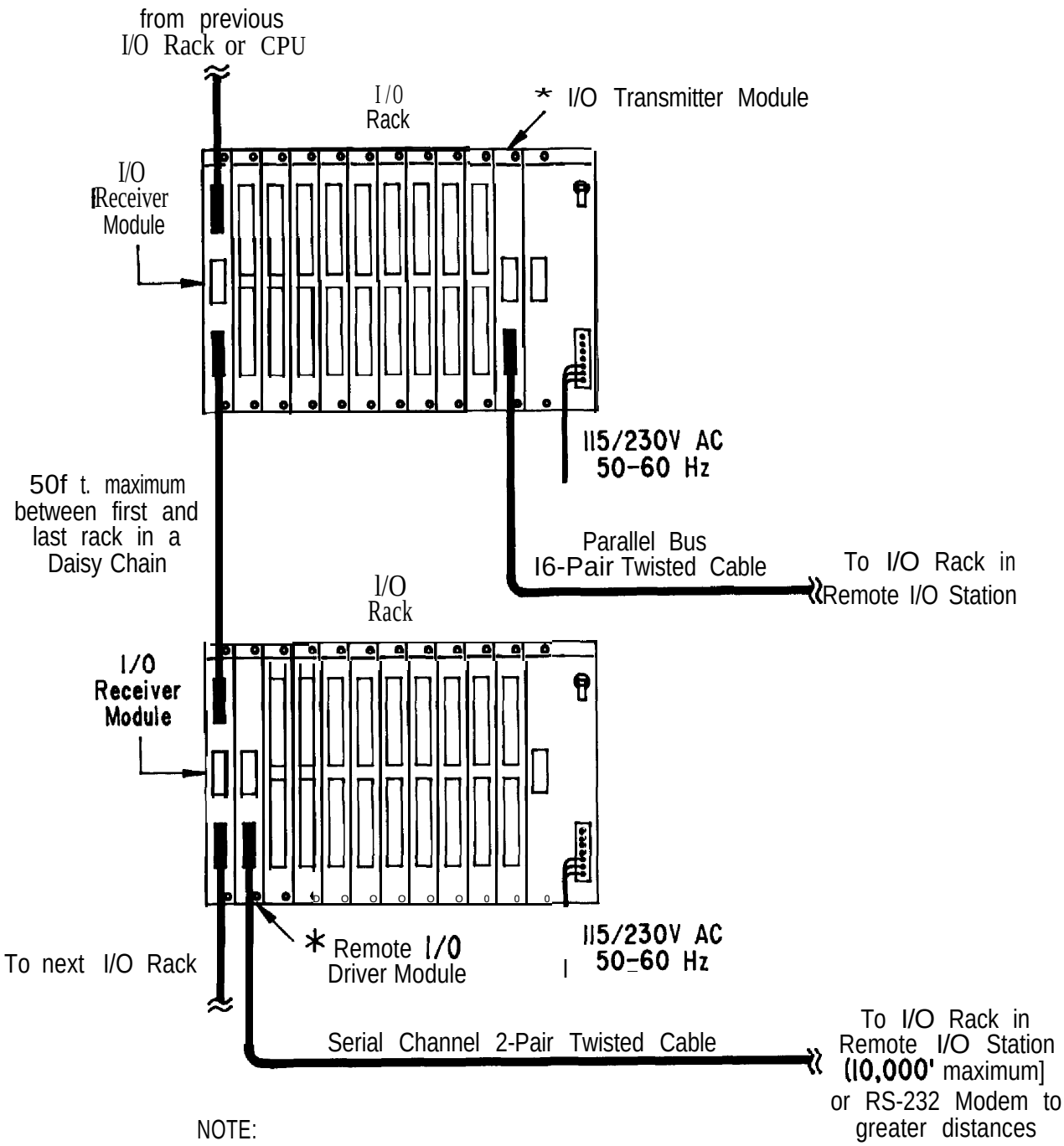
If I/O racks are to be daisy chained on the parallel communications channel, a maximum of 10 racks can be on a daisy chain. Interconnect each rack from the I/O Receiver in one rack to the l/O Receiver in the next rack downstream. A maximum total cable length of 50 feet (15 meters) can interconnect I/O racks on the daisy chain. See Figure 63.

The last I/O Receiver module in a daisy chain must have the I/O chain signals terminated at that module. Refer to the Installation Chapter in this manual for instruction on terminating the I/O chain signals.

The I/O chain of 10 racks can be part of a CPU station, or a Local I/O station. If another Local station is required, an l/O Transmitter module must be located in any I/O slot in any of the I/O racks. This allows connection to an I/O Receiver module in an l/O rack no more than 500 feet (150 meters) away.

If a Remote I/O station is required, a Remote I/O Driver module must be installed and connection made by a cable of no more than 10,000 feet (3 Km) (two pair twisted, shielded) to an I/O rack containing a Remote l/O Receiver module. Remote I/O stations at distances greater than 10,000 feet (3 Km) should be connected to the Local 1/0 station, CPU station or a model 60 CPU through a serial communication link using RS-232 compatible modems. In the Remote I/O station racks can be daisy-chained from the Remote I/O Receiver through I/O Receivers in racks other than the first one.

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NOTE:

IO racks maximum on Daisy Chain.

* I/O Transmitter and Remote I/O Driver may be placed in any slot in an I/O Rack, except the leftmost slot which must be an I/O Receiver or Remote I/O Receiver.

Figure 63.
I/O RACK-TO-I/O RACK CONFIGURATION

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I/O RACK WIRING

I/O rack wiring consists of cabling between racks, 115 or 230V AC power, and wiring to and from external devices. Interconnections between racks should be made as described in the two previous descriptions. See Figure 64. Wiring between external devices to and from the I/O racks should be run in conduit. The cables will be run into the rack through a wiring tray located at the bottom of each I/O rack. Each group of wires or cable will run up to the applicable I/O module and fan out to box lug terminals. The box lug terminals will accept two No. 14 AWG or one No. 12 AWG wire per terminal. After all wiring has been completed and checked, a cover snaps over the wiring tray for operator safety and to give a neat appearance. For detailed instructions on wiring of individual types of modules, refer to the following chapter, Installation, in this manual.

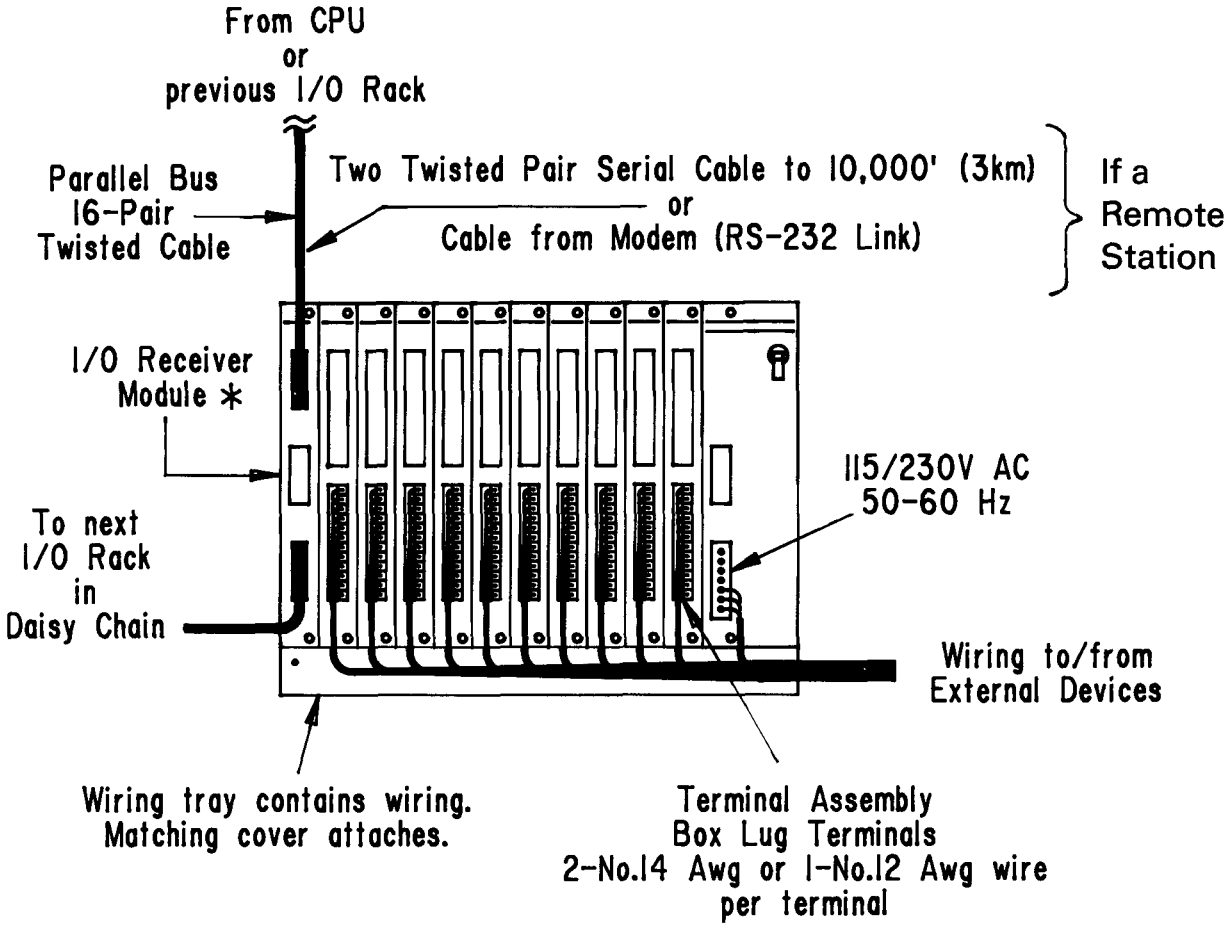


Figure 64.
I/O RACK WIRING SCHEME

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SECTION 7
DATA PROCESSOR

This section describes the hardware and functions of the Data Processor Unit (DPU) for use with the Series Six family of CPU's, The Data Processor provides the ability to perform complex functions and to access large quantities of data without interrupting or slowing down logic processing in the PC. For detailed operation of the DPU, refer to the Data Processor Users Guide, GEK-25363.

PHYSICAL DESCRIPTION

The Data Processor interfaces to the Series Six CPU by physically connecting to the I/O Control module. Two methods of housing the Data Processor modules are used by the Series Six family.

Model 600 CPU

Four module slots are provided in the Model 600 CPU rack for the Data Processor modules. They are the 4 left slots as viewed from the front of the rack. This is the only CPU that can have the Data Processor self-contained. One each of the Data Control, Data Prom, Data Storage and Dual Serial Port modules are required for a DPU system in a model 600 CPU.

Data Processor Rack

The modules for the Data Processor in its own rack are contained in a Series Six universal rack with its own power supply. Eleven slots are available for modules. This separate rack can be used with any model CPU. See Figure 65. DPU modules are described below.

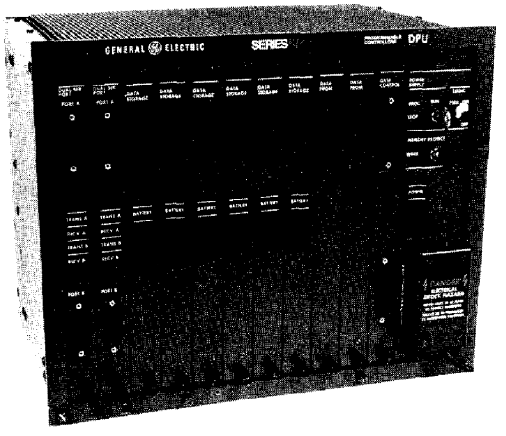
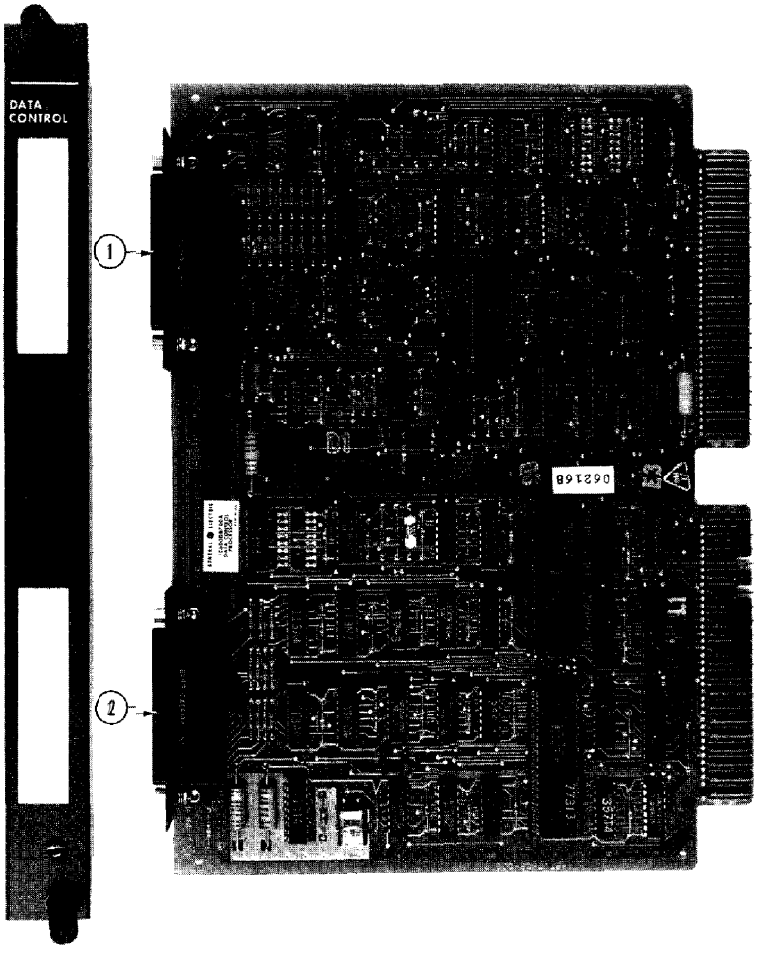


Figure 65.
DATA PROCESSOR UNIT

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Data Control

The Data Control Module contains an 8086 microprocessor and its associated support devices. Its primary function is to perform data processing functions within the Data Processor. See Figure 66. The Data Processor physically connects to the CPU through a cable which connects from the top connector of the l/O Control module in the CPU to either of the connectors on the Data Control module. The cable distance should not exceed 25 feet (7.5 meters).



1. Connector To CPU
2. Connector to PDT

Figure 66.
DATA CONTROL MODULE

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Data Prom

The Data Prom module contains firmware used for control functions within the Data Processor. Firmware instructions are a set of software (program) instructions entered in PROM which are not alterable. See Figure 67.

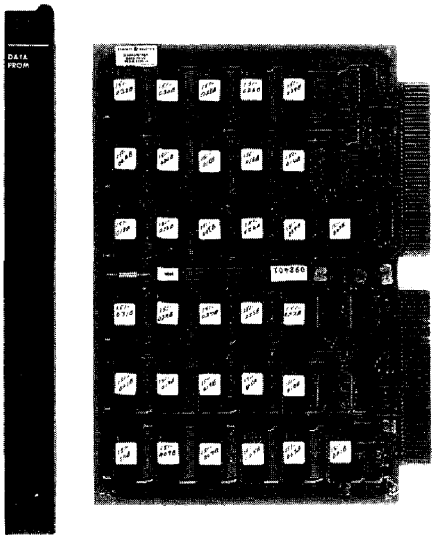


Figure 67.
DATA PROM MODULE

Data Storage

Contains either 8K or 16K of sixteen-bit words of CMOS-RAM memory with Lithium battery back-up, or 64K of sixteen-bit words of dynamic RAM memory. See Figure 68.

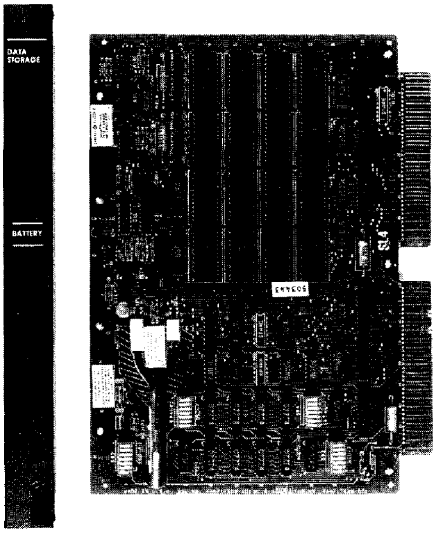


Figure 68.
DATA STORAGE MODULE

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Data Serial Port

The Dual Serial Port module provides two serial communication ports for interfacing peripheral devices to a Data Processor. This module supports RS-232C and 20mA current interfaces for message generation and operator interface. A selectable baud rate of 110, 300, 600, 1200, 2400, 4800 or 9600 baud is configured by a jumper strap. A system must use at least one Dual Port module and can support up to eight of these modules, thereby allowing a system a total of sixteen serial ports.

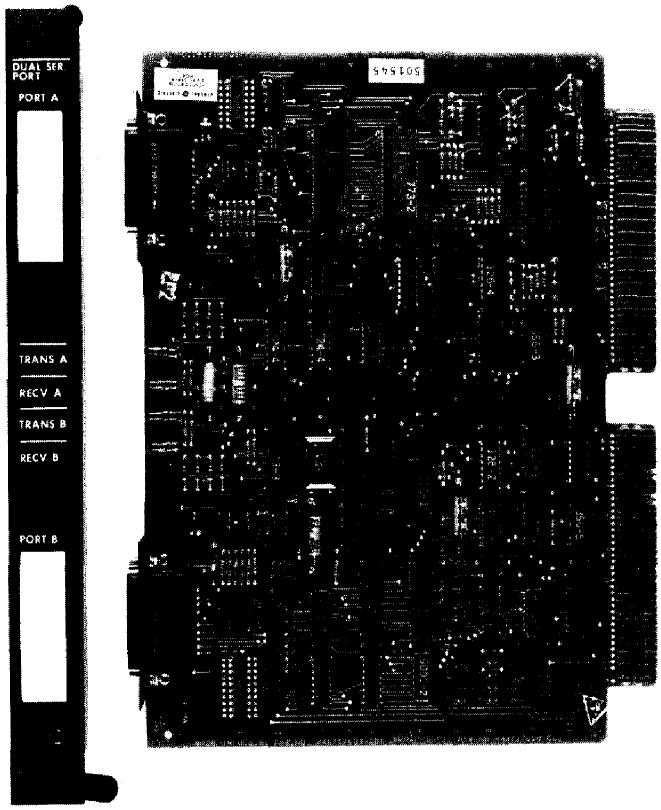


Figure 69.
DUAL SERIAL PORT MODULE

Figure 70 indicates maximum memory available in the Data Processor when used with the indicated CPU. DPU memory capacity when the separate DPU rack is used with a model 600 CPU is the same as **in a DPU** rack used with a model 60 or 6000 CPU.

	MODEL		
MEMORY	60	600*	6000
CMOS	128K	16K	128K
RAM	256K	-	256K

*DPU modules in same rack as CPU.

Figure 70.
MAXIMUM DPU MEMORY IN 16-BIT WORDS

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PROGRAMS

Programs supplied with the Data Processor are briefly explained below. Additional programs will be available in the future.

Message Generator

This program allows the Data Processor to store up to 256 different messages with various formats. Each message can be up to 8000 characters long and can include variables supplied to the Data Processor by the CPU. The CPU also initiates the printing of messages, specifies the command number and identifies the port if more than one port is used in a system.

File Storage and Retrieval

This is a program that allows the Data Processor to store a large quantity of data in a structured file system that is directly accessible by the CPU. Each structure consists of files; each file contains records; each record contains registers. The CPU can read or write into any segment of the file structure. The additional storage provided by these files can be used to expand the CPU's register capability, to store recipes for batch processes, to retain production data for inventory control, and to perform many other processing functions.

The file structure is illustrated below. The maximum file size is 4000 registers. Any allowable combination of files, records, and registers can be used up to the maximum number of registers.

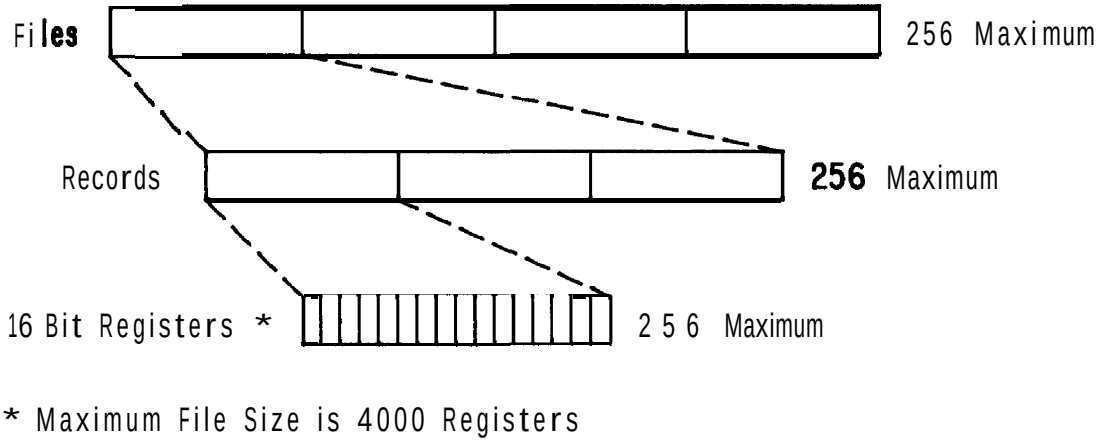


Figure 7 1.
DATA PROCESSOR FILE STRUCTURE

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SECTION 1
RACK AND CPU MODULE INSTALLATION

This chapter contains information which will aid in installing the Series Six family of Programmable Controllers and preparing the system for use. Included are instructions for unpacking/packing, inspecting, installing in a rack or panel, setting internal switches, connecting cables, input/output wiring and initial checkout.

QUALITY CONTROL

Each Series Six system undergoes a thorough quality control inspection and extensive system testing before being shipped. Each part of a system has had environmental and operational tests before leaving the factory. If any problems should arise with a Series Six system, Programmable Control Customer Service should be contacted for instructions. Procedures for contacting Programmable Control Customer Service are given later in this section.

PACKAGING

The method of packing and shipping the components of a Series Six system are outlined in this section.

- CPU racks are shipped with the following modules in their respective slots: Power Supply, I/O Control, Logic Control, and Arithmetic Control. In addition, the Internal Memory module and the Register Memory module are installed in a Model 600 or 6000. In a Model 60 the combined memory module is shipped installed in its respective slot. Blank faceplates are shipped separately for the remaining slots.

- The CPU rack is inserted into 2 halves of foam plastic sections. This is then placed in an antistatic plastic bag along with the rack mounting brackets, hardware for mounting the brackets, a printed circuit board extraction/insertion tool, an I/O terminator plug and the Series Six Installation and Maintenance Manual. This package is then placed in a shipping container.

- The Logic Memory and any optional modules are shipped in a separate container. Each module is placed in the bottom of a two-section foam plastic package. Two inserts are provided, one for the printed circuit board and one for its faceplate. The top section is added and this package is inserted into a sleeve. Either 2, 5 or IO module packages are then placed in a shipping container.

- I/O racks are shipped with only the power supply in place. The I/O racks and I/O modules are packaged the same as the CPU rack and modules.

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Data Processor racks are shipped with only the power supply mounted in the rack. The rack is packaged the same as a CPU rack. Each of the DPU modules is packed in an individual two section package. All of the individual packages are then placed in a shipping container.

The Program Development Terminal is enclosed by a Urethane foam molded two-piece package. The back of the Program Development Terminal is placed in the bottom cap, the carrying handle is folded to its bottom position, and the top cap is placed over the Program Development Terminal. The foam package is then inserted in a shipping container. One GEK-25362, Programming Manual for Series Six Programmable Controllers is included with each Program Development Terminal.

It is recommended that the shipping containers and all packing material be saved in the event that it becomes necessary to transport or ship any part of the system.

VISUAL INSPECTION

Upon receiving your Series Six system, carefully inspect all shipping containers for damage during shipping. If any part of the system is damaged, notify the carrier immediately. The damaged shipping container should be saved as evidence for inspection by the carrier.

It is the reponsibility of the consignee to register a claim with the carrier for damage incurred during shipment. However, General Electric Company will fully cooperate with the customer should such an action be necessary.

PREINSTALLATION CHECK

After unpacking the Series Six CPU and I/O racks, modules, Program Development Terminal and Data Processor rack and modules if included as an option, it is recommended that serial numbers of the CPU and DPU racks and the Program Development Terminal be recorded. The serial numbers are required if Programmable Control Customer Service should need to be contacted for any reason during the warranty period of the equipment.

Verify that all components of the system have been received and that they agree with your order. If the system received does not agree with your order call Programmable Control Product Service at 1-800 GEFANUC. A Customer Service representative will give you further instructions at this time.

RACK INSTALLATION

The Series Six CPU, DPU or I/O racks can be rack, panel or wall mounted. A set of mounting brackets is included with each rack and can be mounted on either the front or rear of each rack. The method for mounting the brackets is determined by the system mounting configuration. Dimensions and placement of the mounting brackets are shown in figures 1 and 2.

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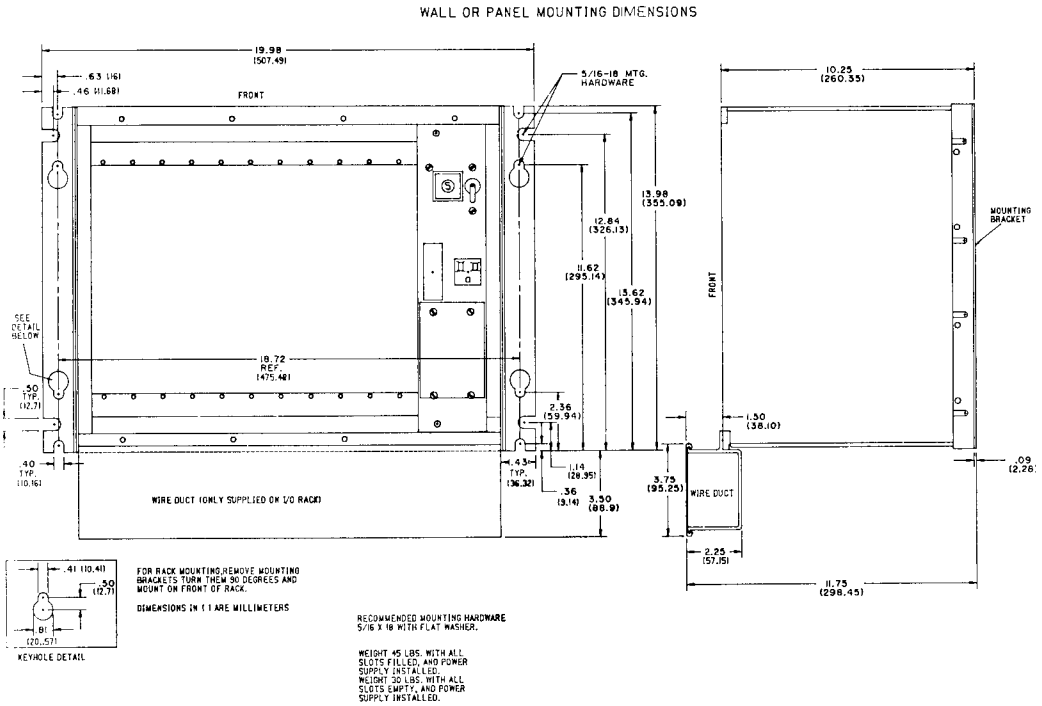


Figure 1.
WALL OR PANEL MOUNTING

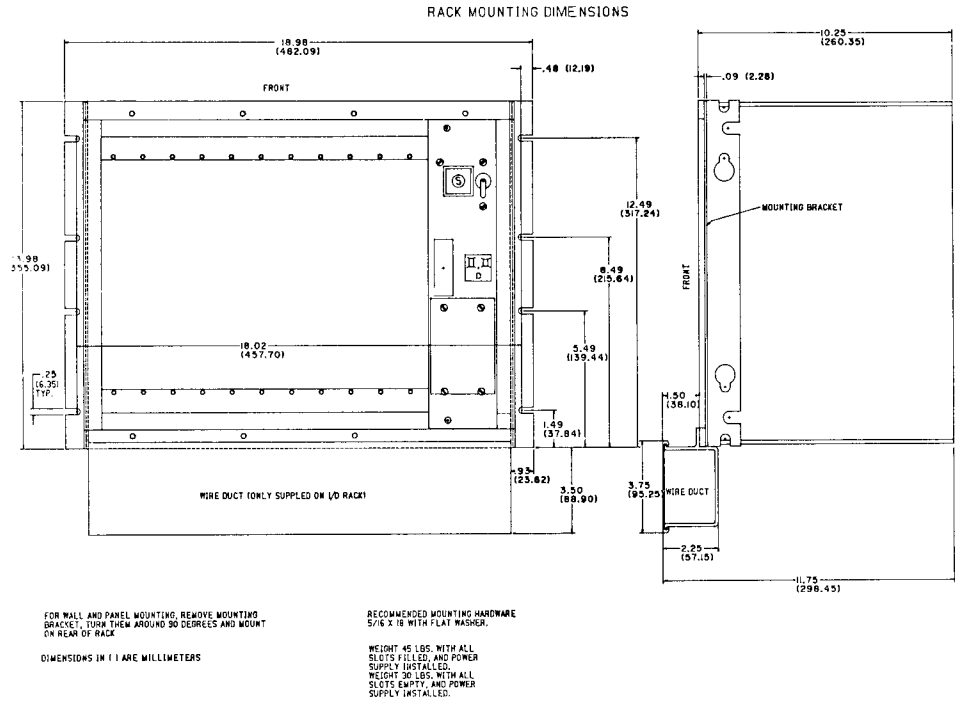


Figure 2.
RACK MOUNTING

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EXTRACTION/INSERTION TOOL

The printed circuit board extraction/insertion tool (board puller), Catalog No. IC6OOMA504A included with your Series Six CPU should always be used when installing or removing a module. The boards in the CPU require an insertion force of about 50 Ibs. (22.68 Kg) and the I/O boards require about 25 Ibs. (11.34 Kg). Use of the extraction/insertion tool should alleviate any problems of possible board damage which could be caused by hand insertion or removal. Refer to Figure 3 for identifying features of this tool.

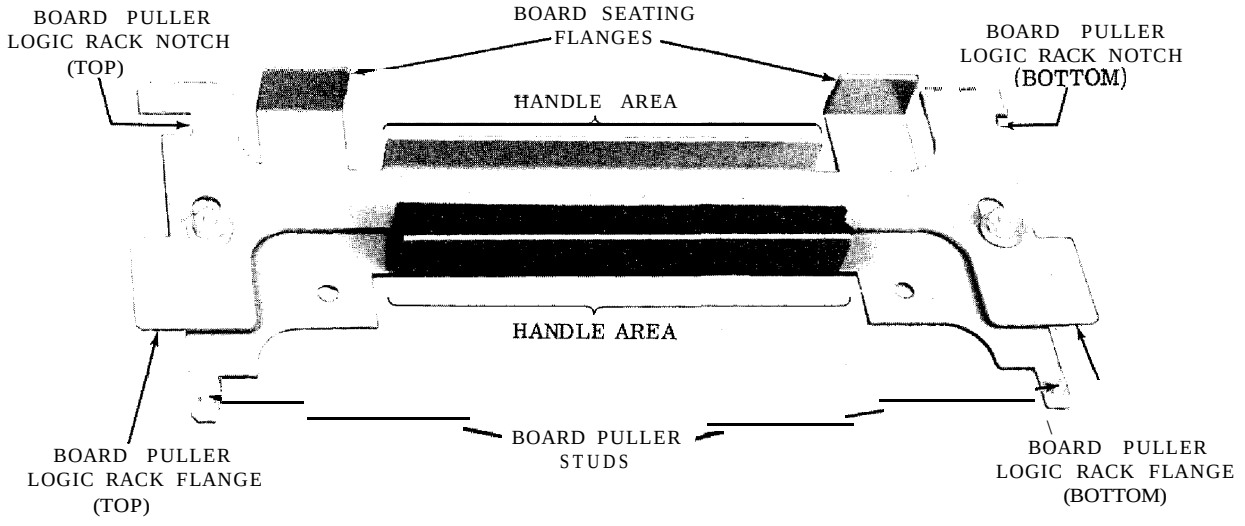


Figure 3.
EXTRACTION/INSERTION TOOL

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NOTE

Power to a rack should be turned off before installing or removing any printed circuit board.

REMOVING A PRINTED-CIRCUIT BOARD

Insert the board puller studs into the printed-circuit board from the solder side of the board. Ensure that the board puller surface is flat against the printed-circuit board. See Figure 4 which shows proper positioning of the tool.

Grasp the handle area with either hand and squeeze it. The board should break loose from the connectors and set loose in the cardguides.

Remove the board puller and slide the board out of its slot. Handle the board carefully.

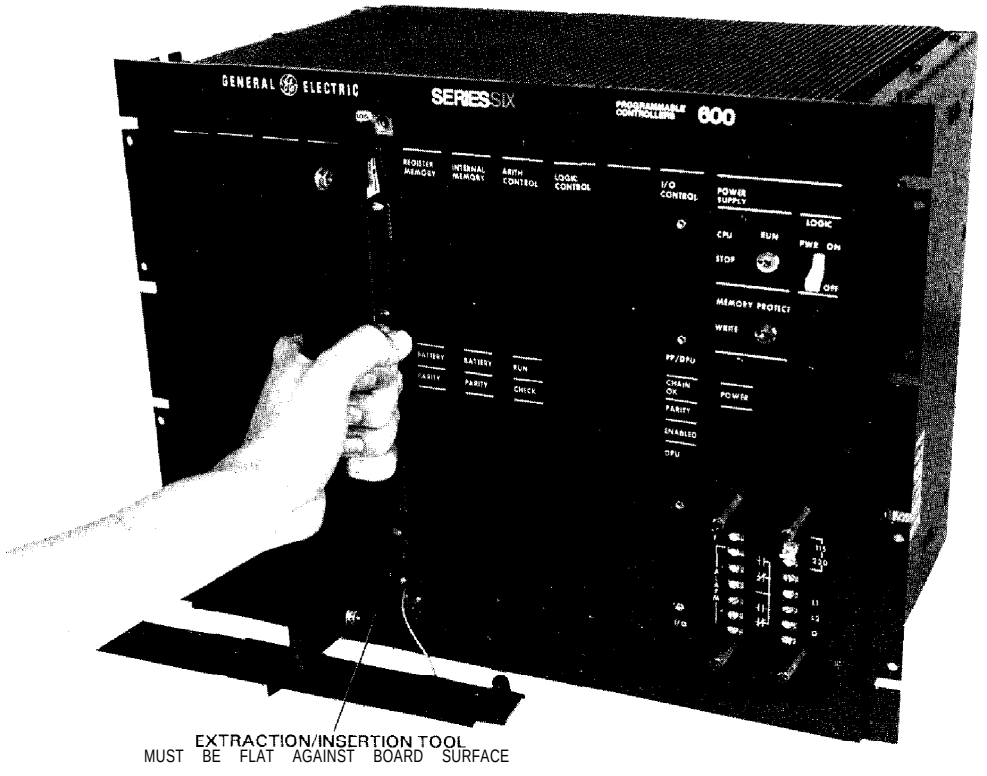


Figure 4.
POSITIONING THE EXTRACTION/INSERTION TOOL
FOR BOARD REMOVAL

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INSERTING A PRINTED-CIRCUIT BOARD

- Grasp the board firmly with your hand and insert it into the cardguide.
- Align the board with the connector(s) on the rack backplane and slide it towards the connector(s) until it has started to seat.
- Insert the board puller Logic Rack Notch (Top) into the short slot beside the top of the solder side of the board. Insert the Logic Rack Notch (Bottom) into the short slot beside the bottom of the solder side of the board. The board puller is now 180° reversed from the position for removing a board. See Figure 5 for proper tool positioning for insertion of a board.
- Grasp the handle area of the board puller with either hand and squeeze it until you feel the board seat. Visually inspect the board to be sure it has seated properly. Remove the tool.

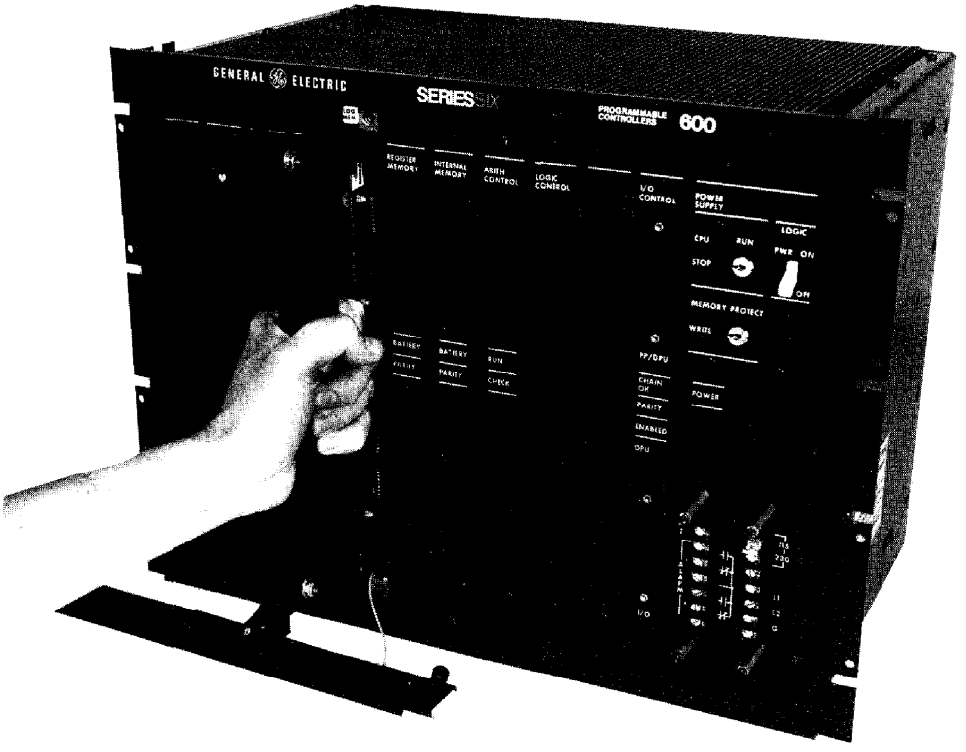


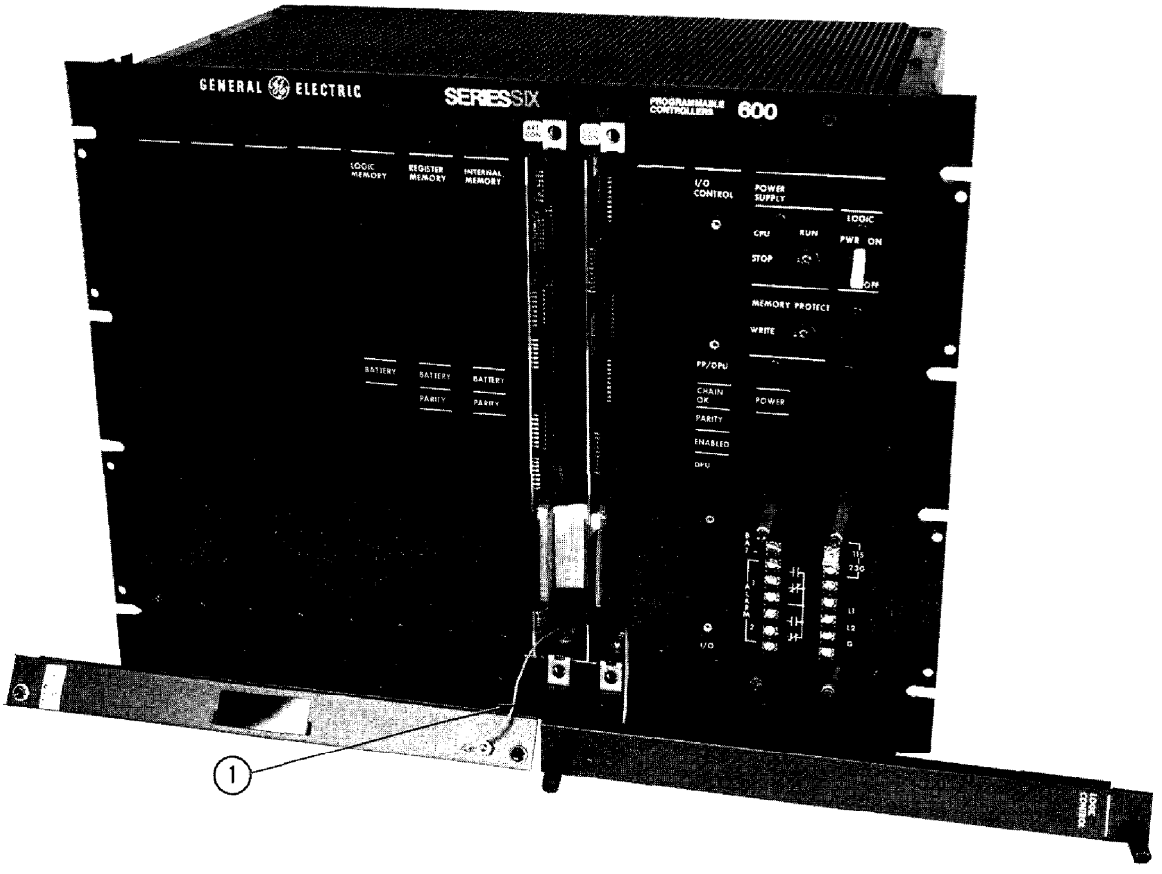
Figure 5.
POSITION OF EXTRACTION INSERTION TOOL FOR BOARD INSERTION

FACEPLATE GROUNDING WIRE

Each faceplate has a short green wire connected to the inside bottom of the faceplate. The purpose of this wire is to ground the faceplate to the rack. Before mounting a faceplate the opposite end of the green wire must be connected to the rack. Figure 6 shows this connection.

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A hex head screw is mounted adjacent to each bottom cardguide about 1 inch (25 mm) in from the front of the rack. Remove this screw, put it through the eyelet of the terminal lug and reinsert the screw into its mounting hole. Loop the wire so that it will not interfere with the insertion of a printed-circuit board into its cardguide. Tighten the screw securely to insure a good ground connection between the faceplate and the rack.



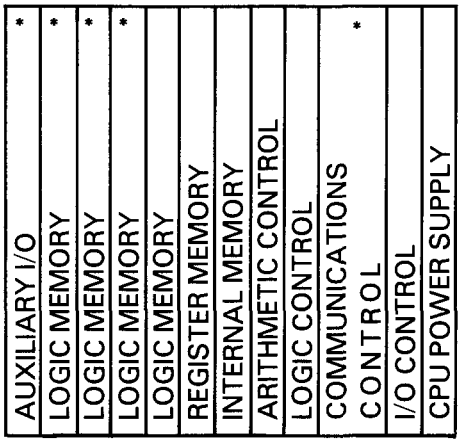
I. Faceplate Grounding Wire. Attaches from Faceplate to Rack.

Figure 6.
FACEPLATE GROUNDING WIRE

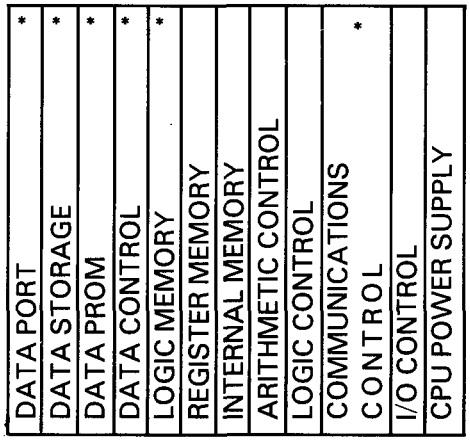
MODULE INSTALLATION

The modules for your system should now be installed in their proper slots in the CPU, DPU or I/O racks. Before installation some of the modules may require configuration of switches or jumpers. Figure 7 is provided as a guide to proper module location in the CPU racks.

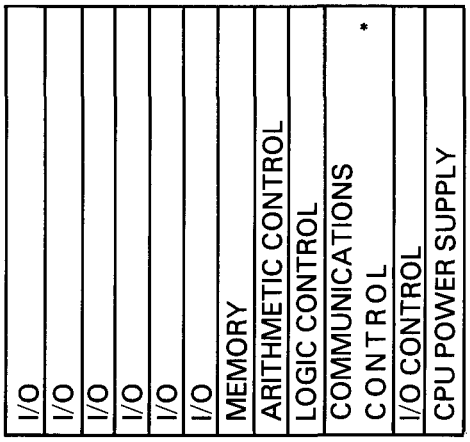
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MODEL 6000



MODEL 600



MODEL 60

Figure 7.
CPU MODULE LOCATION GUIDE

*Optional Modules

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NOTE

Some of the printed-circuit board names printed on the board may differ from the module designation imprinted on the faceplate. To avoid the possibility of placing a printed-circuit board in the wrong slot refer to the following cross reference list.

FACEPLATE AND BOARD LABEL NAME	CATALOG NUMBER	PRINTED CIRCUIT BOARD IMPRINTED NAME
I/O Control	IC6OOCB509A	1014
Communications Control	IC600CB514A	CCMl
Logic Control, Basic	IC600CB50 A	c c u 2
Logic Control, Extended	IC600CB502A	c c u 3
Arithmetic Control	IC600CB500A	ALU2
Internal Memory	IC600CB504A	TMCP1
Register Memory	IC600CB508A	MlPR1
Logic Memory		
2K CMOS	IC600CM542A	MCP21
4K CMOS	IC6OOCM544A	MCP41
8K CMOS	IC600CM548A	MCP81
Combined (Model 60) with 2K CMOS	lC6OOCM552A	CM601
Combined (Model 60) with 4K CMOS	IC600CM554A	CM604
Auxiliary I/O	IC600CB513A	A1011

Table 1.
FACEPLATE/PRINTED CIRCUIT BOARD NAME CROSS REFERENCE LIST

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LOGIC MEMORY MODULE(S)

The Logic Memory module(s), either 2, 4 or 8K should be unpacked and removed from their sleeves. Remove any blank faceplates from the slot(s) where the modules are to be installed. The memory module(s) should then be inserted into the slot or slots beginning with the slot immediately to the left of the Register Memory module. A Model 600 requires 1 Logic Memory module, while a Model 6000 contains a minimum of 1 and a maximum of 4 Logic Memory modules. See Figure 8 which shows the Logic Memory slot(s) available.

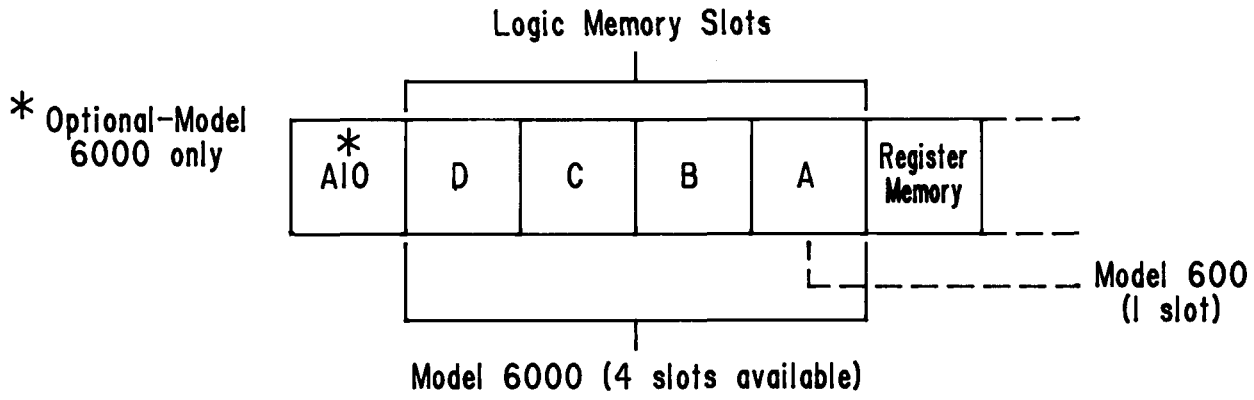


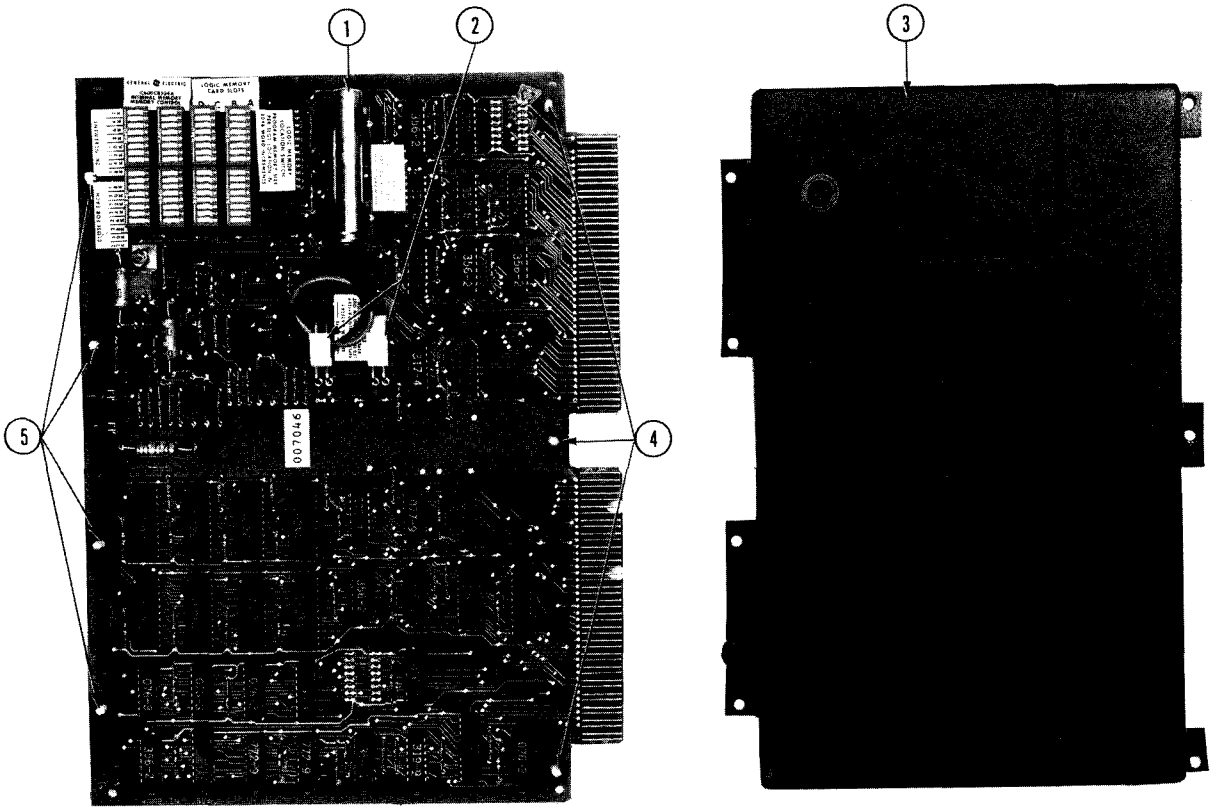
Figure 8.
LOGIC MEMORY SLOTS

The Model 60 CPU Logic Memory module combines the functions of internal memory, register memory and logic memory on one module. This module, in a Model 60 CPU only, should be installed in the slot immediately to the left of the Arithmetic Control module.

BATTERY INSTALLATION

Before installing any memory module in a CPU rack, the Lithium-Manganese Dioxide battery should be connected. These modules are shipped from the factory with the battery connector disconnected from the battery. When connecting a battery, the following procedure is recommended. Refer to Figure 9 which is a memory board, showing a mounted, connected battery and a board cover.

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1. Lithium Battery
2. Battery Connectors
3. Top Board Cover
4. Board Cover Mounting Clips
5. Board Cover Mounting Clips

Figure 9.
MEMORY BOARD, BATTERY CONNECTION

- Remove the top board cover from the component side of the module by pinching in the fangs of the clips holding the cover on, while pulling up on the cover.
- If battery is not mounted, firmly place it in its mounting clips with the cable end facing toward the battery connectors.
- Connect the battery cable to one of the battery connectors.
- Replace the protective board cover by pressing it down firmly onto the seven plastic clips.
- The memory module is now ready for installation into the CPU rack.

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CAUTION

Relatively small amounts of excess charge can cause very intense electrostatic fields in metal-oxide-semiconductor (MOS) devices, damaging their gate structure. When the board covers are removed, avoid handling the circuit boards under conditions favoring the buildup of static electricity. Failure to observe this CAUTION could result in the destruction of the CMOS RAM devices in this module.

With the board covers in place, it is unlikely that normal handling of the memory modules will cause any damage.

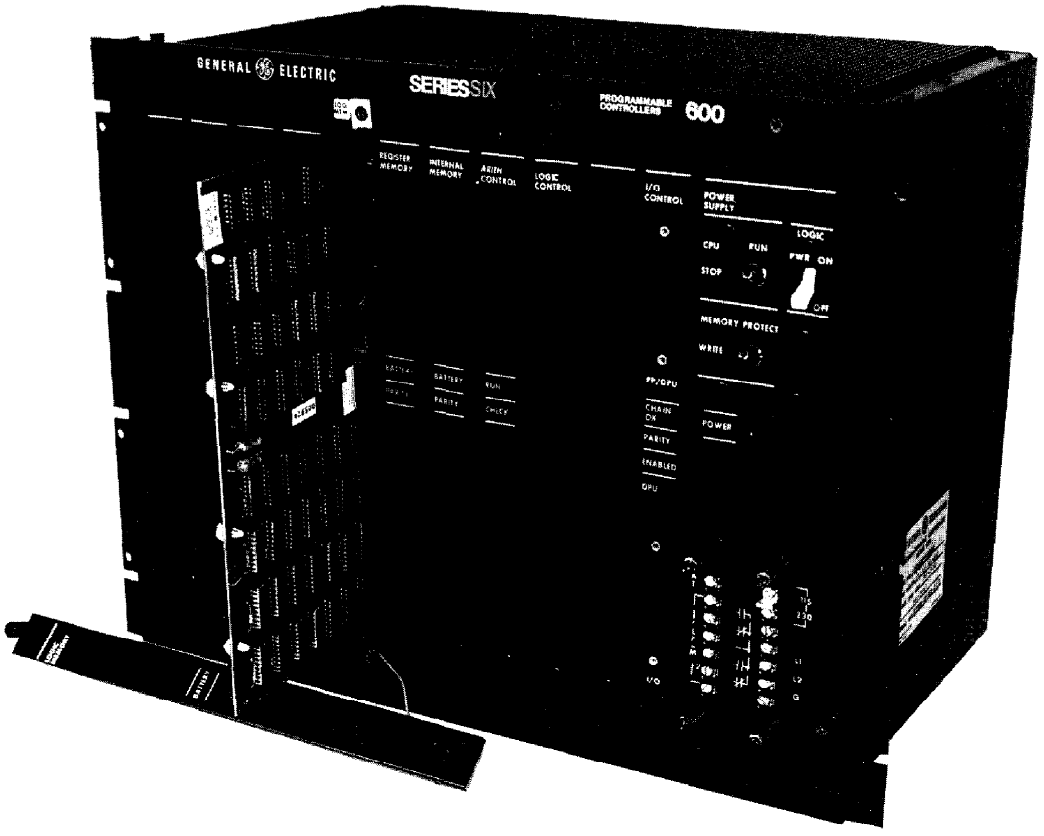
Be sure that the board covers provided with each of the Logic Memory modules are in place before installing the modules.

CAUTION

Do not allow the bottom of a module to come into contact with a conductive (metal) surface when the board covers are removed. Failure to observe this **CAUTION** could result in the discharge of the non-rechargeable Lithium battery and the loss of memory contents.

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When installing a Logic Memory module, position the side of the board with the LED on it to your right **(towards the CPU power supply). Figure** 10 shows proper orientation of a printed circuit board.



NOTE

Proper orientation of printed-circuit boards is with component side towards the power supply.

Figure 10.
PRINTED-CIRCUIT BOARD ORIENTATION IN A RACK

Connect the grounding wire from the faceplate to the rack. Install the faceplate(s) by placing the faceplate in the proper position and while pushing in, turn the quarter-turn thumbscrew clockwise until it feels secure.

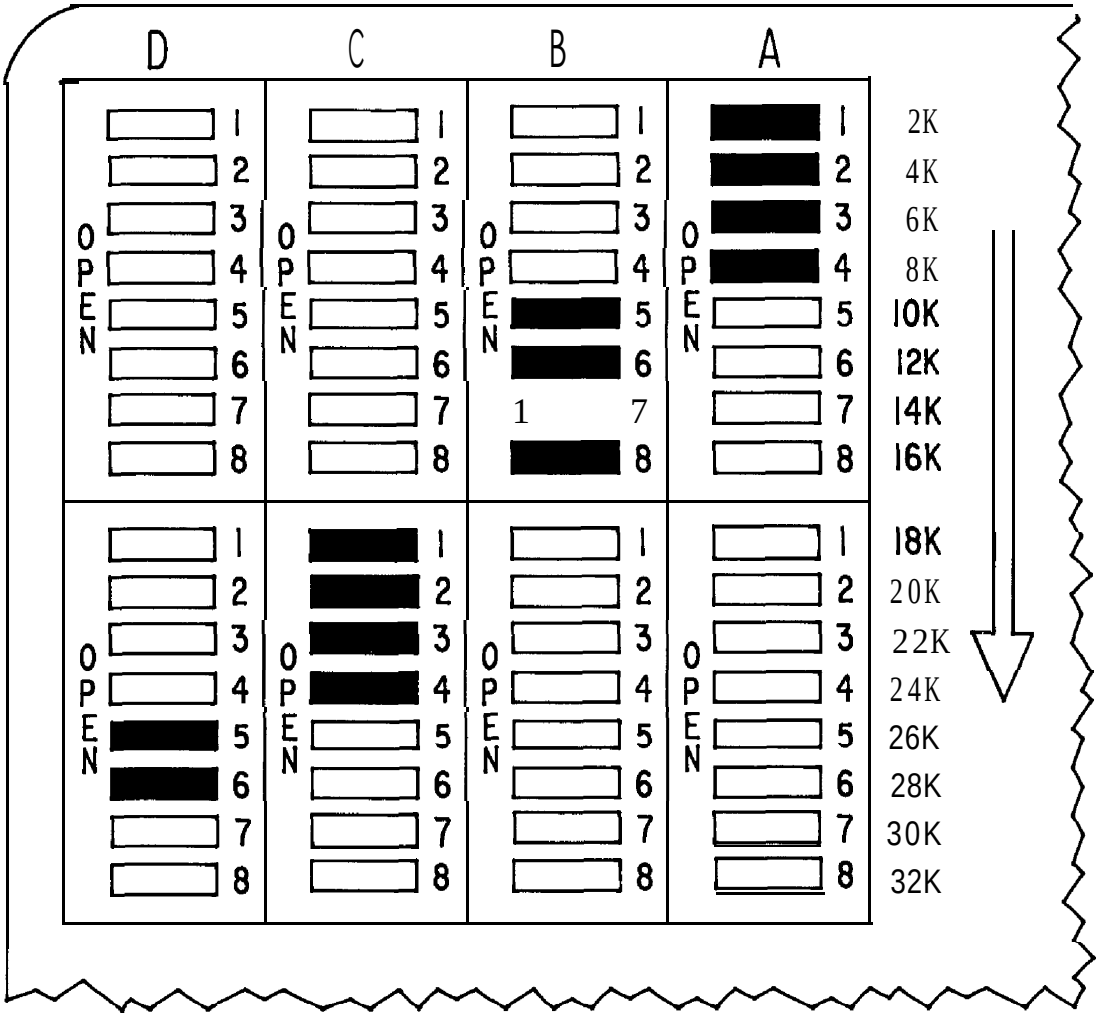
You are now ready to program the Memory Slot Location switches which activate the memory or memories. These switches are located on the Internal Memory module.

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INTERNAL MEMORY MODULE

The Logic Memory location switches which tell the CPU how much memory has been installed (in a Model 600 or 6000) should be programmed before the Internal Memory module is installed in the CPU.

Position the module in front of you so that the Logic Memory location switches are to your upper right. See Figure 11 for an illustration of the switches.



■ = toggle is on (depressed to the closed position) which will activate a 2K increment of memory.

NOTE

The DIP switch settings in the example are programmed for 28k of memory.

Figure 1 1.
LOGIC MEMORY LOCATION SWITCHES

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Note that there are 4 rows of switches, which have 2 DIP switches per row. Each DIP switch has 8 toggles or positions per switch for a total of 16 toggles per row.

The right row of switches control logic Memory slot A, the next row of switches control Logic Memory slot B, the next row controls slot C, and the left row controls slot D.

Each toggle in each row of switches turns on a 2K increment of memory in the appropriate slot. An increment of memory is activated (turned on) when the proper toggle is depressed to the closed position.

The toggles of the switches are connected so that the toggle at the top (DIP switch position I) turns on the first 2K of memory, the second toggle turns on the second 2K of memory and so on until the last toggle on the bottom turns on the last 2K of memory which gives a total of 32K of Logic Memory.

The starting address of the first 2K of memory is 0, the next 2K starts at 2K, the third 2K starts at 4K, the fourth 2K starts at 6K and so on until the last 2K increment which starts at 30K.

Some basic rules must be observed when programming the Logic Memory location switches.

- Do not close more than one switch per 2K of memory in its appropriate slot.

  The memory should be kept in sequence, do not split up a memory.

  Do not double program memory locations. If a memory in slot A is an 8K memory and toggles are on at locations 2K, 4K, 6K and 8K, do not start a second 8K memory in slot B at locations 2K, 4K, 6K or 8K - it must start at location 1 OK.

  Do not program more switches then there is memory present.

  Do not leave holes in a memory. If you have an 8K memory in slot A, it cannot be programmed at 2K, 4K, 6K and 1 OK. If you start at 2K, the switches must be in sequence 2K, 4K, 6K and 8K.

In the illustration, Figure 11, as an example, the switches are programmed for an 8K memory in slots A, B and C and a 4K memory in slot D. A shaded toggle position means that the toggle is turned on.

When the Logic Memory location switches have been properly set, the Internal Memory module is ready to be installed.

WARNING

If the Logic Memory location switches are not set properly, the CPU will not operate properly. An accident to an operator or to your machine could result due to the program running out of sequence.

Position the module so that the side with the LED on it is to your right (facing the CPU power supply). Using the extraction/insertion tool insert the Internal Memory module into its proper slot which is immediately to the left of the Arithmetic Control module.

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Connect the grounding wire attached to the faceplate to the rack. Install the proper faceplate securing it to the rack with the quarter-turn thumbscrews by pushing them in and turning clockwise.

NOTE

Ensure that the proper faceplate is installed over the corresponding module, , Incorrect placement may cause confusion to future operators.

REGISTER MEMORY MODULE

The Register Memory module has no internal devices which need programming. Your CPU will be received with this module installed if you have a Model 600 or 6000 (Model 60 does not have a separate Register Memory module since all memories are combined onto one module).

If you should remove this module, when replacing it be sure to install it in the proper slot, which is the slot immediately to the left of the Internal Memory module. When installing a new Register Memory, it is recommended that the following procedure be used. Power down the PDT, switch to the OFF LINE mode, then power back up. From the Scratch Pad Display set the Register Memory size, then from the Supervisor Display, perform the Clear Scratch Pad and Transition Parity Error function.

ARITHMETIC CONTROL MODULE
LOGIC CONTROL MODULE, BASIC OR EXTENDED

Neither of these modules have any devices needing on-site programming.

The Logic Control module should be installed in the third slot to the left of the CPU power supply.

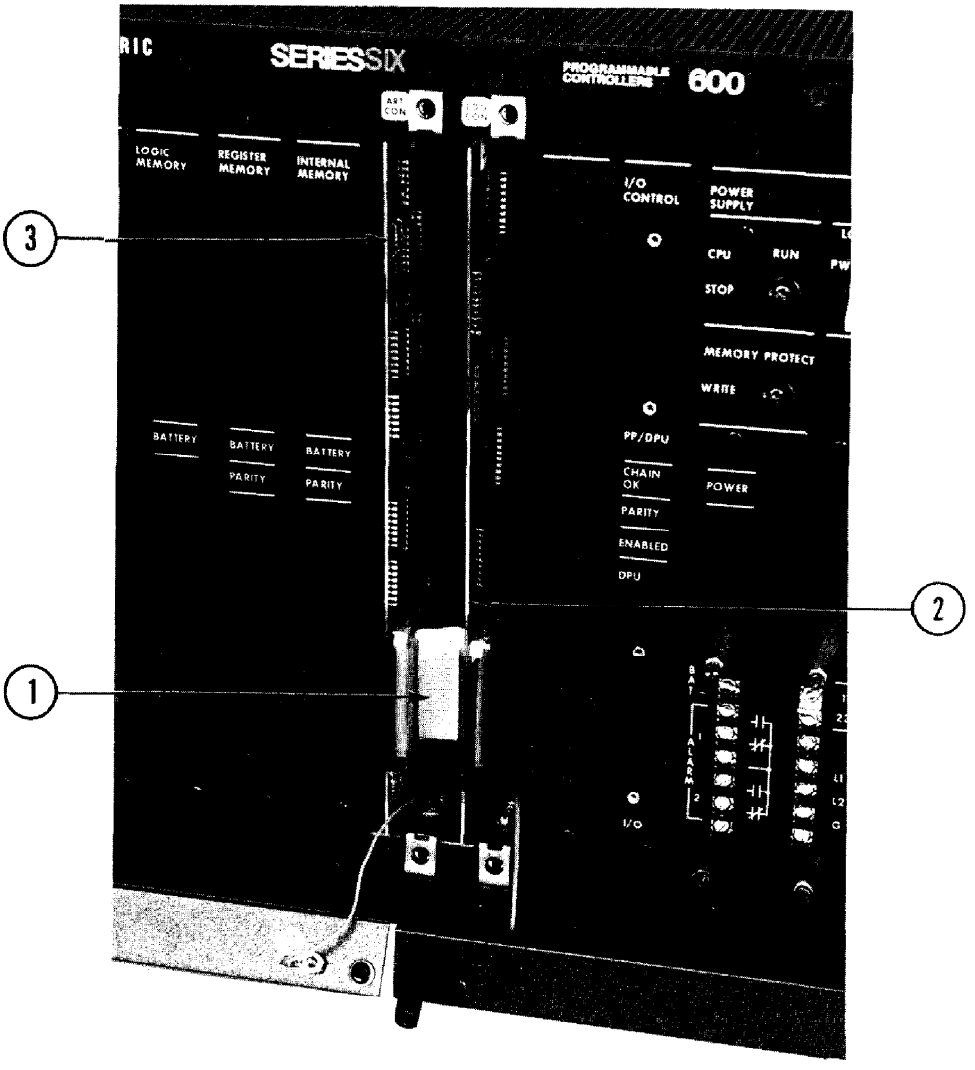
NOTE

Control adjustment and jumper placement on the Logic Control circuit board have been done at the factory and should not be changed by the user.

The Arithmetic Control module should be installed in the slot immediately to the left of the Logic Control module.

A short length of ribbon cable is used to interconnect these two modules through sockets on the lower front edge of each printed-circuit board. See Figure 12. Ensure that this cable is in place and that the connectors are well seated. Attempting to operate the system without the ribbon cable connected between these two modules will cause the CPU to operate unpredictably.

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1. Ribbon Cable Connector Between Logic Control and Arithmetic Control Modules
2. Logic Control Module
3. Arithmetic Control Module

Figure 12.
LOGIC CONTROL TO ARITHMETIC CONTROL CONNECTOR

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I/O CONTROL MODULE

The I/O Control module contains three labeled jumper terminals which are for selection of board options. These jumpers are located on the lower right of the component side of the printed circuit board (with component side towards you and LEDs and connectors to the left).

The jumper configuration and definitions are indicated in the following table. To change a configuration, move the jumper plug to the correct pins. Jumpers should be configured to conform to the requirements for a particular application.

JUMPER CONFIGURATION	DEFINITION
A-B B-C	DPU Present DPU Not Present
D-E	DPU Fault Trips Alarm No. 1 and Alarm No. 2. CPU Stops.
E-F	DPU Fault Trips Alarm No. 2. Provides an Advisory Indication.
G-H	Communications Control Fault Trips Alarm No. 1 and Alarm No. 2. CPU stops.
H-I	Communications Control Fault Trips Alarm No. 2. Provides an Advisory Indication.

Table 2.
I/O CONTROL OPTION JUMPERS

The I/O Control connects to an I/O Receiver in the first I/O rack in a CPU I/O station through a 16 pair parallel cable.

AUXILIARY I/O MODULE

The Auxiliary I/O module is available as an option for the Model 6000 CPU only. This module contains no programmable devices.

The Auxiliary I/O module should be installed in the leftmost slot of the Model 6000 CPU rack. This module connects to the first I/O rack in a CPU I/O station in the auxiliary I/O chain through a 16 pair parallel cable.

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COMMUNICATIONS CONTROL MODULE

The Communications Control module is to be installed in the slot immediately to the left of the I/O Control module.

There are jumpers on the board which should be configured to set operating parameters for the module. The jumpers and their functions are listed in the following table.

Jumper	Option	Jumper Setting
15	STR LINK IIA 1200 Baud Operation	15-16
17	STR LINK III 9600 Baud Operation	17-I8
55 59 63 66	RS-232C Operation	55-56 59-60 62-63 66-67
55 59 63 66	RS-422 Operation	54-55 58-59 63-64 65-66
31	Turnaround Delay (1 O-20ms)	30-31
	No Turnaround Delay	31-32
34	Test Mode Timeouts Enabled Disabled	 33-34 34-35

Table 3.
OPTION JUMPER SETTINGS (IC600CB5 14A)

NOTE

The jumper settings in Table 3 are for the Communications Control module, Catalog No. IC600CB514A. Catalog No. IC600CB514B has several options not available on 514A. The following tables list all of the jumpers required for operation by the 514B module.

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Jumpers / Baud Rate	Jumper In or Out of Circuit			
	28-29	26-27	21-22	19-20
110	out	out	out	In
134.5	In	out	In	In
150	In	out	In	out
300	out	out	In	out
600	out	In	In	out
1200	out	In	out	out
1800	In	out	out	In
2400	out	In	out	In
3600	In	In	out	out
4800	out	out	In	In
7200	out	In	In	In
9600	In	out	out	out

Table 4.
SELECTABLE BAUD RATE JUMPER CONFIGURATION (IC600CB514B)

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Jumper	Option	Jumper Setting
49	Odd Parity	49-50
	No Parity	48-49
55 59 63 66	RS-232C Operation	55-56 59-60 62-63 66-67
55 59 63 66	RS-422 and Current Loop Operation	54-55 58-59 63-64 65-66
72	RS-232C and RS-422 Operation	72-73
	Current Loop	71-72
31	Turnaround Delay (10-20 ms)	30-3 1
	No Delay	31-32
34	Test Mode Timeouts Enabled Disabled	 33-34 34-35

Table 5.
OPTION JUMPER SETTINGS (IC600CB5 14B)

Other jumpers have been factory set and should not be changed.

Connect the grounding wire from the faceplate to the screw adjacent to the cardguide for the board.

Insert the printed-circuit board using the extraction/insertion tool. Install the faceplate and tighten the quarter-turn thumbscrews.

NOTE

When all of the jumpers and switches have been configured as described in the previous paragraphs, the CPU module configuration is complete.

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CPU POWER SUPPLY

The CPU power supply has 2 terminal boards located on the lower part of the faceplate. Remove the protective cover and make the following connections. Refer to Figure 13 which is an illustration of the terminal boards and their connections.

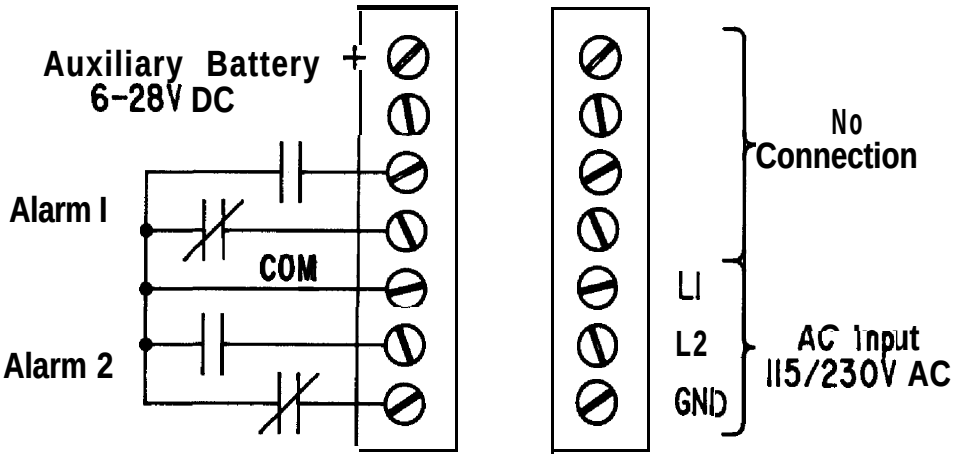


Figure 13.
CPU POWER SUPPLY CONNECTIONS

Provide an AC power source of the proper voltage for your system, either 115V AC or 230V AC.

Connect a 3-wire AC power cord to the 3 lower terminals of the terminal board on the right. The power cord plug should be of the proper pin configuration for either 115V AC or 230V AC.

CAUTION

If the same AC power source is used to provide AC power to other racks in a Series Six system, ensure that all AC input connections are identical at each rack. Do not cross Line 1 (LI) and Line 2 (L2). A resulting difference in potential can cause damage to equipment.

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Connect the alarm relay contacts to external alarm devices as required by your system configuration. (Optional)

- Connect the + and - Auxiliary Battery contacts to an external battery with a voltage of 6-28V DC. This is an option that will provide a back-up to the memory back-up battery mounted on each memory module.

CAUTION

If a memory auxiliary battery is used, the circuit connecting it to the Power Supply module should be isolated from the rest of the system. If this CAUTION is not observed, the battery could be short-circuited.

The user devices connected to each set of alarm terminals on the Power Supply module should present a resistive load drawing no more than one amp of current at 115V AC or 28V DC. Failure to observe this CAUTION may result in damage to the circuit board.

After these connections have been completed the protective cover plate should be reinstalled.

WARNING

Ensure that the protective cover is installed over the terminal boards. During normal operation either 115V AC or 230V AC is present. The cover protects against accidental shorting of terminals which could cause damage to the machine or injury to the operator or maintenance personnel.

SYSTEM GROUND

A common system ground connection is provided by the GND connection from the 115V AC or 230V AC power source to the terminal board on the power supply. The programmable control is connected internally to this point.

All racks located within a CPU station, a Local I/O station or a Remote I/O station must have a common ground between racks. Stations do not need to have a common ground run between them since they are isolated from one another by circuitry on the transmitter and receiver modules.

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SECTION 2
THE I/O RACK

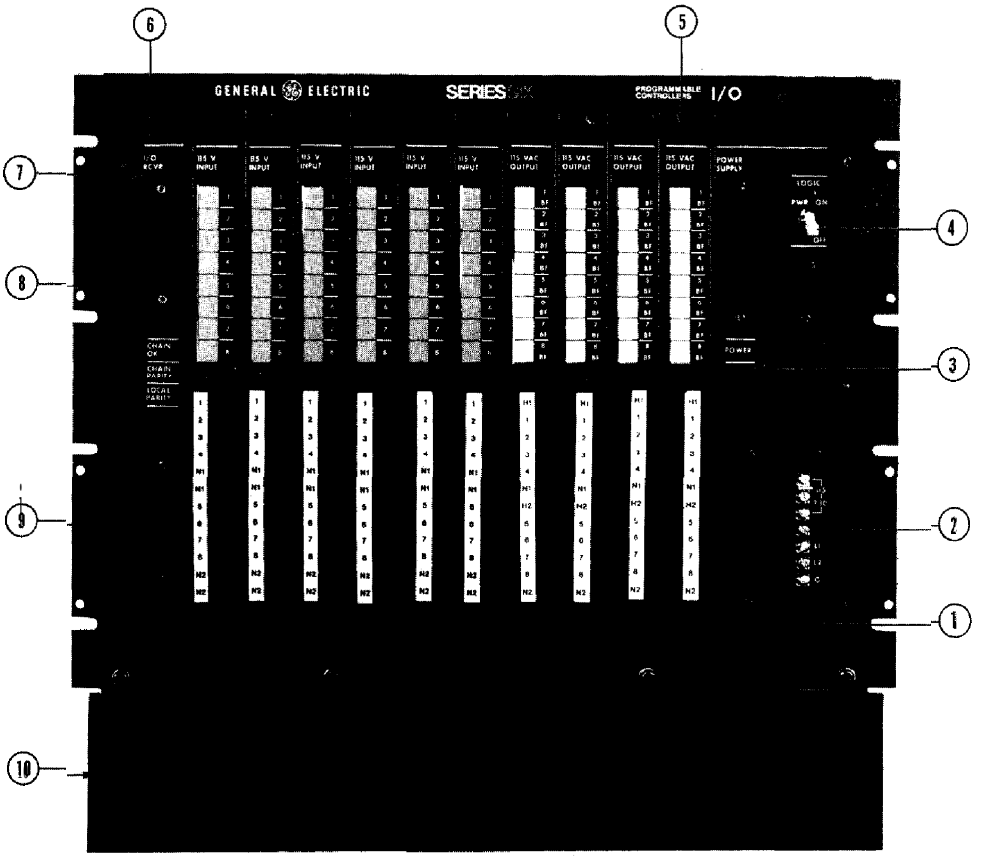
I/O SYSTEM CONFIGURATION

I/O rack(s) should be rack, panel or wall mounted in the same manner as the CPU rack. When mounting multiple racks at the same location, enough space should be allowed between racks, both horizontally and vertically, to allow sufficient air flow between racks (minimum of 6 inches vertically).

I/O Communication modules should be available for installation in racks The types of I/O Communication modules are determined by the number of I/O points required and the location of the racks in a system. Refer to Section 4 of Chapter 1 for a discussion of the 3 types of stations possible in an I/O system (CPU, Local and Remote). The type of I/O station will determine whether your I/O racks will contain I/O Receivers, I/O Transmitters, Remote I/O Drivers, Remote I/O Receivers or combinations of these modules. Figure 14 is an example of a typical I/O rack.

To prevent accidental mating of an I/O module with a faceplate containing voltages not compatible with that module, all of the I/O printed circuit boards are keyed to match the corresponding faceplates.

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1. I/O Power Supply, Available in a Standard or High-Capacity Model
2. Power supply, Terminal Block, AC Input Connections
3. DC Power OK Light
4. Logic Power Switch/Circuit Breaker
5. I/O Slot Number 11, For Reference Only
6. I/O Slot Number 1, For Reference Only
7. I/O System Communications Module (I/O Receiver Shown)

a. Connector to I/O Control, Another I/O Receiver, an I/O Transmitter or a Remote I/O Receiver

9. Connector to a Downstream I/O Receiver

IO. Tray for Field Wiring

Figure 14.
TYPICAL I/O RACK

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I/O POWER SUPPLY

The I/O power supply is shipped from the factory installed in the I/O rack. 5V DC at 6.1 A is provided for the standard I/O rack or 5V DC at 16.5A, + 12V DC at 1.5A and -12V DC at 1 .0A for the high capacity I/O rack.

There is one terminal board located on the lower part of the faceplate. Remove the protective cover plate and make the following connections. Refer to Figure 15 which is an illustration of the terminal board and its connections.

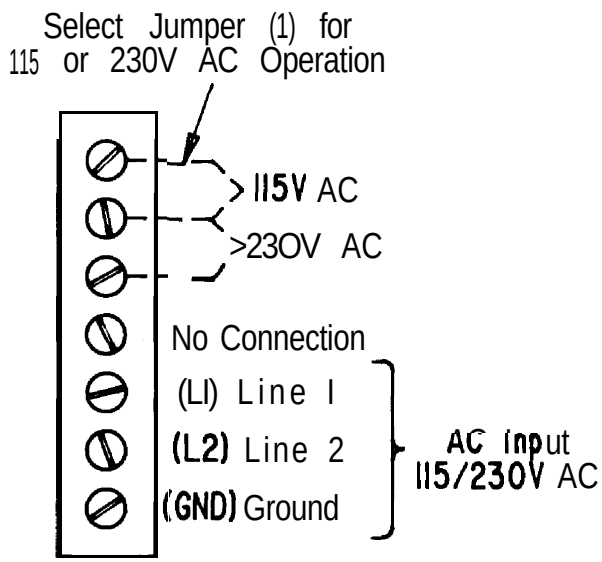


Figure 15.
I/O POWER SUPPLY CONNECTIONS

- **Select 115V AC or 230V AC input by configuring the jumper to the proper terminals as shown. The jumper will be configured for 115V AC when shipped from the factory. (If a dual voltage model).**
- **Connect a 3-wire AC power cord to the 3 lower terminals.**

CAUTION

When connecting multiple I/O racks to the same AC power source, ensure that all AC input connections are identical at each rack. Do not cross Line 1 (L1) and Line 2 (L2). A resulting difference in potential can cause damage to equipment.

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After completing the above connections the protective coverplate should be reinstalled.

WARNING

Ensure that the protective cover is installed over the terminal board. During normal operation either 115V AC or 230V AC is present. The cover protects against accidental shorting of terminals which could cause damage to the machine or injury to the operator or maintenance personnel.

I/O SYSTEM COMMUNICATION MODULES

The I/O system communication modules are the I/O Receiver, I/O Transmitter, Remote I/O Driver, and Remote I/O Receiver. Individual functions of these modules are described in Chapter 1. Installation instructions for each of these modules is included in this section.

I/O RECEIVER

The I/O Reciever module is normally installed in the left most slot of an I/O rack since this module does not require an I/O address. The left most slot does not have a seven segment DIP switch adjacent to the slot on the backplane.

Before installing an I/O Receiver, determine whether the I/O Receiver is to be in the last rack of an I/O station daisy chain or in a rack within the chain. If it is to be in the last rack, the I/O chain signals must be terminated. If the receiver is to be in a rack within the daisy chain it must be configured to continue the I/O chain signals through the module, passing these signals on to the next I/O rack.

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All I/O Receivers are shipped from the factory configured to continue the I/O chain signals through the module. Refer to Figure 16.

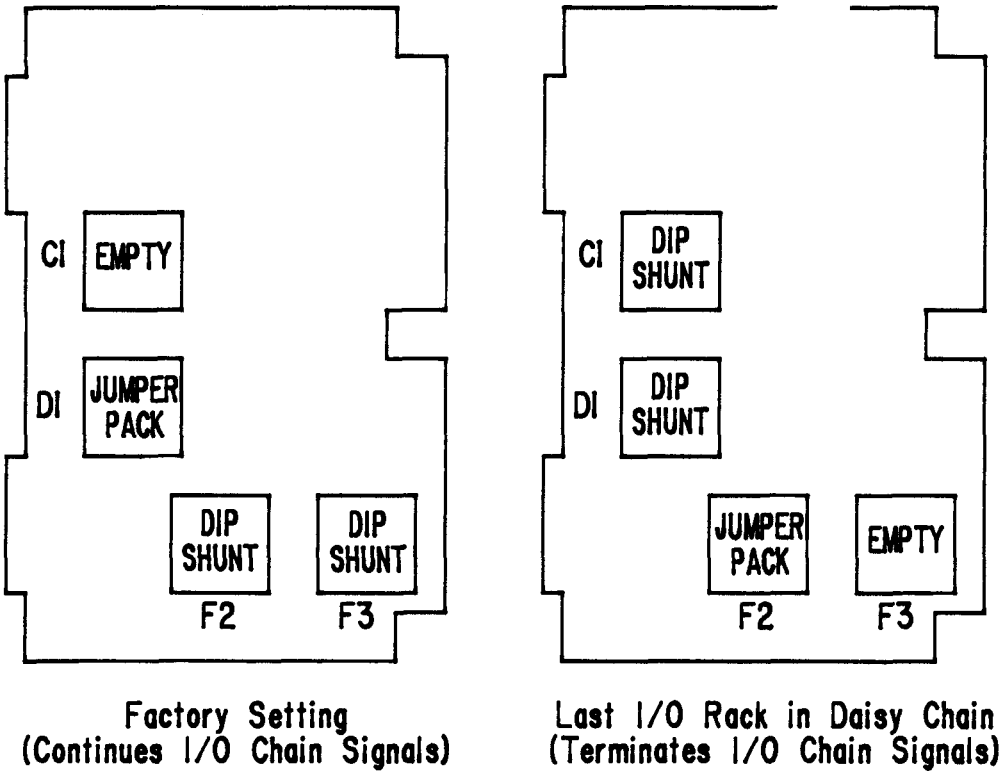


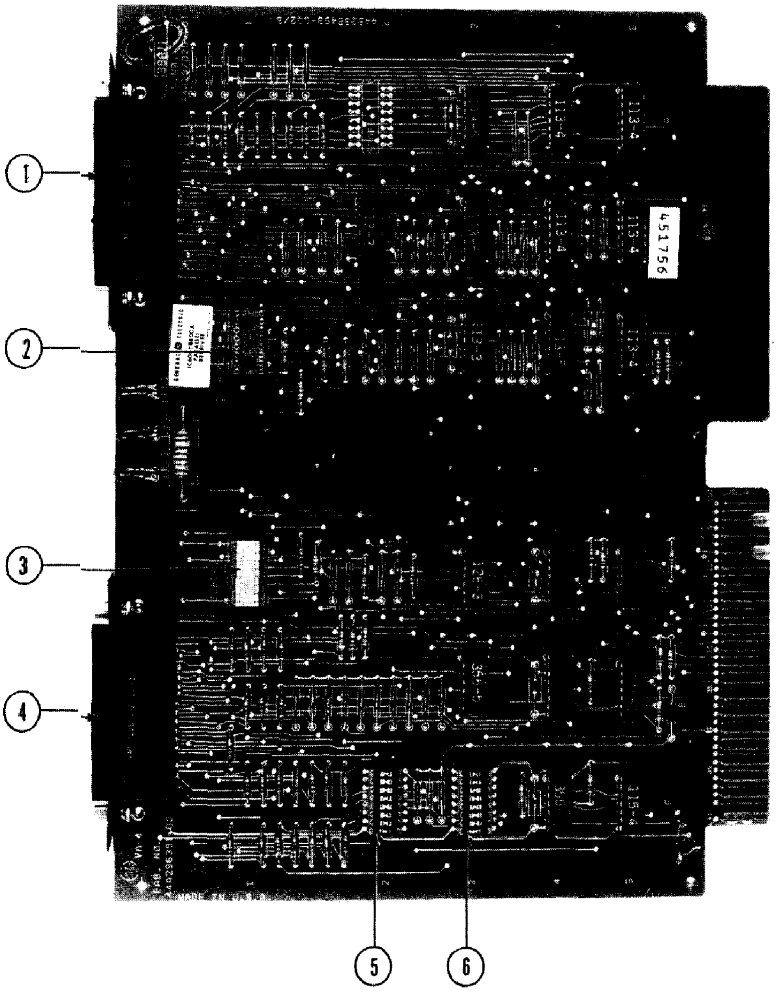
Figure 16.
I/O RECEIVER DIP SHUNT/JUMPER PACK CONFIGURATION

Procedure for configuring I/O Receiver if in last rack of a daisy chain.

- Remove jumper from location D1.
- Remove DIP shunts from locations F2 and F3. These two locations are for storing the DIP shunts or the jumper pack when they are not being used.
- Insert the DIP shunts in locations C1 and D1.
- Insert the jumper pack in location F2 for storage.

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If an I/O Receiver should be removed from the last rack and moved to an upstream rack in a daisy chain, the module must be reconfigured to continue the I/O chain signals. Figure 17 shows the physical locations described above.



1. Connector to I/O Control, I/O Transmitter or Another I/O Receiver (Upstream)
2. Board Location Cl
3. Board Location Dl
4. Connector to I/O Receiver in Next Downstream I/O Rack
5. Board Location F2
6. Board Location F3

Figure 17.
I/O RECEIVER CONFIGURATION LOCATIONS

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The top connector on an I/O Receiver can be connected to several points as determined by system configuration. Possible connections are:

I/O Control module in a CPU rack.
Next upstream I/O rack in a daisy chain of racks.
An l/O Transmitter in a model 60 CPU I/O slot, a CPU l/O station, a Local l/O station or a Remote l/O station.

The lower connector connects to the next rack downstream, if additional racks are to be included in a daisy chain of I/O racks.

I/O TRANSMITTER

The I/O Transmitter requires no field configuration. An I/O Transmitter module can be installed in any slot in an I/O rack or in an I/O slot in a model 60 CPU. Connect an I/O cable (refer to Table 12) from the connector on an I/O Transmitter to the first l/O Receiver in the next downstream I/O station.

The maximum distance separating an I/O Trasmitter from the I/O Receiver to which it is connected is 500 feet (150 meters). Also, no Local station should interface through more than four I/O Transmitter links.

Install the I/O Transmitter in the selected I/O slot using the extraction/insertion tool provided with each CPU.

REMOTE I/O DRIVER

A Remote I/O Driver can be installed in any I/O slot (except the left slot) in an I/O rack located in a CPU I/O station, a Local I/O station or a model 60 CPU I/O slot. Before installing this module, the seven segment DIP switch on the backplane adjacent to the selected I/O slot for the module must be configured to select the group of I/O references for the Remote I/O station.

Switches 5, 6, and 7 are used to establish the I/O references for groups of 120 Inputs and 120 Outputs. If the option is selected for 248 Inputs and 248 Outputs, then switches 6 and 7 wilt establish the I/O references. The remaining switches, either 1, 2, 3 and 4 or 1, 2 and 3 respectively, are used to select a unique address for the Remote I/O Driver. The unique address will assign 8 consecutive I/O. points to the Driver which will be used to provide status data to the CPU for the Remote I/O station. Table 6 is a guide to the switch settings for selecting the I/O references in a Remote l/O station.

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REMOTE I/O STATION I/O REFERENCES	USER I/O QUANTITY	DIP SWITCH POSITION 7	6	5	4	3	2	1
0001-0128	120/120							
0129-0256	120/120			X				
0257-0384	120/120		X					
0385-0512	120/120		X	X	Selects Group(s) of 8 Consecutive			
0513-0640	120/120	X			I/O Points For Individual Modules			
0641-0768	120/120	X		X				
0769-0896	120/120	X	X					
0897-1000	96/96	X	X	X				
		7	6	5	4	3	2	1
0001-0256	248/248			Module I/O Point Selection, As Above.				
0257-0512	248/248		X					
0513-0768	248/248	X						
0769-1000	224/224	X	X					

[X] = Switch Depressed To Left (OPEN)

Table 6.
DIP Switch Settings For Remote I/O

All I/O modules used in a Remote I/O station must use I/O references within the group established by the Remote I/O Driver backplane DIP switch setting. For example, if the group selected is 0129-0256, an I/O module in a remote station cannot use I0625 as a reference. All I/O modules in the remote station must have switches 5, 6 and 7 (120/120 I/O) or switches 6 and 7 (248/248 I/O) set the same as the Remote I/O Driver.

In addition to setting the DIP switches for a Remote I/O Driver, several jumper plugs on the printed circuit board must be configured for proper system operation. These jumpers are used to select various options. Figure 18 shows the location of each of the jumpers on the printed circuit board. Each option selection location has three pins with the center pin being common to the two outer pins. A jumper plug connects the center pin to one of the outer pins. The jumpers are identified by the center pin, i.e. pins 1, 2, and 3 are identified as Jumper 2.

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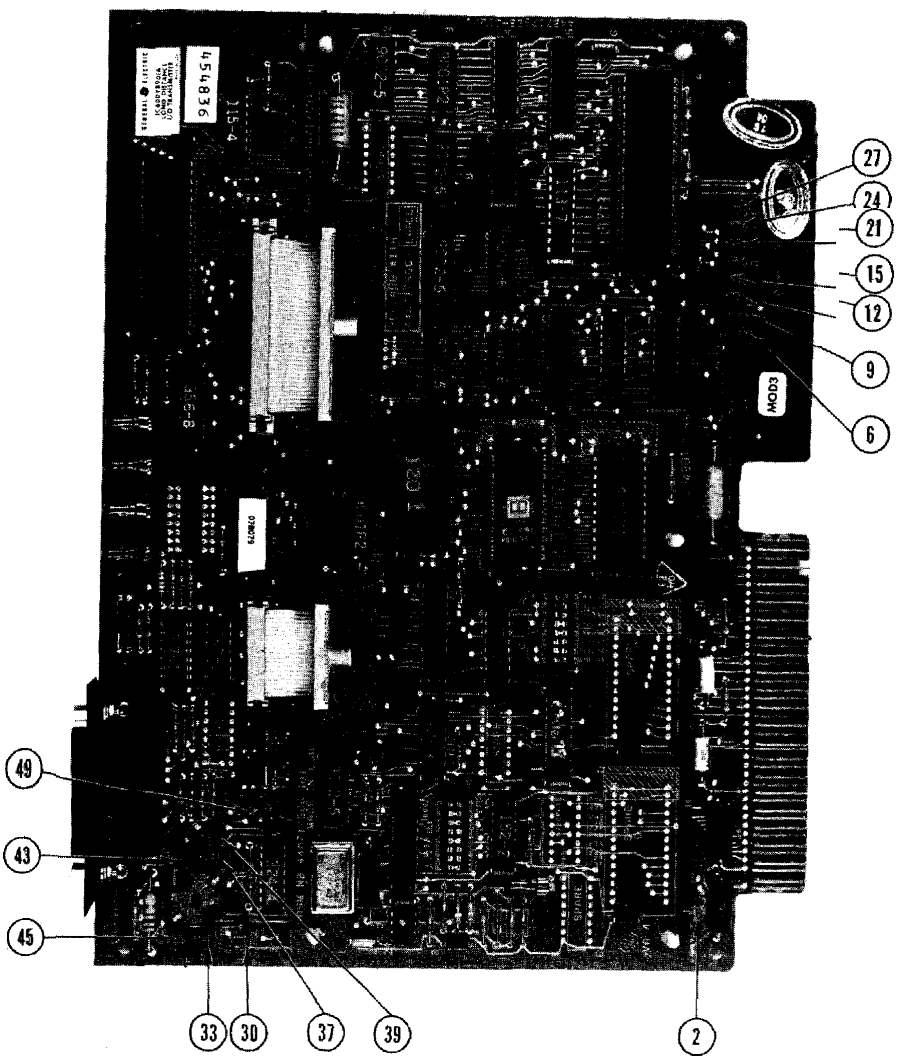


Figure 18.
REMOTE I/O DRIVER JUMPER LOCATIONS

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Table 7 lists the options and jumper settings necessary for configuration of this module for proper system operation. The table lists the jumper number, its function, factory setting and the alternate setting. Factory configuration is for operation with a two twisted pair cable (communications up to 10,000 feet (3 Km).

JUMPER	FUNCTION	FACTORY SETTING		ALTERNATE SETTING	
2	Quantity of I/O	1-2	120/120 I/O	2-3	248/248 I/O
6	Remote I/O Parity Error Effect On CPU	6-7	STOP CPU	5-6	CPU Continues to RUN
9	Communications Failure Effect on CPU	9-10	STOP CPU	8-9	CPU Continues to RUN
12	Even or Odd Parity	12-13	Odd	11-12	Even
15	Specify Parity Check	15-16	Yes	14-15	No
21 24 27	Baud Rate	21-22 24-25 27-28	57.6 Kb	(1)	
30	Carrier Detect	30-50	No	29-30	Yes
33	Clear To Send	33-51	No	32-33	Yes
37 39	Output Mode	36-37 38-39	Twisted Pair	35-37 39-40	RS-232
43 45	Input Mode	42-43 44-45	Twisted Pair	41-43 45-46	RS-232
49	Sensitivity	48-49	Medium	47-49	Minimum

(1) Alternate setting for the baud rate is a selectable baud rate for RS-232 operation. The selectable baud rates and their appropriate jumper settings are listed in Table 8. Note that three jumpers must be set when changing the baud rate configuration.

Table 7.
REMOTE I/O DRIVER JUMPERS

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Baud Rate	Jumper		
	21	24	27
57.6K	21-22	24-25	27-28
19.2K	21-22	24-25	26-27
9600	21-22	23-24	27-28
2400	21-22	23-24	26-27
1200	20-21	24-25	27-28
300	20-21	24-25	26-27
110	20-21	23-24	27-28

Table 8.
SELECTABLE BAUD RATE JUMPERS, RS-232 OPTION

NOTE

If the RS-232 option is selected, the Remote I/O Driver module must be installed in a High-Capacity I/O rack (Catalog Number IC600YR510A, 115V AC or IC600YR5 12A, 230V AC) or a Model 60 CPU rack.

When all of the option jumpers are properly configured for either operation with two twisted pair cable or RS-232 modem as required, the Remote I/O Driver can then be installed in its I/O slot. Install the printed circuit board using the extraction/insertion tool. Connect the faceplate grounding wire and install the faceplate by placing it in position and securing it by turning the quarter-turn thumbscrews clockwise.

Connection from the Remote I/O Driver to a Remote I/O station is by a two shielded, twisted pair cable for direct cable connection up to 10,000 feet (3 Km) or a cable with a length up to 50 feet (15 meters) to a modem for RS-232 connection. Refer to Figures 50 and 51 in Chapter 1 for connector, cable, and wiring specifications. These cables are to be user supplied.

REMOTE I/O RECEIVER

A Remote I/O Receiver should be installed in the left slot of the first I/O rack in a Remote I/O station. The Remote Receiver does not require an I/O address. Before installing a Remote Receiver module, several jumper plugs on the printed circuit board must be configured to be compatible with the Remote I/O Driver to which it is connected. The jumper locations are arranged on the board in groups of three pins and are identified by the center pin. Figure 19 shows the board location for each of the jumpers.

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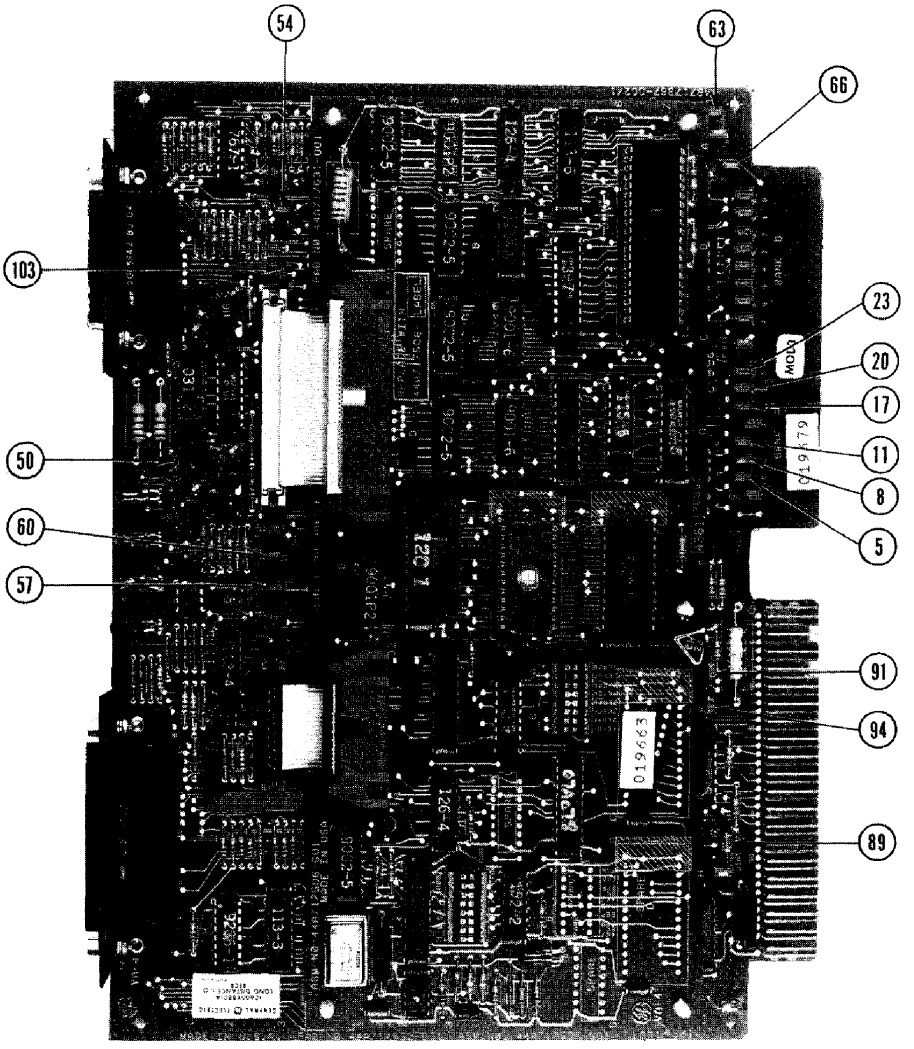


Figure 19.
REMOTE I/O RECEIVER JUMPER LOCATIONS

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Table 9 lists the options and jumper settings necessary for configuration of this module for proper system operation. Factory configuration is for operation using a two-twisted pair cable for communications up to 10,000 feet (3Km).

JUMPER	FUNCTION	FACTORY SETTING		ALTERNATE SETTING	
5	Communications Failure Effect on Remote I/O	4-5	Turn all Outputs OFF	5-6	Hold All Outputs at Last State
8	Even or Odd Parity	7-8	Odd	8-9	Even
11	Specify Parity Check	10-11	Yes	11-12	No
17, 20, 23	Baud Rate	16-17, 19-20, 22-23	57.6Kb	(1)	
54	Sensitivity	53-54	Medium	52-54	Minimum
57	Carrier Detect	57-0V	No	56-57	Yes
60	Clear To Send	60-0V	No	59-60	Yes
63, 66	Output Mode	63-64, 65-66	Twisted Pair	62-63, 66-67	RS-232
50, 103	Input Mode	49-50, 102-103	Twisted Pair	50-61, 103-104	RS-232
89, 91, 94	Terminate I/O Chain Signals If Last Rack in Remote Station	88-89, 91-92, 94-95	Additional Racks in Remote Station	87-89, 90-91, 93-94	Last Rack

(1) Alternate setting for the baud rate is a selectable baud rate for RS-232 operation. Table 10 lists the selectable baud rates and their jumper settings.

Table 9.
REMOTE I/O RECEIVER JUMPERS

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Baud Rate	Jumper		
	23	20	17
57.6K	22-23	19-20	16-17
19.2K	23-24	19-20	16-17
9600	22-23	20-21	16-17
2400	23-24	20-21	16-17
1200	22-23	19-20	17-18
300	23-24	19-20	17-18
110	22-23	20-21	17-18

Table 10.
SELECTABLE BAUD RATE JUMPERS, RS-232 OPTION

NOTE

If the RS-232 option is selected, the Remote I/O Receiver module must be installed in a High-Capacity I/O rack.

In addition to the above jumpers, there are a number of other jumpers on the board which are for future expansion or production testing. These jumpers are not to be changed. They are listed for reference only. If this module should need to be returned to the factory for any reason, verify the position of these jumpers prior to returning the module. See Table 11.

Jumper	Factory Setting	Jumper	Factory Setting
14	13-14	78	78-79
2	1-2	82	81-82
69	68-0V	84	84-85
72	72-0V	97	96-97
75	74-75	100	99-100

Table 11.
BOARD JUMPERS, REFERENCE ONLY

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When the option jumpers have been properly configured for operation using either a two twisted pair cable or an RS-232 modem link, the Remote I/O Receiver can then be installed in its I/O slot. Install the printed circuit board using the extraction/insertion tool. Connect the grounding wire from the faceplate to the rack, then install the faceplate by placing it in position and securing it by turning the quarter-turn thumbscrews clockwise.

If direct connection to the Remote I/O Driver is to be through a serial two twisted pair cable at a distance up to 10,000 feet (3Km), the end of this cable at the Remote I/O station should be connected to the top connector. If connection is to be through an RS-232 modem link, a cable, not to exceed 50 feet (15 meters) in length should be connected from the top connector to the modem in the Remote I/O station.

Wiring connections and part numbers for the connectors and cable required are listed in Figures 50 and 51 in Chapter 1. The cables are to be user supplied.

If there is to be more than one I/O rack in the Remote I/O station, the next downstream rack will connect to the bottom connector using a 16 pair parallel I/O chain cable. This cable will in turn connect to an I/O Receiver in the next rack. If the rack containing the Remote Receiver is the only rack in a Remote Station, terminate the I/O chain signals by configuration of jumpers 89, 91, and 94 on the Remote Receiver printed circuit board (see Table 9).

CABLE CONNECTIONS

Cables are available for interconnection between racks on the parallel I/O chain in standard lengths. The maximum cable lengths in a system configuration are determined by the type of I/O station used. For cable limitations refer to Figures 54, 55, and 56 in section 4 of Chapter 1 in this manual, Table 12 lists the standard length I/O cables available.

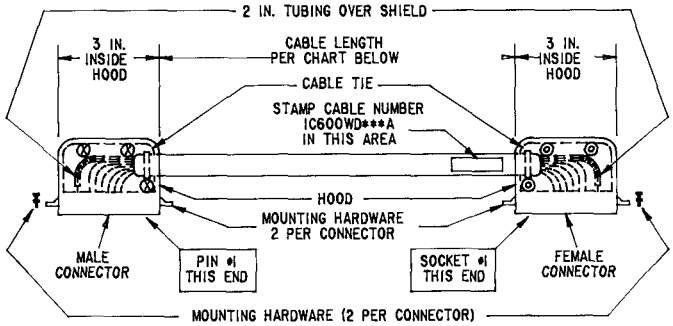
Length		Catalog Numbers
Feet	Meters	
2	0.6	IC600WD002A
5	1.5	IC600WDOO5A
IO	3.0	IC600WD01 OA
25	7.5	IC600WD025A
50	15.0	IC600WD050A
100	30.0	IC600WD100A
200	60.0	IC600WD200A
300	90.0	IC600WD300A
400	120.0	IC600WD400A
500	150.0	IC600WD500A

Table 12.
I/O CABLES FOR LOCAL I/O EQUIPMENT

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I/O CABLES

The following drawing is the I/O Cable used to connect a CPU to I/O rack of between I/O racks when utilizing local I/O equipment.



WIRE TABLE FOR ALL CABLE LENGTHS

PLUG #1	WIRE TABLE	PLUG #2
PIN #1	NO CONNECTION	SOCKET #1
PIN #2	BLUE-WHT	SOCKET #2
PIN #3	WHT-BLU	SOCKET #3
PIN #4	ORN-WHT	SOCKET #4
PIN #5	WHT-ORN	SOCKET #5
PIN #6	GRN-WHT	SOCKET #6
PIN #7	WHT-GRN	SOCKET #7
PIN #8	BRN-WHT	SOCKET #8
PIN #9	WHT-BRN	SOCKET #9
PIN #10	GRY-WHT	SOCKET #10
PIN #11	WHT-GRY	SOCKET #11
PIN #12	BLU-RED	SOCKET #12
PIN #13	RED-BLU	SOCKET #13
PIN #14	ORN-RED	SOCKET #14
PIN #15	RED-ORN	SOCKET #15
PIN #16	GRN-RED	SOCKET #16
PIN #17	RED-GRN	SOCKET #17
PIN #18	BRN-RED	SOCKET #18
PIN #19	RED-BRN	SOCKET #19

PLUG #1	WIRE TABLE	PLUG #2
PIN #20	GRY-RED	SOCKET #20
PIN #21	RED-GRY	SOCKET #21
PIN #22	BLU-BLK	SOCKET #22
PIN #23	BLK-BLU	SOCKET #23
PIN #24	ORN-BLK	SOCKET #24
PIN #25	BLK-ORN	SOCKET #25
PIN #26	GRN-BLK	SOCKET #26
PIN #27	BLK-GRN	SOCKET #27
PIN #28	BRN-BLK	SOCKET #28
PIN #29	BLK-BRN	SOCKET #29
PIN #30	GRY-BLK	SOCKET #30
PIN #31	BLK-GRY	SOCKET #31
PIN #32	BLU-YEL	SOCKET #32
PIN #33	YEL-BLU	SOCKET #33
PIN #34	NOT USED	SOCKET #34
PIN #35	NOT USED	SOCKET #35
PIN #36	NOT USED	SOCKET #36
PIN #37	SHIELD	SOCKET #37

LENGTH		CATALOG NUMBER
FEET	METERS	
2	0.6	IC600WD002A
5	1.5	IC600WD005A
10	3.0	IC600WD010A
25	7.5	IC600WD025A
50	15.0	IC600WD050A

LENGTH		CATALOG NUMBER
FEET	METERS	
100	30.0	IC600WD100A
200	60.0	IC600WD200A
300	90.0	IC600WD300A
400	120.0	IC600WD400A
500	150.0	IC600WD500A

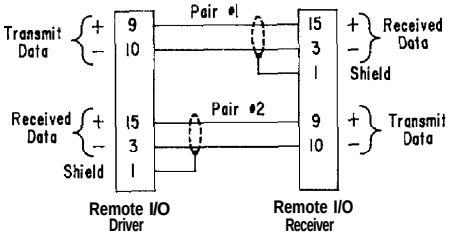
NOTE

Minimum conduit size for running this cable (with the hoods in place) should be 2 inches.

Figure 20.
I/O PARALLEL CHAIN CABLE

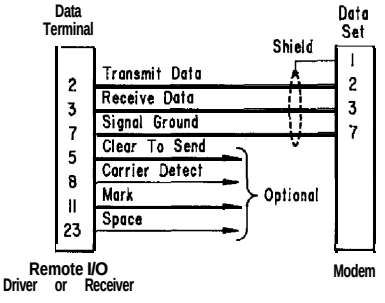
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The following data is provided as an aid when building cables for connecting a local I/O system to a Remote I/O system.



CABLE SPECIFICATIONS
l Length, Maximum - 10,000 feet (3 Kilometers) ● Two Individual Shielded,Twisted pairs ● 22 AWG, Minimum l 15 pf/foot, Maximum ● Cable Type - National Electric Cable Co. 22P 1 SLCBT or equivalent ● Connector (Driver and Receiver End) - D-Subminiature Type, Cannon DBC25P with 207908-7 Hood or equivalent connector and hood

Figure 21.
REMOTE I/O TWISTED PAIR CABLE



CABLE SPECIFICATIONS
Length, Maximum - 50 feet (15 Meters) l Overall Shield 24 AWG, Minimum Connector, Driver or Receiver End - D-Subminiature Type, Cannon DBC25P with 207908-7 Hood or equivalent ● Connector, Modem - User selected

Figure 22.
REMOTE I/O CABLE FOR RS-232 MODEMS

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I/O POINT SELECTION

After I/O racks have been installed, cables run, and AC power cables connected, the racks are ready for installation of I/O modules. The I/O module starting point numbers should now be programmed by setting the DIP switches mounted on the rack backplane adjacent to the connectors. Refer to Figure 23, which is a guide to configuration of the DIP switches for 8 circuit modules. The I/O point number selected is the first of eight consecutive I/O points (one I/O address) starting with that number. Several modules require different switch settings. Refer to the installation instructions for each module for the proper configuration of the DIP switches.

After configuring the DIP switches, install the I/O modules in their respective slots as determined by your program.

NOTE

There are limitations on the combination of types of I/O modules which may be installed in an I/O rack. The combination of I/O modules allowed is determined by the load placed on the power supply by the various modules.

I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1
1-8							
9-16							X
17-24						X	
25-32						X	X
33-40					X		
41-48					X		X
49-56					X	X	
57-64					X	X	X
65-72				X			
73-80				X			X
81-88				X		X	
89-96				X		X	X
97-104				X	X		
105-112				X	X		X
113-120				X	X	X	
121-128				X	X	X	X
129-136			X				
137-144			X				X
145-152			X			X	
153-160			X			X	X
161-168			X		X		
169-176			X		X		X
177-184			X		X	X	
185-192			X		X	X	X
193-200			X	X			
201-208			X	X			X
209-216			X	X		X	
217-224			X	X		X	X
225-232			X	X	X		
233-240			X	X	X		X
241-248			X	X	X	X	
249-256			X	X	X	X	X
257-264		X					
265-272		X					X
273-280		X				X	
281-288		X				X	X
289-296		X			X		
297-304		X			X		X
305-312		X			X	X	
313-320		X			X	X	X
321-328		X		X			
329-336		X		X			X

I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1
337-344		X		X		X	
345-352		X		X		X	X
353-360		X		X	X		
361-368		X		X	X		X
369-376		X		X	X	X	
377-384		X		X	X	X	X
385-392		X	X				
393-400		X	X				X
401-408		X	X			X	
409-416		X	X			X	X
417-424		X	X		X		
425-432		X	X		X		X
433-440		X	X		X	X	
441-448		X	X		X	X	X
449-456		X	X	X			
457-464		X	X	X			X
465-472		X	X	X		X	
473-480		X	X	X		X	X
481-488		X	X	X	X		
489-496		X	X	X	X		X
497-504		X	X	X	X	X	
505-512		X	X	X	X	X	X
513-520	X						
521-528	X						X
529-536	X					X	
537-544	X					X	X
545-552	X				X		
553-560	X				X		X
561-568	X				X	X	
569-576	X				X	X	X
577-584	X			X			
585-592	X			X			X
593-600	X			X		X	
601-608	X			X		X	X
609-616	X			X	X		
617-624	X			X	X		X
625-632	X			X	X	X	
633-640	X			X	X	X	X
641-648	X		X				
649-656	X		X				X
657-664	X		X			X	
665-672	X		X			X	X

I/O POINT	DIP SWITCH POSITION 7	6	5	4	3	2	1
673-680	X		X		X		
681-688	X		X		X		X
689-696	X		X		X	X	
697-704	X		X		X	X	X
705-712	X		X	X			
713-720	X		X	X			X
721-728	X		X	X		X	
729-736	X		X	X		X	X
737-744	X		X	X	X		
745-752	X		X	X	X		X
753-760	X		X	X	X	X	
761-768	X		X	X	X	X	X
769-776	X	X					
777-784	X	X					X
785-792	X	X				X	
793-800	X	X				X	X
801-808	X	X			X		
809-816	X	X			X		X
817-824	X	X			X	X	
825-832	X	X			X	X	X
833-840	X	X		X			
841-848	X	X		X			X
849-856	X	X		X		X	
857-864	X	X		X		X	X
865-872	X	X		X	X		
873-880	X	X		X	X		X
881-888	X	X		X	X	X	
889-896	X	X		X	X	X	X
897-904	X	X	X				
905-912	X	X	X				X
913-920	X	X	X			X	
921-928	X	X	X			X	X
929-936	X	X	X		X		
937-944	X	X	X		X		X
945-952	X	X	X		X	X	
953-960	X	X	X		X	X	X
961-968	X	X	X	X			
969-976	X	X	X	X			X
977-984	X	X	X	X		X	
985-992	X	X	X	X		X	X
993-1000	X	X	X	X	X		

X = Switch in OPEN Position (Depressed to the Left)

DIP SWITCH SETTINGS FOR I/O POINT SELECTION

Figure 23.
DIP SWITCH SETTINGS FOR I/O POINT SELECTION
FOR 8 CIRCUIT MODULES

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I/O MODULE LOAD

Two I/O racks are available, the difference being the load capacity of the power supply. The load capacity of the power supply is the internal load placed on it by the I/O modules and is expressed as units of load. The power supply in a standard I/O rack can supply 100 units of load while the power supply in the high capacity I/O rack can supply 275 units of load. The I/O racks to be used in a system are determined by installation of modules in the racks in a combination that does not exceed the load capacity of the power supply in a rack. Table 13 lists the I/O load for each I/O module.

The power supply in a Model 60 CPU rack allows up to 100 units of load for the I/O modules contained in that rack:

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MODULE	NO. OF CIRCUITS	UNITS OF LOAD
12V AC/DC Input	8	2
24-48V AC/DC Input	8	2
115V AC/DC Input	8	2
230V AC/DC Input	8	2
12V DC Sink Output	8	7
24V DC Sink Output	8	7
48V DC Sink Output	8	7
1 15V AC Output	8	9
230V AC Output	8	9
12V DC Source Output	8	7
24V DC Source Output	8	7
48V DC Source Output	8	7
O-l OV DC Analog Input	8	29
-10 to + 1 OV DC Analog Input	8	29
4-20 mA/1-5V DC Analog Input	8	29
0 to + 10V DC Analog Output	4	29
-10 to + 10V DC Analog Output	4	29
4 - 20 mA Analog Output	4	29
Isolated AC Output	6	8
Reed Relay Output	6	17
5V TTL/10-50V DC Input	32	9
5V TTL Output	32	5
10-50V DC Output	32	5
Interrupt Input	8	3
Thermocouple Input	8	9
I/O Receiver		9
Remote I/O Receiver		42
I/O Transmitter		34
Remote I/O Driver		38

Table 13.
SUMMARY OF I/O LOADS

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The following 2 examples show combinations of modules in standard I/O racks with 11 available I/O slots.

Example 1

Standard I/O Rack (100 Units of Load)

Quantity	Module	Unit of Load Per Module	Total Units
1	I/O Receiver	9	9
5	115V AC/DC Input	2	10
5	115V AC Output	9	45
			64 (Total)

Example 1 is an allowable combination since the total of the units of load do not exceed the 100 units available.

Example 2

Standard I/O Rack (100 Units of Load)

Quantity	Module	Unit of Load Per Module	Total Units
1	I/O Receiver	9	9
1	I/O Transmitter	34	34
3	115V AC/DC Input	2	6
6	115V AC Output	9	54
			103 (Total)

Example 2 is not allowable. The total units of load exceed the 100 units available. This combination of modules requires the high-capacity I/O rack with 275 units of load available.

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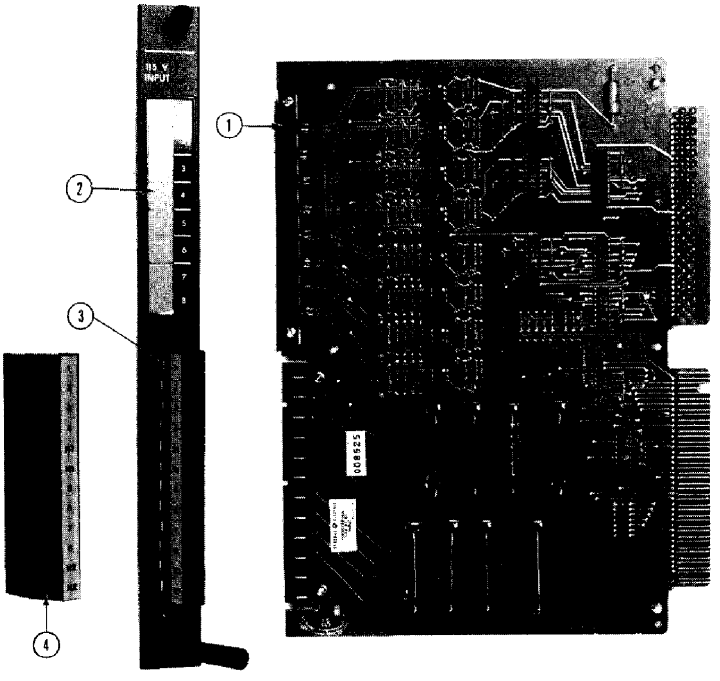
SECTION 3
I/O MODULE WIRING

AC/DC INPUT MODULE

An Input module can be installed in any I/O slot in an I/O rack except the one at the extreme left. This slot does not have a DIP switch for setting an I/O point starting number and is reserved for a communication module. In a Model 60 CPU, the 6 slots to the left are for I/O modules. More than 192 I/O points in a Model 60 system require an I/O rack(s) to be connected to the CPU.

Before installing a discrete 8 circuit AC/DC module, select the starting I/O point reference number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. Refer to Figure 23 for DIP switch settings.

The module has 2 parts: the terminal assembly and the logic board (see Figure 24, Typical Input Module). Install the printed circuit board using the extraction/insertion tool furnished with the CPU. With the circuit board in place in its I/O slot, slip the terminal assembly over the circuit board so that the terminals **near** the bottom of each part are mated properly. Next, secure the terminal assembly to the rack using the quarter-turn thumbscrews.



1. Input "On" Indicators
2. Markable lens surface
3. Box Lug Terminals
4. Cover

Figure 24.
TYPICAL INPUT MODULE

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Wiring to field devices should be routed through the tray attached to the bottom front of the rack. Run the wiring to the appropriate module, and fan the individual wires to their respective terminals. Then insert the wires into the box lugs on the terminal assembly and tighten the screws to ensure a good connection. The lugs will accept one No. 12 AWG wire or two No. 14 AWG wires. Wiring connections conform to UL standard 230 C.

The following wiring instructions can be used for these modules:

Module	Catalog Number
12V AC/DC Input	IC600BF806A
24-48V AC/DC Input	IC600BF802A
1 15V AC/DC Input	IC600BF804A
230V AC/DC Input	IC600BF805A

Note that the input connections are divided into 2 groups of 4, each having 2 neutral connections. See Figure 25. Remove the cover from the terminal assembly before proceeding with wiring.

- Connect the high side of each input to the appropriate input terminal 1 through 8.
- **Connect the low side of the inputs going to terminals 1 through 4 to either of the Nl terminals** (Neutral No. 1)
- **Connect the low side of the inputs going to terminals 5 through 8 to either of the N2 terminals** (Neutral No. 2).

All wires connected to either Nl terminal are at the same potential as are all wires connected to either N2 terminal.

After connections have been made to the box lug terminals, the terminal cover should be installed by guiding both of its edges onto the top of the terminal board and sliding it downward over the terminals.

The markable **area provided on the left side of the plastic lens beside each LED should be used for** noting the function or source of each input.

WARNING

When the Logic Power switch is turned off on an I/O or CPU rack, potentially dangerous voltages may remain at the box lug terminal connections on I/O modules. These voltages are user supplied and are controlled externally from the CPU or I/O racks. Operators and maintenance personnel should exercise extreme care when working with the I/O modules to prevent personal injury.

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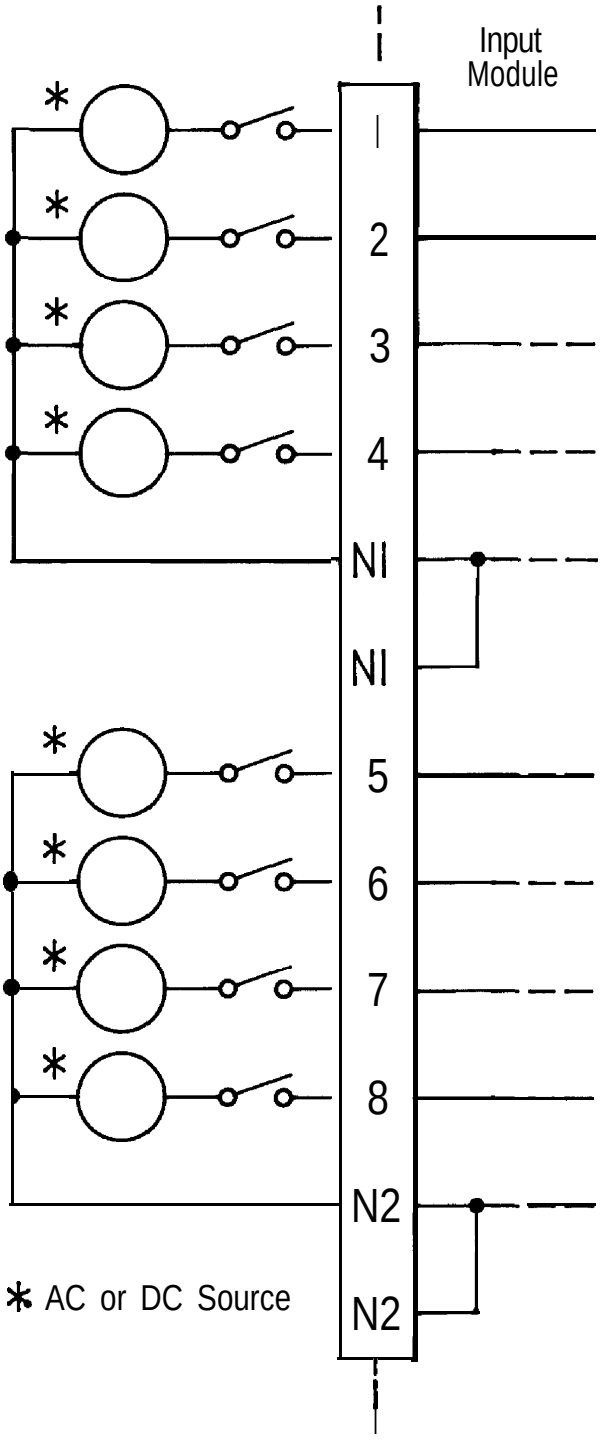


Figure 25.
TYPICAL INPUT MODULE WIRING CONNECTIONS

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HIGH DENSITY INPUT MODULE

A High Density Input module, (5V TTL/10-50V DC, catalog number IC600BF811A) can be installed in any I/O slot in an I/O rack, except the left most slot or an I/O slot in a model 60 CPU. Before installing the module, select the I/O starting point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. This will assign a group of 32 consecutive inputs to the module. Refer to Figure 26 for DIP switch settings.

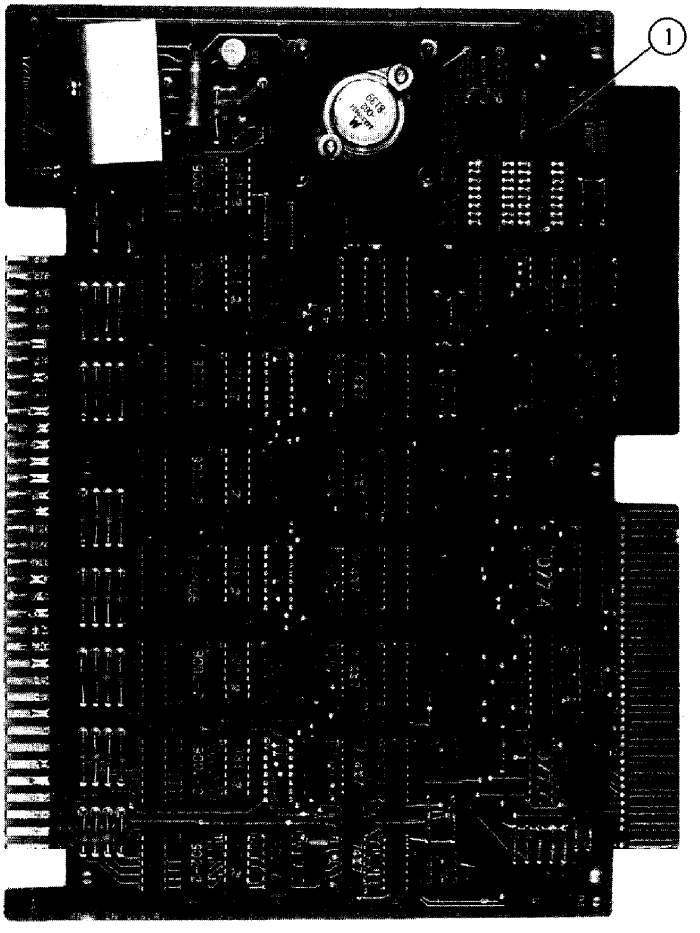
INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X X X X X (NOT USED)				
321-352		X		X		673-704	X		X		X						

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 26.
HIGH DENSITY INPUT MODULE I/O POINT SELECTION

In addition to setting the DIP switches, a circuit board jumper for configuration of the module to operate in the Inverting or Non-Inverting state should be set. Refer to Figure 27 for the location of this jumper.

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1. Jumper For Selection of Inverting or Non-Inverting Mode.

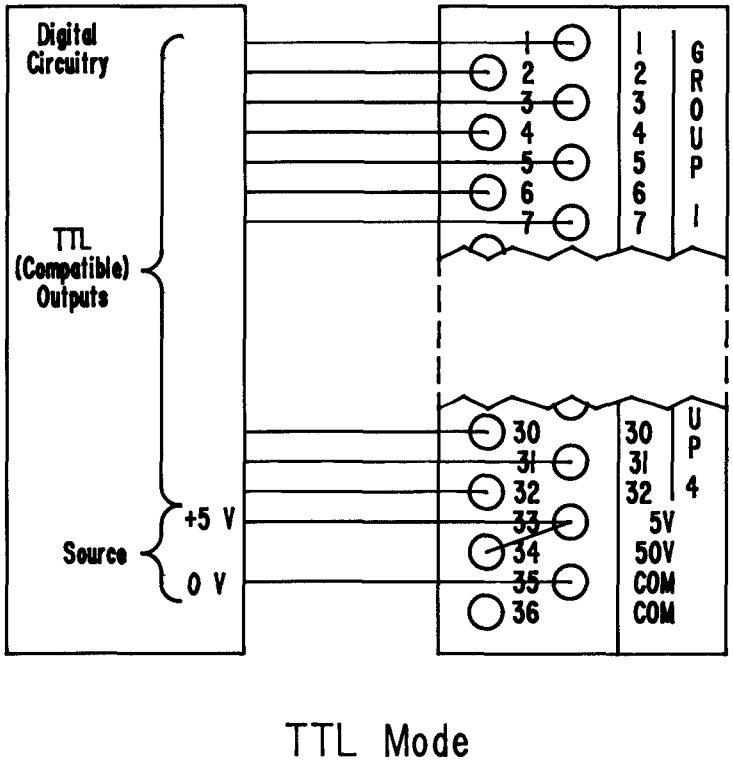
Figure 27.
HIGH DENSITY INPUT MODULE

Install the printed circuit board by using the extraction/insertion tool provided with each CPU. Connect the grounding wire from the faceplate to the rack. With the board in place in the rack, slip the terminal assembly over the circuit board so that proper contact is made. Secure the faceplate to the rack using the quarter-turn thumbscrews.

Refer to Figure 28 for typical user input connections. Both the TTL mode and the 10-50V mode are shown.

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When using the TTL mode, the module operates with negative logic; i.e., a high input is read to the Input Status table as a "0". To use positive logic, the module should be configured to operate in the Inverting mode.



When using the TTL mode, the module operates with negative logic; i.e., a high input is read to the Input Status table as a "0". To use positive logic, the module should be configured to operate in the Inverting mode.

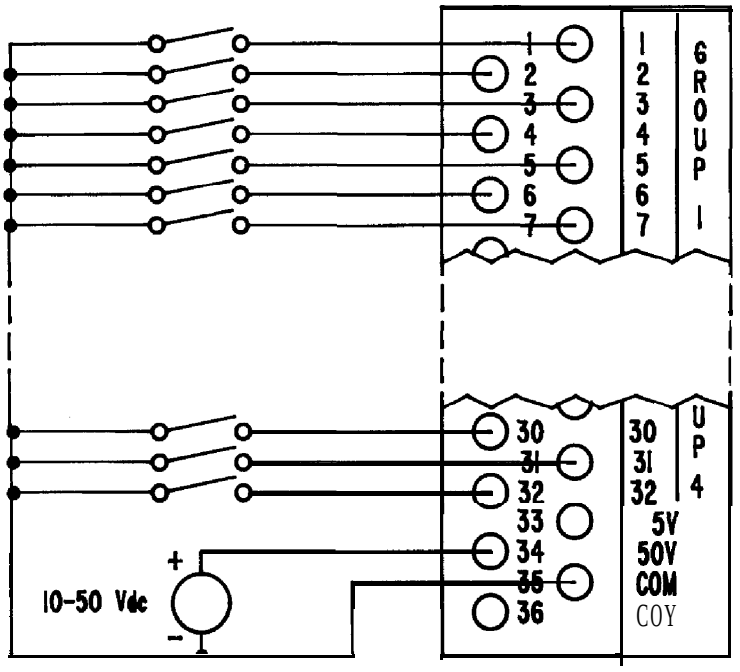
Figure 28A.
TYPICAL USER INPUT CONNECTIONS

TTL Mode Connections

- For operation in the TTL mode, the 5V and 50V terminals should be jumpered together. The positive side of the user 5V DC power supply is connected to one of these terminals.
- Connect the negative side of the power supply to either of the COM terminals.
- Connect the high side of each user input to the appropriate numbered terminal.
- Connect the low side of each input to either of the COM terminals. The two COM terminals are tied together inside the module.

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When using the 10-50V mode, a closed switch turns its corresponding input On; an open switch turns the input Off.



When using the IO-50V mode, a closed switch turns its corresponding input ON: on open switch turns input OFF.

IO-50V Mode

Figure 28B.
TYPICAL USER INPUT CONNECTIONS

IO-50V Mode Connections

- **Connect the positive side of a power supply providing 10-50V DC to the 50V terminal.**
- **Connect the negative side of the power supply to either of the COM terminals.**
- **Connect the high side of each user input to the appropriate numbered terminal.**
- **Connect the low side of each user input to either of the COM terminals. Both COM terminals are tied together inside the module.**

Note that the 32 inputs are divided into four groups, with each group containing eight inputs. During the four consecutive I/O cycles required to read all 32 inputs, GROUP 1 is read during the first I/O cycle, GROUP 2 during the second I/O cycle, etc.

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ANALOG INPUT MODULE

The installation and wiring instructions following are for the Analog Input module available in the three versions listed below. The 4 → 20 mA module can also be connected to operate as a +1 → +5 DC or a 10 → 50 mA module.

Module	Catalog Number
0 → +10V DC	IC600BF841A
-10 → +10 V DC	IC600BF842A
4 → 20 mA	IC600BF843A

An Analog Input module can be installed in any I/O slot, except the left most slot, in an I/O rack or in an I/O slot in a model 60 CPU. Before installing the module, select the starting I/O point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. This will assign a group of 32 consecutive input points to the module. Refer to Figure 29 for specific DIP switch settings.

INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X	X	X	X	X
321-352		X		X		673-704	X		X		X		(NOT USED)				

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 29.
ANALOG INPUT MODULE I/O POINT SELECTION

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Install the printed circuit board by using the extraction/insertion tool provided with each CPU. Connect the grounding wire from the faceplate to the rack. With the board in place in the rack, place the terminal assembly over the circuit board so that proper contact is made.

An Analog Input module has eight channels. Each channel has four terminals that can be used for input device wiring. The combination of terminals used depends on the voltage or current input from user devices. Figure 30 shows typical user input connections to each of the Analog Input modules.

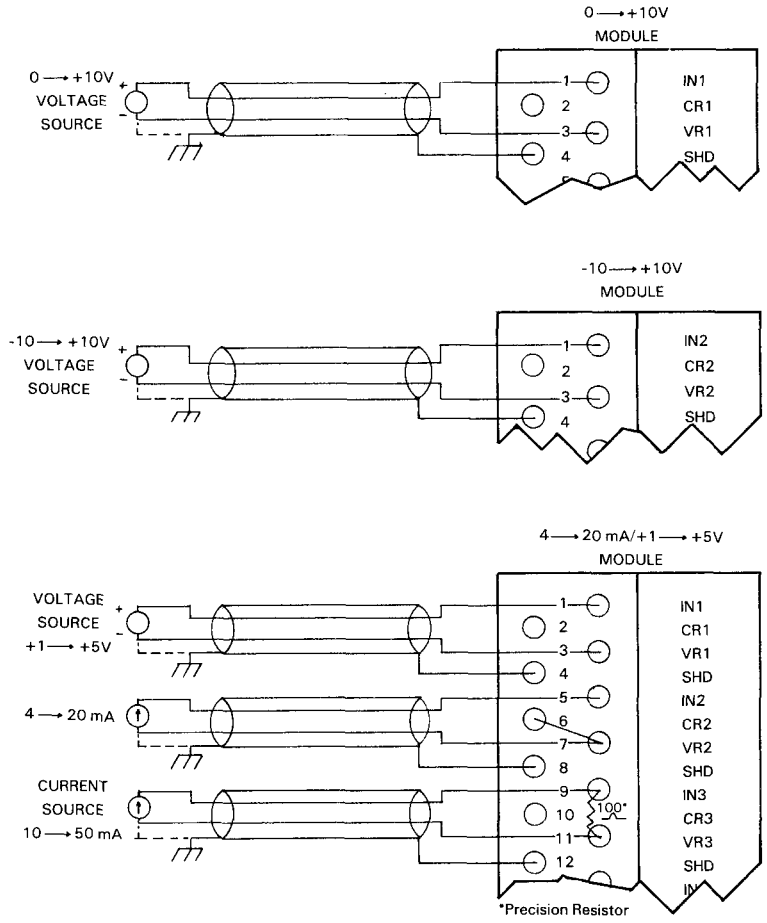


Figure 30.
TYPICAL USER INPUT CONNECTIONS FOR ANALOG INPUTS

To operate as a 10 ⟶ 50 mA module, a 100 Ω precision resistor is connected between the IN and VR terminals as shown.

For the 0 ⟶ +10V and -10 ⟶ +10V modules, any input channel should be connected as shown; for the 4 ⟶ 20 mA/+1 ⟶ +5V module, any input channel can be connected in any of the three ways shown. If driving an input from an unbalanced source (one side grounded), you should connect the cable shield to the ground side at the source. In any event, neither the input terminal (IN) nor the return terminal (VR) should be more than ± 11 V from the shield terminal (SHD) at the module. Both the input terminal and the return terminal of any unused input channel(s) should be connected to the shield terminal. Note that all shield terminals are connected inside the module.

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NOTE

The Analog Input module will function properly only when used with CPUs with the following serial numbers:

Model 60 CPU: Cl 88-8135-0130, and higher.

Model 600 CPU: C188-81 38-0100, and higher.

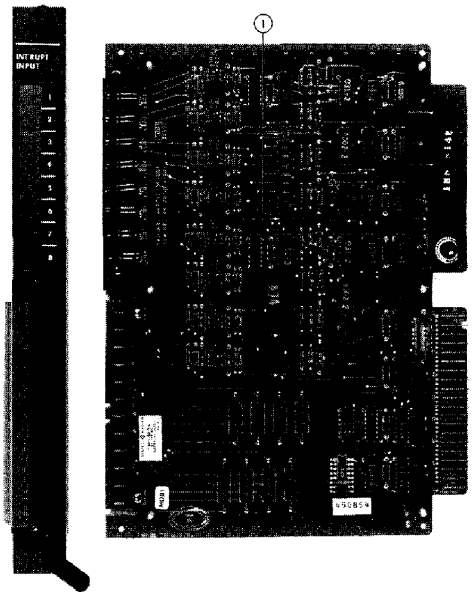
Model 6000 CPU: Cl 88-8138-6000, and higher.

If your CPU has a serial number lower than that listed, contact a PC Product Service specialist at 1-800 GEFANUC for assistance.

INTERRUPT INPUT MODULE

An Interrupt Input module (Catalog Number IC600BF808A) can be installed in an I/O slot in a model 60 CPU or any I/O slot in an I/O rack in a CPU station or a Local I/O station. One Interrupt Input module can be used by a system with a model 60 or a model 600 CPU A model 6000 CPU can support two Interrupt Input modules, one in the main I/O chain and one in the auxiliary I/O chain. An Interrupt Input module has eight input circuits.

The input terminals are arranged in four groups of two, with each group having an isolated neutral. Figure 31 is an Interrupt Input module.



1. Jumpers for Selection of Either Rising Edge or Falling Edge Transitions for each Input

Figure 31.
INTERRUPT INPUT MODULE

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The DIP switch on the backplane is ignored by the Interrupt Input module since the module address is hardwired on the circuit board. In the main I/O chain, the module input numbers 1-8 (I/O points I1001-I1008), correspond to subroutines I-8 in the user program. In the auxiliary I/O chain, the module input numbers I-8 (I/O points AI 1001 -AI 1008) correspond to subroutines 9- 16 in the user program.

Before installing the module, the eight blue jumper plugs on the circuit board (refer to Figure 3 I) should be configured to respond to either rising edge transitions or falling edge transitions. Each of the eight jumper locations has three pins. For rising edge transitions, the jumper plug should connect the middle pin to the N pin. For falling edge transitions, connect the jumper plug from the middle pin to the I pin. Input response to rising or falling edge transitions can be configured as required for each individual input. The module is shipped from the factory with all eight inputs configured to respond to rising edge transitions.

After configuring the eight jumpers, install the module using the extraction/insertion tool. Connect the grounding wire between the faceplate and the rack. When the board is in place in the rack, the edge connector on the faceplate should be slipped over the circuit board so that proper contact is made. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews while turning them clockwise.

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For typical user connections to an Interrupt Input module refer to Figure 32.

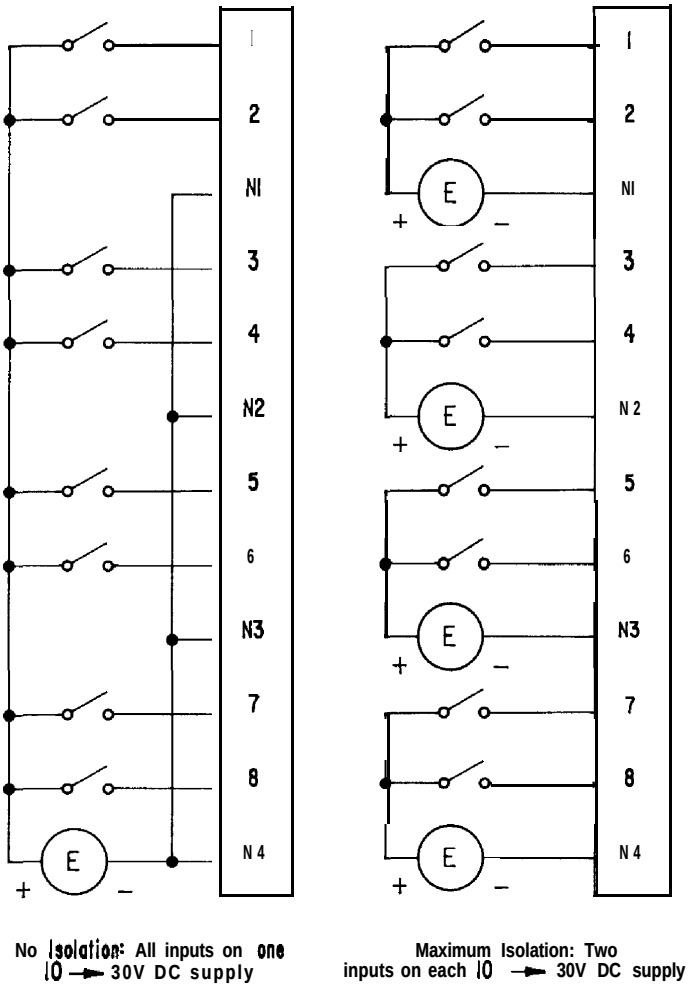


Figure 32.
TYPICAL USER CONNECTIONS

As shown above, all neutral connections N 1, N2, N3, and N4 can be tied together when all inputs are connected to the same 10 to 30V DC power supply. For electrical isolation, each of the four groups of two inputs and the corresponding neutral connection can be connected to separate power supplys.

- Provide either a single or for electrical isolation up to four 10 to 30V DC power supplies.
- Connect one side of the switching device to the corresponding input terminal (1 -8).
- Connect the other side of the switching device to the positive side of the power supply.
- Connect the negative side of the power supply to the neutral terminal associated with the input.

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NOTE

We recommend that you power-down your Series Six Programmable Controller before installing or removing the Interrupt Input module. A parity error could result at any address in the I/O structure if you do not power-down as recommended.

THERMOCOUPLE INPUT MODULE

The installation and wiring instructions which follow are for the Thermocouple Input module available in the four versions listed below.

Module	Temperature Range	Catalog Number
J	-210 to 760°C -346 to 1400°F	IC600BF813A
K	-212 to 1232°C -350 to 2250°F	IC600BF814A
S	0 to 1768°C 32 to 3200°F	IC600BF815A
T	-270 to 400°C -454 to 752°F	IC600BF816A

A Thermocouple Input module can be installed in any I/O slot in a model 60 CPU or in an I/O slot in an I/O rack, except the left most slot. Before installing the module, select the starting I/O point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. This will assign a group of 32 consecutive input points required for operation of this module. Refer to Figure 33 for specific DIP switch settings.

INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION					INPUT NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X X X X X (NOT USED)				
321-352		X		X		673-704	X		X		X						

X = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 33.
THERMOCOUPLE INPUT MODULE I/O POINT SELECTION

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In addition to setting the DIP switches for I/O point selection, several circuit board jumper plugs and a configuration DIP switch must be set to conform with the user application. The following tables provide a guide to configuration of the various board options.

Table 14 is for selection of the format for data transferred to the CPU. The data format can be either signed magnitude or 2's complement.

Data Format	Jumper Setting
Signed Magnitude	56-58
2's Complement	56-57

Table 14.
DATA FORMAT OPTIONS

Table 15 lists the optional conversion rates for the sampled temperature readings.

Line Frequency	Sample Rate	Jumper Settings
50 Hz	12.5	43-44 45-46 50-51 69-70
50 Hz	25	43-44 46-47 49-51 68-69
60 Hz	15	42-43 45-46 48-50 51-52 69-70
60 Hz	30	42-43 46-47 48-49 51-52 68-69

Table 15.
SAMPLE RATE OPTIONS

Table 16 lists the jumpers used to select either the RUN mode or the calibrate mode.

MODE	JUMPER SETTING
RUN	1-2
Calibrate	2-3

Table 16.
OPERATING MODE OPTIONS

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Table 17 lists the DIP switch settings for module type configuration.

OPTION	DIP Switch Position							
	1	2	3	4	5	6	7	8
Type J T/C	ON	ON	ON	ON	ON	ON		
Type K T/C	OFF	ON	ON	OFF	ON	ON		
Type S T/C	ON	OFF	ON	ON	OFF	ON		
Type T T/C	OFF	OFF	ON	OFF	OFF	ON		
4 Channels (I-4)							ON	
8 Channels (1-8)							OFF	
Degrees C								ON
Degrees F								OFF

Table 17.
USER SELECTABLE OPTIONS

DIP switch positions 1 through 6 select the thermocouple type, either J, K, S, or T for the module. DIP switch position 7 selects either one 4 channel input group (allows four input channels) or two 4 channel input groups (allows eight input channels). DIP switch position 8 selects the temperature scale.

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Figure 34 identifies the location of the jumpers and DIP switch referenced in Tables 14, 15, 16, and 17.

Figure not available.

Figure 34.
JUMPER LOCATIONS

Install the printed circuit board by using the extraction/insertion tool. Connect the grounding wire from the faceplate to the rack. With the board in place in the rack, place the terminal assembly over the circuit board so that proper contact is made between the two parts. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews and turning them clockwise.

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Refer to Figure 35 for typical user input connections to a Thermocouple input module.

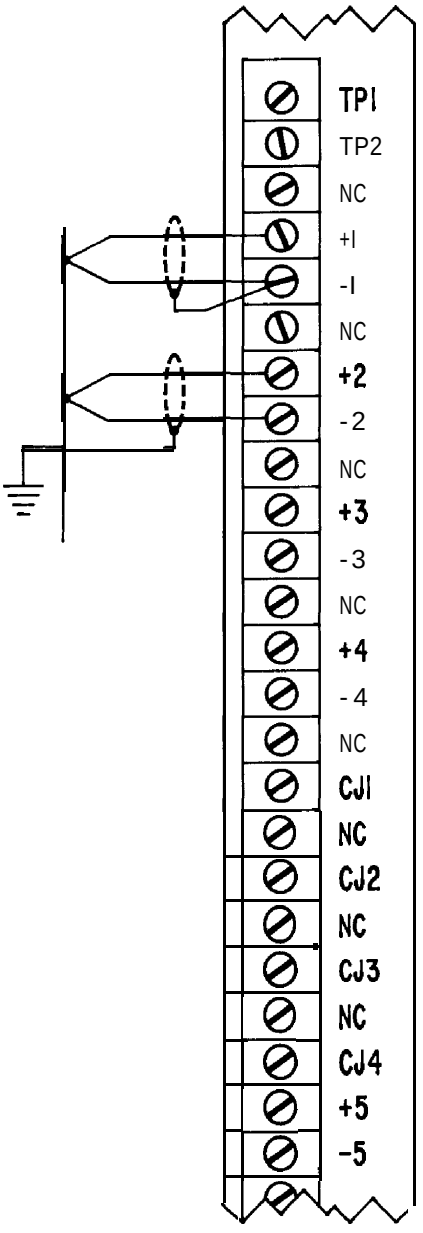


Figure 35.
TYPICAL USER CONNECTIONS

Each of the eight channels has two connections, + and -. Channel 1 (+ 1, -1) connection illustrates the shield grounded to the faceplate. Channel 2 (+2, -2) shows the shield connected to the thermocouple device ground. Either ground connection can be used on any of the eight channels. Terminals CJI through CJ4 are for the optional cold junction compensation element.

It is recommended that calibration of the Thermocouple Input module be performed at least every 180 days at normal operating temperature. Calibration procedures can be found in Chapter 3.

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AC OUTPUT MODULE

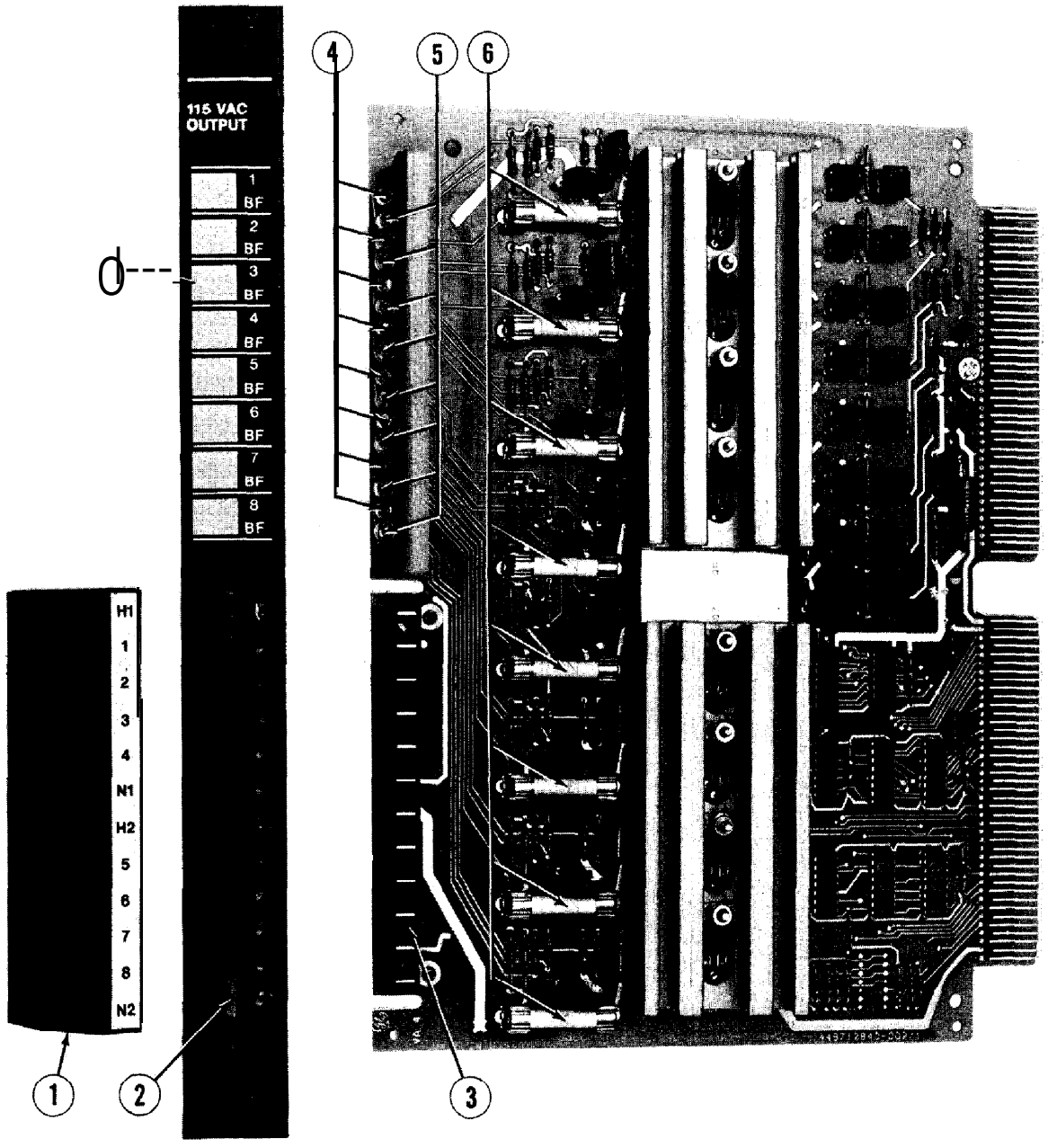
The discrete 8-point AC Output module is available in two versions as listed below.

Module	Catalog Number
115VAC	IC600BF904A
230V AC	IC600BF905A

These modules can be installed in any I/O slot in a model 60 CPU or in any I/O slot in an I/O rack, except the left most slot. Before installing an AC Output module, select the I/O starting point number for the module by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. The I/O point selected is the first of eight consecutive I/O points for that module. For specific switch settings, refer to Figure 23.

Terminals for field connections are arranged on the faceplate connector in two groups with four outputs in each group. Each group has its own H (High) and N (Neutral). connection. Figure 36 is an AC Output module showing the terminal arrangement along with other module features.

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1. Terminal Cover
2. User Terminal Block
3. Circuit Board Terminal Block, Mates With User Terminal Block
4. Output "ON" Lights (1-8)
5. BF (Blown Fuse) Lights (1-8)
6. Fuses, 3A (One Per Circuit)
7. Markable Lens Surface

Figure 36.
AC OUTPUT MODULE

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Install the circuit board using the extraction/insertion tool. With the circuit board in place in the rack, slip the faceplate over the circuit board so that the terminals near the bottom of each part are properly mated. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews while turning them clockwise.

Wiring to devices to be controlled should be routed from the devices through conduit or cabling to the rack, into the wiring tray and to the output module. The wires should then fan out to the proper box lug terminals. insert the wires into their respective box lug terminal and tighten each screw to ensure a good contact. Each box lug will accept one No. 12 AWG or two No. 14 AWG wires.

Refer to Figure 37 for typical user output connections. Wiring instructions for an AC output module follow the figure.

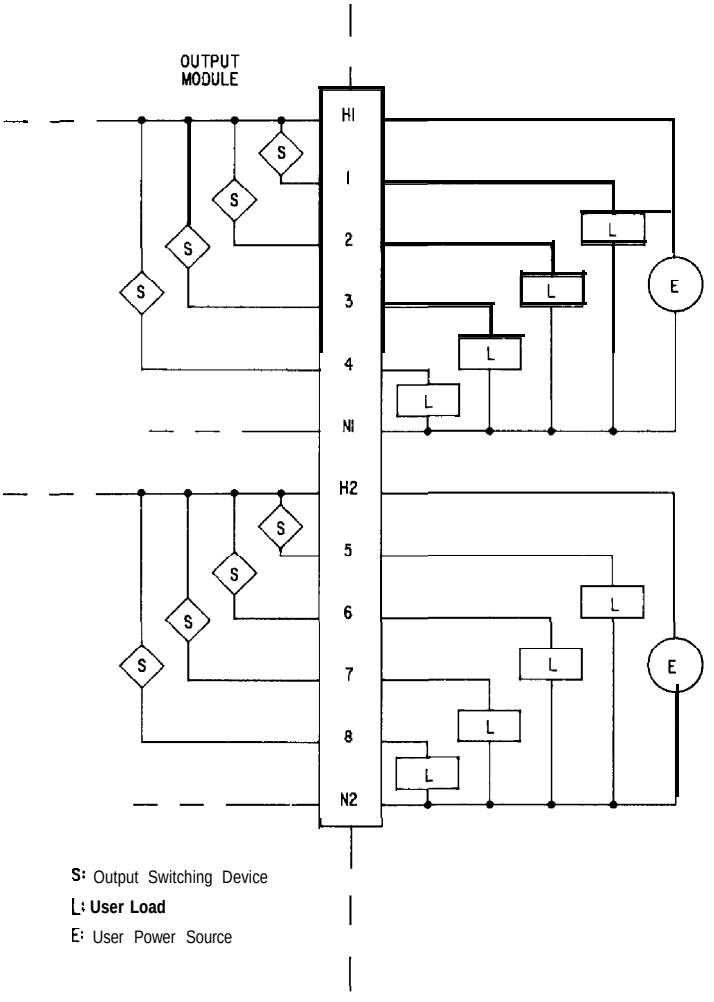


Figure 37.
AC OUTPUT MODULE TYPICAL USER CONNECTIONS

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- Connect one side of the load to be controlled to one of the output terminals, 1 through 8.
- Connect the other side of each load connected to terminals 1 through 4 to a common line connected to the Neutral # 1 (N 1) terminal.
- Connect the other side of each load connected to terminals 5 through 8 to a common line connected to the Neutral #2 (N2) terminal.
- Connect a user power source between the High #I (H1) and Neutral # 1 (N1) terminals, and between the High #2 (H2) and Neutral #2 (N2) terminals.

After completing field wiring to the module, install the terminal cover by guiding both of its edges onto the top of the terminal block and sliding it down over the terminals.

WARNING

Voltages from user field devices may be present on the faceplate terminals, even if the power supply in the I/O rack is off. Care should be taken when handling the faceplate or any wires connected to it.

ISOLATED AC OUTPUT MODULE

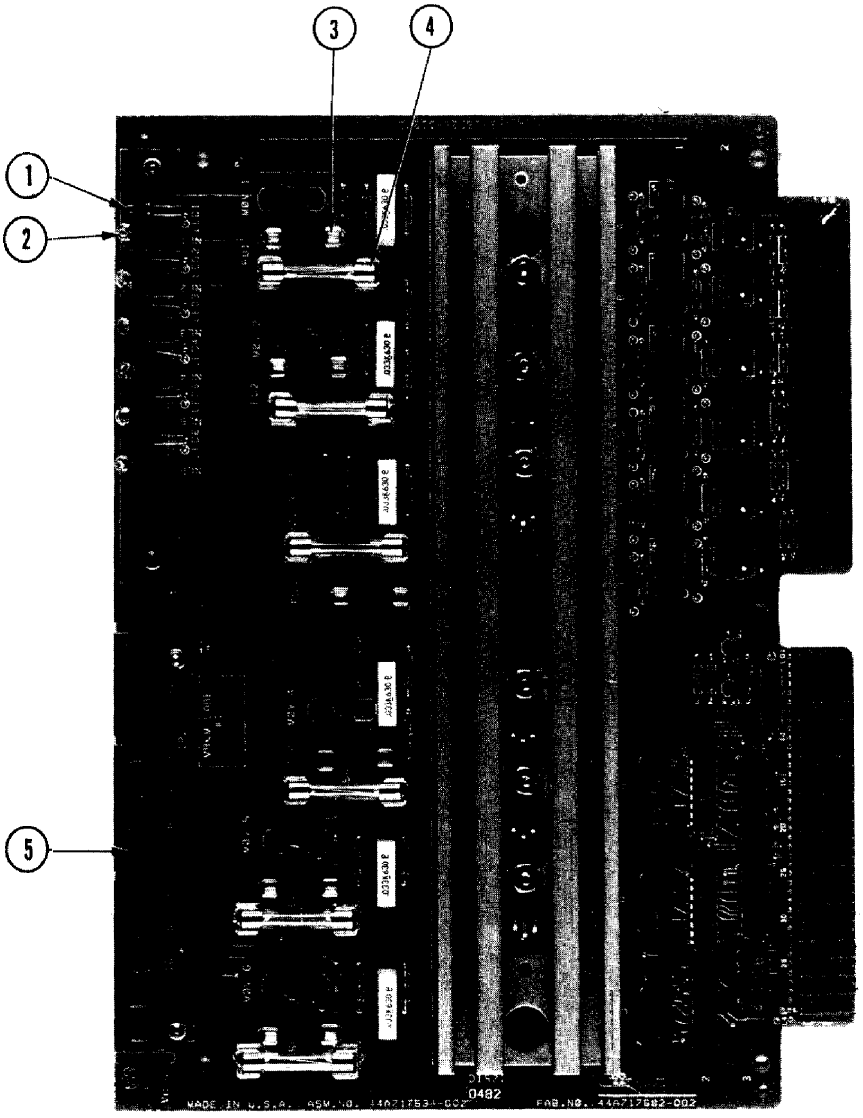
The Isolated AC Output module providing six isolated outputs is available in two versions as listed below.

Module	Catalog Number
115VAC	IC600BF91 0A
230V AC	IC600BF9 12A

An Isolated AC Output module can be installed in any I/O slot in a model 60 CPU or in any I/O slot in an I/O rack, except the left most slot. Before installing one of these modules, select the I/O starting point number for the module by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. The I/O point selected is the first of six consecutive I/O points for that module. Figure 23 can be used as a guide for setting the DIP switches; however, for each DIP switch setting, this module will respond to only the first six I/O points.

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Terminals for connecting loads to be controlled by this module are arranged in six groups. Each group has an output number (01 through 06) and a corresponding High terminal (Hl through H6). Figure 38 is an Isolated AC Output module showing the terminal arrangement and other module features.



1. Output ON Lights, LED1 -LED6
2. Blown Fuse Lights, BFl -BF6
3. European Style Fuse Clip (6)
4. Fuse, 5A (6)
5. Circuit Board Terminal Block

Figure 38.
ISOLATED AC OUTPUT MODULE

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Install the circuit board using the extraction/insertion tool. With the circuit board in place in the rack, slip the faceplate over the board, ensuring that the terminals near the bottom of each part are properly mated. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews while turning them clockwise.

Refer to Figure 39 for typical user connections to this module. Wiring instructions follow the figure. Each box lug terminal can accommodate one No. 12 AWG wire or two No. 14 AWG wires.

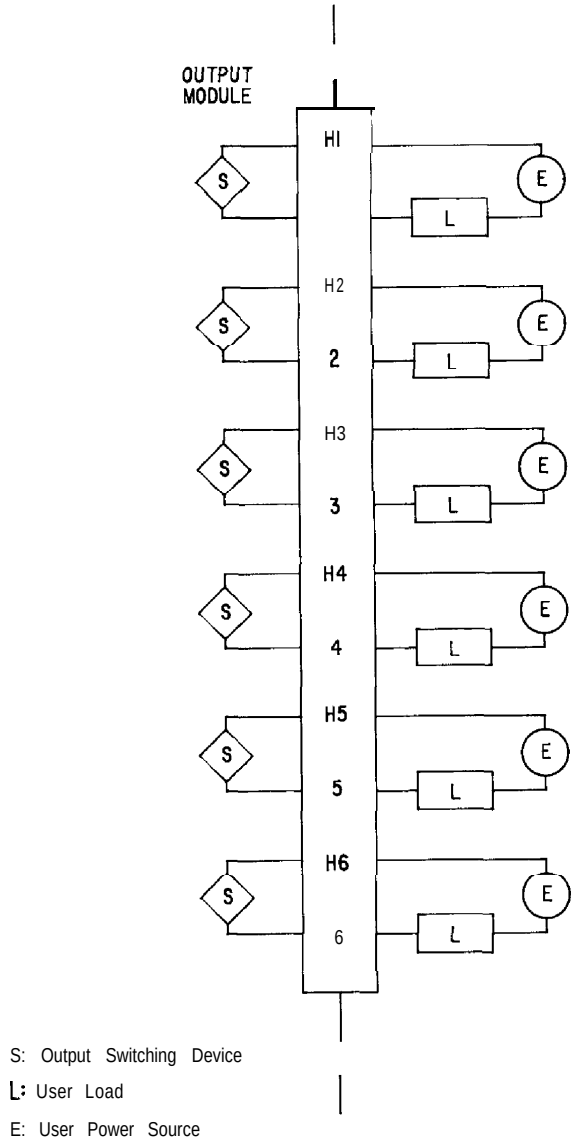


Figure 39.
ISOLATED AC OUTPUT TYPICAL USER CONNECTIONS

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- Connect the high side of the user power source to one of the High terminals (HI -H6).
- Connect one side of the load to be controlled to the corresponding Output terminal (01-06).
- Connect the other side of the load to the low side of the user power source.

After completing field wiring to the module, install the terminal cover by guiding both of its edges onto the top of the terminal block and sliding it down over the terminals.

WARNING

Voltages from user field devices may be present on the faceplate terminals, even if the power supply in the I/O rack is off. Care should be taken when handling the faceplate or any wires connected to it.

DC OUTPUT MODULES

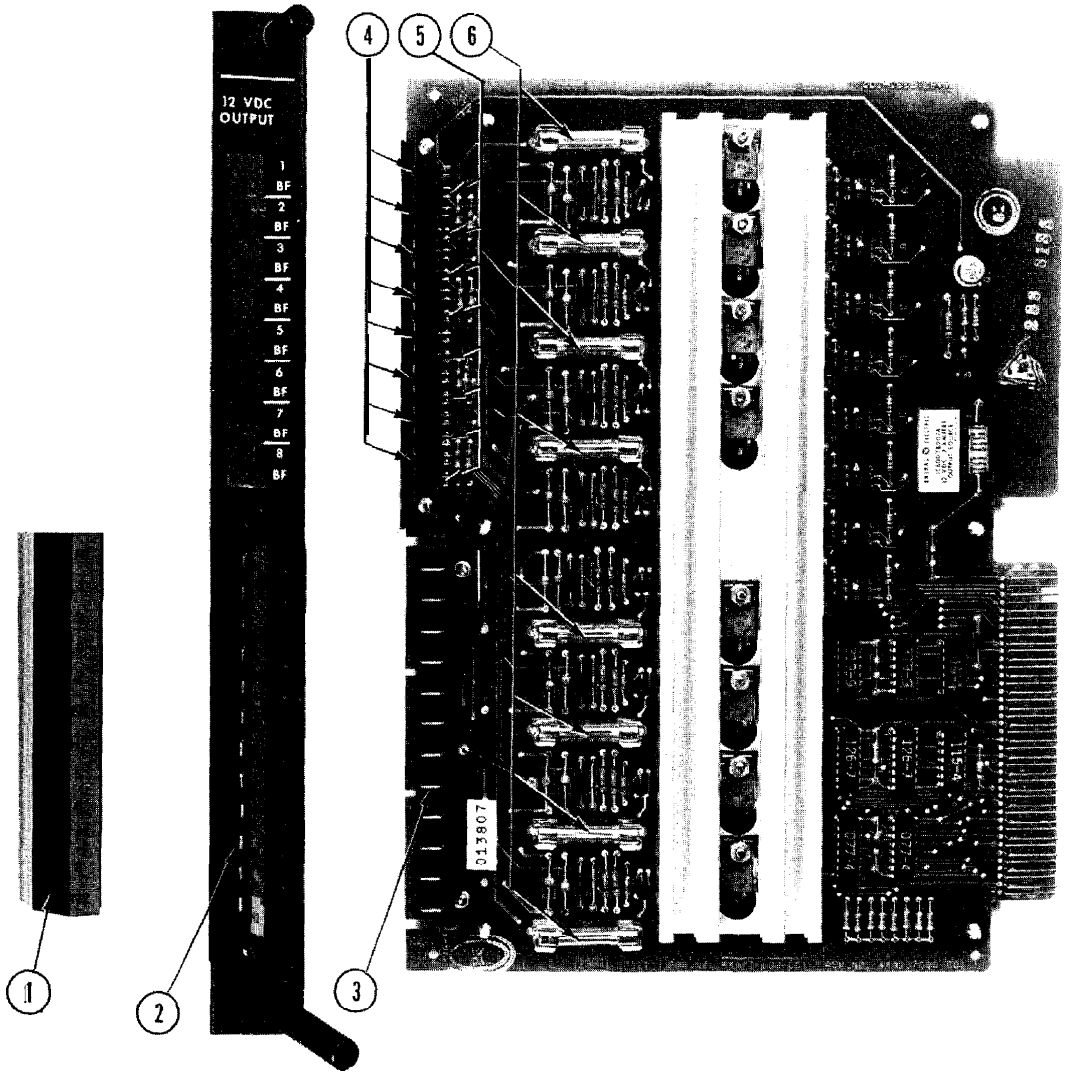
The discrete 8-point DC Output modules are available as 12V, 24V and 48V DC sink or source modules as listed below.

Module	Catalog Number
12V DC SINK	IC600BF906A
24V DC SINK	IC600BF902A
48V DC SINK	IC600BF903A
12V DC SOURCE	IC600BF907A
24V DC SOURCE	IC600BF908A
48V DC SOURCE	IC600BF909A

A DC Output module can be installed in any I/O slot in a model 60 CPU or in any slot in an I/O rack, except the left most slot. Before installing one of these modules, select the I/O starting point number for the module by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. The I/O point selected is the first of eight consecutive I/O points for the module. Use Figure 23 as a guide for setting the DIP switches.

Terminals for connection to loads to be controlled by one of the DC Output modules are arranged in two groups with four outputs in each group (1-4 and 5-8). Each group has a neutral (N) and a high (H) connection. Each terminal can accommodate one No. 12 AWG wire or two No. 14 AWG wires. Figure 40 is a typical DC Output module showing the terminal arrangement and other module features.

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1. Terminal Cover
2. User Terminal Block
3. Circuit Board Terminal Block
4. Output "ON" Light (I-8)
5. BF (Blown Fuse) Light (I-8)
6. Output Circuit Fuses: 3A, Normal Blow (AGC3)

Figure 40.
DC OUTPUT MODULE

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Install the circuit board using the extraction/insertion tool. With the circuit board in place in the rack, slip the faceplate over the board, ensuring that the terminals near the bottom of each part are properly mated. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews while turning them clockwise.

When wiring the 12V, 24V, and 48V DC sink and source modules the location of the module in relation to the high side of the user DC power source and the load must be considered. Refer to Figure 41.

When using a sink module, current must flow through the load into the output terminal of the module.

When using a source module, current is provided by the module and current flows out of the module towards the load.

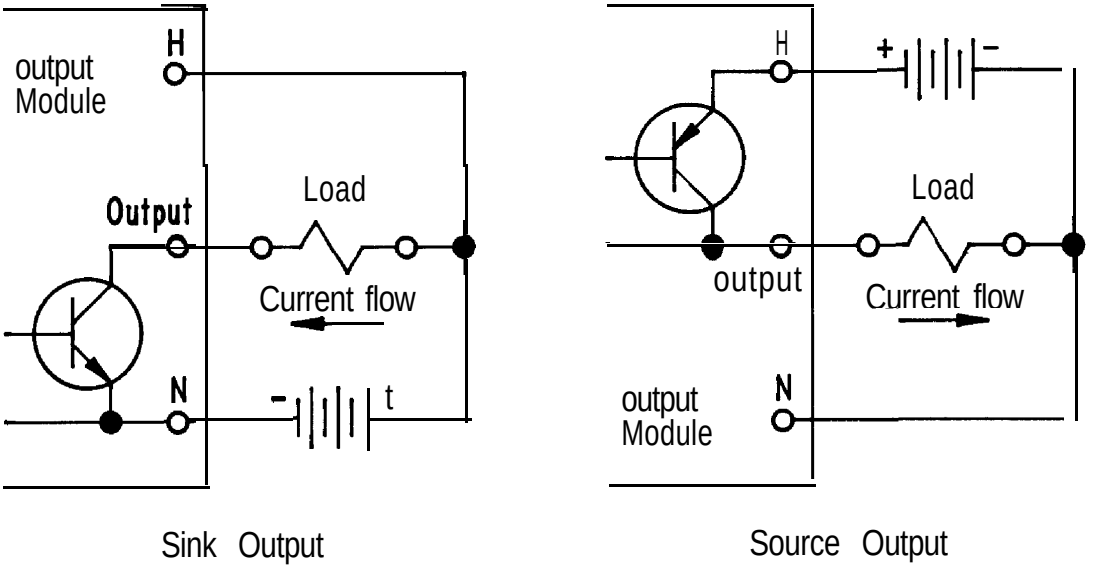


Figure 41.
DC SINK AND SOURCE OUTPUT MODULE WIRING

Refer to Figure 42 for typical user connections to a DC Output module. Wiring instructions follow the figure.

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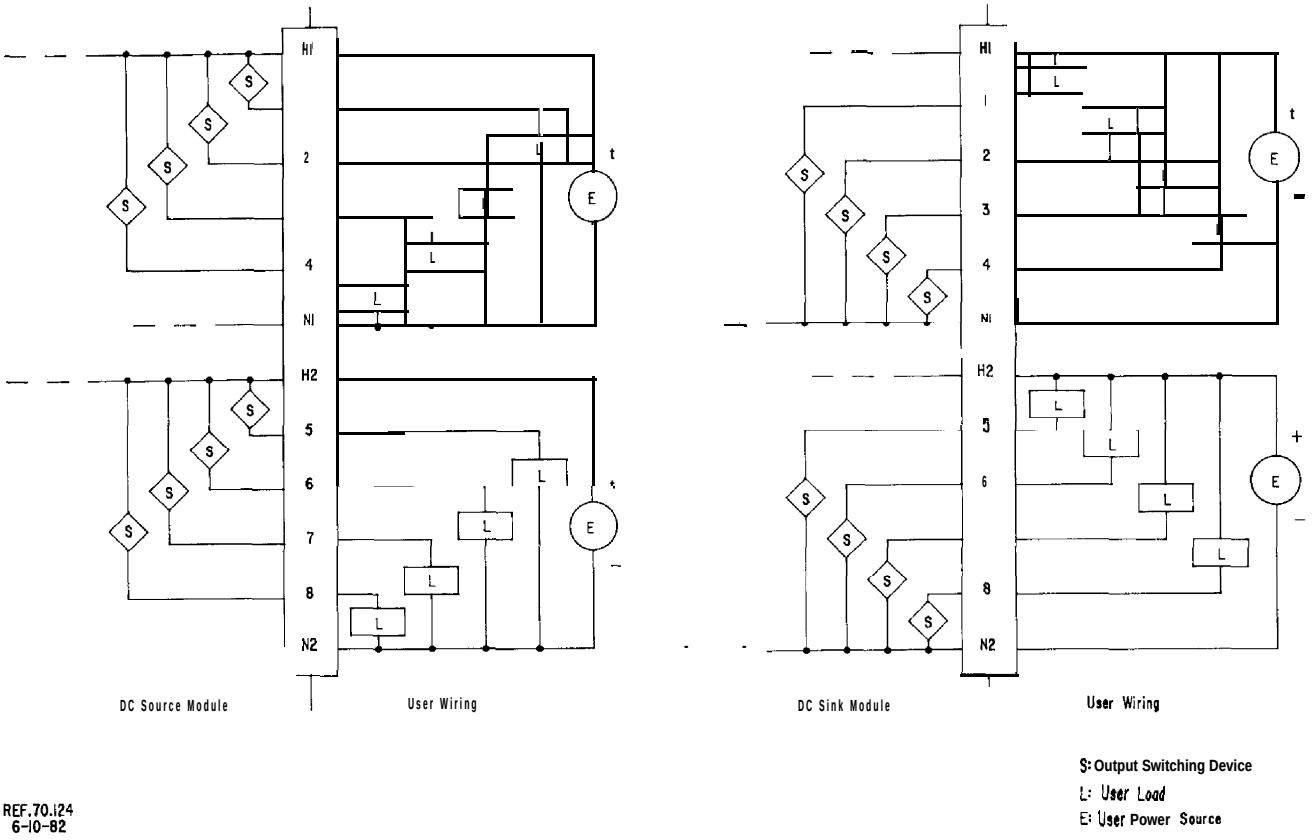


Figure 42.
DC OUTPUT TYPICAL USER CONNECTIONS

- **Connect one side of each load to be controlled by the module to an appropriate output terminal (I-8).**
- **Connect the other side of each load connected to terminals 1 through 4 to a common line connected to the Neutral No. 1 (NI) terminal for a SOURCE module, or to the High No. 1 (H1) terminal for a SINK module.**
- **Connect the other side of each load connected to terminals 5 through 8 to a common line connected to the Neutral No. 2 (N2) terminal for a SOURCE module, or to the High No. 2 (H2) terminal for a SINK module.**
- **Connect the positive (+) side of a user DC power source to the HI terminal.**
- **Connect the negative (-) side of a user DC power source to the NI terminal.**
- **A user DC power source must also be connected between the H2 (+) and the N2 (-) terminals.**

After completing field wiring to the module, install the terminal cover by guiding both of its edges onto the top of the terminal block and sliding it down over the terminals.

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HIGH DENSITY OUTPUT MODULE

The High Density Output module, providing 32 output points per module, is available in two versions as listed below.

Module	Catalog Number
5V TTL	IC600BF911A
10-50V DC	IC600BF913A

A High Density Output module can be installed in any I/O slot in a model 60 CPU, or in any I/O slot in an I/O rack, except the left most slot. Before installing the module, select the I/O starting point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. This will assign a group of 32 consecutive output points to this module. Refer to Figure 43 for specific DIP switch settings.

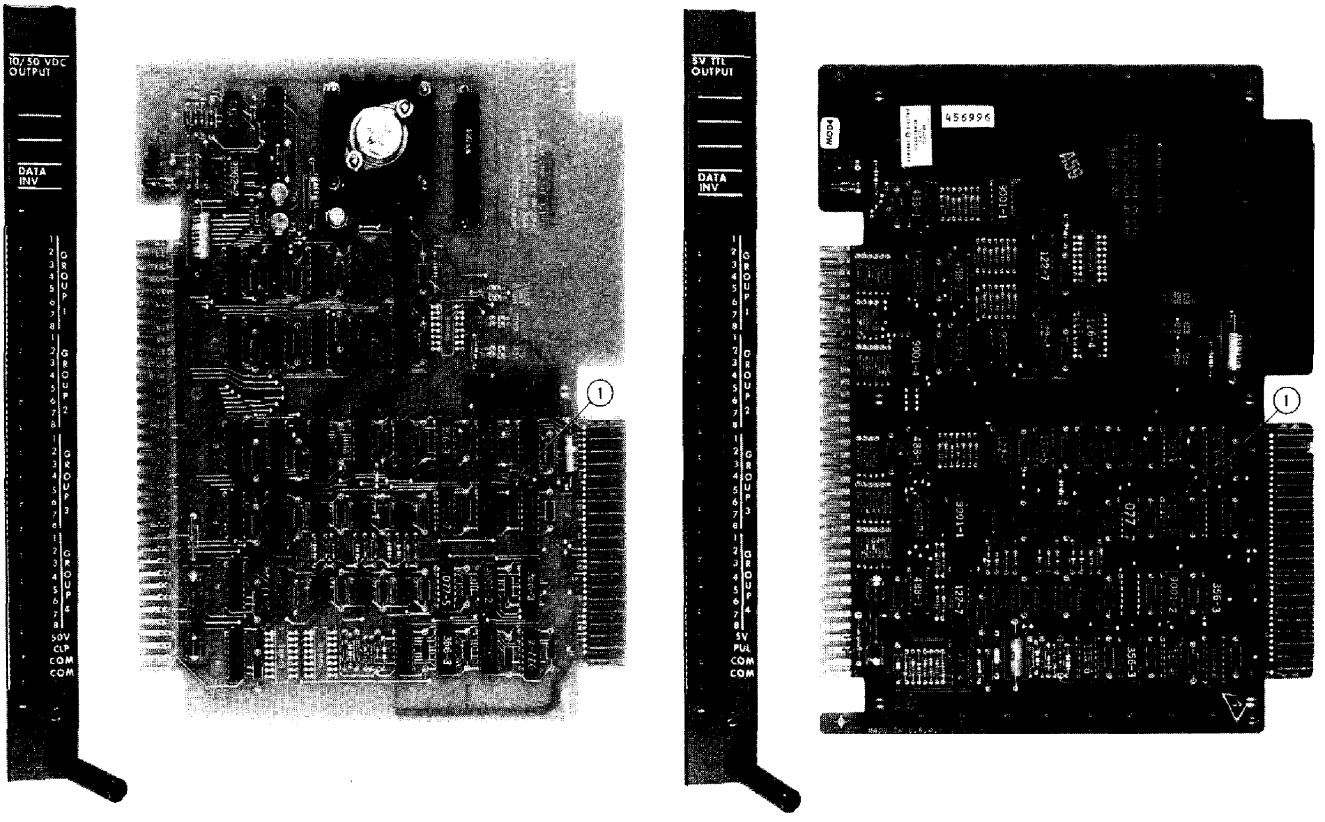
NUMBER	DIP SWITCH POSITION					NUMBER	DIP SWITCH POSITION					NUMBER	DIP SWITCH POSITION				
	7	6	5	4	3		7	6	5	4	3		7	6	5	4	3
1-32						353-384		X		X	X	705-736	X		X	X	
33-64					X	385-416		X	X			737-768	X		X	X	X
65-96				X		417-448		X	X		X	769-800	X	X			
97-128				X	X	449-480		X	X	X		801-832	X	X			X
129-160			X			481-512		X	X	X	X	833-864	X	X		X	
161-192			X		X	513-544	X					865-896	X	X		X	X
193-224			X	X		545-576	X				X	897-928	X	X	X		
225-256			X	X	X	577-608	X			X		929-960	X	X	X		X
257-288		X				609-640	X			X	X	961-992	X	X	X	X	
289-320		X			X	641-672	X		X			993-1024	X X X X X				
321-352		X		X		673-704	X		X		X		(NOT USED)				

[X] = Switch in OPEN Position (Depressed to the Left)
Switches #1 and #2 Should be in CLOSED Position

Figure 43.
HIGH DENSITY OUTPUT MODULE I/O POINT SELECTION

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In addition to setting the DIP switches, a circuit board jumper for configuration of the module to operate in either the Inverting or Non-Inverting state should be set. Refer to Figure 44 for the board location of this jumper.



10/5OV DC

5V TTL

1. Jumper for Selection of Either inverting or Non-Inverting state.

Figure 44.
HIGH DENSITY OUTPUT MODULES

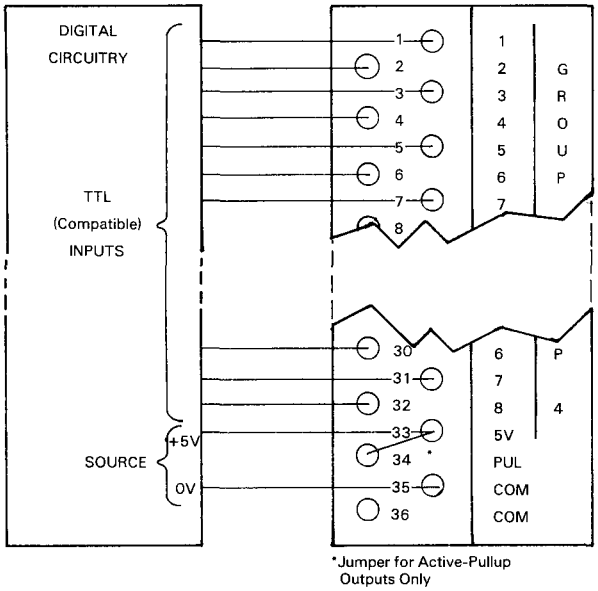
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NOTE

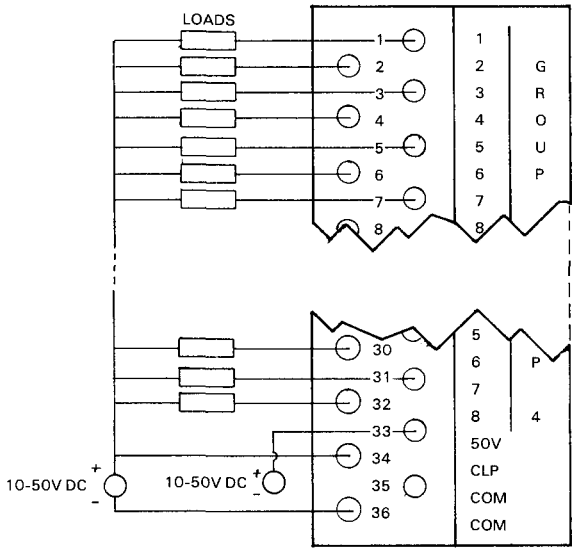
When using a High-Density Output module to drive a High-Density Input module, both modules should be configured in the same mode (Inverting or Non-Inverting). Following this procedure ensures that the bit values sent from the Output Status Table to the Input Status Table are not inverted.

Install the printed circuit board using the extraction/insertion tool. Connect the grounding wire from the faceplate to the rack. With the board in place, slip the terminal assembly over the circuit board so that proper contact is made between the two parts. Secure the faceplate to the rack by pushing in on the quarter-turn thumbscrews while turning them clockwise.

Refer to Figure 45 for typical user input connections. Note that the 32 output terminals on the connector block are divided into four groups, each group containing eight inputs. A single group is updated by the CPU during an I/O cycle. Four consecutive I/O cycles are required to update all 32 outputs.



TTL MODULE



10-50V MODULE

NOTE

The two separate power supplies shown for the 10-50 V module can be replaced by a single supply, provided the 50 V and CLP terminals are connected together. The voltage of this supply should be the voltage to be switched to each of the loads, i.e., that voltage formerly applied between the CLP and COM terminals. Although up to 50 volts may be applied between the 50 V and COM terminals, only 10 volts is required, and any excess represents wasted power which must be dissipated by the module.

Figure 45.
HIGH DENSITY OUTPUT, TYPICAL USER CONNECTIONS

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Both common (COM) terminals are tied together inside the module. If active pullup outputs are required with the TTL module, a jumper should be connected between the 5V and PUL terminals. For open collector operation, the jumper is not required.

ANALOG OUTPUT MODULE

The following installation and wiring instructions are for the Analog Output module which is available in the three versions listed below.

Module	Catalog Number
0 → +10V DC	IC600BF941A
-10 → +10V DC	IC600BF942A
4 → 20 mA	IC600BF943A

An Analog Output module can be installed in any I/O slot in a model 60 CPU, or in any slot in an I/O rack except the left most slot. Before installing the module, select the starting I/O point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. This will assign a group of 16 consecutive output points to the module. Refer to Figure 46 for specific DIP switch settings.

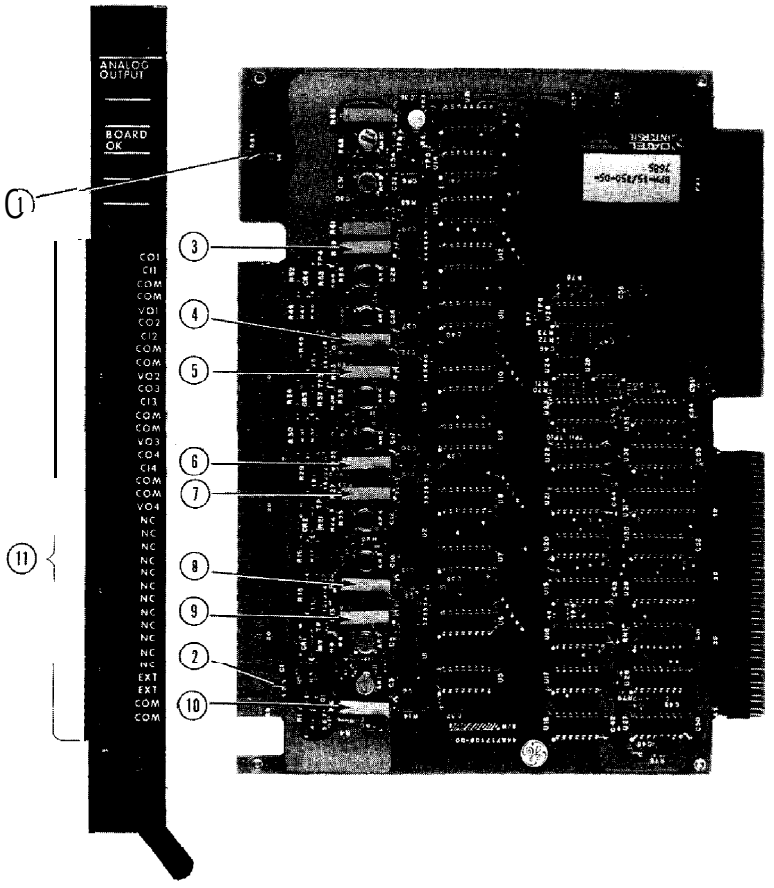
NUMBER	DIP SWITCH POSITION						NUMBER	DIP SWITCH POSITION						NUMBER	DIP SWITCH POSITION					
	7	6	5	4	3	2		7	6	5	4	3	2		7	6	5	4	3	2
1-16							353-368		X		X	X		705-720	X		X	X		
17-32						X	369-384		X		X	X	X	721-736	X		X	X		X
33-48					X		385-400		X	X				737-752	X		X	X	X	
49-64					X	X	401-416		X	X			X	753-768	X		X	X	X	X
65-80				X			417-432		X	X		X		769-784	X	X				
81-96				X		X	433-448		X	X		X	X	785-800	X	X				X
97-112				X	X		449-464		X	X	X			801-816	X	X				X
113-128				X	X	X	465-480		X	X	X		X	817-832	X	X			X	X
129-144			X				481-496		X	X	X	X		833-848	X	X		X		
145-160			X			X	497-512		X	X	X	X	X	849-864	X	X		X		X
161-176			X		X		513-528	X						865-880	X	X		X	X	
177-192			X		X	X	529-544	X					X	881-896	X	X		X	X	X
193-208			X	X			545-560	X				X		897-912	X	X	X			
209-224			X	X		X	561-576	X				X	X	913-928	X	X	X			X
225-240			X	X	X		577-592	X			X			929-944	X	X	X		X	
241-256			X	X	X	X	593-608	X			X		X	945-960	X	X	X		X	X
257-272		X					609-624	X			X	X		961-976	X	X	X	X		
273-288		X				X	625-640	X			X	X	X	977-992	X	X	X	X		X
289-304		X				X	641-656	X		X				993-1008	X X X X X					
305-320		X			X	X	657-672	X		X			X	1009-1024	X X X X X X					
321-336		X		X			673-688	X		X		X		(Not Used)						
337-352		X		X		X	689-704	X		X		X	X							

X = Switch in OPEN Position (Depressed to the Left)
Switch #1 Should be in CLOSED Position

Figure 46.
ANALOG OUTPUT MODULE I/O POINT SELECTION

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A jumper on the printed circuit board must be configured properly when using the 4 ⟶ 20 mA module. If the internal loop supply is used to power the outputs, the jumper should connect pins 1 and 2 (Refer to Figure 47, item 2). If a common external source that provides a regulated + 18V to +42V DC, @ 100 mA is used, the jumper should be connected between pins 2 and 3. During operation, there is a significant voltage drop across the output device; i.e. between the low side of the load and the low side of the source.



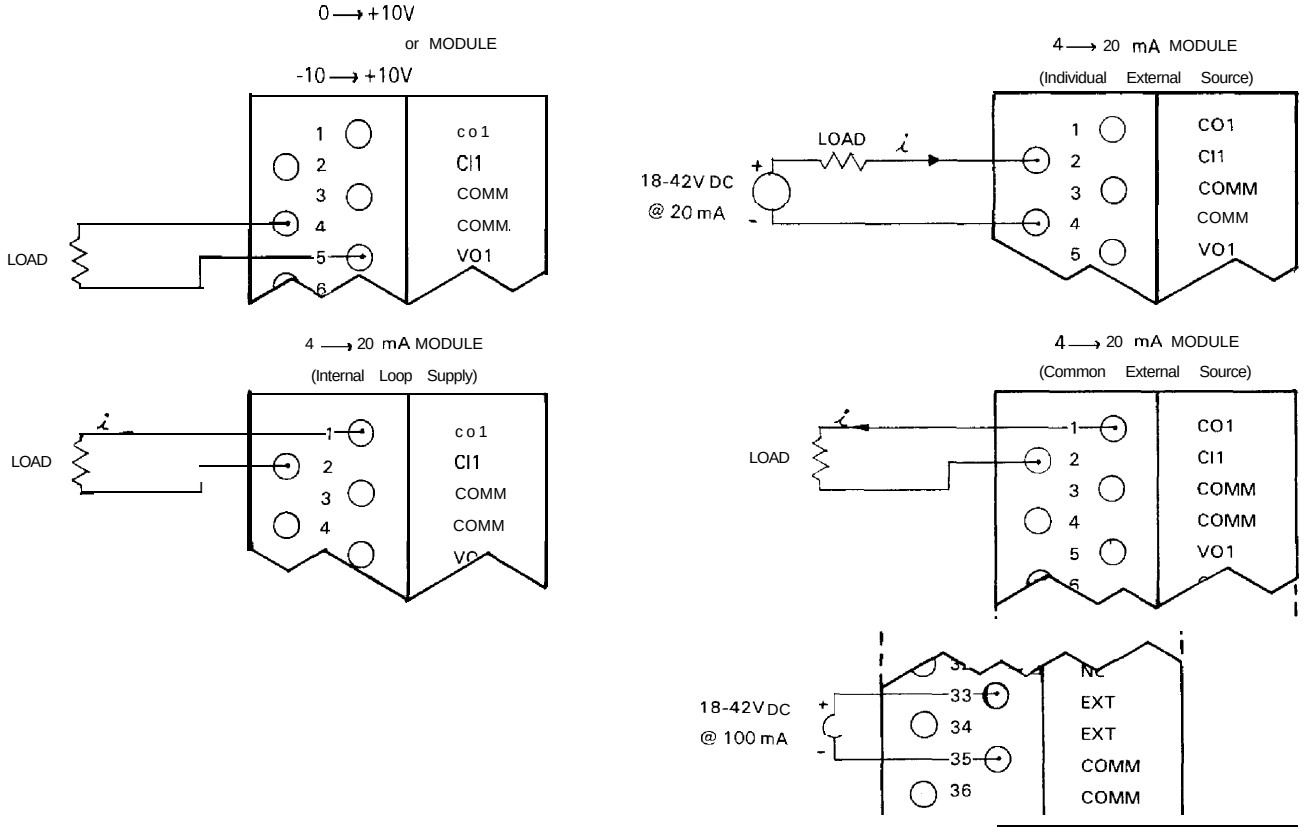
1. Board OK light
2. Jumper to select Internal Loop Supply or Common External Source
3. R59, Gain Pot, Channel 1
4. R5 1, Offset Pot, Channel 0
5. R43, Gain Pot, Channel 1
6. R35, Offset Pot, Channel 1
7. R27, Gain Pot, Channel 2
8. R20, Offset Pot, Channel 2
9. R13, Gain Pot, Channel 3
10. R6, Offset Pot, Channel 3
11. User Connector Block

Figure 47.
ANALOG OUTPUT MODULE

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Install the printed circuit board by using the extraction/insertion tool. Connect the grounding wire from the faceplate to the rack. With the board in place in the rack, slip the edge connector on the faceplate over the circuit board so that proper contact is made between the two parts.

An Analog Output module has four channels. Refer to Figure 48 for typical user output connections to the Analog Output modules.



NOTE

Maximum loading of an output channel on the 0 ⟶ 10 V or the -10 ⟶ +10 V module is ±5 mA. The loading of the 4 ⟶ 20 mA module should be in accordance with ISA transmitter class 2L when using the internal loop supply or class 4U when using an external power source. (Ref. ISA-S50.1)

Figure 48.
ANALOG OUTPUT, TYPICAL USER CONNECTIONS

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For the 0 → +10V and -10 → + 10 V modules, any output channel can be connected as shown. For the 4 → 20 mA module, the channels can be connected for internal or external common source operation depending on the setting of the circuit board jumper previously discussed. Alternately, any individual channel can be connected with its own external source. All of the common (COMM) terminals are connected together inside the module. To minimize capacitive loading of the outputs, twisted-pair cables should be used for wiring to the output connections whenever possible.

NOTE

Pots R69 and R61 (the two top pots on the board) are factory set and should not be adjusted. tings are accidentally changed, contact the assistance.

Each channel on the module can be set independently for an output range of 0 → + 10 V, - 10 → + 10 V, or 4 → 20 mA, by configuring the jumpers so that the numbered pins on the circuit board are connected as shown in Table 18.

Note that whenever the range of a channel is changed, the channel should be recalibrated. See Chapter 3 for calibration procedures.

OUTPUT RANGE	First Channel	Second Channel	Third Channel	Fourth Channel
o - + I O V	30-31 27-28 41-42	23-24 20-21 38-39	16-I 7 13-14 35-36	9-10 6-7 32-33
-10 → +10 V	29-30 25-27 42-43	22-23 18-20 39-40	15-16 II-13 36-37	8-9 4-6 33-34
4 → 20 mA	30-31 26-27 41-42	23-24 19-20 38-39	16-17 12-13 35-36	9-10 5-6 32-33
4 → 20 mA output range only: For Common External Source, connect 2-3. For Internal Loop Supply, connect 1-2.				

Table 18.
CHANNEL CONFIGURATION

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NOTE

The Analog Output module will function properly only when used with CPU's with the following serial numbers:

Model 60 CPU: CI 88-8135-0130, and higher.

Model 600 CPU: CI 88-8138-0100, and higher.

Model 6000 CPU: CI 88-8138-6000, and higher.

If your CPU has a serial number lower than that listed, contact the PC Product Service Specialist at (804) 978-5624 for assistance.

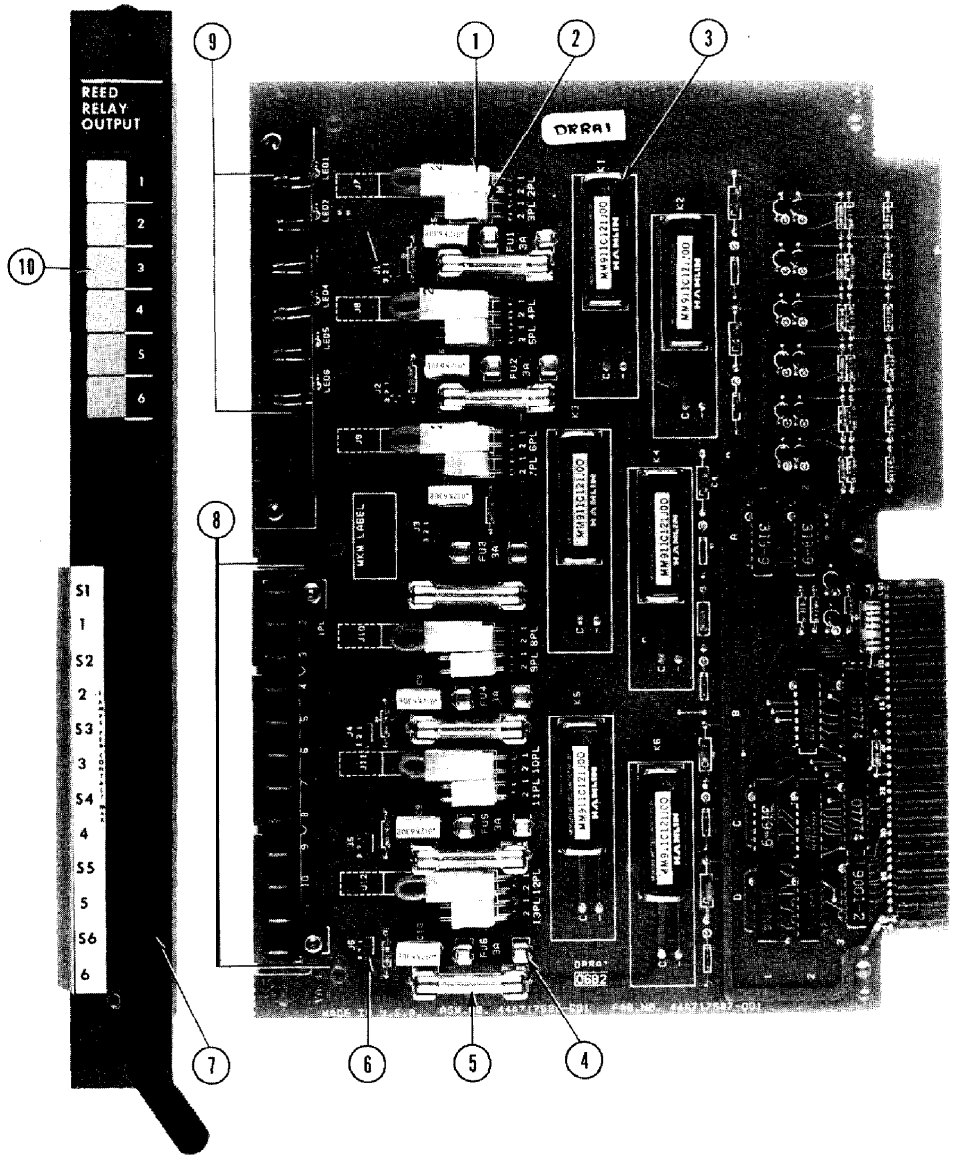
REED RELAY OUTPUT MODULE

The Reed Relay Output module (Catalog Number IC600BF914A) provides six form C, mercury wetted contact outputs.

A Reed Relay Output module can be installed in any I/O slot in a model 60 CPU or in any slot in an I/O rack, except the left most slot. Before installing the module, select the I/O starting point number by configuring the seven segment DIP switch on the backplane adjacent to the selected I/O slot. The I/O point selected will be the first of six consecutive outputs assigned to the Reed Relay module. Figure 23 can be used as a guide for setting the DIP switches; however, remember that only the first six I/O points will be used by this module.

There are two jumper selectable options on the circuit board. It should be determined if the factory configuration is suitable for the application. Factory configuration is for normally-open contacts and RC protection circuits for each of the six output circuits.

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1. Jumpers: 2,4, 6,8, 10, 12 PL - Select Normally Open Contacts.
2. Jumpers: 3, 5, 7,9, 1 1, 13 PL - Select Normally Closed Contacts.
3. K1 to K6, Mercury Wetted Contact Reed Relays.
4. Fuse Clip, European Style Fuses (6).
5. Fuse, 3A Normal Blow (6).
6. Jumpers (Jl -J6) from Selection of Contact Protection RC Network to be In or Out of Circuit.
7. User Terminal Block
8. Circuit Board Terminal Block.
9. LED1 to LED6, On When Relay Coil Energized.
10. Markable Lens Surface.

Figure 49.
REED RELAY OUTPUT MODULE

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One of the circuit board jumpers is set to select the de-energized state of each relay to have either normally-open (N.O.) or normally-closed (N.C.) contacts. In addition, a second jumper in each circuit is in series with the RC protection circuit for each output. When this jumper is removed, the RC circuit is removed which allows operation with low level analog and instrumentation signals where arc suppression is not a factor during normal operation.

Install the printed circuit board by using the extraction/insertion tool. Connect the grounding wire from the faceplate to the rack. With the board in place in the rack, slip the edge connector on the faceplate over the circuit board so that proper contact is made between the two parts. Secure the faceplate to the rack using the quarter-turn thumbscrews.

NOTE

A Reed Relay Output module must be installed in a vertically oriented position. Otherwise, the module will not function properly.

Figure 50 is a schematic representation of a Reed Relay output circuit (circuit No. 1 is illustrated, each of the six circuits are identical).

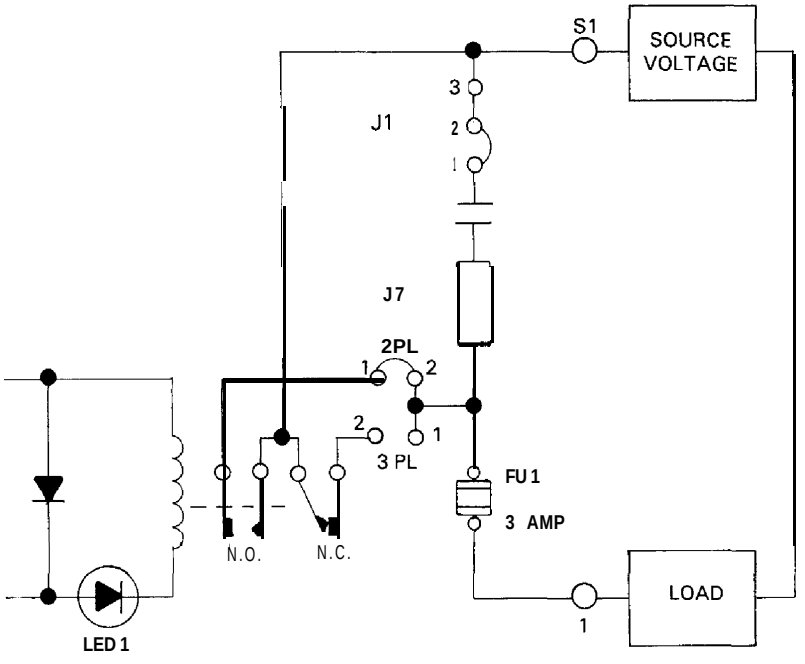


Figure 50.
TYPICAL REED RELAY OUTPUT CIRCUIT

JI is the protection circuit jumper, 2PL is the N.O. jumper plug, 3PL is the N.C. jumper plug, LED1 is the energized coil indicator and FU1 is the fuse for this circuit.

Each output has two connections. One of the connections is the output terminal (1 through 6), the other terminal (SI through S6) connects to the user power source. Each of the box lug terminals can accommodate one No. 12 AWG or two No. 14 AWG wires. Figure 51 shows typical user connections to the module. Wiring instructions follow the figure.

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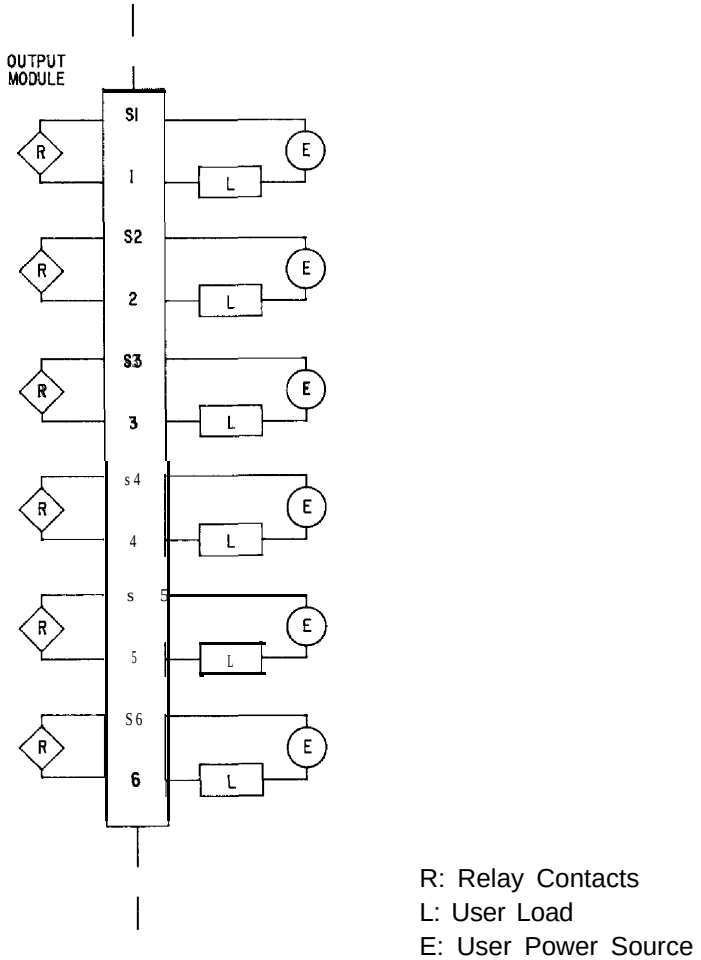


Figure 5 1.
REED RELAY OUTPUT, TYPICAL USER CONNECTIONS

- Connect one side of the load to be controlled to one of the output terminals, 1 through 6.
- Connect the other side of the load to the user power source.
- Connect the other side of the user power source to the applicable terminal S1 through S6.

After completing field wiring install the terminal block protective cover by guiding both its edges onto the top of the terminal block and sliding it down over the terminals. The markable area on the lens beside each circuit indicator can be used for noting the function or destination of each output.

WARNING

Voltages from user field devices may be present on the faceplate terminals, even if the power supply in the I/O rack is off. Care should be taken when handling the faceplate or any wires connected to it.

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SECTION 4
PROGRAM DEVELOPMENT TERMINAL

The Program Development Terminal requires minimal installation procedures. It is recommended that the following sequence be followed. For detailed installation procedures, refer to GEK-25362, Programming Manual For Series Six.

l Lower the hinged panel in the back of the Program Development Terminal, allowing access to the cable storage compartment as shown below in Figure 52.

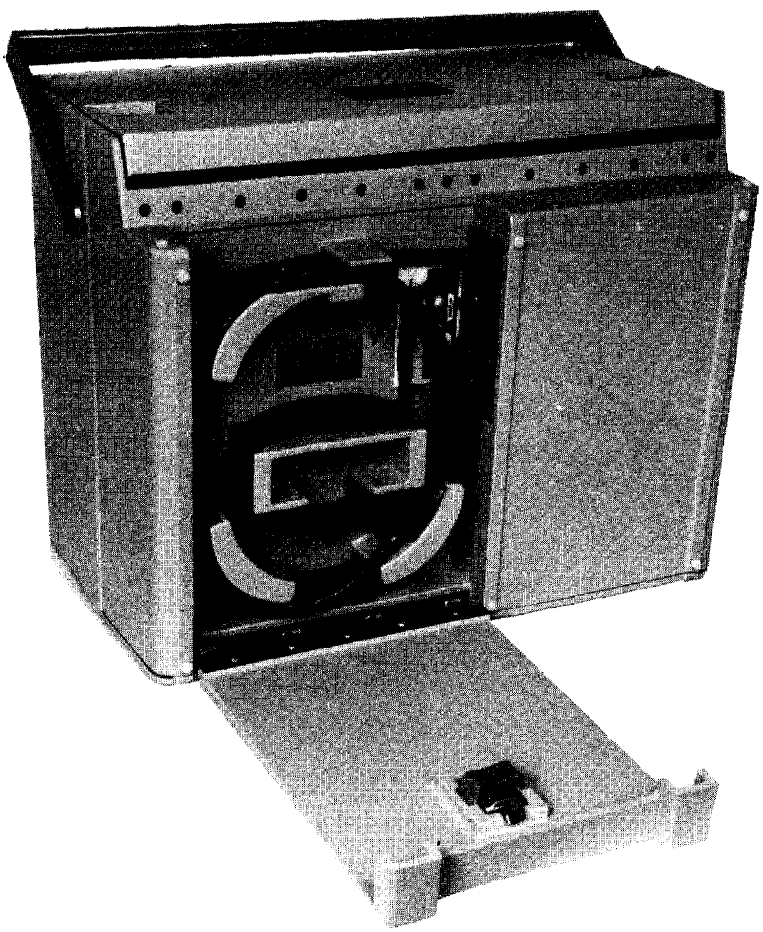


Figure 52.
PROGRAM DEVELOPMENT TERMINAL STORAGE COMPARTMENT

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- Unwrap the Program Development Terminal to CPU cable and the AC line cord from the cable wrap area.

- Plug the 3-prong (grounding) line cord into a 115V AC outlet. The Program Development Terminal and CPU should be connected to an AC source providing a common ground between the two units if the PDT is connected directly to the CPU.

- Connect the 12 foot interface cable to the top connector of the I/O Control module in the CPU rack. Tighten the mounting screws on the connector to ensure a secure connection.

- If any peripheral equipment is to be used connect the appropriate cable. Connectors are provided for a printer or a minicartridge tape unit. A connector is also provided for a composite video monitor.

- Close the hinged cover; the cables will feed out of the opening towards the top of the unit.

- If the front hinged cover has not been lowered, do so at this time. This will allow access to the keyboard, CRT and switches.

- Turn power on by depressing the illuminated rocker switch towards the top.

- Call up the Supervisor Display, select each item from the menu and observe that they are operating properly.

- Select the item, DISPLAY PROGRAM from the menu and enter a sample ladder diagram program.

- If all keys and functions appear to be working properly, you are ready to begin entry of your ladder diagram program.

- If any problems are encountered, proceed to Chapter 3, Troubleshooting and Repair in this manual.

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SECTION 1
INTRODUCTION

This chapter provides the data required for basic troubleshooting and repair should a malfunction of your system occur. Included are sections on troubleshooting and repair of the Central Processing Unit, the I/O system and the Program Development Terminal. Parts lists are included as a guide for ordering parts. Calibration procedures are included for those modules requiring periodic calibration for required accuracy.

The technology used in the design of the Series Six system is such that under normal operating conditions few hardware failures are expected. If any failures should occur, they can quickly be isolated and the defective assembly replaced with minimum downtime.

Troubleshooting is accomplished by thinking logically of the function of each part of the system and how they relate to each other. A basic understanding of the various indicator lights will usually quickly isolate the problem to the CPU rack, DPU rack, an I/O rack or the Program Development Terminal.

By use of the Program Development Terminal in conjunction with the CPU, troubleshooting of the program is accomplished. Any input or output can be looked at and changed or overridden as required.

The total system has to be considered when problems occur. The CPU, Program Development Terminal, DPU, I/O's and external devices connected to or controlled by the programmable controller must all be operating and connected properly. All screw-down or soldered connections should be checked carefully as well as all cable connections.

Troubleshooting procedures for the DPU can be found in the Data Processor Unit Users Guide.

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PROGRAMMABLE CONTROL SERVICE CENTER

The Programmable Control Service Center is staffed by experienced Programmable Control Service Personnel. The Service Center is available to aid the customer in diagnosing and solving equipment problems.

24-HOUR NUM8ER FOR PROGRAMMABLE CONTROL EMERGENCY SERVICE

1-800 GEFANUC

This number is for Programmable Control Service only. Contact your normal service number for service on other General Electric products.

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TROUBLESHOOTING

The maintenance and troubleshooting section of this manual is designed to help you isolate and correct any problems that may arise in your Series Six system. It is recommended that all maintenance and programming personnel read this manual thoroughly so that if a problem does arise it can be isolated quickly and the defective part replaced, thus minimizing downtime of the system.

However, we realize that troubleshooting isn't always that simple. Sometimes you need someone to talk to who can answer your questions. When you do, please don't hesitate to call Programmable Control **Service at 1-800 GEFANUC.**

REPLACEMENT MODULE CONCEPT

The troubleshooting and maintenance techniques described in this manual promote the concept of complete board replacement. The prime objective of this concept is to minimize system downtime.

When a problem arises, first isolate it to the major assembly (Program Development Terminal, Central Processing Unit, I/O rack, etc.), then to the defective module within that assembly. The defective module is then replaced from a duplicate set of modules maintained on site. Your production line or system is back up fast.

The defective module can be returned through normal channels under warranty or for service without keeping your production line or system down for an extended period of time. The replacement concept minimizes downtime to minutes as opposed to days. The potential savings far outweigh the comparatively small cost of duplicate modules.

If you did not purchase a duplicate set of modules with your initial system, we recommend that you contact your General Electric Sales Engineer and do so. Then, with the help of this manual and the staff at the Programmable Control Service Center, you will be able to troubleshoot and repair just about any problem that may arise.

NOTE

The following symbols are used to identify steps in the troubleshooting sequences.

(HEX symbol) PDT sequence

CPU sequence

(Square symbol) I/O system sequence

Corrective action to be taken for repair.

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SECTION 2

PROGRAM DEVELOPMENT TERMINAL TROUBLESHOOTING



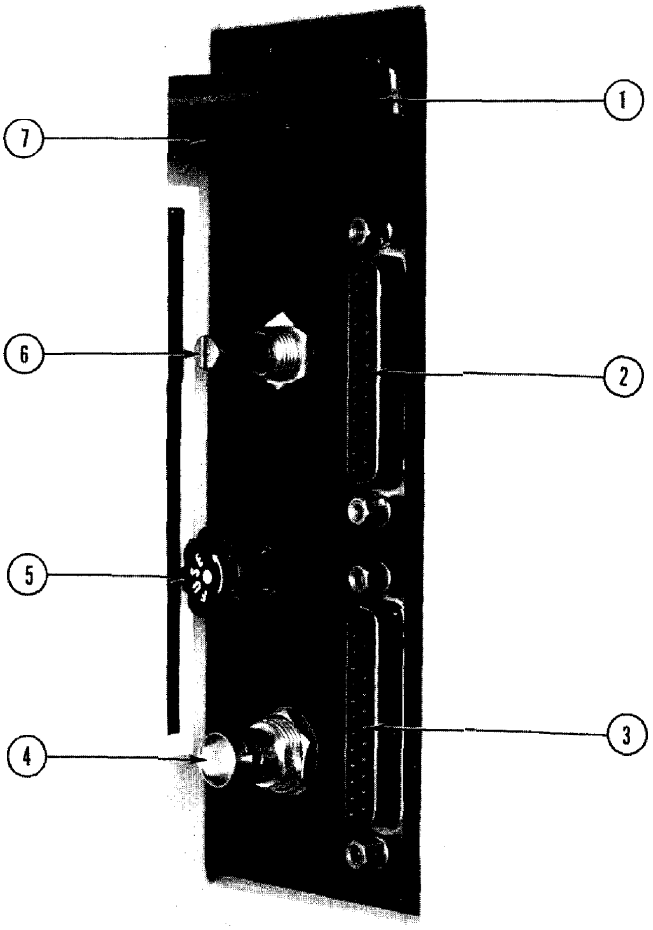
Initial troubleshooting steps for any suspected Program Development Terminal (PDT) malfunction should include the following:

- Check the keyswitch position on both the PDT and CPU.
- Insure that the proper sequence of pushbuttons was entered.
- Check all external cable connections.
- If there is a communications problem with a CPU, check for proper PDT operation by connecting the PDT to another CPU (if one is available).
- Check for blown fuse.
- Ensure that the fan filter is clean and passes air easily. Failure to do so on a regular basis can result in overheating of the PDT and possible erratic operation.

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02

To check the fuse and connections to the PDT open the cable storage compartment of the PDT. See Figure 1 for location of these items.



1. AC Power Cable
2. Printer Connection
3. External Tape Unit
4. Composite Video Connector
5. Fuse, 1.5A, Slo-Blo
6. Brightness Control
7. Program Development Terminal To CPU Cable

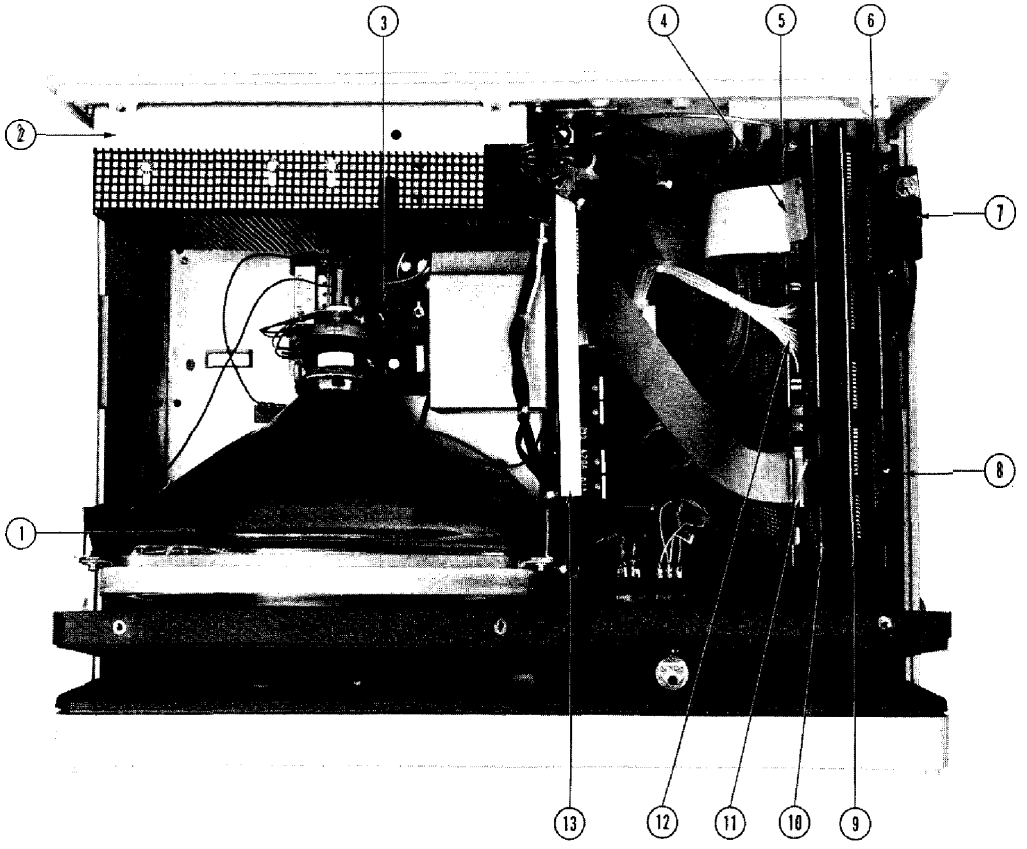
Figure 1.
PROGRAM DEVELOPMENT TERMINAL CONNECTORS, CONTROL AND FUSE LOCATION

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03

If the malfunction is isolated to the PDT proceed as follows:

- Remove the top cover from the PDT to gain access to internal circuitry. Location of the internal components is shown below.



1. 12 inch (304.8mm) CRT
2. Power Supply
3. Video Monitor board
4. Connection to tape unit
5. Video Control Board
6. Processor Control Board
7. Connection to CPU
8. Spare Connector
9. RAM Board
10. PROM Board
11. Connection to Keyboard
12. Connection to CRT, Keyswitch and EIA (Connectors in storage compartment)
13. Tape Interface board

Figure 2.
PROGRAM DEVELOPMENT TERMINAL COMPONENT LOCATION

WARNING

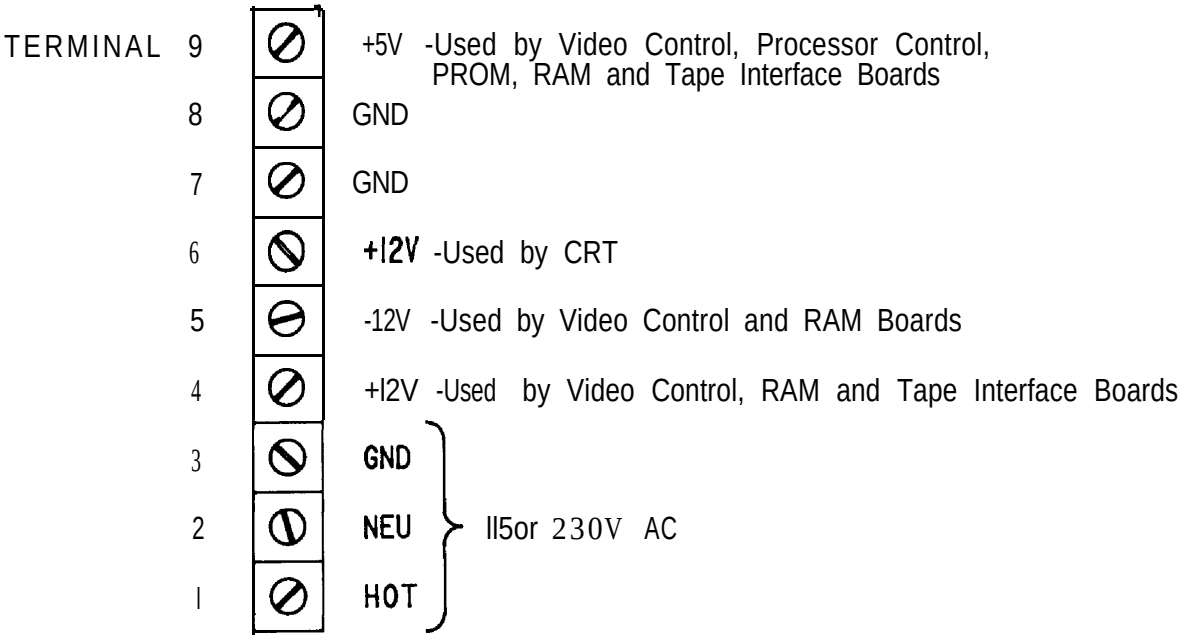
Cathode Ray Tube (CRT) has 12,000 Volt potential. A high voltage potential may remain for a period of time after removal of power.

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l Check power supply voltages at the terminal board on the power supply. Voltages must be within the specified range.

Voltage	Range
+5V DC	+4.75 to +5.25V DC
+12VDC	+11.40 to +12.6OV DC
-12VDC	-11.40to-12.60VDC

These voltages may be checked on the terminal board located at the side of the power supply. The following illustration shows the location of each terminal for checking the voltages.



NOTE

A printed circuit board, mother board or cable short may be loading down the power supply. Remove circuit boards that use the voltage in question and check again.

If any voltage is out of range replace the power supply.

l Check all of the internal cable connections to insure proper seating. Figure 2 (previous page) shows the location of the various cables.

l Reseat the circuit boards in the PDT. Board positions are shown in Figure 2.

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To change the PDT power supply, use the following procedure:

- Remove AC power to the PDT by unplugging the line cord.
- Set the PDT on a table with the display screen facing up. Open the cable storage compartment door and remove 2 screws holding the bottom of the power supply bracket.
- Remove 2 screws holding the top of the power supply bracket. The power supply can now be removed from the PDT and set on the table with wiring intact.
- Remove the power supply shield by removing 3 screws from the top of the power supply and 1 screw from each corner of the lower part of the power supply bracket.
- Remove the power supply bracket by removing 4 screws from the rear of the bracket.
- Set the new power supply next to the one being replaced. Remove the wires from the terminal board of the old power supply and connect them to the terminal board on the new power supply. Remove the wires one at a time. Ensure that the wires are connected to the correct terminals.
- Attach the power supply bracket to the new power supply.
- Attach the power supply shield to the new power supply and to the bracket.
- Install the new power supply and tighten the screws holding the shield and bracket. Be careful not to pinch the cable going to the CRT.
- Check all power supply voltages.

4 CRT ADJUSTMENT PROCEDURES

WARNING

High voltage exists in the Program Development Terminal CRT assembly. Use extreme caution when making adjustments or personal injury may result. No adjustments should be performed on the CRT assembly by anyone not familiar with servicing procedures and precautions.

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The following adjustments are made on the video monitor board. See Figure 2 for location of board. All adjustment controls are clearly marked on the board (Figure 3).

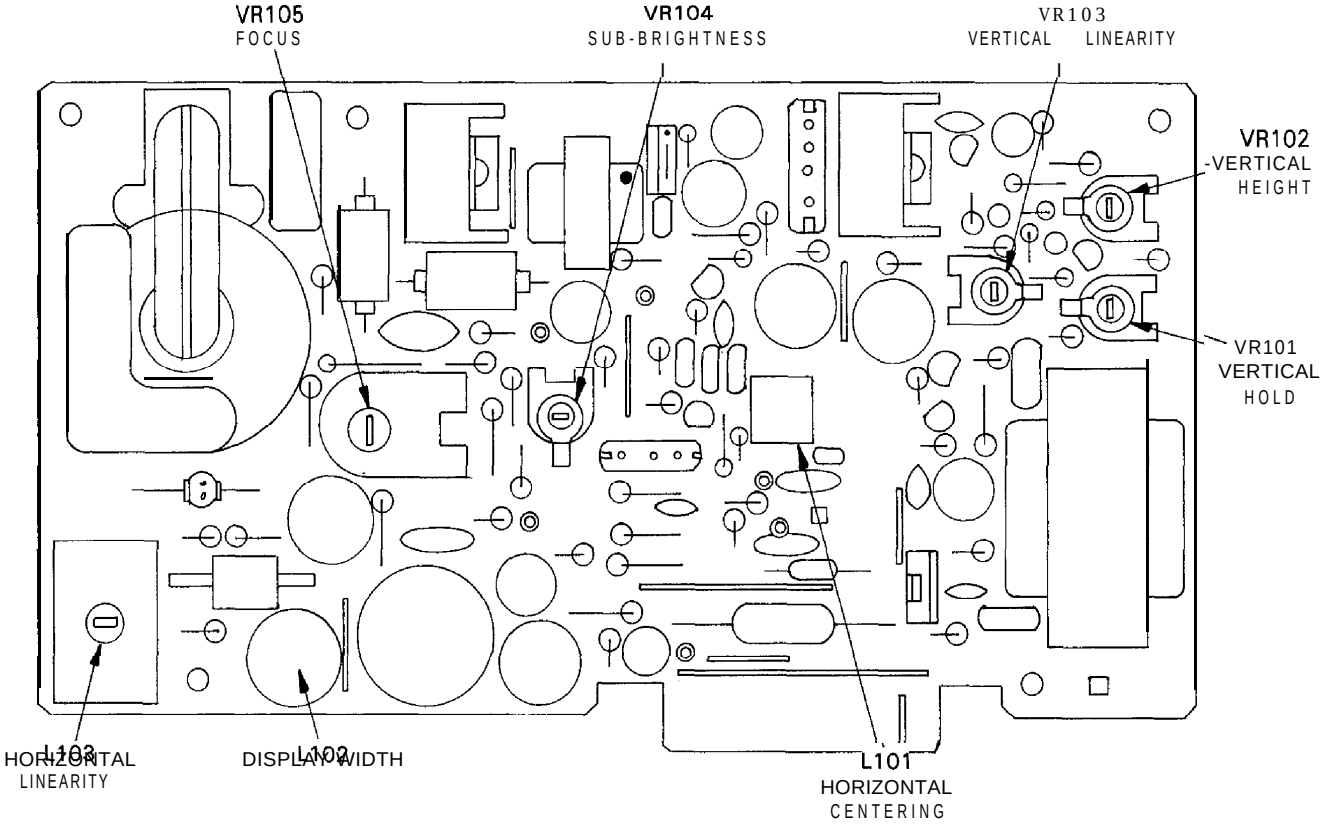


Figure 3.
CRT ADJUSTMENT CONTROLS, VIDEO MONITOR BOARD

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- **Sub-Brightness**
  The brightness can be controlled by adjusting VR104. Set the external brightness control (on panel inside of the cable storage compartment) to its center position, then adjust VR104 so that the background raster is barely visable. Back off VR1 04 until the raster just disappears. The focus is affected to some extent as the brightness control is adjusted to provide the user with optimum viewing conditions.

- **Focus**
  The focus control (VR105) allows adjustment for the sharpest display on the CRT screen. The focus control should be adjusted to provide the desirable amount of line detail in the display.

- **Vertical Hold (Vertical Frequency)**
  The vertical hold control (VRI 01) allows adjustment to eliminate vertical rolling of the display. Rotate this control slowly until the display locks in vertically.

- **Vertical Height**
  The vertical height control (VRI 02) adjusts the vertical height of the display area.

- **Vertical Linearity**
  The vertical linearity control (VR103) allows an adjustment to provide equal spacing on either side of the center line of the display. Linearity of the vertical scanning can be checked by observing crowding or spreading from top to bottom in the raster and displayed information.

- **Horizontal Centering (Video Center)**
  The horizontal centering control (L101) allows centering of the picture from left to right. Rotate L101 slowly until the raster and displayed information are centered in the display area.

- **Display Width**
  The display width control (L102) allows adjustment of the width of the display area. Rotate L102 until the display area is sufficiently filled.

- **Horizontal Linearity**
  This control (L103) allows adjustment to provide equal spacing on either side of the center line. Horizontal linearity can be checked by observing crowding or spreading from left to right in the raster and displayed information.

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05

If the problem still persists after making the above checks and adjustments, proceed according to the type of malfunction encountered. Refer to the following table.

PROBLEM	PROCEDURE
NO DISPLAY OR DISTORTED DISPLAY	1. Adjust CRT controls as required. (See above procedure.) 2. Turn PDT keyswitch to off-line, then power down. Wait a few seconds and power up. 3. Replace Video Control board. 4. Replace Processor Control board. 5. Replace PROM board. 6. Replace RAM board.
NO COMMUNICATIONS	1. Replace Processor Control board. 2. Replace RAM board. 3. Replace Video Control board. 4. Replace PROM board. 5. Check CRT-to-PDT cable connection at both ends. 6. Replace cable.
NO RESPONSE TO KEYBOARD ENTRY, DISPLAY OK	1. Check keyboard connector at keyboard and Video Control board. 2. Replace Processor Control board. 3. Replace Video Control board. 4. Replace RAM board. 5. Replace PROM board. 6. Replace keyboard.
NO RESPONSE FROM SOME KEYBOARD PUSHBUTTONS	1. Replace keyboard. 2. Replace Video Control board. 3. Replace Processor Control board. 4. Replace RAM board. 5. Replace PROM board.
INTERNAL MAGNETIC TAPE UNIT FAILURE	1. Perform preventive maintenance (see below). 2. Replace Video Control board. 3. Replace Processor Control board. 4. Replace magnetic tape transport and tape interface board. (Call Programmable Control Service.) 5. Replace RAM board. 6. Replace PROM board.

Table 1.
PDT TROUBLESHOOTING

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PROBLEM	PROCEDURE
EXTERNAL TAPE LOADER DOES NOT OPERATE	1. Check front panel switch settings. STR LINK IIA l Baud rate: 300,600 or 1200' (same as PDT) *Recommended by General Electric. l Stop bit: 1 l I/O Select: RS232 l Mode Select: Half duplex STR LINK III l Track select: 1 l Baud select: 1200 Baud recommended. Must be same as PDT.
WRITE PROTECT message is displayed in work area of PDT when attempting to write to tape.	The sliding tab on the tape cartridge should be in the RECORD position.
BAD RAM LOC message on power up	Power down, then back up to reinitiate the PROM INTEGRITY CHECK. If it fails a second time, check seating of all four printed circuit boards (check the RAM board first). If problem still exists, replace the RAM board.
BAD PROM LOC message on power up	Same as above, except check seating of PROM board message on power up first. If problem still exists, replace the PROM board.

Table 1. (Cont.)
PDT TROUBLESHOOTING

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PREVENTIVE MAINTENANCE

The preventive care and maintenance of the STR LINK mini-cartridge recorders involves only simple, easily accomplished procedures that enhance the performance of the unit and assure long-term, trouble-free operation.

- After every 8 hours of operation, clean the read/write heads with a magnetic head cleaner solvent. Use cotton swabs to clean and dry the heads, taking care not to touch the heads with fingers or other foreign objects.

- After every 8 hours of operation, clean the capstan drive roller with a rubber drive cleaner solvent, and wipe the roller dry.

- After every 100 hours of operation, clean the entire unit thoroughly, removing any dust, metal oxide particles, and lint that may have accumulated. Use an air hose or a soft brush to accomplish this cleaning. After every 100 hours of operation, demagnetize the recorder heads.

- If mechanical parts begin to squeak, they may be oiled sparingly with TSI-301 oil (or equivalent), taking care to avoid dripping oil onto other parts or leaving an oil film that may attract dirt deposits.

Proper care of the tape cartridges can contribute to the long-term operation of the unit. Tape cartridges should be protected from dirt and dust, preferably being stored in closed containers. The surface of the tape must not be touched with fingers or other foreign objects. Cartridges in storage should be protected from heat and electromagnetic fields.

PROGRAM DEVELOPMENT TERMINAL RENEWAL PARTS LIST

A list of the replaceable parts in the PDT is provided in Table 2.

Catalog Number	Name	Function
IC600PB553A	Processor Board	Generates addresses and data via an 8086 microprocessor. Contains circuitry for a Direct memory Access (DMA) between the CPU and the PDT. Contains interrupt controller circuitry.
IC600DM736A	RAM Board (Random Access Memory)	128K bytes of dynamic RAM memory.
IC600PB552A	PROM Board	Contains Executive instructions in PROM memory for proper PDT operation.
IC600PB551A	Video Control Board	Video control circuitry, keyboard interface, serial and parallel data port interfaces.
IC600WE5OOA	PDT to CPU Cable	Connects PDT to the CPU.

Table 2.
RENEWAL PARTS LIST
FOR PROGRAM DEVELOPMENT TERMINAL

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SECTION 3
CENTRAL PROCESSING UNIT TROUBLESHOOTING

FAULT ISOLATION AND REPAIR

The malfunction causing the improper operation of a CPU can be isolated by checking the condition of status indicator lights and keyswitch positions. The status indicator lights and keyswitches indicate the current operating condition of the CPU and I/O system.

The normal condition of the status indicator lights is the on state. If any of the status indicator lights are not on, check the troubleshooting sequence in this section for the proper course of action. Be sure to note the positions of the keyswitches on both the CPU and the Program Development Terminal.

Table 3 is an indicator chart that gives a quick reference for the normal condition and definition of the status indicator lights.

Refer to Figure 4 which is an illustration of a Series Six CPU showing the location of the Status indicator lights and the keyswitches. The numerals and references on the illustration refer to a step in the troubleshooting sequence.

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MODULE	INDICATOR	NORMAL CONDITION	DEFINITION
Power Supply	POWER	ON	Power is applied, DC voltages are within tolerance.
I/O Control	CHAIN O.K.	ON	All I/O stations in primary chain have continuity, good output parity and power supply is O.K.
	PARITY	ON	Input data parity is O.K.
	ENABLED	ON	CPU is in the normal Run Enabled mode (outputs enabled).
	DPU	ON	DPU connected and operating normally. (If no DPU in system and DPU present jumper is in, light will be on).
Arithmetic Control	RUN	ON	Run signal (from I/O Control) toggles within every 200 milliseconds (± 50 milliseconds).
	CHECK	ON	CPU passed self-test routine which is executed once per sweep.
Internal Memory	BATTERY	ON	Status of CMOS RAM back-up battery.
	PARITY	ON	Logic Memory parity error.
Register Memory	BATTERY	ON	Status of CMOS RAM back-up battery.
	PARITY	ON	Table memory parity error on Internal or Register memory board.
Logic Memory	BATTERY	ON	Status of CMOS RAM back-up battery.
Auxiliary I/O Control	CHAIN O.K.	ON	All I/O stations in auxiliary chain have continuity, good output parity and power supply is O.K.
	PARITY	ON	Input data parity is O.K.
	ENABLED	ON	CPU is in the normal Run Enabled mode (outputs enabled).

Table 3.
CPU INDICATOR CHART

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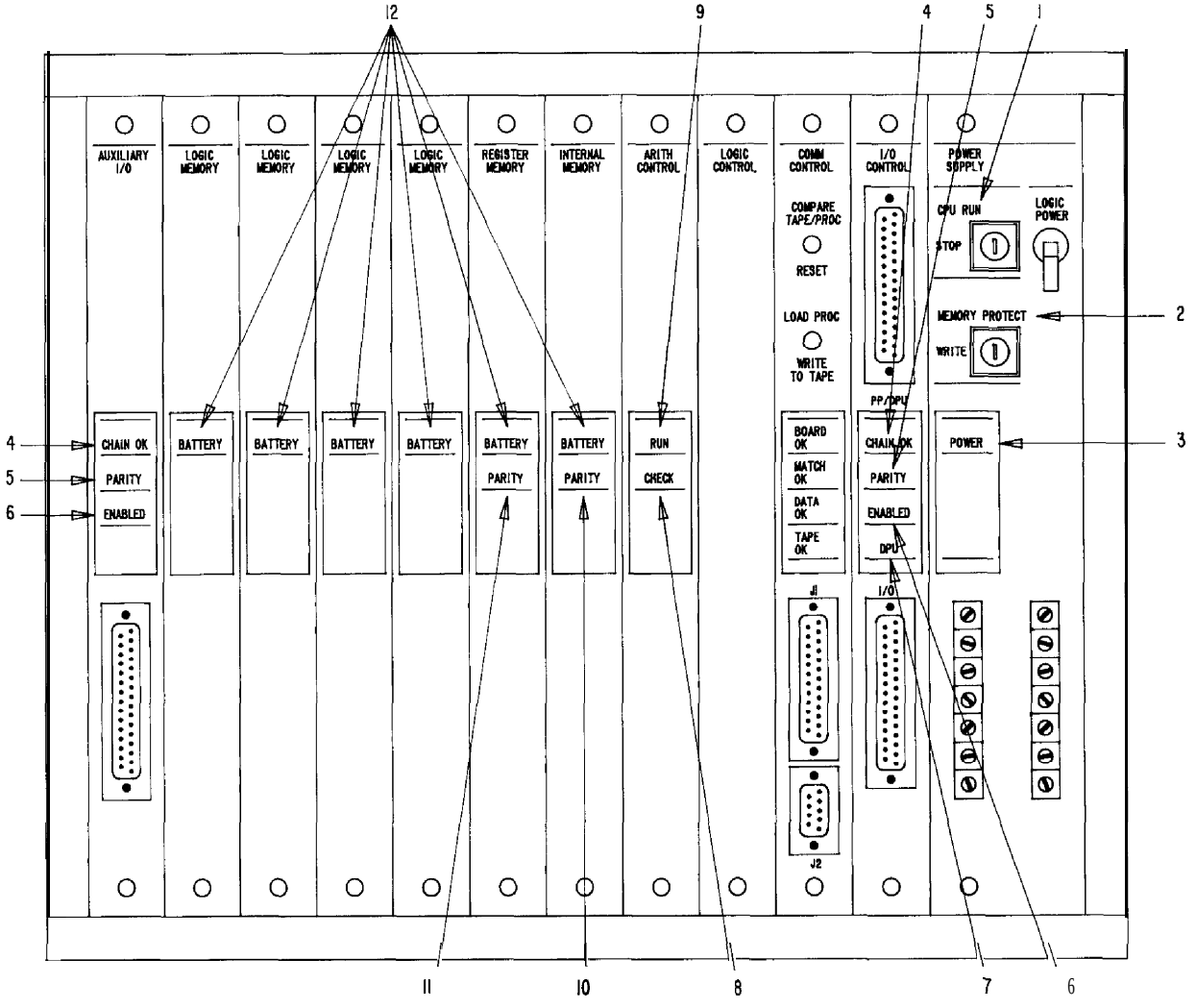


Figure 4.
CPU INDICATOR/KEYSWITCH REFERENCE

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0 1

	CPU RUN/STOP KEY SWITCH
Position	DEFINITION
STOP	CPU is unconditionally in the STOP mode.
RUN	CPU is in the RUN mode unless this condition has been altered by commands from the Program Development Terminal, DPU or by the state of various control signals. When this switch is turned from STOP to RUN, the system will start with the outputs enabled. IF THE CPU WILL NOT RUN, CHECK OTHER STATUS LIGHTS.

0 2

	MEMORY PROTECT KEY SWITCH
Position	DEFINITION
PROTECT	The contents of the Logic Memory and the Override Table are protected from being changed.
WRITE	The User program in the Logic Memory may be changed and an override condition may be added to or removed from inputs or outputs through the Override Table.

If keyswitches in ① and ② do not operate and all status indicator lights are OK, check the P2 connections on the CPAXI board in the power supply module (See Figure 5).

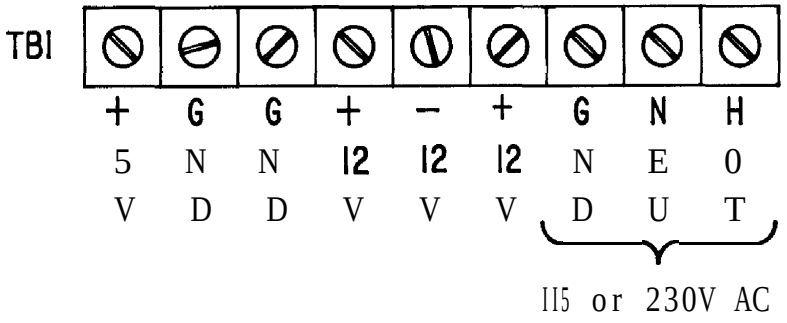
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0 3

Power Light	CPU Power Supply
Status	**DEFINITION**
ON	The voltage levels of all 3 DC outputs (+5V, + 12V, -12V) are within the specified tolerance.
OFF	At least one of the voltage levels is out of tolerance. The CPU RUN and ENABLE status lights should also be off. Alarm No. 1 relay switches.

Corrective Action

- **Check the power supply voltages by partially pulling out the power supply module and measuring the voltages. The voltages are checked at the terminal board assembly (TB1) located at the top of the power supply. The connections are labeled as shown below.**



1 **Check the P1 connections on the CPAXI board in the power supply module.**

NOTE

A printed-circuit board, backplane or cable short may be loading down the power supply. If a DC voltage is found to be out of tolerance, back out all printed-circuit boards and then recheck the voltage. If it is still bad, replace the power supply. If the voltage is OK, reinsert the printed-circuit boards one at a time to determine which one is loading down the power supply. Keep in mind that the power supply may be bad under normal load conditions.

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Voltage	Range
+5V DC	+4.75 to 5.25V DC
+12VDC	+11.40to+12.60VDC
-12VDC	- 11.40 to - 12.6OV DC

If any of the voltages are out of tolerance replace the power supply.

Figure 5 is a block diagram of the CPU power supply for reference.

NOTE

After a power fault, the system will come back on in the mode (STOP, RUN ENABLED, or RUN DISABLED) in which it was operating before power was lost.

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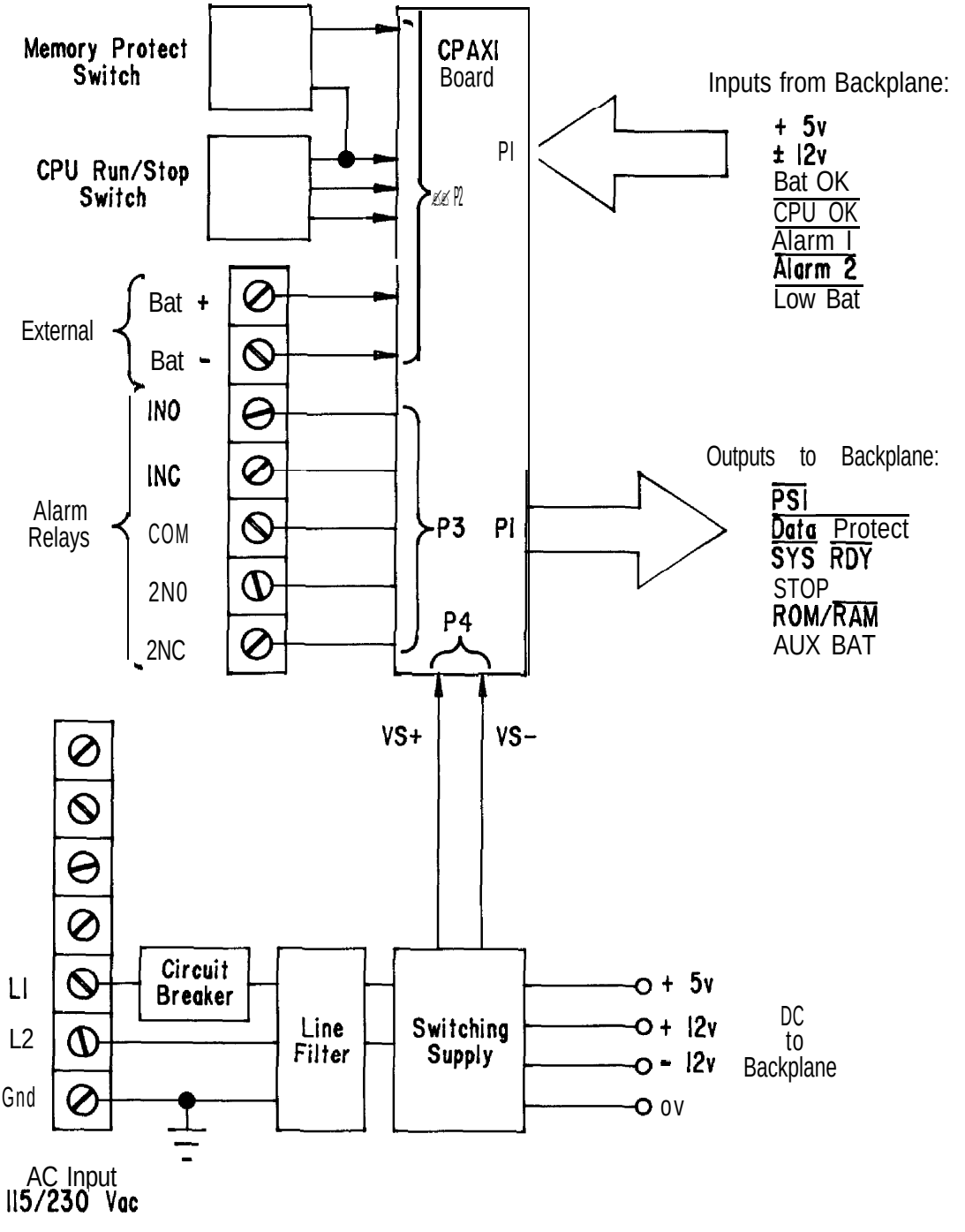


Figure 5.
CPU POWER SUPPLY BLOCK DIAGRAM

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CHAIN OK Light	I/O Control Module Auxiliary I/O Module
Status	**Definition**
ON	Continuity, output data parity and power supplies are good at all f/O stations in the primary and auxiliary chains.
OFF	A continuity, power supply or output data parity error exists at one or more primary or auxiliary chain I/O station(s). The CPU RUN and ENABLE lights are off. Alarm No. 1 relay switches. When the fault is removed, CPU resumes its previous status.

Corrective Action

- Check for proper i/O chain signal termination on the fast I/O Receiver module of each I/O station in a parallel chain.
- Check cable connections to each I/O rack.
- Check for power on each I/O rack. If power indicator is off, check the +5V DC on the terminal board assembly by partially pulling out the Power Supply module. Check voltage as in 5. If the +5V DC is out of tolerance, replace the I/O power supply.
- Check CHAIN OK and CHAIN PARITY lights in the CPU station I/O racks.
  1. If any of the above status lights are off proceed to the I/O troubleshooting section.
  2. If all status lights are on, replace the f/O Control or Auxiliary I/O module as applicable.

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	PARITY Light	I/O Control Module Auxiliary I/O Module
	Status	**Definition**
	ON	Input data parity is good at the I/O Control module.
	OFF	**Input data parity error exists. The CPU RUN and ENABLE lights are off.** Alarm No. 1 relay switches,

Corrective Action

- Verify that no two input cards have the same address.
- Turn the CPU Keyswitch to STOP, then power down and back up.
- **If an input parity error is confirmed, check Scratch Pad CPU Flags (see GEK-25362, page 4.21) which will give the address of the input board where the data originated.**
- **Replace the Input board corresponding to the address shown in the Scratch Pad.**
- Replace the I/O Receiver in that I/O rack.
- Replace the I/O Transmitter between that rack and the CPU.
- Replace the I/O Control board.

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ENABLED Light	I/O Control Module Auxiliary I/O Module
Status	**Definition**
ON	Outputs are enabled. CPU is operating in the Run Enabled mode.
OFF	Outputs are disabled. CPU is in the Run Disabled or STOP mode. If in the STOP mode, the RUN light on the Arithmetic Control module is also off.

NOTE

When CPU is in RUN DISABLED mode, outputs are disabled, but inputs are still updated in the CPU status table.

Corrective Action

- **Check the position of the CPU Run/Stop key switch. See ① .**
- **Check the condition of other status lights (PARITY, CHAIN OK and POWER).**
- **If no other problem is indicated by other status lights, try re-enabling the CPU from the PDT or with the RUN/STOP keyswitch.**

7

DPU Light	I/O Control Module
Status	**Definition**
ON	The Data Processor is connected and operating properly or DPU not connected and option jumper is connected on the board.
OFF	A continuity error or other type problem exists in the DPU.

Corrective Action

- Check power to the Data Processor unit.
- If the Data Processor is in its own rack check the power supply voltages.
- **Refer to the DPU Users Guide for further troubleshooting procedures.**

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CHECK Light	Arithmetic Control Module
Status	Definition
ON	CPU execution sequence is proceeding normally, self-test routine is passed at least once each 200 milliseconds, ± 50 milliseconds.
OFF	CPU self-test routine has not been passed within 200 milliseconds ± 50 milliseconds. The RUN and ENABLE lights are off. Alarm No. 1 relay switches. Reset signal is sent to the I/O chain.

Corrective Action

- Check the condition of the POWER and memory BATTERY lights. If any are off, correct them first.
- Turn the CPU Keyswitch to STOP, power down and back up.
- Make sure that the user program has an End of Sweep.
- Disconnect any peripheral device such as the Program Development Terminal or a Mini-cartridge Tape Unit.
- Reseat the Arithmetic Control and Logic Control modules. if this does not correct the problem, replace the Arithmetic Control and the Logic Control modules one at a time.

NOTE

A program which causes the CPU sweep time to be in the 200 milliseconds, ± 50 milliseconds range can cause the CHECK light to go off. (Use care when programming subroutines.)

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RUN Light	Arithmetic Control Module
Status	Definition
ON	CPU execution sequence is proceeding such that the self-test routine is passed and the I/O scan is completed at least once every 200 milliseconds, ± 50 milliseconds. CPU is in the Run mode.
OFF	CPU is in the Stop mode. The Enable light is also off.

Corrective Action

- Check the position of the RUN/STOP keyswitch, See ① .
- Check the condition of other status lights (PARITY, BATTERY, CHAIN OK, CHECK and POWER).
- If no other problem is indicated, try restarting the CPU with the Program Development Terminal or CPU keyswitch.
- Reset the Arithmetic Control and/or the Logic Control modules.
- If reseating does not solve the problem, replace the two modules, one at a time.

NOTE

Both the RUN and the CHECK indicator may flash momentarily when power is turned on in the CPU. A valid RUN or CHECK state, however, is indicated by a steady glow of the LED.

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PARITY Light	Internal Memory Module
Status	Definition
ON	Logic Memory parity is good.
OFF	Logic Memory parity error exists. The RUN and ENABLE lights are off. Alarm No. 1 relay switches. The parity error and its address is recorded in the Scratch Pad CPU Flags.

Corrective Action

- Turn the MEMORY PROTECT keyswitch to WRITE.
- If the CPU will not go into the RUN Mode at this time because the parity error has reoccurred, go to the Supervisor Display on the PDT. Move the cursor down to CLEAR LOGIC MEMORY PARITY ERROR and depress the ENTER key, then SHIFT and ENTER simultaneously. This will clear soft parity errors.
- Reload the user program. The program can be transferred from the CPU to the PDT, then from the PDT back to the CPU. Try to restart the CPU by turning the CPU Key-switch to STOP, then back to RUN.
- Try to restart the CPU.
- If the parity error still exists, replace the Logic Memory module (Model 600).
- In a Model 6000 with multiple Logic Memory modules, the Scratch Pad error message display on the PDT must be decoded to determine which Logic Memory module is defective. Replace that module.

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PARITY Light	Register Memory Module
Status	Definition
ON	Table Memory parity is good.
OFF	Table Memory parity error exists. The RUN and ENABLE lights will be off. Alarm No. 1 relay switches. The parity error and its address is recorded in the Scratch Pad memory CPU flags.

Corrective Action

- Reload the user program. The program can be transferred from the CPU to the PDT, then transferred back to the CPU. Do the PDT to CPU transfer in the off-line mode.
- If the CPU will not go into the Run mode because the parity error is still present, call up the Supervisor display on the PDT for access to its menu.
- Move the cursor down to CLEAR SCRATCH PAD AND TRANSITION PARITY ERROR; depress the ENTER key, then SHIFT and ENTER simultaneously.
- Try to restart the CPU.
- If the parity error still exists, use the Scratch Pad CPU Flags to determine if the error was Register or Table parity. If a Register parity error, replace the Register Memory module. If a Table parity error, replace the Internal Memory module, if that error still exists replace the Register Memory module.

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BATTERY Light	All Memory Modules
Status	Definition
ON	Battery condition is normal; 2.75 to 3.0V DC.
FLASHING	Battery low; 2.54 to 2.75V DC: CPU continues running, will restart if stopped. Alarm No. 2 switches. To ensure protection of memory contents, replace the battery before it fails.
OFF	Battery failed; below 2.54V DC: CPU continues running, but will not restart if stopped. Alarm No. 2 remains switched. Memory contents will be lost when power is turned off or lost.

Replacement Information

- The Lithium-Manganese Dioxide battery will maintain the user program in memory for a period of 6 months (minimum) on the shelf (at a temperature range of O to 65°C).
- It is recommended that the battery be replaced every 4 years in a running CPU.
- If a battery fails, replace it immediately.
- To install a new battery on a memory board proceed as follows: (Refer to Figure 6).

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Corrective Action

- **Turn off power to the CPU.**
- Remove the faceplate from the appropriate memory slot.
- Remove the memory board using the extraction/insertion tool.
- **Remove the top board cover (component side) by pinching in the fangs of the clips** that hold the cover on, while pulling up on the cover.
- **If the light was flashing, install the new battery. (Catalog Number IC600MA507A)** as follows.
  1. Do not disconnect the battery, but do remove it from its mounting clips.
  2. Place the new battery in the clips.
  3. Connect the battery by using the second (unused) battery connector.
  4. Disconnect the defective battery and discard it.

WARNING

Do not discard the Lithium-Manganese Dioxide battery in fire. Do not attempt to recharge the battery. Do not short the battery. The battery may burst or burn or release hazardous materials.

  5. Care must be taken not to short any runs on the memory board during battery replacement as this will result in the loss of memory data.

- If the BATTERY light was out, install the new battery as follows.
  1. Disconnect the defective battery from its battery connector. Memory data will be lost. Be sure to have a backup (program on tape or in PDT).
  2. Remove the battery from its mounting clips.
  3. Discard the defective battery.
  4. Place the new battery in the mounting clips.
  5. Connect the new battery to either of the battery connectors.
- Replace the top cover of the memory board by pushing it down on the 7 plastic clips.
- **Install the memory board in the CPU using the extraction/insertion tool. The component side of the board should be to your right (toward the power supply).**
- **Replace the faceplate. Secure it in place by turning the quarter-turn thumbscrews** clockwise until they are tight.
- **If the BATTERY light had been flashing, turn power on and the CPU should commence** running in its previous state.
- **If the BATTERY light had been out, the memory must be reloaded before the CPU can** be restarted since the memory may contain invalid data.

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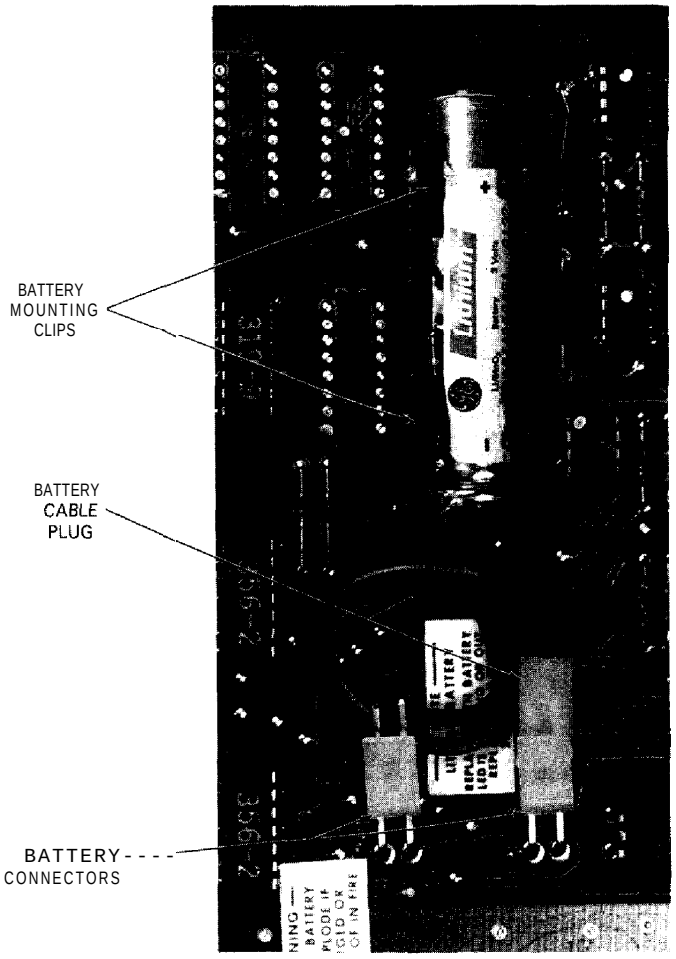


Figure 6.
BATTERY MOUNTING CLIPS AND CONNECTORS

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If the status indicator lights are in the correct state but the CPU is not functioning properly, the malfunctions below may describe the problem. If so, follow the procedures listed under the appropriate malfunction.

The CPU is running, but is not solving the ladder diagram correctly.
Check to see if the problem is resulting from a user program error such as overrides, multiple register usage, SKIP, MCR, or suspend I/O instructions.
Reset the Arithmetic Control and Logic Control boards.
Replace the Arithmetic Control board.
Replace the Logic Control board.

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The CPU will not communicate with the PDT.
Check the cable connector from the PDT to the CPU; be sure that it is mated securely.
Insure that the PDT will work with another CPU.
Reset the I/O Control board, Arithmetic Control board and the Logic Control board.
If reseating does not solve the problem, replace the above boards, one at a time in the order given above.

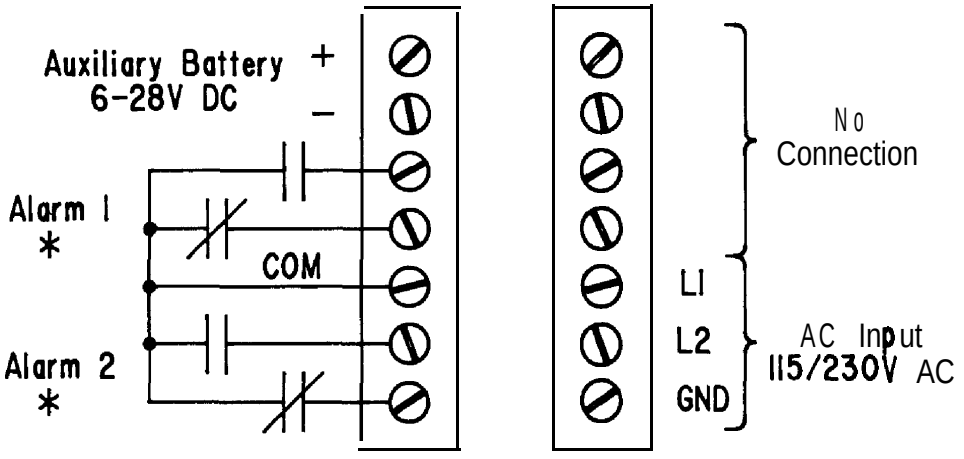
Parity error on initial power-up.
Call up the Supervisor display on the PDT and perform the CLEAR SCRATCH PAD AND TRANSITION TABLE PARITY ERROR and CLEAR LOGIC MEMORY PARITY ERROR functions.

DPU light not on (I/O Control module) and DPU is not connected.
Check I/O Control module board option jumpers. Jumper should be connected from A to B.

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ALARM RELAY

The CPU can be monitored at a location remote from the CPU by connecting an alarm device (buzzer, light, etc.) to the alarm relay output terminals on the CPU power supply. The alarm contacts on the power supply terminal board are shown below in Figure 7.



*Relay contacts are internal to the power supply.

Figure 7.
CPU POWER SUPPLY TERMINAL BOARD

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Alarm relay outputs are rated at 115V AC or 28V DC, 1 amp resistive load.

Alarm No. 1 is switched by hard failures, the CPU status is set to STOP. The RUN and ENABLE lights go off.

Alarm No. 2 is switched by a soft failure, error indications are recorded in memory, the CPU does not go to STOP.

Alarm conditions are listed in the table shown below. See ① through ⑫ for troubleshooting alarm conditions.

Alarm No. 1	Alarm No. 2
CPU or I/O parity error.	Voltage of any memory battery drops too low.
CPU self-test failure. CPU watchdog timer timed out. Any memory backup battery dead when power turned on.	CPU or I/O power supply turned Off.
Any CPU or I/O power supply voltage out of tolerance. CPU or I/O power supply turned off. Communications Control or Data Processor error (fault jumpers in circuit).	Communications Control or Data Processor error (fault jumpers in or out of circuit).

CAUTION

User devices connected to each set of alarm terminals should present a resistive load drawing no more than 1 amp of current at 115V AC or 28V DC. Failure to observe this CAUTION may result in damage to the CPAX1 circuit board in the power supply.

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CPU RENEWAL PARTS LIST

A list of the replaceable parts in the Central Processing Unit is provided in Table 4.

CATALOG NUMBER	MODULE NAME	60	600	600	FUNCTION
IC600CB500A	Arithmetic Control	x	x	x	Contains circuitry that performs arithmetic and logical operations on data and address lines.
IC600CB501A	Basic Logic Control	x	x	x	Contains the Basic instructon set. Has a microprogram controller and PROM memory for generation of Control signals for all CPU boards. Generates timing signals.
IC600CB502A	Extended Logic Control	X	X	X	Contains the Extended instruction set. Generates control and timing signals for the CPU. Controls the Auxiliary I/O's.
IC600CB504A	Internal Memory		x	x	Contains a status table for all inputs and outputs. Has an override table for inputs and outputs. Contains Logic Memory size location programming switches and has battery back-up.
IC600CB509A	I/O Control	x	x	x	Interfaces the CPU bus to the primary I/O bus (1000 inputs, 1000 outputs). Provides control circuitry for the Auxiliary I/O module and the Communications Control module.
IC600C8508A	Register Memory		x	x	Contains 1024 Register memory locations. Contains parity memories for the 4 internal memory tables. Has memory parity checking circuitry. Has battery back-up.

Table 4.
CPU MODULE RENEWAL PARTS LIST

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CPU RENEWAL PARTS LIST

CATALOG NUMBER	MODULE NAME	600	600	600	FUNCTION
IC6OOCB5 13A	Auxiliary I/O Control			X	Interfaces the CPU to an Auxiliary I/O bus with 1000 inputs and 1000 outputs.
IC600CB514A	Communications Control	X	X	X	Contains circuitry for serially interfacing the CPU to a Mini-cartridge Tape Unit or a high speed Data Highway.
IC600CB514B	Communications Control	X	X	X	Same as above. Has additional baud rates and current loop capabilities.
IC6OOCM542A	Logic Memory 2K-CMOS		x	x	Contains CMOS circuitry for storing the user's ladder diagram program. Has a Lithium-Manganese Dioxide backup battery for memory retention during no power situations. Battery will retain memory for about 6 months.
IC600CM544A	Logic Memory 4K-CMOS		x	x	
IC600CM548A	Logic Memory 8K-CMOS		x	x	
IC600CM552A	Combined Memory	X			Combines Register memory, Internal memory and Logic Memory (2K-CMOS).
IC600CM554A	Combined Memory	X			Combines Register memory, Internal memory and Logic Memory (4K-CMOS).
IC600PM506A	Power Supply,115VAC	X	X	X	Provides +5V DC, + 12V DC and -12V DC regulated voltages. Also used in DPU.
IC600PM501 A	Power Supply,230VAC	X	X	X	

Table 4.
CPU MODULE RENEWAL PARTS LIST (Continued)

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SECTION 4
I/O SYSTEM TROUBLESHOOTING (Part 1)

POWER SUPPLY

Two versions of the I/O power supply are available for use in the I/O racks, standard and high-capacity.

NOTE

The Standard and High-Capacity power supplies are not interchangeable. A Standard power supply must go in a Standard I/O rack and a High-Capacity power supply must go in a High-Capacity I/O rack.

I/O RACK	CATALOG NUMBER	DESCRIPTION
Standard	IC600PM502A	Power Supply provides +5V DC at 6.1 amps, allows 100 units of load. Strap selectable for 115V AC or 230V AC.
High Capacity	IC600PM505A (115V AC) IC600PM504A (230V AC)	Power Supply provides +5V DC at 16.5 amps, +12V DC at 1.5 amps and -12V DC at 1.0 amps. allows 275 units of load.

A block diagram of the I/O power supply is shown below for reference.

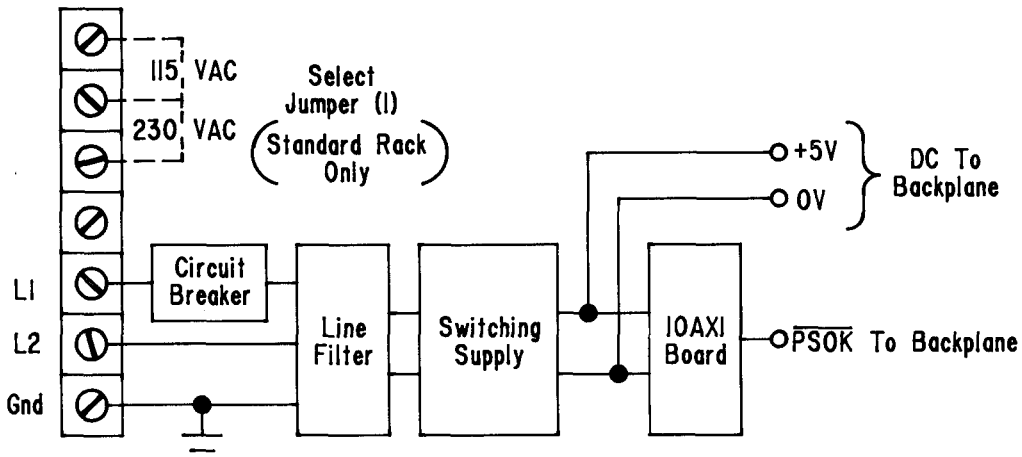


Figure 8.
I/O POWER SUPPLY BLOCK DIAGRAM (STANDARD)

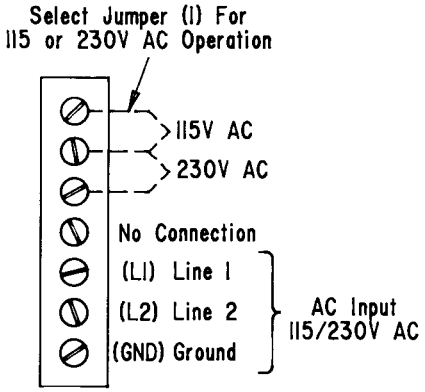
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There is 1 status indicator light on the I/O power supply.

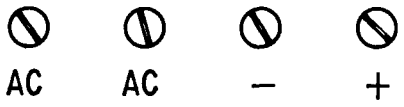
INDICATOR	STATUS	DEFINITION
POWER	ON	Power is applied, +5V DC output voltage is within tolerance. (+4.75 to +5.25V DC)
	OFF	No AC power. +5V DC out of tolerance. CHAIN OK lights from the applicable rack back to and including the CPU turn off. CPU RUN and ENABLE lights turn off. Alarm No. 1 relay switches.

➔ Corrective Action

- Check AC input power to power supply terminal board. Ensure that the jumper is in the correct position for either 115V AC or 230V AC (Standard rack only).



- Check the +5V DC output by pulling the power supply module partially out of its slot and measuring the voltage at the screw conection on the board. There are 4 screw connections labeled as show below.



- If the +5V is out of tolerance, replace the power supply.

NOTE

A Printed-circuit board, backplane or cable short may be loading down the power supply. If +5V DC is out of tolerance, back out all printed-circuit boards and recheck the voltage. If still bad, replace the power supply. If voltage is OK, reinsert the printed-circuit boards one at a time to determine which one is loading the supply down. Keep in mind that the supply may be bad under normal load conditions.

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I/O INDICATOR CHART

Table 5 is an indicator chart that gives a quick reference to the status indicator lights on the I/O system modules.

MODULE	INDICATOR	STATUS	DEFINITION
Power Supply	POWER	ON	Power is applied and DC voltage(s) within tolerance.
AC/DC Input	1 through 8	ON	Input is energized.
AC/DC output	1 through 8	ON	Output is energized.
	BF(l-8)	ON OFF	Blown fuse in output circuit. No problem.
High Density Input	DATA INV	ON	Module is in the Inverting mode.
		OFF	Module is in the Non-Inverting mode.
High Density output	DATA INV	ON	Module is in the Inverting mode.
		OFF	Module is in the Non-Inverting mode.
Analog Input	BOARD OK	ON	Module operating normally.
		OFF	A/D converter malfunction. I/O rack power supply problem. CPU in Stop or Run Disabled mode.
Analog output	BOARD OK	ON	Module operating normally.
		OFF	Board malfunction. I/O rack power supply problem. CPU in Stop or Run Disabled mode.
Isolated 115VAC output	1 through 6	ON	Output is energized.
	BF(1-6)	ON OFF	Blown fuse in output circuit. Fuse good.

Table 5.
I/O INDICATOR CHART

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MODULE	INDICATOR	STATUS	DEFINITION
Reed Relay output	1 through 6	ON	Relay coil is energized.
		OFF	Relay coil is de-energized
Interrupt Input	1 through 8	ON	Current flowing through input circuit.
Thermocouple Input	BOARD OK	ON	Module operating normally.
		OFF	Board malfunction.
I/O Receiver	CHAIN OK	ON	Power is OK in this and all downstream racks and stations. Continuity is OK to all downstream stations.
	CHAIN PARITY	ON	Output parity is OK at all downstream stations connected through an I/O Transmitter in this rack.
	LOCAL PARITY	ON	Output parity good at this module.
I/O Transmitter	CHAIN OK	ON	Power is OK at all downstream stations. Continuity OK to all downstream stations.
	CHAIN PARITY	ON	All downstream stations have good output parity.
	ISOLATED POWER	ON	Output voltage of the +5V DC isolated power converter is within tolerance.

Table 5.
I/O INDICATOR CHART (Continued)

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MODULE	INDICATOR	STATUS	DEFINITION
Remote I/O Driver	LOCAL OK	ON	Module operating normally.
		OFF	Fault exists in this module.
	LINK OK	ON	Communications link between this module and Remote I/O Receiver good.
		OFF	Communications error between this module and Remote I/O Receiver.
	REMOTE OK	ON	Remote system operating normally. Valid I/O data received from the Remote Receiver.
		OFF	Fault in Remote I/O system. Power supply failure, loose cable, module not seated properly, etc.
	REMOTE PARITY	ON	No parity errors in Remote I/O system.
		OFF	Parity error detected in Remote I/O system. On-board jumper selects if CPU will stop or continue running.

Table 5.
I/O INDICATOR CHART (Continued}

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MODULE	INDICATOR	STATUS	DEFINITION
Remote I/O Receiver	LOCAL OK	ON	Module operating normally.
		OFF	Communications failure due to timeout or successive transmission errors.
	LINK OK	ON	Communications link between this module and Remote I/O Driver established and valid.
		OFF	Communications failure between this module and Remote I/O Driver.
	REMOTE OK	ON	Remote system operating normally.
		OFF	Fault in Remote I/O system. Illegal address block, loose connection, power supply failure, etc.
	REMOTE PARITY	ON	No parity errors in this Remote I/O system.
		OFF	Parity error detected in this Remote I/O system.

Table 5.
I/O INDICATOR CHART (Continued)

When troubleshooting the I/O system it is important to understand the interconnection of I/O racks and stations. Refer to the following illustrations of CPU to I/O rack connections, I/O rack to I/O rack connections and an I/O rack wiring scheme. Be sure that all cables are connected to the proper modules and are secure.

The limitations as to distance between racks and stations should be followed, otherwise unpredictable problems may occur.

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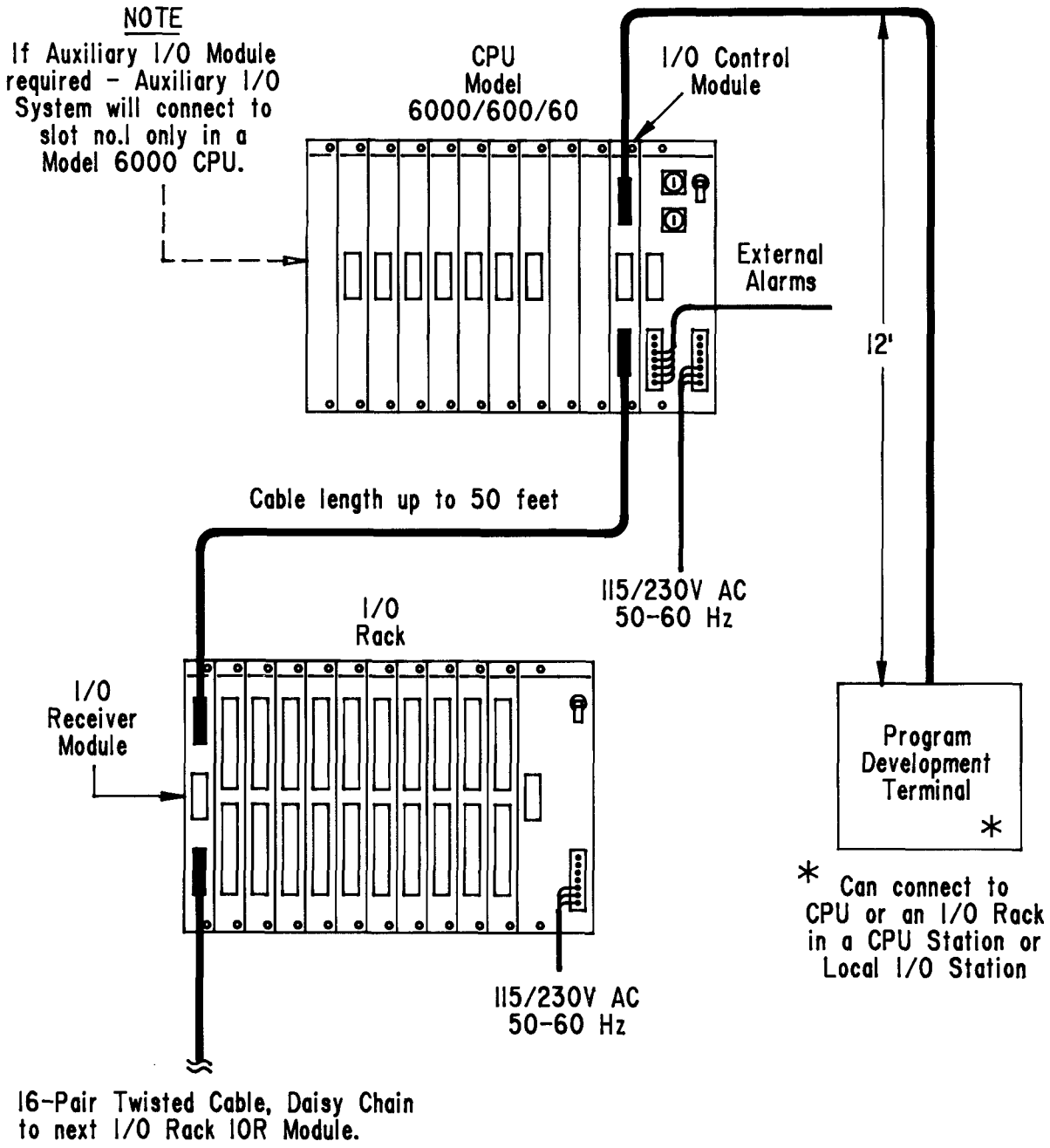


Figure 9.
CPU TO I/O RACK CONFIGURATION

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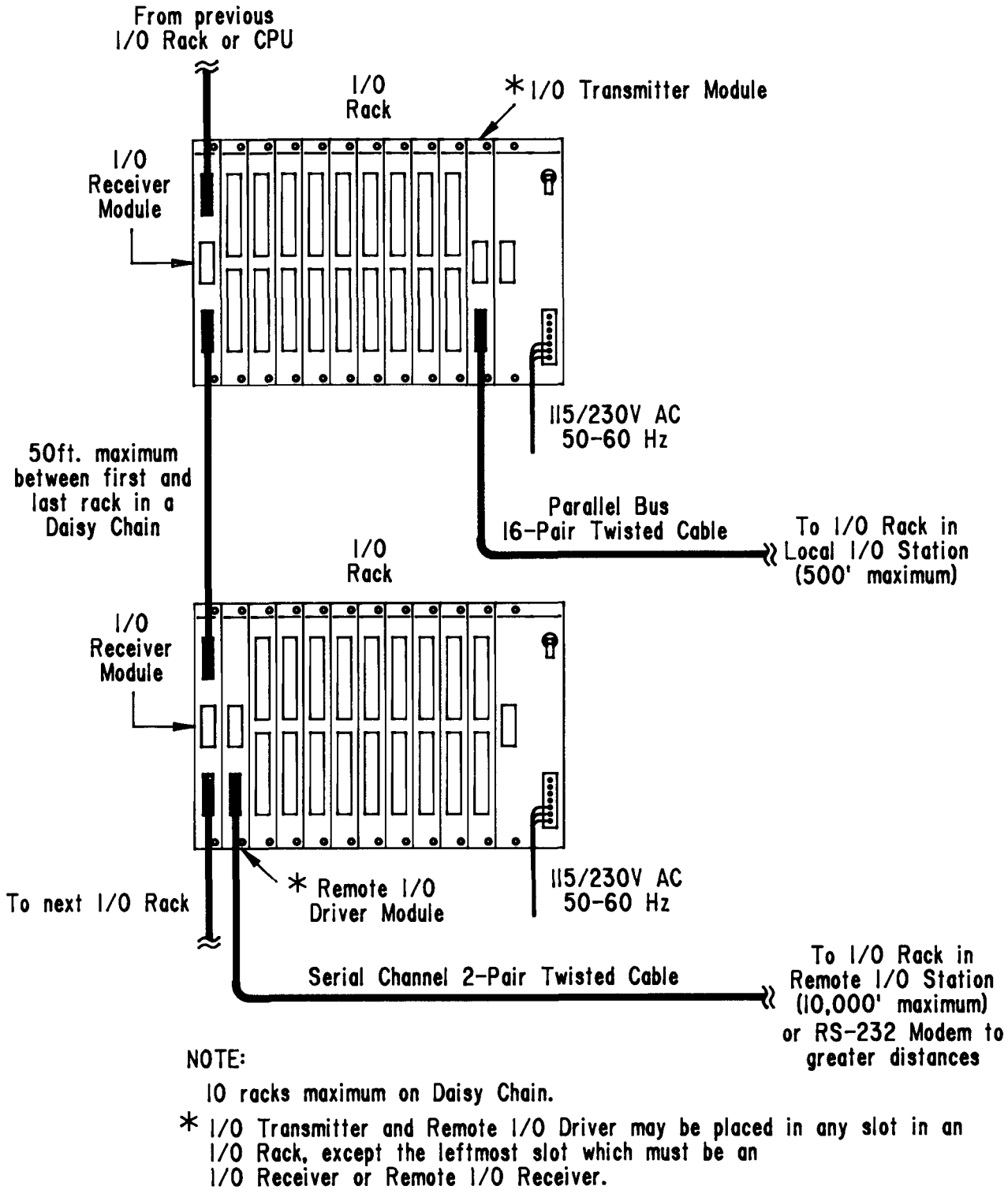
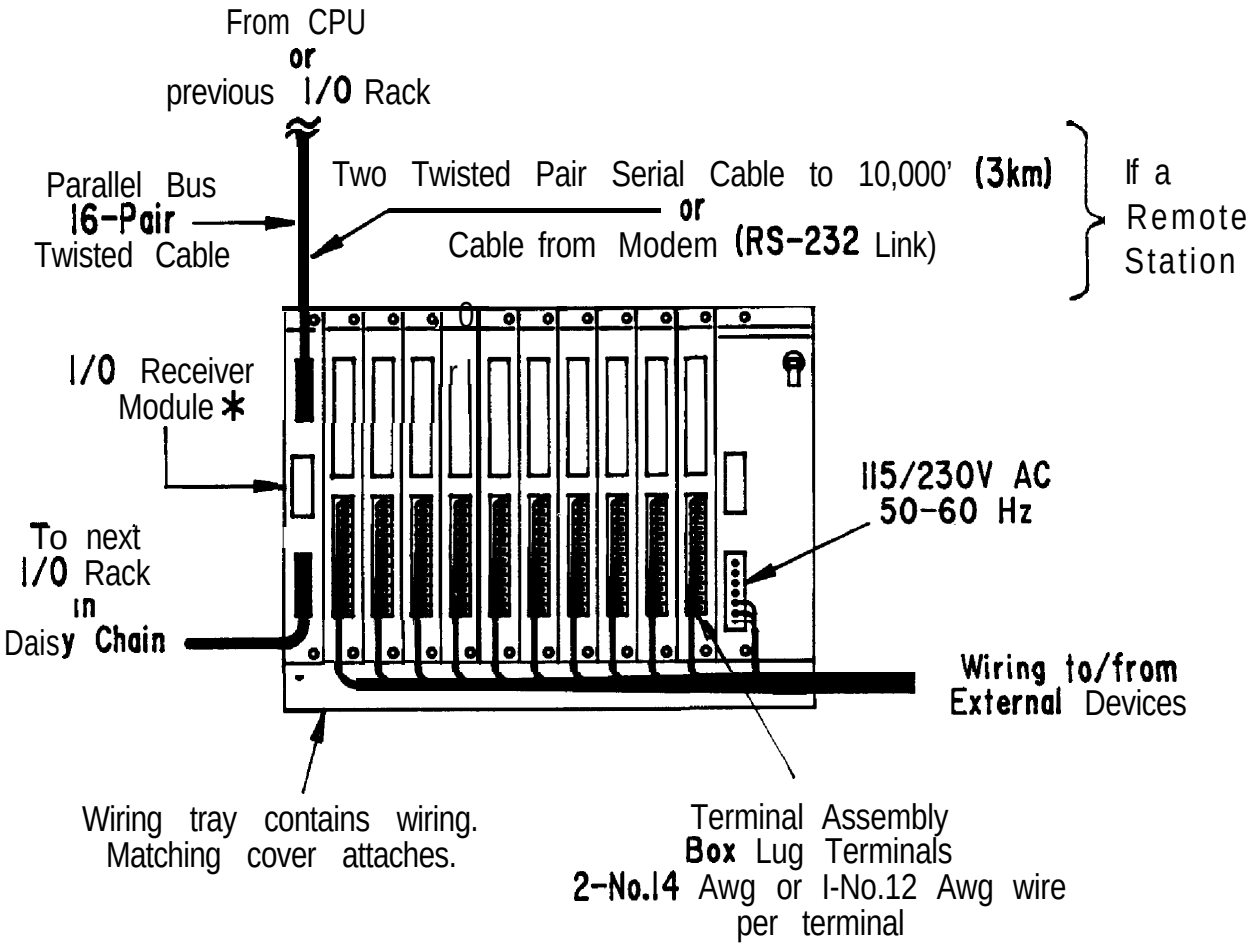


Figure 10.
I/O RACK TO I/O RACK CONFIGURATION

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* Remote I/O Receiver if first rack in a Remote I/O Station.

Figure 1 1.
I/O RACK WIRING SCHEME

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Many problems are first identified by the failure of an input or output to operate properly. It is important in the initial stages of troubleshooting to take an overall look at the problem. The first step should be to check the condition of the status indicator lights in the I/O racks and the originating CPU where an apparent malfunction has occurred.

1 Check at CPU

- Condition of all status lights.
- If all the CPU status lights are on, proceed to I/O troubleshooting 11
- If the CHAIN OK status light on the I/O Control module is on, but one or more of the other CPU status lights are off refer to the CPU troubleshooting section (1) through (12)
- If the CHAIN OK status light on the I/O Control module is off, a CHAIN OK or CHAIN PARITY problem is indicated. Proceed to I/O troubleshooting 11 .
- Check the CPU station I/O racks for the condition of the status lights.

2

	CHAIN OK Light	I/O Receiver I/O Transmitter
	Status	Definition
	ON	I/O power is OK in this and all downstream racks and stations. Continuity is OK to all downstream stations.
	OFF	A power or continuity problem has occurred. The CPU RUN and ENABLE lights also turn off. Alarm No. 1 relay switches.

➡ Corrective Action

- Locate the last I/O rack in the I/O chain that has the CHAIN OK light off. Check I/O Receivers and I/O Transmitters.
- Check cable connections.
- Check circuit breaker (on the power supply).
- If Power status light is off check AC input and +5V DC voltages. Refer to 5 .
- Replace the I/O Receiver.
- If there is an I/O Transmitter, replace it.
- Replace the I/O Receiver in the next I/O rack downstream in the I/O chain.

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3

	CHAIN PARITY Light	I/O Receiver I/O Transmitter
	Status	Definition
	ON	Output parity is good in this rack and all links* connected to this rack.
	OFF	Indicates that an output parity problem has been identified by an I/O Receiver module. The CHAIN OK light on the CPU I/O Control module is off. RUN and ENABLE lights at the CPU will also be off and Alarm Relay #1 switches.

Corrective Action

- Isolate the problem by following the CHAIN PARITY status indicators until a link* is found where CHAIN PARITY is off on an I/O Transmitter module, but is on in the I/O rack's of the Local station it is driving.
- Locate the first I/O rack in that chain with the LOCAL PARITY light off.
- Replace the I/O Receiver in that rack.
- Replace the I/O chain interconnecting cable.
- Replace the I/O Transmitter that is driving the I/O station.

*A link is made up of an I/O Transmitter module, a 16-pair, twisted, shielded parallel bus I/O cable and one or more I/O Receiver boards.

4

	LOCAL PARITY Light	I/O Receiver
	Status	Definition
	ON	Output parity is OK in this I/O rack.
	OFF	Output parity has been detected by the I/O Receiver module.

Corrective Action

- Replace the I/O Receiver module.
- Replace the parallel chain I/O cable between this rack and the next rack upstream (Back toward the CPU).
- Replace the I/O Transmitter or I/O Control module driving this station.

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5

POWER Light	I/O Power Supply
Status	Definition
ON	The voltage level of the +5V DC supply is within tolerance, 4.75 to 5.25V DC.
OFF	The voltage level of the +5V DC supply is out of tolerance. The CHAIN OK light from this rack back to and including the CPU rack will be off. The RUN and ENABLE lights on the CPU are off and Alarm No. 1 relay switches.

➡ Corrective Action

- Check the circuit breaker.
- Check the AC power line. Input voltage should be either 115V AC or 230V AC, ± 15%.
- Partially remove the power supply module from its slot and measure the +5V DC output. The voltage level should be +4.75 to +5.25V DC. (Refer to I/O power supply troubleshooting, page 3-36 for further troubleshooting).

6

ISOLATED POWER Light	I/O Transmitter
Status	Definition
ON	Isolated +5V DC bus is within tolerance.
OFF	Isolated +5V DC bus is out of tolerance. CHAIN OK lights from this rack back to and including the CPU will turn off. RUN and ENABLE lights will turn off. Alarm No. 1 relay switches.

➡ Corrective Action

- Replace the I/O Transmitter (if the POWER status light is on).
- If the POWER Status light is off, go back to 5 and troubleshoot that problem first.

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7

	LOCAL OK Light	Remote I/O Driver Remote I/O Receiver
	Status	Definition
	ON	This module is operating normally.
	OFF	Problem exists in this module, if light never comes on during power up LED test or stays off at end of test.

Corrective Action

- Replace the Remote I/O Driver module.
- Replace the Remote I/O Receiver module.

8

	LINK OK Light	Remote I/O Driver Remote I/O Receiver
	Status	Definition
	ON	Option jumpers on both the Remote Receiver and Remote Driver are identical. Communications link established between the two modules.
	OFF	Valid communications between Remote Driver and Remote Receiver not established. Baud rates different, serial parity sense different or some other option jumper not compatible.

Corrective Action

- Verify that all common circuit board option jumpers are set identical on both boards (Refer to Tables 7 8, 9 and 10, Chapter 2).
- Check cable connections at each end of link.
- If REMOTE OK and LINK OK lights turn off simultaneously check for a power down condition in the Remote station rack containing the Remote Receiver. Excessive noise on the link could also cause both lights to turn off.
- Replace Remote I/O Driver module.
- Replace Remote I/O Receiver module.

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9

REMOTE OK Light	Remote I/O Driver Remote I/O Receiver
Status	**Definition**
ON	Remote Driver: Valid I/O data has been received from the Remote Receiver. No I/O faults in the Remote system. Remote Receiver: No I/O faults, Remote system operating normally.
OFF	Fault exists in Remote system.



Corrective Action

- Check for loose or improper connection between I/O cables connecting racks in the Remote system.
- Ensure that all boards are seated properly in the Remote system racks.
- If the REMOTE OK and LINK OK lights turn off simultaneously on the Remote Driver, check for a break in the cable between the Driver and Receiver, excessive noise on the link or a power down condition in the rack containing the Remote Receiver.
- If the light on the Remote Receiver turns on, then off again almost immediately check the DIP switches for I/O addresses assigned to I/O modules that are outside of the legal blocks of addresses assigned at the Remote Driver.
- Replace Remote I/O Receiver module.
- Replace Remote I/O Driver module.

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10

REMOTE PARITY Light	Remote I/O Driver Remote I/O Receiver

Status	Definition
ON	No parity errors in Remote system.
OFF	Parity error detected in the Remote I/O system.

Corrective Action

- Clear parity error by switching the CPU from RUN to STOP and back to RUN.
- Replace Remote Receiver if only one rack in the Remote system.
- If more than one rack in the Remote system, locate the first rack in the chain with the LOCAL PARITY light off.
- Replace the I/O Receiver in that rack.
- Replace the I/O chain cable.

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I/O System Troubleshooting
(Part 2)

If none of the status indicator lights are found to be off in the CPU or I/O racks but the malfunction appears to be an input or output problem, then proceed with the troubleshooting in part 2.

11 An input is not being recognized by the CPU.

Corrective Action

- **Ensure that the correct voltage level for your type of input is being supplied to the input terminal assembly.**

- If the input status indicator (LED) is not on.
  1. Reseat the terminal assembly.
  2. Check wiring connections.
  3. Replace the input board.

- If the input status indicator (LED) is on.
  1. Reseat the input board.
  2. Check the input number starting point selection on the DIP switch adjacent to the input board (DIP switch mounted on motherboard). The starting point selected for this input module must agree with the user program.
  3. Replace the I/O Receiver.
  4. Replace the input board.
  5. Replace the I/O cable.

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12 Only 1 output on a board fails to operate.

Corrective Action

Check wiring for that output.
Check for a blown fuse.
Reseat the output board.
Replace the output board.

13 **No outputs function**

Corrective Action

If the problem is limited to 1 board.

1. Check the I/O point selection DIP switches.
2. Check terminal assembly wiring.
3. Check terminal assembly voltage. Ensure it is proper for your module.
4. Replace the output board.
5. Replace the I/O cable.

If one I/O rack has no functioning outputs.

1. If outputs further up the I/O chain (towards the CPU) function, replace the I/O Receiver in this rack.
2. Pull out all I/O boards and reinsert one at a time.
3. Replace the I/O cable.

If there are no functioning outputs in any of the I/O racks.

1. Check the condition of the CPU status indicator lights.
2. If any CPU status light is off, troubleshoot that problem.
3. If all CPU status lights are on, replace the I/O Control board in the CPU.
4. Model 6000 system only. If problem is in the Auxiliary I/O chain and all CPU status lights are on, replace the Auxiliary I/O Control board in the CPU.
5. Replace the I/O cable.

14 I/O status change or override change during I/O rack power down.

Corrective Action

1 **Check the position of the jumper pack and DIP shunts on the I/O Receiver modules.** Refer to I/O Receiver installation in Chapter 2 for correct positions.

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I/O SYSTEM RENEWAL PARTS LIST

A list of the replaceable parts in the I/O system is provided in Table 6.

Catalog Name	Module Name	Function
IC600YB800A	I/O Receiver	Interfaces between the parallel I/O Chain bus and the I/O modules within an I/O rack. Checks output parity and generates input parity.
IC600YB900A	I/O Transmitter	Translates the I/O backplane signals into isolated and balanced signals for transmission up to 500 feet to one or more I/O Receivers.
IC600PM502A	I/O Power Supply Standard 115VACand 230V AC	Provides a +5V DC @ 6.1 amp regulated voltage for the standard I/O rack. Allows 100 units of load. Strap selectable for either 1 15V AC or 230V AC operation.
IC600PM505A IC600PM504A	I/O Power Supply High Capacity 115VAC I/O Power Supply High Capacity 230V AC	Provides +5V DC @ 16.5 amps, +12V DC @ 1.5 amps and -12V DC @ 1.0 amps regulated voltages for the high capacity I/O rack. Allows 275 units of load.
IC600YB801 A IC600YB901A	Remote I/O Receiver Remote I/O Driver	Circuitry provides for a serial, full duplex I/O data communications link via a two twisted pair cable. Allows communication up to 10,000 feet from a CPU station or a Local I/O station (greater distances using RS-232C modems). Allows up to 248 inputs and 248 outputs in a Remote I/O station.
IC600YB804A	input Board 115V AC/DC	Contains 8 isolated input circuits with LED indicators and noise filtering. Decodes input addressing and puts input data on the bus. On range is 90- 130V AC/DC.
IC600YB806A	Input Board 12V AC/DC	Accepts IO-20V AC/DC input voltage. Input voltage isolated from +5V logic by an opto-isolator. Contains filtering and threshold detection circuitry.
IC600YB802A	Input Board 24-48V AC/DC	Accepts 20-60V AC/DC input voltage. Input voltage isolated from +5V logic by an opto-isolator. Has filtering and threshold detection circuitry.
IC600YB805A	Input Board 230V AC/DC	Contains 8 isolated input circuits with LED indicators and noise filtering. Decodes input addressing and puts input data on the bus. On range is 180 to 260V AC/DC.

Table 6.
I/O RENEWAL PARTS LIST

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Catalog Name	Module Name	Function
IC600YE3811A	Input Board High Density	Contains 32 circuits. Accepts inputs of 5V TTL or 'IO-50V DC, user selectable.
IC600YB808A	Input Board Interrupt	Contains 8 circuits for user interrupts. Io-30V DC required.
IC600YB906A	Output Board 12V DC (9-2OV) Sink	2 amp sink versions of the DC output modules which are isolated in 2 groups of 4 outputs. Each output has an Output On indicator and a Blown Fuse indicator. Each output stage has overload protection.
IC600YB902A	Output Board 24V DC(19-40V) Sink	
IC600YB903A	Output Board 48V DC (38~55V) Sink	
IC600YB907A	Output Board 12V DC(9-2OV) Source	2 amp source versions of the DC output modules which are isolated in 2 groups of 4 outputs. Each output has an Output On indicator and a Blown Fuse indicator. Each output stage has overload protection.
IC600YB908A	Output Board 24V DC(19-40V) Source	
IC600YB909A	Output Board 48V DC(38-55V) Source	
IC600YB904A	Output Board 115VAC	Contains 8 isolated Triac outputs capable of switching 2 amperes each. Each circuit has an Output On indicator and a Blown Fuse indicator. Decodes address and accepts output data from the I/O bus.
IC600YB905A	Output Board 230V AC	
IC600YB911A	Output Board 5V TTL High Density	32 outputs capable of driving 11 TTL loads each. Maximum of 50 mA per output. Requires user supplied +5V DC supply.
IC600YB913A	Output Board Io-50V DC High Density	32 unfused outputs. Maximum of 250 mA per output. Requires user supplied power supply.

Table 6.
I/O RENEWAL PARTS LIST (Continued)

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Catalog Name	Module Name	Function
IC6OOYB841A IC600YB842A IC600YB843A	Input Board High Level Analog	Contains 8 input circuits with ranges of 0 to +10V (YB841 A), -10 to + 10V (YB842A) and 4-20 mA/1-5 volts (YB843A). 12 bit resolution.
IC600YB941A ICBOOYB942A IC600YB943A	Output Board High Level Analog	Contains 4 output circuits with ranges of 0 to + 10V (YB941 A), -10 to + 10V (YB942A) and 4-20 mA (YB943A). 12 bit resolution.
IC600YB813A IC600YB814A IC6OOYB815A IC600YB816A	Input Board Thermocouple	Contains eight input channels for temperature measurement. Four types J (YB813A), K (YB814A), S (YB815A), and T (YB816A). 12 bit resolution.
iC600YB91OA IC600YB912A	Output Board Isolated AC	Contains six isolated output circuits. 3 amp outputs. Two versions 1 15V AC (YB91OA) and 230V AC (YB912A).
IC600YB9I4A	Output Board Reed Relay	Contains six form C, mercury-wetted relays. Each circuit has a coil energized LED indicator.

Table 6.
I/O RENEWAL PARTS LIST (Continued)

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SECTION 5
I/O MODULE CALIBRATION

This section provides the information required for performing the periodic calibration of I/O modules requiring calibration. The recommended frequency of calibration for each of the modules assumes that the module is operating at its normal operating temperature which is 0 to 60°C (32 to 140°F) at the outside of the rack containing the module. The frequency of calibration should be adjusted as required for specific applications.

Analog Input Module

CALIBRATION PROCEDURE

Calibration of the Analog Input module should be performed every 90 days at normal operating temperature.

1. **SET UP:**

   - **Disconnect the field wiring going to the channel 1 connections on the faceplate. Connect an analog source with an accurate voltmeter between the first (IN1) and third (VR1) terminals along the front edge of the card, counting from the top downward.**

   - **Program the CPU to move the converted digital data from this channel to a convenient register location, where its value can be observed using the Program Development Terminal. This can be done by using the following program:**



where:

IWWWW: **Lowest of the 32 consecutive input numbers used by this Analog Input module.**

IXXXX: **Next input number: XXXX = WWWW + 1**

IYYYY: **Next input number: YYYY = WWWW + 2**

IZZZZ: **Input number corresponding to the LSB of digital input data: ZZZZ = WWWW + 16.**

RAAAA: **Register to display digital input data.**

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2. LOW END:

- Set the voltage source as close as possible to the value shown in Table 7.
- Adjust R12 (Refer to Figure 12) until the digital output agrees with the value in Table 7.

3. HIGH END:

- Set the voltage source as close as possible to the value in Table 7.
- Adjust RI 1 (Refer to Figure 12) until the digital output matches the value in Table 7.

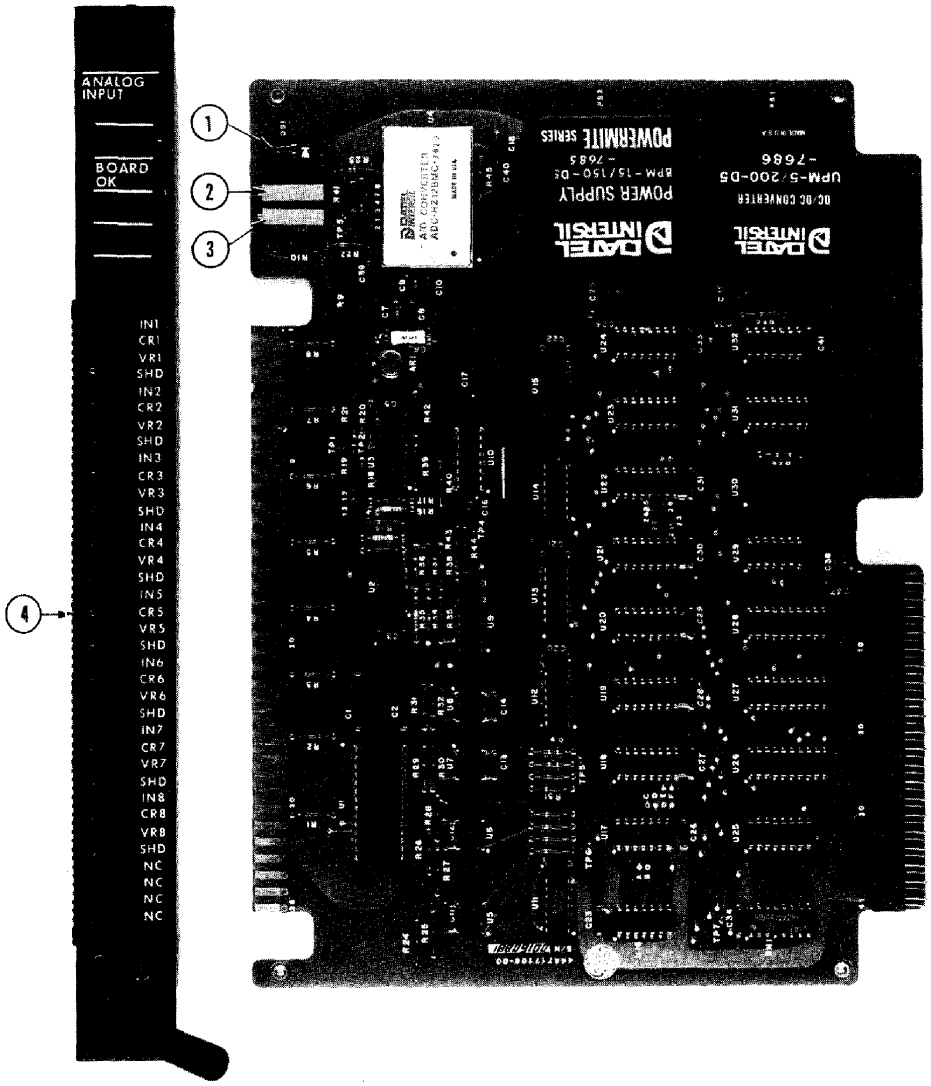
4. Repeat steps No. 2 and No. 3 until the module is in calibration at both ends of its range simultaneously.

MODULE	LOW END		HIGH END	
	Source Voltage	Digital output*	Source Voltage	Digital Output'
0 → +10V	+0.0024V	0001	+9.9951 v	OFFE
+1 → +5V (4 → 20mA)	+1.0010V	0001	+4.9980V	OFFE
-10 → +10V	-9.995 1 v	F801	+9.9902V	07FE

*In Hexadecimal Format

Table 7.
MODULE CALIBRATION

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1 BOARD OK Light:
The LED is Off if there is an A/D converter malfunction, an I/O rack power supply problem, or the CPU is in the Stop or the Run Disabled mode. It is also Off if the module has not been read since one of these conditions existed, or since power has been applied.

2 RI 2: Offset Pot, (All Channels)

3 RI 1: Gain Pot, (All Channels)

4 User Connector Block

Figure 12.
POTENTIOMETER LOCATIONS

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Analog Output Module

CALIBRATION PROCEDURE

Calibration of the Analog Output module should be performed every 90 days at normal operating temperature.

1. **SETUP:**
   - **After loosening the thumbscrews, remove the faceplate, taking care that the field wiring is not disturbed. For the 0 → +10 V or the -10 → +10 V module, connect a digital voltmeter (DVM) between the terminals along the front edge of the card which are listed in the "V" column for the first channel in Table 8. For the 4 → 20 mA module, connect a 250 ohm precision resistor in parallel with the DVM, using the terminal numbers in the "I" column in Table 8. Note that the terminals are numbered from the top downward, and that the double "common" printed-circuit pads count as two terminals. Be sure that the circuit-board jumper is set for the internal loop supply.**

   - **Display the Ouput Status Table on the screen of the Program Development Terminal, with the cursor on the lowest output number assigned to this module by the DIP switches. Shift the display to hex format, obtaining a display of four hexadecimal digits corresponding to the 16 Output Status bits used by this module.**

2. **LOW END:**
   - **Using the PDT keyboard, enter the four hex digits shown in the LOW END column of the Calibration Table into the Output Status Table. Note that the first digit assigns the channel number (0 → 3).**
   - **Adjust the Offset Pot (Refer to Figure 13) for this channel until the DVM reads the voltage shown in Table 9.**

3. **HIGH END:**
   - **Using the PDT keyboard, enter the four hex digits shown in the HIGH END column of Table 9 into the Output Status Table.**
   - **Adjust the Gain Pot (Refer to Figure 13) for this channel until the DVM reads the voltage shown in Table 9.**

4. **Repeat steps No.2 and No.3 until no further change in either pot setting is required.**

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5. Change the connections according to Table 8, and repeat steps No.2, No.3, and No.4 for:

- the second channel;
- the third channel;
- the fourth channel.

	Terminals V	Terminals I	Channel Number (*X)	Offset Pot	Gain Pot
First Channel	5, 4	1, 2	0	R51	R59
Second Channel	10, 9	6, 7	1	R35	R43
Third Channel	15, 14	11, 12	2	R20	R27
Fourth Channel	20, 19	16, 17	3	R6	R13

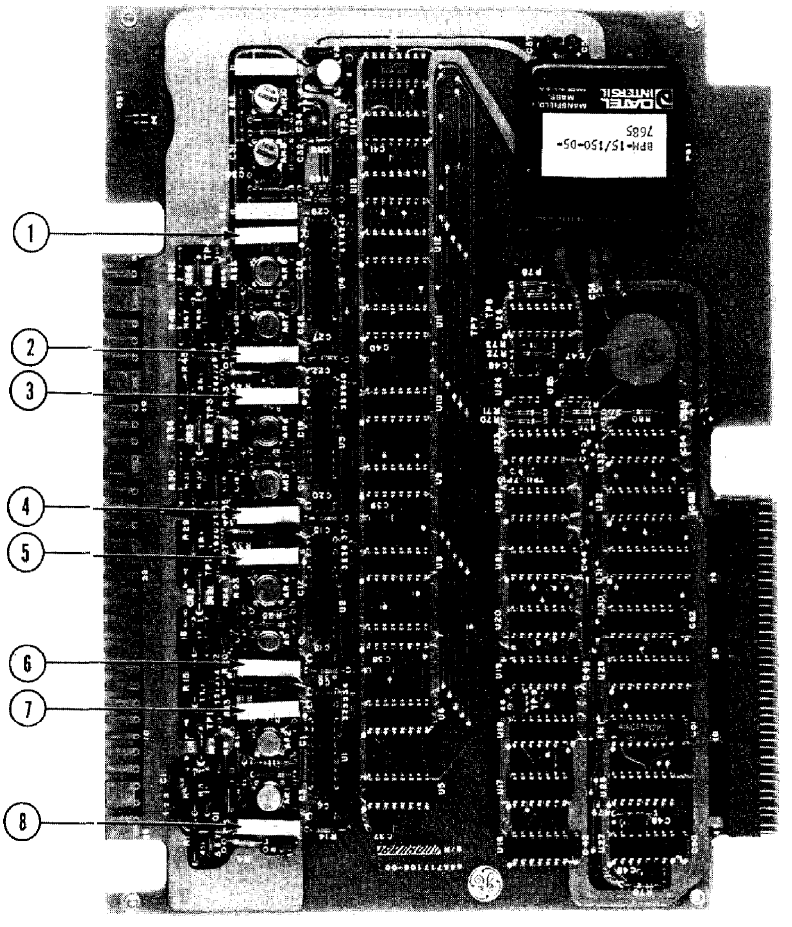
TABLE 8.
CHANNEL ADJUSTMENT

MODULE	LOW END Digital Input**	LOW END Output Voltage	HIGH END Digital Input**	HIGH END Output Voltage
0 → +10 V	*X000	0.0000 V	*XFFF	9.9976 V
-10 → +10 V	*X800	-10.0000 V	*X7FF	9.9951 V
4 → 20 mA	*X000	1.0000 V	*XFFF	4.9990 V

**In Hexadecimal Format

Table 9.
MODULE CALIBRATION

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1. R59: Gain Pot, Channel No. 0
2. R51: Offset Pot, Channel No. 0
3. R43: Gain Pot, Channel No. 1
4. R35: Offset Pot, Channel No. 1
5. R27: Gain Pot, Channel No. 2
6. R20: Offset Pot, Channel No. 2
7. RI 3: Gain Pot, Channel No. 3
8. R6 : Offset Pot, Channel No. 3

Figure 13.
POTENTIOMETER LOCATIONS

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