SECTION 2. SYSTEM OVERVIEW
PC-700/900 Programmable Controllers

2-1. BASIC CONTROL SYSTEMS

Control systems basically consist of three sections, as shown in Figure 2-1.

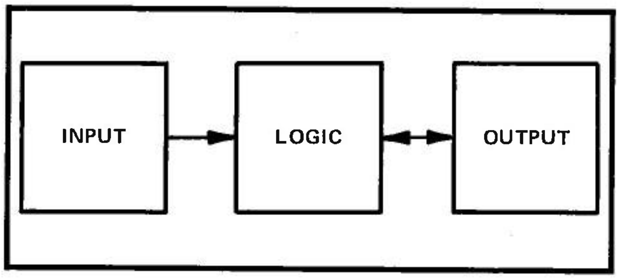


Figure 2-1. Basic Control System

- An **INPUT SECTION**, which gathers the information required to keep track of the real-world operations being controlled.

- A **LOGIC SECTION**, which processes the information acquired by the input section to determine which output function should be activated.

- An **OUTPUT SECTION**, which provides control by activating the appropriate devices within the real-world operations being controlled.

The three basic sections of a relay control system are shown in Figure 2-2. In relay control applications, the input section consists of input devices, (e.g., pushbuttons, limit-switches, and photo cells). The logic section is composed of control relays wired together to produce the desired real-world operations. The output section contains output devices, (e.g., motor starters, solenoids, and lights).

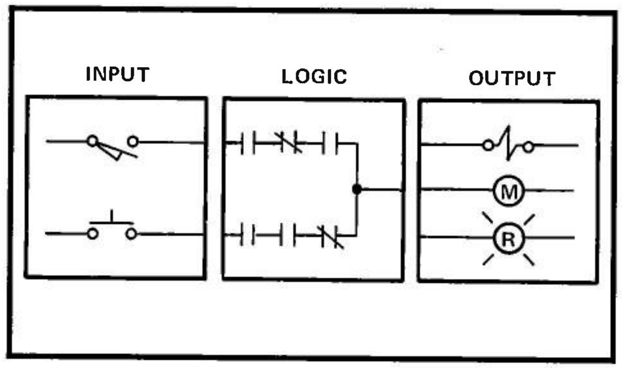


Figure 2-2. Relay Control System

Figure 2-3 shows these three sections for a programmable control system. The primary difference between the relay and programmable control systems is that the control relay logic is replaced by a solid-state processor and memory configuration. Through programming, this processor and memory configuration digitally processes all the data for system operation. The processor's memory is programmed to duplicate the required operating instructions of the control relay circuits. An advantage of this type of control is the ease with which the system's control logic can be modified into a variety of operating configurations via a program loader. The input section contains the same input devices that are found in the relay control system. However, the process input signals produced by these input devices are converted into low-level d-c logic voltages, suitable for solid-state controller operations. The output section in programmable control applications converts the low-level logic signals from the processor, producing the voltage levels required to operate output devices. The output devices are the same as those used in relay control systems.

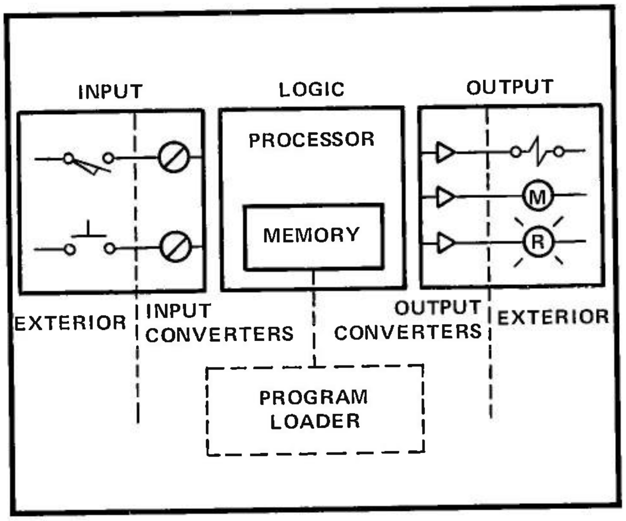


Figure 2-3. Programmable Control System

2-2. PROGRAMMABLE CONTROLLER SYSTEMS

A block diagram of the basic PC-700 or PC-900 Programmable Controller system is shown in Figure 2-4. The programmable controller system contains rack-mounted input and output modules, I/O cables, a PC-700 or PC-900 processor, and a program loader. A description of each of these system components follows.

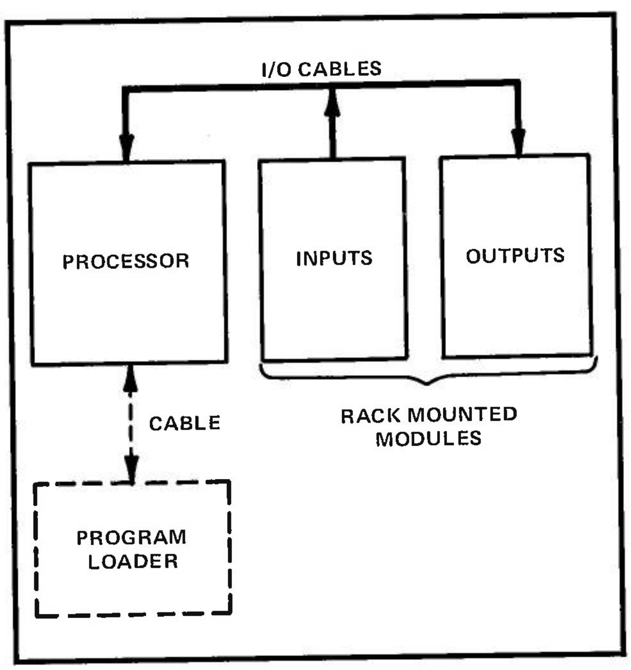


Figure 2-4. Basic Programmable Controller System Block Diagram

2-3. INPUT MODULES

All **Numa-Logic** 700 Series Input Modules are compatible with both the PC-700 and PC-900 Programmable Controllers. **Numa-Logic** input modules contain circuitry which converts the process signal levels from the input pilot devices into logic voltage levels for programmable controller operation. Each input module contains one or more identical conversion circuits mounted on a printed-circuit board. A variety of input modules is available for PC-700 and PC-900 applications; each module provides specific input voltage parameters and formats.

Discrete Input Modules: Each input circuit on a discrete input module converts an individual input signal into the proper processor logic voltage. These input signals are typically supplied by pushbuttons, switches, contacts, etc. There are three basic discrete input module types: a 16-point shown in Figure 2-5, an isolated 8-point shown in Figure 2-6, and an isolated 4-point shown in Figure 2-7. As shown in these figures, each module type has a faceplate with a translucent lens. These lenses are available as a standard lens or, optionally, as a blank or custom lens. Each input circuit has an LED mounted behind its corresponding symbol on the faceplate lens to indicate the status of the circuit (e.g., ON or OFF, AUTO or MANUAL, etc). Discrete input modules are available for a variety of input signals, which are detailed in Table 2-1. Refer to the I/O manual for specifications and a description of each discrete input module type.

Analog Input Modules: Each of the two input circuits on this module provides analog-to-digital (A/D) conversion. This module's A/D converters convert analog input signals into 12 bits of register information at processor logic levels. The two-circuit module converts into 12 bits. The eight-circuit module converts into 10 bits. These analog input signals are typically supplied by process instrumentation, transducers, etc. The height of each analog input module is equivalent to the height of two 4-point discrete input modules. Analog input modules are available for a variety of analog input signal ranges, which are detailed in Table 2-2. Refer to the individual Instruction Leaflet for specifcations and a description of each analog input module type.

Register Input Modules: This module's circuitry converts multi-bit, TTL compatible input logic signals into the proper processor logic levels and coding. These input logic signals are typically supplied by thumbwheel switches, process

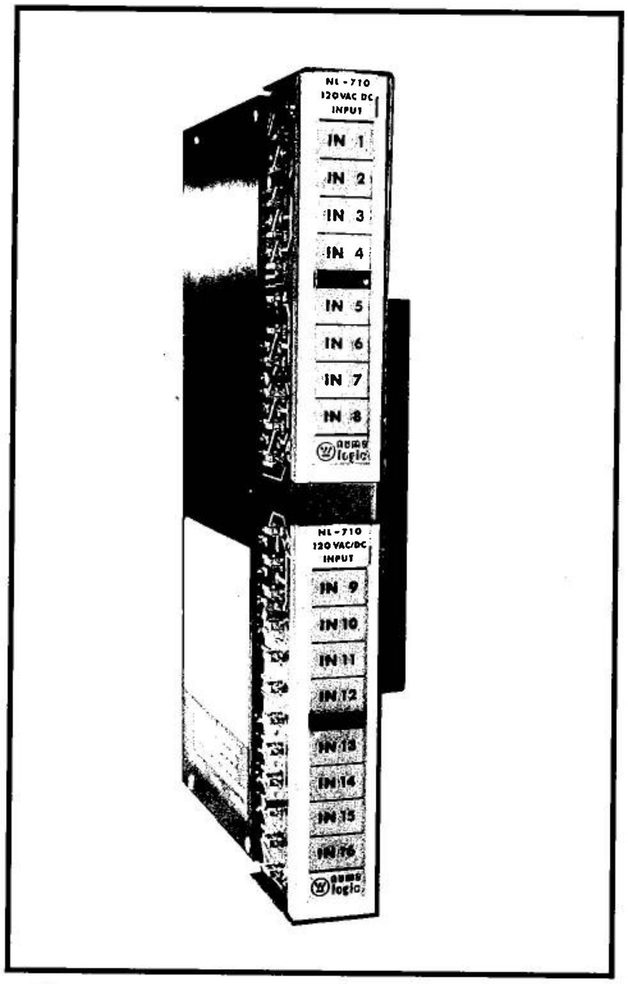


Figure 2-5. Typical 16-Point Discrete Input Module

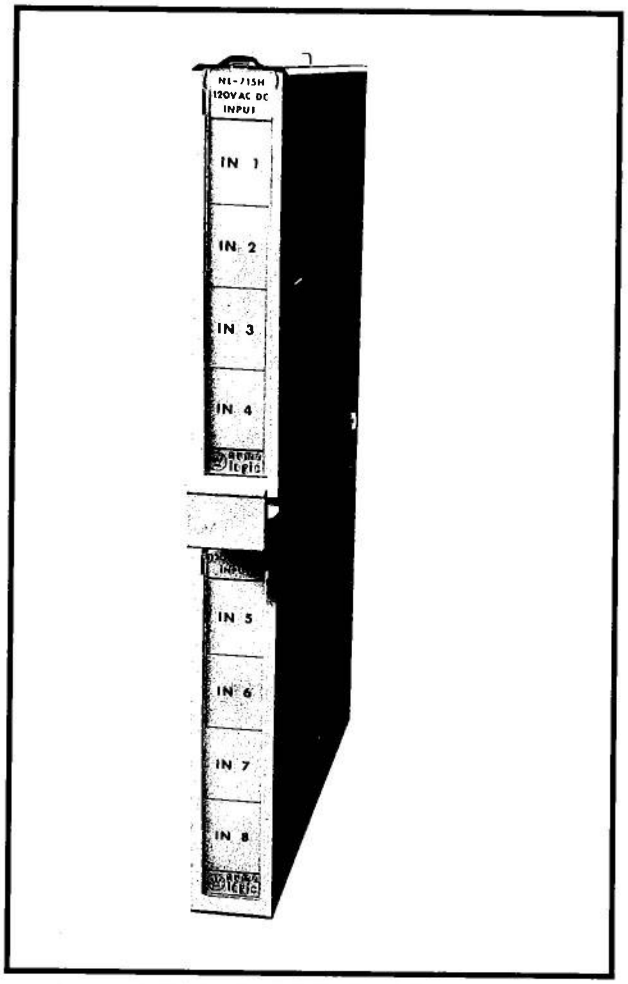


Figure 2-6. Typical 8-Point Discrete Input Module

TABLE 2-1. DISCRETE INPUT MODULE TYPES

Input Signal*	Module Type	Catalog Number
5 Vdc	4-Point	NL-701
12 Vac/dc	16-Point	NL-707
24 Vac/dc	16-Point	NL-708
48 Vac/dc	16-Point	NL-709
120 Vac/dc	4-Point	NL-705
120 Vac/dc	16-Point	NL-710
240 Vac/dc	16-Point	NL-711-H
120 Vac/dc	8-Point (isolated)	NL-715-H
*Vac given in RMS.		

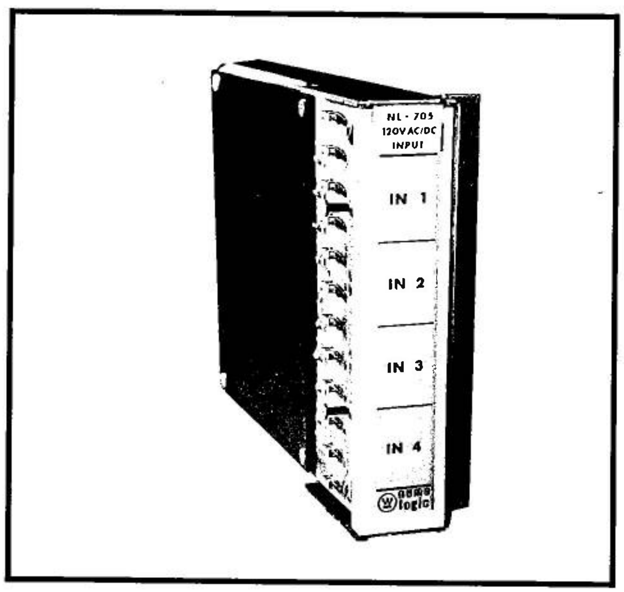


Figure 2-7. Typical 4-Point Discrete Input Module

TABLE 2-2. ANALOG INPUT MODULE TYPES

Input Range	Catalog Number
0 to 5 Vdc	NL-740A-H
0 to 10 Vdc	NL-740B-H
1 to 5 Vdc	NL-740C-H
0 to 1 Vdc	NL-740D-H
0 to 500 mVdc	NL-740E-H
0 to 100 mVdc	NL-740F-H
*0 to 20 mA	•
*4 to 20 mA	•
*0 to 50 mA	•
*10 to 50 mA	•
0 to 5 Vdc	NL-742A-H
0 to 10 Vdc	NL-742B-H
-5 to 5 Vdc	NL-742C-H
-10 to 10 Vdc	NL-742D-H
1 to 5 Vdc	NL-742E-H

*These optional ranges are obtained by adding the appropriate precision resistors to the NL-740A through C modules.

instrumentation, etc. There are two register input module types, a single-point (NL-743) and a multiplexed (NL-744). The single-point register input module accepts single 16-bit numbers which have a binary or BCD format. The multiplexed register input module accepts up to sixteen 4-digit BCD numbers for processing. Like the analog input modules, the register input modules are equivalent to the height of two 4-point discrete input modules. Refer to the I/O manual for specifications and a description of both register input module types.

2-4. OUTPUT MODULES

All **Numa·Logic** 700 Series Output Modules are compatible with both the PC-700 and PC-900 Programmable Controllers. **Numa·Logic** output modules contain circuitry which converts logic levels from the processor into signal levels required to drive output pilot devices. Each output module also contains one or more identical conversion circuits and is mounted on a printed-circuit board. A variety of output modules is available for PC-700 and PC-900 applications, each providing specific output voltage parameters and formats.

Discrete Output Modules: Each output circuit on a discrete output module converts one of the processor's logic output signals into individual output voltage and current levels required by output devices. Typically, output signals are used to drive motor starters, solenoids, pilot lights, etc. There are three basic discrete output module types: a 16-point shown in Figure 2-8, an 8-point isolated shown in Figure 2-9, and an 4-point isolated shown in Figure 2-10. Like the input modules, each output module type has a faceplate with a translucent lens and corresponding LED. These output module lenses are also available as a standard lens or, optionally, as a blank or custom lens. With the exception of the 5 Vdc TTL compatible module, all discrete output modules have individually fused circuits. Also, with the exception of the 48 Vac module, all Vac discrete output modules have blown-fuse indicators. Discrete output modules are available for a variety of output signals, which are detailed in Table 2-3. Refer to the I/O manual for specifications and a description of each discrete output module type.

Analog Output Modules: Each output circuit on this module provides digital-to-analog (D/A) conversion. This module's D/A converters convert processor output logic voltages into analog output signal levels required by output-device operation. Typically, output analog signals are used to control instrumentation devices. The height of each analog output module is equivalent to the height of two 4-point discrete output modules. Analog output modules are available for a variety of analog output signal ranges, which are detailed in Table 2-4. Refer to the individual Instruction Leaflet for specifications and a description of each analog output module type.

Figure 2-8. Typical 16-Point Discrete Output Module

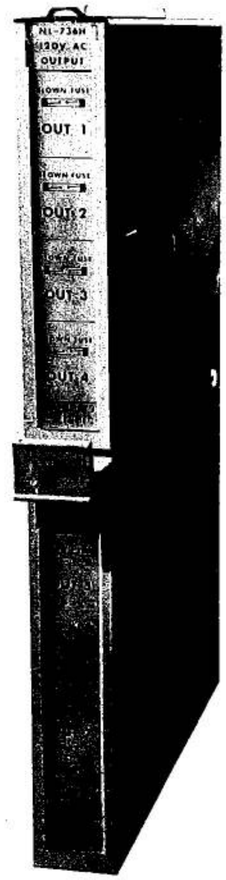


Figure 2-9. Typical 8-Point Discrete Output Module

Register Output Modules: This module's circuitry converts 16-bit register data signals from the processor into multi-bit, 5 Vdc TTL compatible output logic levels and coding. These output logic levels are typically used to control process instrumentation and readouts. As in the case of the register input module, there are two register output module types, a single-point (NL-753) and a multiplexed (NL-754). The single-point register output module produces single, 16-bit, binary or BCD numbers. The multiplexed register output module produces up to sixteen 4-digit BCD numbers. This module is also equivalent in height to two 4-point discrete output modules. Refer to the I/O manual for specifications and a description of both register output module types.

2-5. I/O RACKS

Numa-Logic 700 Series Input and Output Modules are mounted into standard vertical I/O racks or optional, high-density horizontal I/O racks. A detailed description of each rack is provided in Section 7 "Installation and Start-Up" of this manual.

2-6. Vertical I/O Rack

A PC-700 or PC-900 system's input or output modules can be mounted into NLR-704 vertical I/O racks. Each vertical rack holds up to four single-height modules (see Fig. 2-11) or two double-height modules (see Fig. 2-12). Electrical connections between the input and output

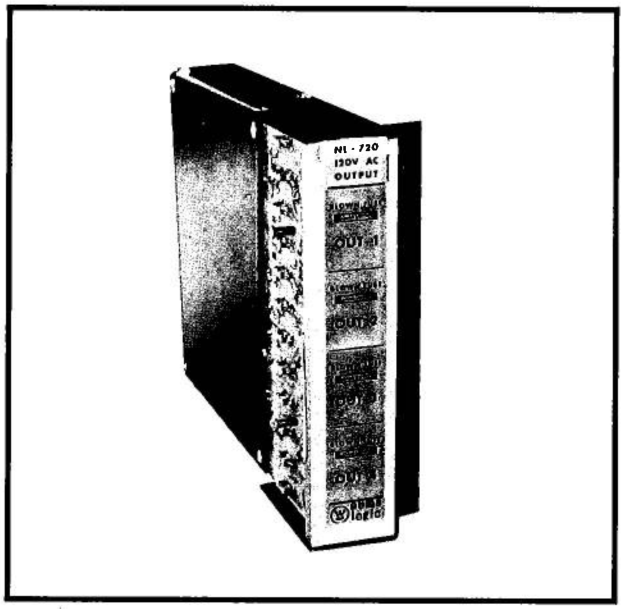


Figure 2-10. Typical 4-Point Discrete Output Module

TABLE 2-3. DISCRETE OUTPUT MODULE TYPES

Output Signal*	Maximum Current @ 60°C	Module Type	Catalog Number
120 Vac	1.5 A	4-Point	NL-720
5 Vdc TTL	160 mA	4-Point	NL-723
Contacts	——	4-Point	NL-728**
Contacts	——	4-Point	NL-729**
120 Vac	1.25 A	16-Point	NL-731
12 to 125 Vdc Sink	1.5 A	16-Point	NL-732-H
240 Vac	1.25 A	16-Point	NL-733-H
12 to 125 Vdc Source	1.5 A	16-Point	NL-735-H
120 Vac	1.25 A	8-Point	NL-736-H
Contacts	——	8-Point	NL-737-H**
Contacts	——	8-Point	NL-738-H**
Contacts	——	8-Point	NL-739-H**

*AC values given in RMS
**These are Form C relay output modules.

TABLE 2-4. ANALOG OUTPUT MODULE TYPES

Output Range	Catalog Number
0 to 5 Vdc 4 to 20 mA	NL-750A-H
0 to 10 Vdc 4 to 20 mA	NL-750B-H
0 to 10 Vdc 10 to 50 mA	NL-750C-H
0 to 5 Vdc 0 to 10 Vdc −5 to 5 Vdc −10 to 10 Vdc	NL-751-H
4 to 20 mA 0 to 20 mA 10 to 50 mA 0 to 50 mA	NL-752-H

modules and the input and output devices of the controlled system are made via each rack's terminal strips. Each of the four module positions (slots) within a rack has 12 terminals available for field wiring to input and output modules. Each rack terminal is rated at 300 V; the corresponding module connectors enable module removal or replacement without disturbing field wiring.

Each screw terminal accommodates two number 14 AWG wires. Wiring for the rack's terminals is routed through a wiring duct, located under a cover on the side of the rack (see Fig. 2-13). Each set of terminals is labeled via a terminal identification strip located on the face of each rack. Each strip contains space for its corresponding terminal, which is used for marking input and output wire numbers. A set of address selection switches is provided on each rack. These switches enable the processor to address and select each rack's input and output circuit with a specific reference number (address).

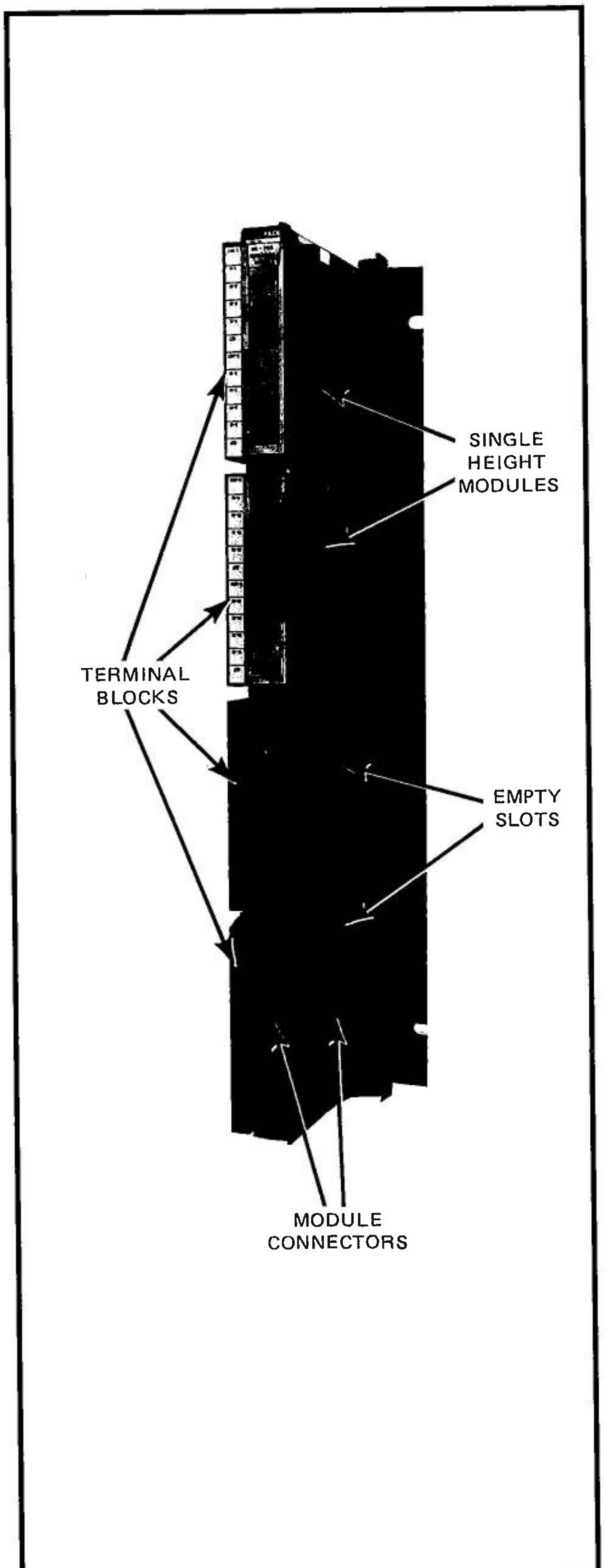


Figure 2-11. Vertical I/O Rack With Two Single-Height Modules Installed

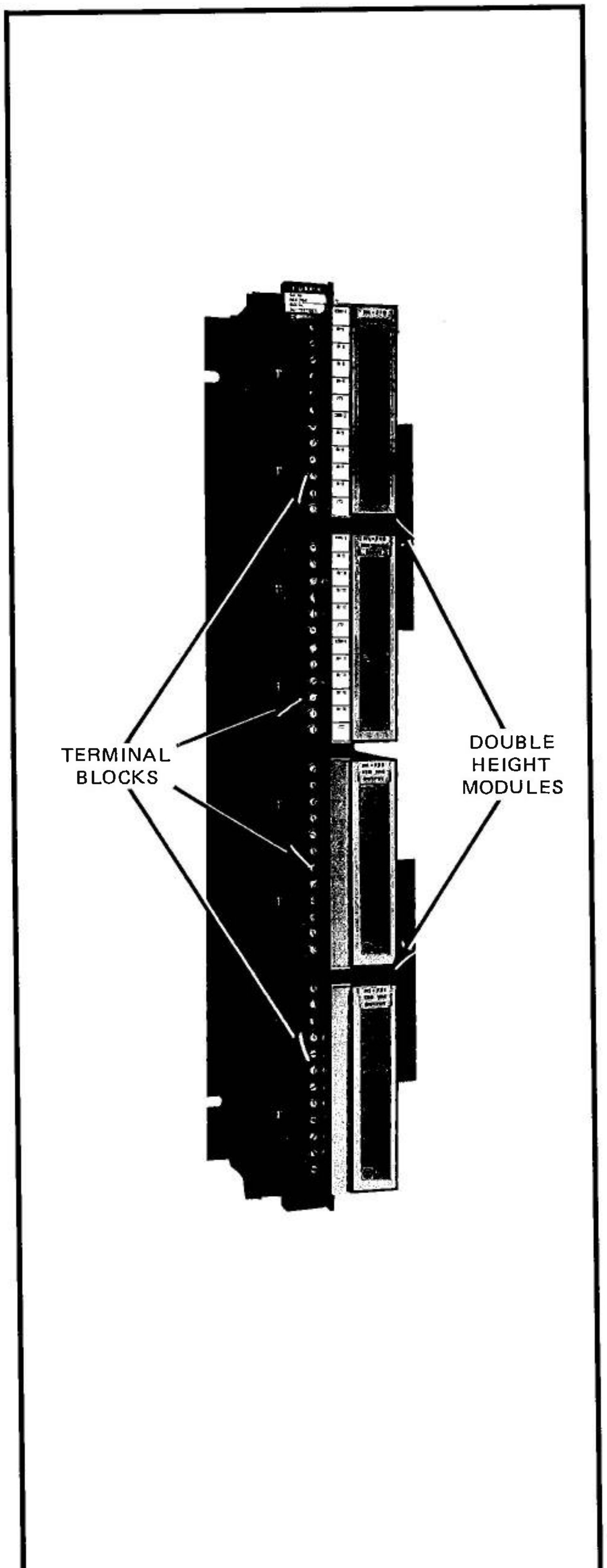


Figure 2-12. Vertical I/O Rack With Two Double-Height Modules Installed

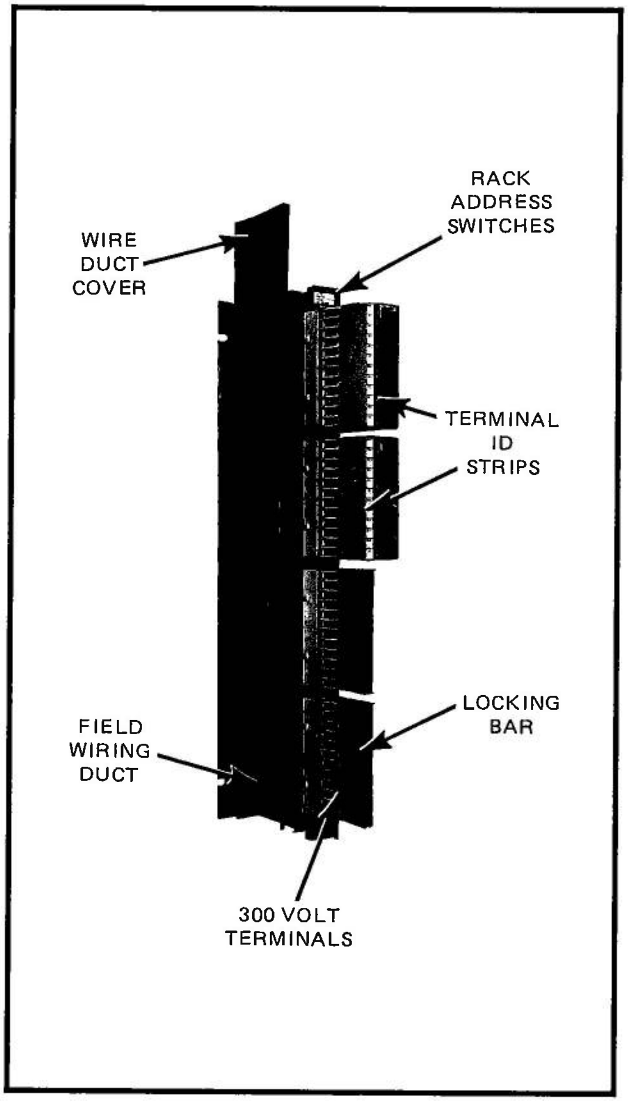


Figure 2-13. Vertical I/O Rack Structure

To properly align each module when inserting it into a rack, each module has two guide pins which mate with corresponding rack guide-pin slots. A locking bar snaps over the inserted module to secure it into place.

Processor-to-module electrical connection is made by using a 50-conductor I/O flat cable (see Fig. 2-14). The I/O flat cable connects the processor's edge connector to the rack's edge connectors. The rack's edge connectors are located on the top and/or bottom of each rack.

The PC-700 and PC-900 control systems are available in a variety of configurations, each with its specific I/O flat cable requirements. The available I/O flat cables are listed in Table 2-5. Refer to Section 7 "Installation and Start-Up," for details on PC-700 or PC-900 system configurations.

2-7. Horizontal I/O Rack

The optional horizontal I/O racks provide a compact and economical enclosure for **Numa-Logic** double-height input and output modules in high-density PC-700 and PC-900 applications. Horizontal racks are available for both panel (P) and rack (R) mounting, and can contain 4 or 8 modules. Each horizontal I/O rack type is listed in Table 2-6. Figure 2-15 shows the NLRH-708R horizontal I/O rack with 8 modules installed.

CAUTION

These horizontal I/O racks accept double-height modules designated "-H" only.

Each module position of a horizontal I/O rack contains a terminal raceway assembly, enabling field wiring to each module's terminals. Each screw terminal accomodates two number 14 AWG wires. Wiring for the rack's terminals is routed through a terminal raceway gutter, directly behind each terminal block. Each set of terminals is labeled via a terminal identification strip located on the face of each raceway assembly.

Processor-to-rack and rack-to-rack connection is made by using four 50-conductor I/O flat cables (see Fig. 2-16). The I/O flat cable connects the processor's edge connector to the rack's edge connector, or connects the edge connectors of two racks. Refer to Section 7 "Installation and Start-Up," for details on PC-700 or PC-900 system configurations.

2-8. PROCESSOR

The PC-700 or PC-900 Programmable Controller or processor is the center of the **Numa-Logic**

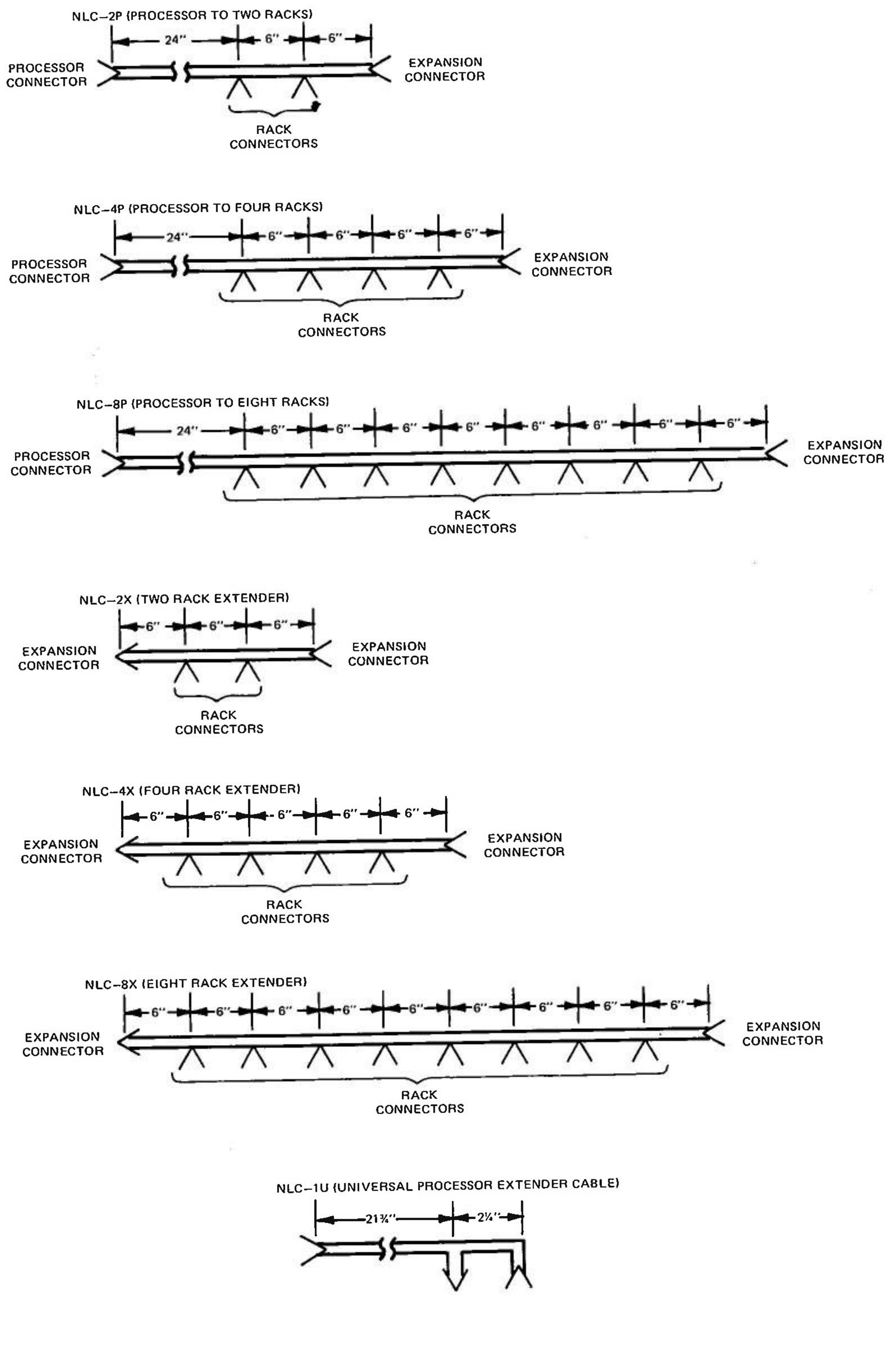


Figure 2-14. Vertical I/O Flat Cables

TABLE 2-5. VERTICAL RACK I/O FLAT CABLES

Type	Catalog Number
2 rack extender	NLC-2X
4 rack extender	NLC-4X
8 rack extender	NLC-8X
Universal processor cable	NLC-1U

TABLE 2-6. HORIZONTAL I/O RACK TYPES

Rack	Description
NLRH-704P	4 module, panel-mounted I/O rack
NLRH-704R	4 module, rack-mounted I/O rack
NLRH-708P	8 module, panel-mounted I/O rack
NLRH-708R	8 module, rack-mounted I/O rack

programmable control system. The processor coordinates the operation of the entire control system. A simplified block diagram for the PC-700 or PC-900 processor is shown in Figure 2-17. The processor in the programmable control system monitors inputs, scans and solves logic, and controls the state of outputs. The PC-700 and PC-900 Programmable Controllers are shown in Figure 2-18. A description of each functional processor module shown in the block diagram follows.

2-9. Memory

The PC-700 and PC-900 Programmable Controllers incorporate two memories: the User Memory, and the I/O Image Memory. In PC-700 and PC-900 applications, one 16-bit word of memory is used for each contact and for each coil. Nodes, branches, and unused contacts do not require any words of memory, thereby increasing memory utilization over conventional memory schemes.

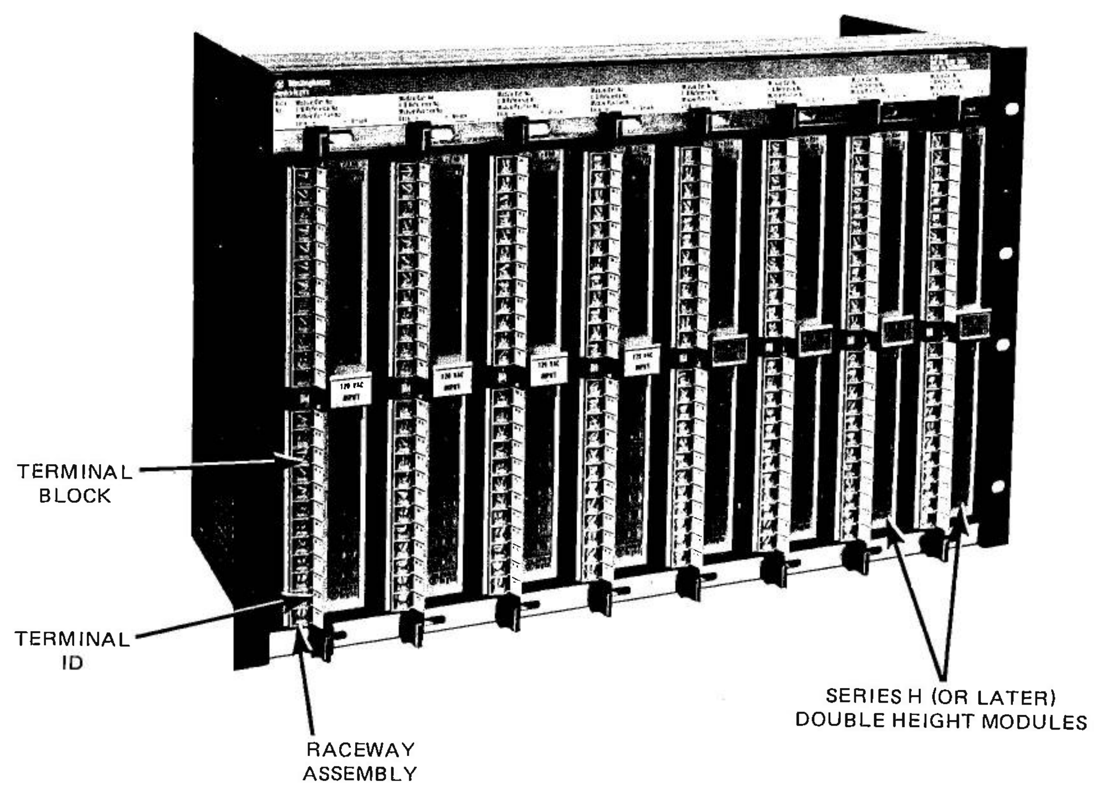


Figure 2-15. NLRH-708R Horizontal I/O Rack With 8 Modules Installed

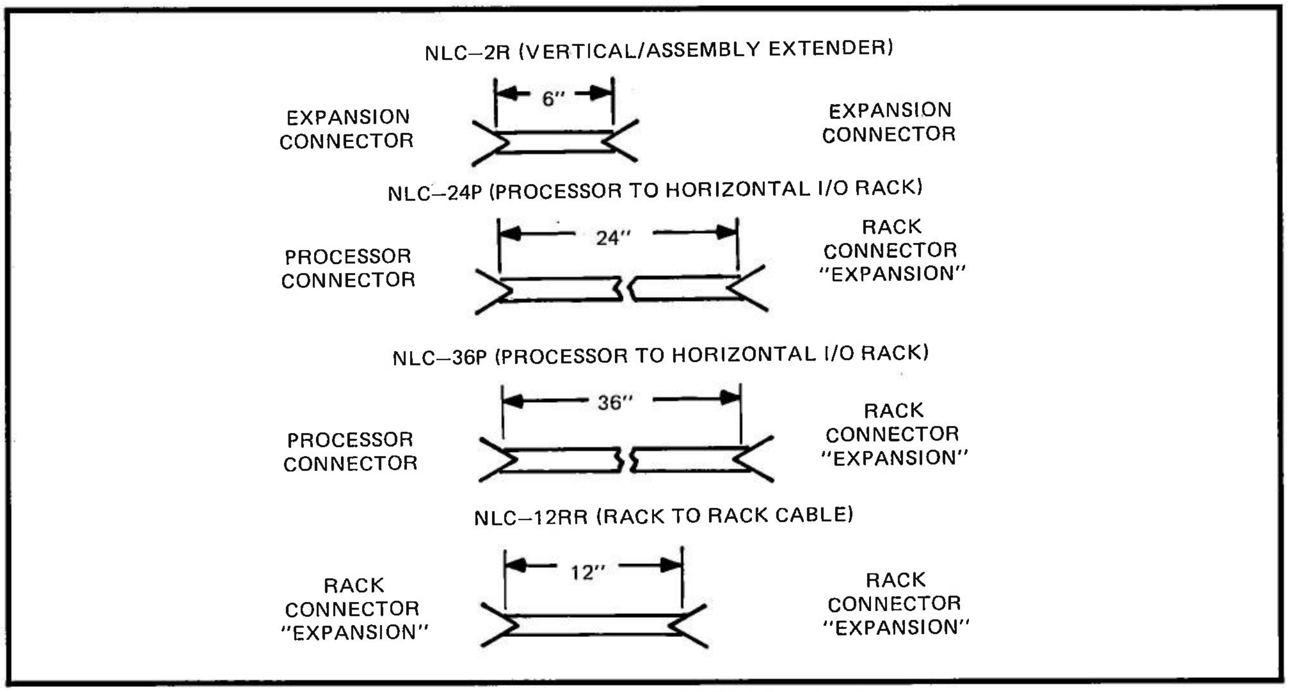


Figure 2-16. Horizontal I/O Flat Cables

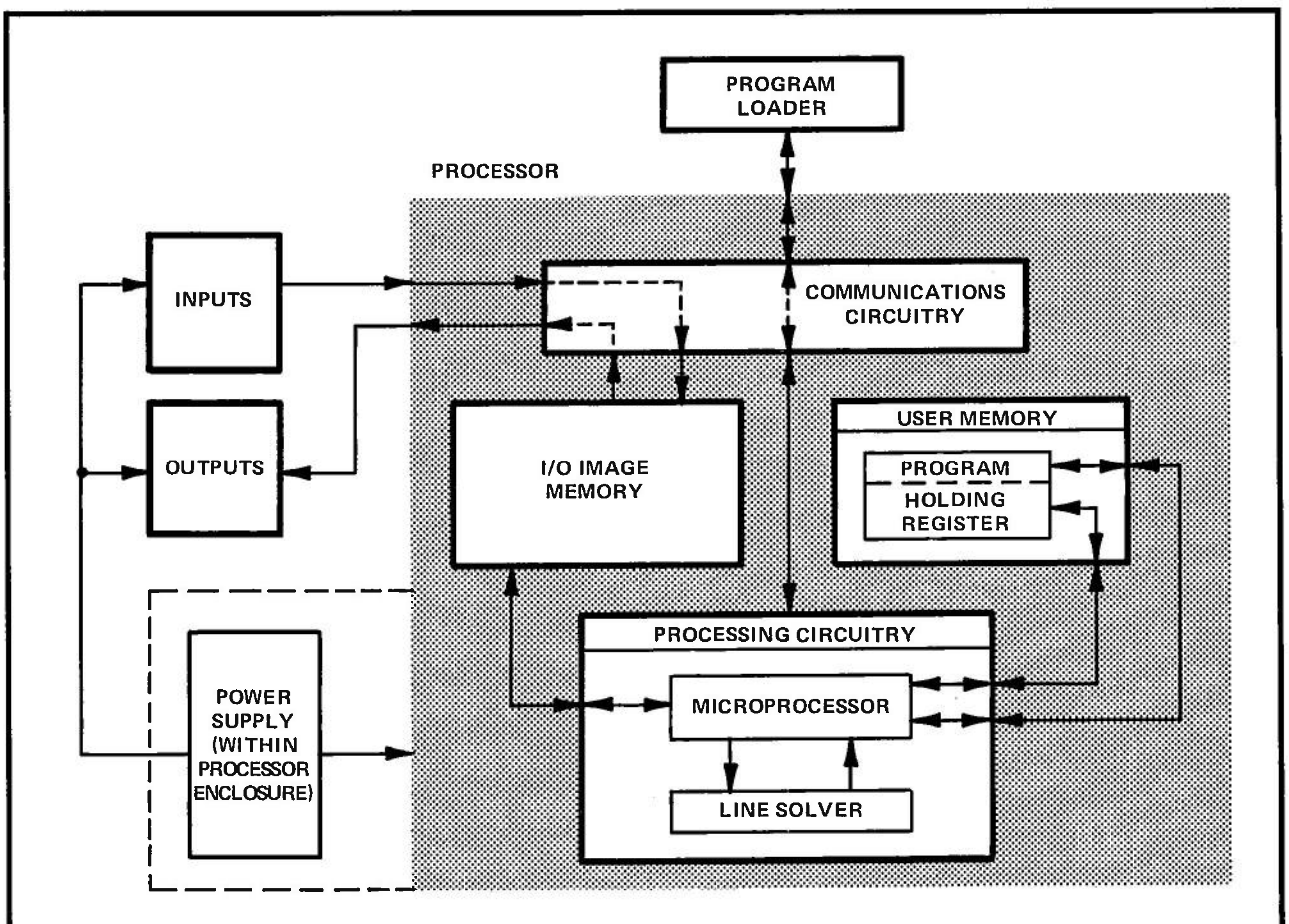
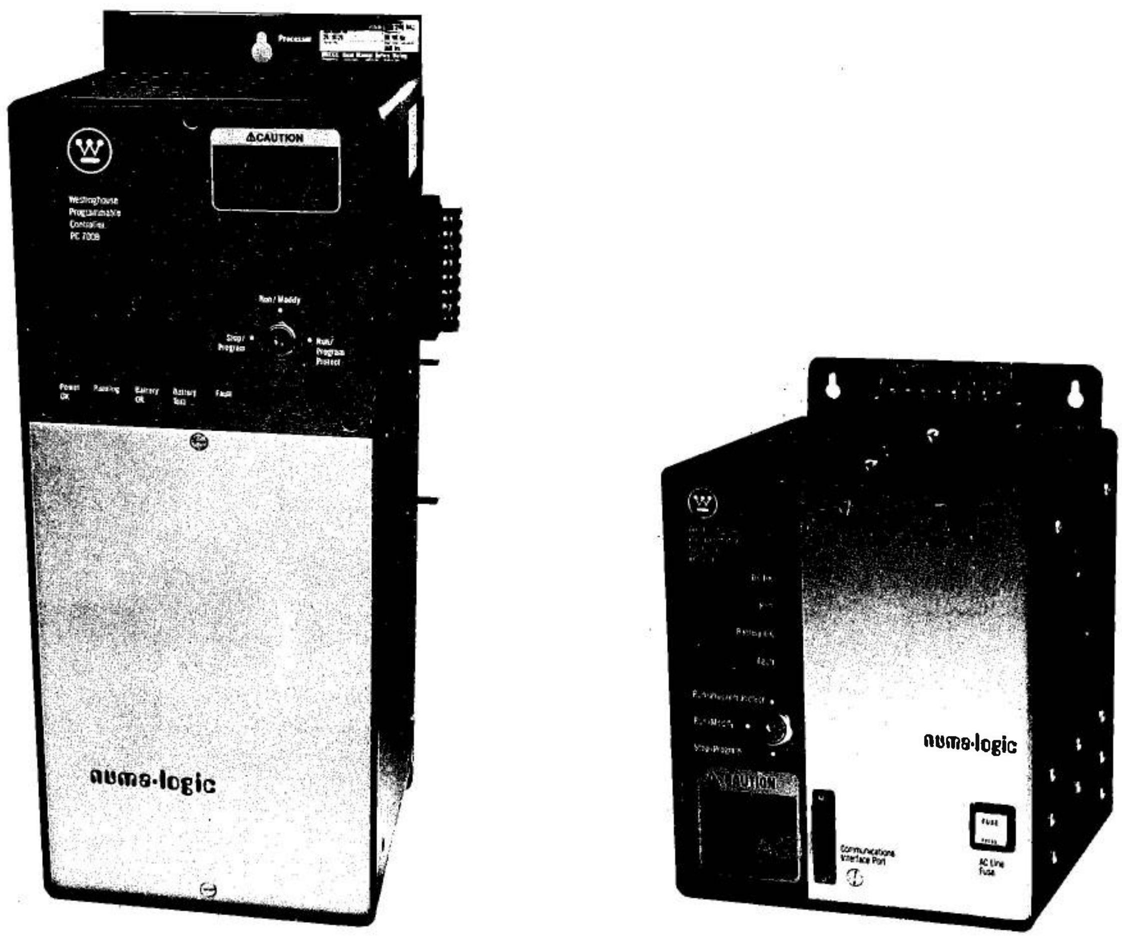


Figure 2-17. Simplified PC-700 or PC-900 Processor Block Diagram



PC-700 PC-900

Figure 2-18. PC-700 and PC-900 Programmable Controllers (Processors)

As shown in Figure 2-18, both the PC-700 and PC-900 Programmable Controllers have memory protect keyswitches mounted on the front panels. In the **Run/Program Protect** or **Run** position of this switch, the processor simply executes user programs. In this key position, the user cannot alter programming. However, the user can monitor program operation, change stored register data, or force contacts ON or OFF. In the **Run/Modify** position, the user can alter programming, monitor program operation, change stored register data, and force contacts ON or OFF.

The PC-700 Programmable Controller is available in three optional memory sizes: 2048, 4096, and 8192 words of RAM. Each PC-700 memory configuration supports up to 256 discrete inputs, 256 discrete outputs, 32 register inputs and 32 register outputs. Additionally, the PC-700 supports 256 internal logic coils and up to 1792 holding registers, depending on memory size.

The PC-900 Programmable Controller is available in two basic memory types, RAM and EPROM. The PC-900 RAM memory is available in three optional memory sizes: 1024, 1536, and 2560 words of RAM. The PC-900 EPROM memory is available in three optional memory configurations: 1024 word EPROM/512 word RAM, 1024 word EPROM/1536 word RAM, and 2048 word EPROM/512 word RAM. Both PC-900 Programmable Controllers support 128 discrete inputs, 127 discrete outputs, 1 battery status coil, 16 register inputs, 16 register outputs, and up to 1792 holding registers, depending upon memory size, and 128 logic coils.

User Memory

The processor's user memory contains the ladder diagram instructions and serves as the storage location for holding register values required by the program.

I/O Image Memory

The I/O image memory contains the status for all input circuits at the beginning of each scan, and stores newly determined coil and output register states during each scan. The stored input circuit states indicate the states of input contacts and input registers. The newly determined coil and output register stored states control the states of control relay (CR) contacts, output registers, and output circuits.

2-10. Processing

The PC-700 or PC-900 Programmable Controller processing circuitry contains microprocessor and line-solver logic, which provides the vehicle for program processing. The PC-700 and PC-900 processors are programmed identically. Circuits are programmed into either processor from a reference ladder diagram using relay symbology. This processing circuitry sets the output circuit states based on programming information contained in the memories. The open or closed state of the input contacts and CR contacts is stored in the I/O image memory. The states of the stored contacts involved in each programmed circuit are selected according to reference labels (addressing) of the program stored in user memory. Each circuit is constructed contact-by-contact under program control. The selected contact states are used to determine whether the programmed circuit is conducting.

If the programmed circuit controls a coil, the state of the coil in the I/O image memory is specified according to the newly determined state of the circuit. The state of this coil's contacts (and output circuit, if any) is determined as the processor scans subsequent circuits.

If the programmed circuit controls a special function, the special function sequence is activated when the circuit (and other circuits, if required) changes to the proper state. The special function sequence changes the associated coil state and register values in the processor memories. These states are used when the processor scans subsequent circuits.

Both the PC-700 and PC-900 Programmable Controllers offer an online programming option. This option enables the user to enter, delete, and alter the reference ladder diagram while the processor is executing a program, without disruption of control operations. Refer to Sections 3, 4, and 5 for detailed descriptions of reference ladder diagrams and programming information.

2-11. Communications

At the beginning of each processor scan, the input circuit states are transferred into the I/O image memory by the communications circuitry.

At the end of each processor scan, the communications circuitry transfers the stored output states from the I/O image memory to the output circuits: The communications circuitry also transfers program loader instructions to the processor.

2-12. Power Supply

The d-c power required to operate the basic processor and input/output circuit configuration is provided by the processor's internal power supply. However, for more complex configurations where the I/O exceeds processor power supply capacity, an external I/O expander power supply must be used. Specifically, this I/O expander power supply is used in remote-unit or remote-I/O-link applications.

A backup battery maintains the program in RAM memory in the event of an a-c power failure. In PC-700 applications, this backup battery maintains memory for a minimum of 31 to 208 days, depending on RAM memory size. In PC-900 applications, RAM memory is maintained for a minimum of 90 days by the backup battery. The PROM version of the PC-900 is operated with or without a backup battery for the RAM portion of its memory.

2-13. CONTROLS AND INDICATORS

The PC-700 Programmable Controller front panel controls and indicators are shown in Figure 2-19.

Figure 2-20 shows the front panel controls and indicators for the PC-900. A description of each front panel control or indicator is given in Table 2-7.

2-14. REMOTE I/O SYSTEM

The **Numa-Logic** 700 Series Remote I/O system allows the PC-700 and PC-900 Programmable Controllers to accept inputs from or send outputs to remote locations up to two miles from the processor. Figure 2-21 shows a typical remote I/O system configuration. Each remote location requires one or more remote links, consisting of a local unit (NL-771) and a remote unit (NL-772).

Each local/remote pair provides communication for 64 discrete inputs, 64 discrete outputs, 8 register inputs, and 8 register outputs. Each pair (link) is connected via a cable (two shielded, twisted pairs). The local and remote units of a remote I/O link are double-height modules which mount into a standard I/O rack. The local unit is connected to the processor and acts like an extension of the local I/O racks. Remote I/O circuits appear as local I/O circuits to the processor. The remote unit acts like a processor to the remote location; the remote unit appears to be the processor to the remote I/O circuits.

Remote locations are connected to the PC-700 or PC-900 processor in parallel links. Due to this parallel connection, the update time for remote communications does not vary with the number of links. The average update time for a remote I/O system is 30 msec.

The local unit obtains operating power from the processor's internal power supply or a locally based I/O expander power supply. The remote unit obtains operating power from a remote I/O expander power supply. A switch on the I/O expander power supply selects its remote configuration. Both the local and remote units have a front panel LED to indicate when the link is operating.

Both units of a remote I/O link have a Form C contact which de-energizes upon detection of a communications error. When a communications error is detected, the output circuits controlled by the corresponding link shut down. When shut down, these output circuits are optionally OFF or in the Last Valid States. Remote communications are restarted either manually or automatically. A button on both units provides for manual restarts. An automatic restart occurs when the local unit receives two successive valid transmissions after the detected error.

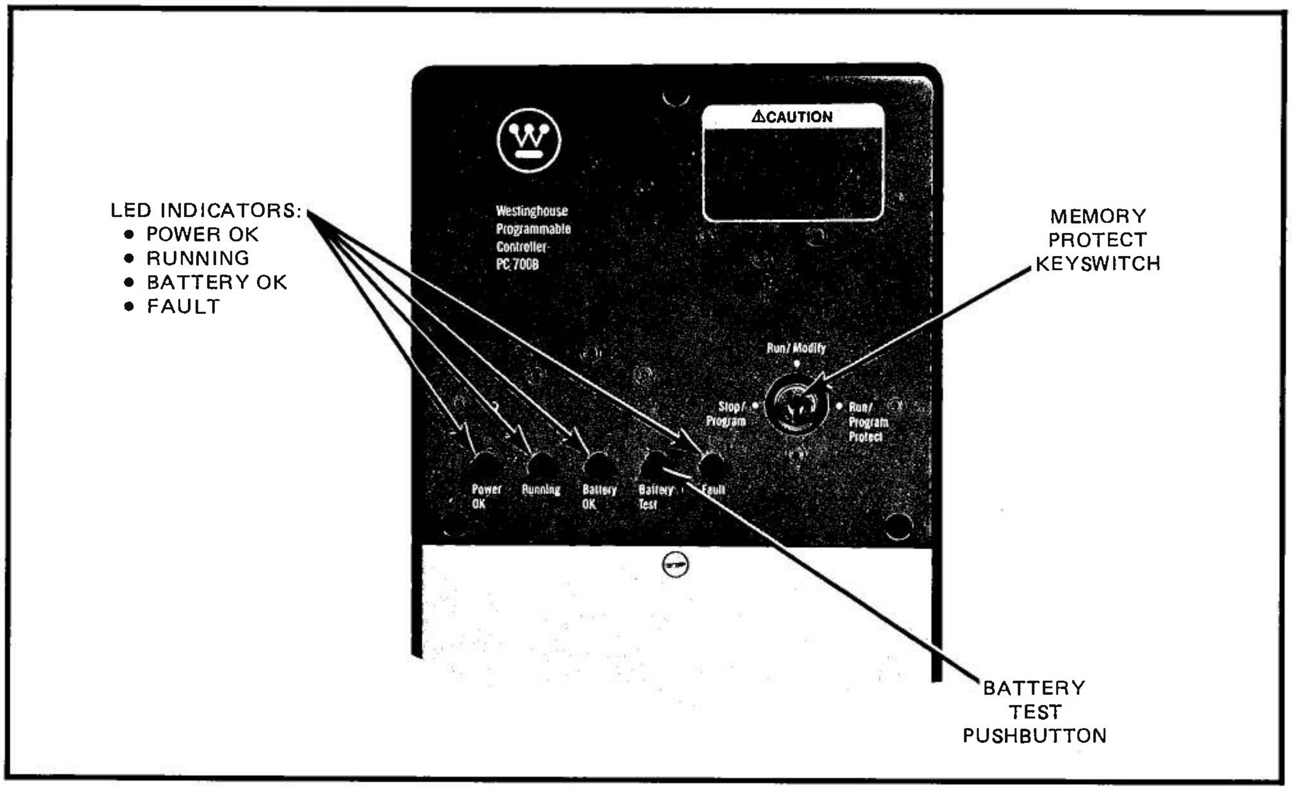


Figure 2-19. PC-700 Controls and Indicators

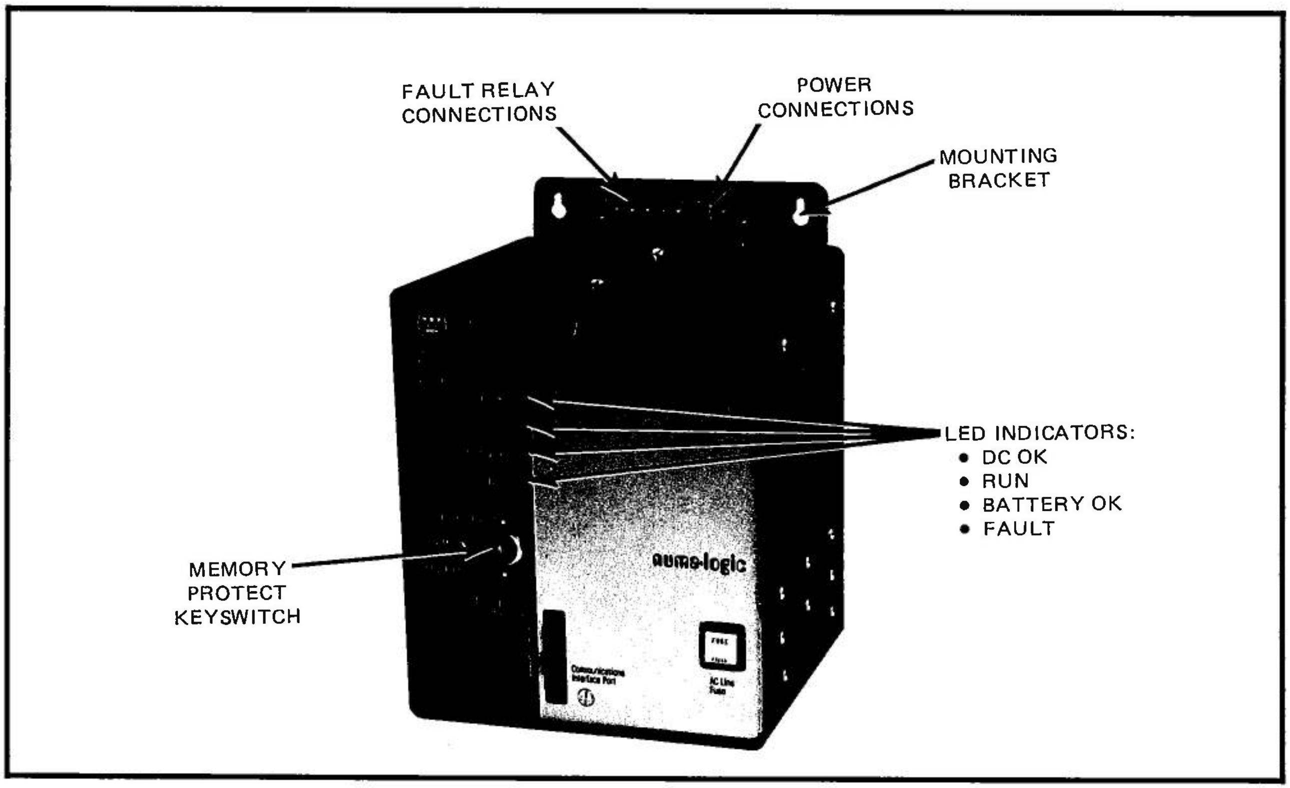


Figure 2-20. PC-900 Controls and Indicators

TABLE 2-7. CONTROLS AND INDICATORS

Panel Function		
PC-700	**PC-900**	**Description**
Memory Protect Keyswitch	Memory Protect Keyswitch	Select the mode of processor operation as follows:
Run	**Run/Program Protect**	This switch position prevents unauthorized programming. It permits the processor to operate normally; lines cannot be added, deleted, or changed.
Run/Modify	**Run/Modify**	This optional switch position enables the processor to continue to operate while the existing program is modified or edited.
Program	**Stop/Program**	This switch position enables processor programming; however, processor and I/O operation is inhibited.
Power OK LED	**DC OK** LED	Indicates that the internal power supply voltages are present and within limits.
Running LED	**Run** LED	Indicates that the processor is scanning the program and controlling outputs. The outputs are disabled when the LED is OFF.
Battery OK LED	**Battery OK** LED	Indicates that the battery and its charging circuit are operational and will maintain RAM memory.
Fault LED	**Fault** LED	Indicates that a processor or power supply failure has been detected.
Battery Test Pushbutton	——	In PC-700 applications, works with the **Battery OK** LED to test the battery and charging circuit.
——	AC LINE FUSE	Cover for the PC-900's a-c line fuse. When pressed, this cover accesses the fuse.
——	COMMUNICATIONS INTERFACE PORT	RS-232-C port for the program loader or hierarchical computer communications.

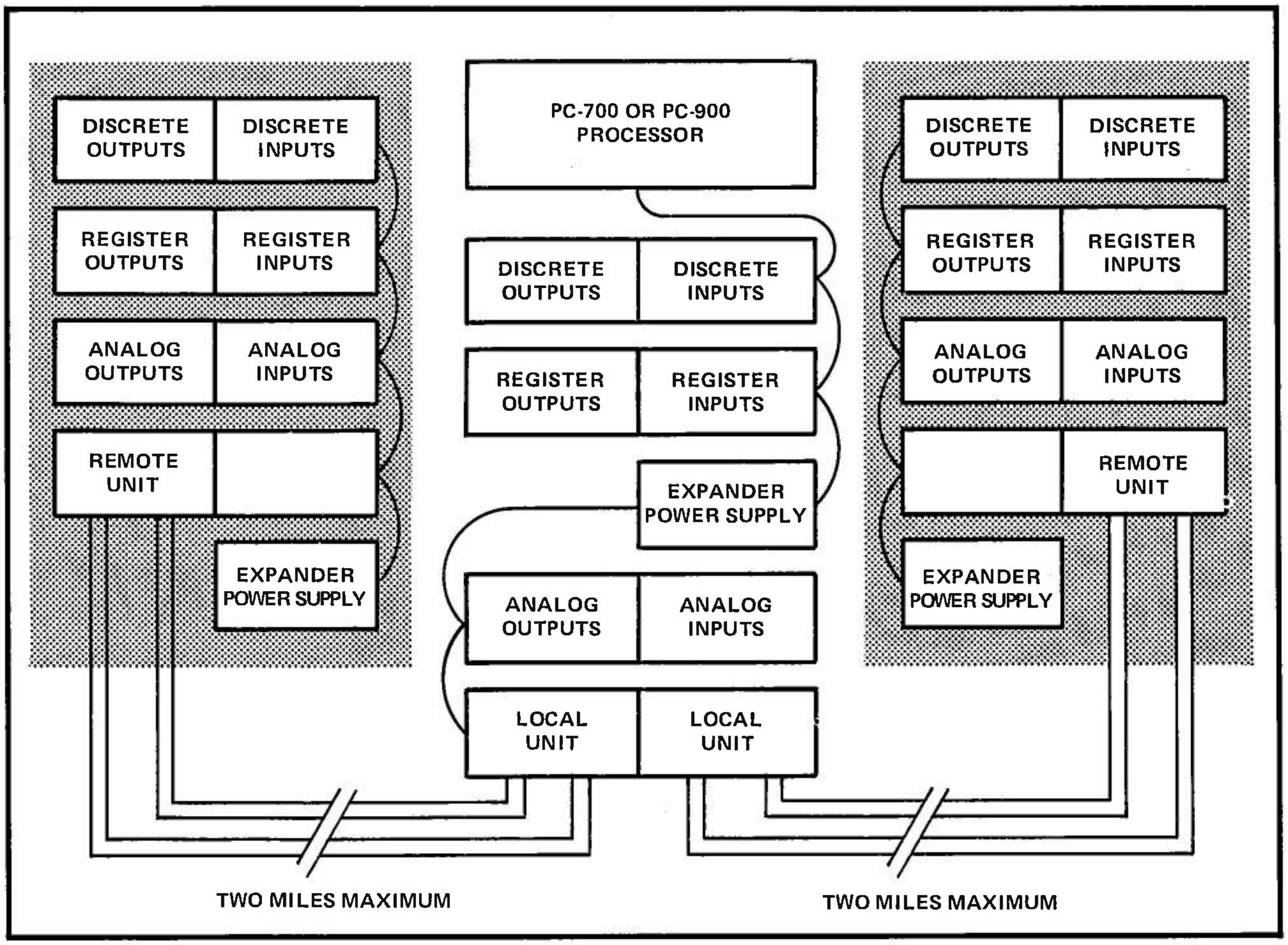


Figure 2-21. Typical Remote I/O System Configuration

2-15. DISTRIBUTED PROCESSING SYSTEM

The PC-700 and/or PC-900 systems can be configured with multi-processors to form distributed processing systems. A distributed processing system can contain multiple PC-700 processors, multiple PC-900 processors, or a combination of both processor types. The local unit used in the remote I/O system applications is used to provide communications between processors within a distributed processing system. The configuration of distributed processing systems is similar to that used for remote I/O systems. A PC-700-to-PC-900 multi-processor distributed processing system is shown in Figure 2-22. As shown, a pair of local units connects the two processors and related local I/O modules over a distance of up to two miles.

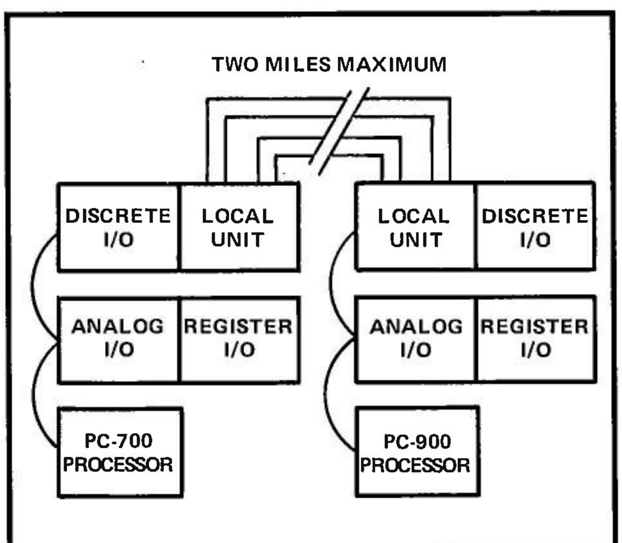


Figure 2-22. Interprocessor Communications

A typical distributed processing configuration using three daisy-chained processors is shown in Figure 2-23. Again, processor-to-processor communications are handled by local unit communications links. Each processor shown controls its own input and output circuits, based upon the state of output circuits controlled by the processors connected via the processor-to-processor links within the system. A processor communicates directly with processors to which it is connected by a local unit communications link. Thus, in the example of Figure 2-23, Processor 1 communicates directly with Processor 2 and Processor 3. However, Processors 2 and 3 only communicate indirectly through a common connection, to Processor 1. For example, Processor 2 (or 3) affects Processor 1's output circuits, which, in turn, may affect Processor 3 (or 2).

The processor-to-processor communication for distributed processing operation is similar to the operation of the remote I/O communication, described in paragraph 2-14. Indicating lights, fault conditions, and restarting of the distributed processing system operate in the same manner as in the remote I/O system.

2-16. PERIPHERAL EQUIPMENT

To facilitate system programming, documentation, and operator control of **Numa-Logic** PC-700 or PC-900 systems, a wide selection of peripheral equipment is available. The selection of peripheral devices is dependent on specific user applications.

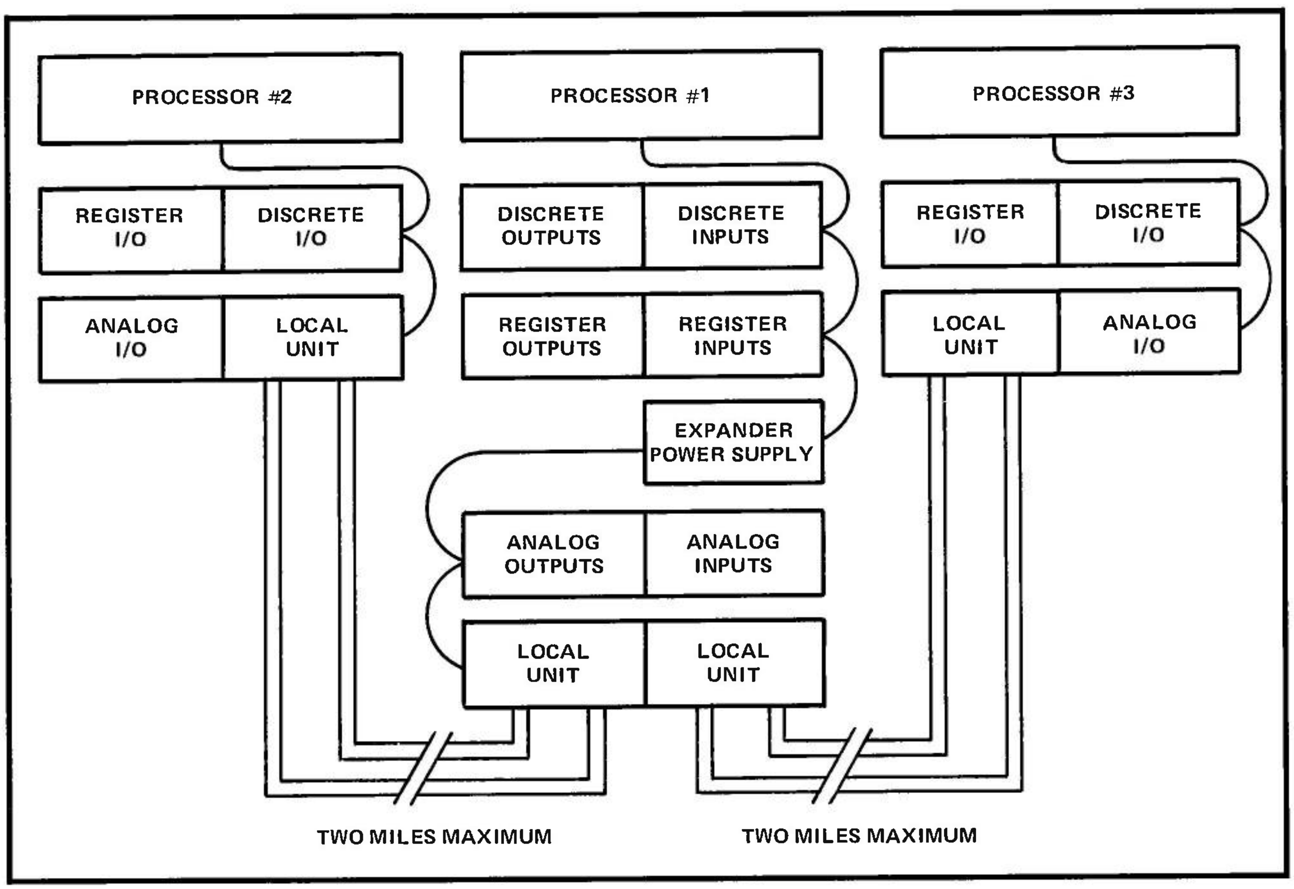


Figure 2-23. Typical Daisy-Chained Distributed Processing Configuration

When selecting peripherals, several facts must be considered to ensure that user needs are satisfied:

- The NLTL-783 Tape Loader is used with either the NLPL-780 or NLPL-780P CRT Program Loaders.
- The NLP-786 Printer is used with only the NLPL-780P CRT Program Loader with print option.
- The NLPL-789 Mini Loader is **not** used with the NLTL-783 Tape Loader or the NLP-786 Printer.
- The NLPL-789 Mini Loader does optionally use a standard audio cassette recorder/player.
- The NLPL-780P CRT Program Loader can use other RS-232-C compatible printers, operating at 110, 300, 600, 1200, 2400, 4800, or 9600 baud. However, internal printer modification may be required.
- The PC-700 or PC-900 processor's program loader port can be used as an RS-232-C interface with a computer when suitable handshaking software is present in the computer. Refer to the "PC Communications Manual" (NLAM-B58).
- The NLP-786 Printer is used with both the PC-700 and PC-900 when the respective processor contains the ASCII transmit function.

2-17. PC-700 PROCESSOR SPECIFICATIONS

2-18. GENERAL

As shown previously in Figure 2-17, the PC-700 Programmable Controller houses printed-circuit modules to store programs, monitor inputs, and control outputs. This PC-700 processor also houses one of two power supply versions and a backup battery. The power supply provides operating power for the processor and its associated input and output modules. Figure 2-24 shows the PC-700 processor with its Version 1 power supply. The PC-700 processor with its Version 2 power supply is shown in Figure 2-25. The NLB-700 backup battery provides memory retention during loss of power.

2-19. PC-700 TERMINATION

The input a-c power and fault relay connections are made to 300 V, dead-front pressure terminals located near the back-edge of the side panel of the PC-700 enclosure. Figure 2-26 shows the PC-700 Processor Connector Identification strip. I/O rack connections are made to either or both 50-pin edge connectors (J3 and J4) located directly under the Power and Relay terminals. I/O rack to PC-700 processor connections are made via I/O cables. Program loader connection to the PC-700 processor is made on the D-type connector at the bottom via the program loader communications cable.

Note

The PC-700 Programmable Controller contains a second D-type connector mounted below the program loader's D-type connector. This port provides a computer interface for hierarchical computer applications. However, an optional NLCI-792 Computer Interface Module is also required to implement this computer interface.

2-20. PC-700 INDICATORS

The PC-700 Programmable Controller's front panel indicators are shown in Figure 2-27. A description of each follows.

Power OK.

This LED, when lit, indicates that the PC-700 processor's internal power supply is operating within limits. All outputs are disabled when this LED is out.

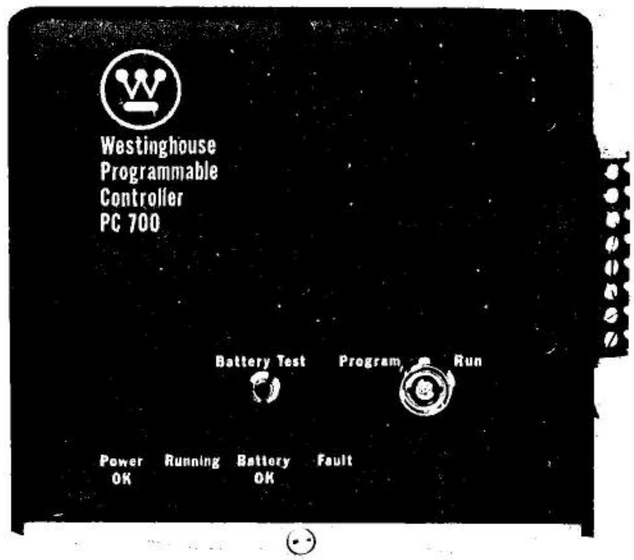


Figure 2-24. PC-700 Processor with Version 1 Power Supply

Figure 2-25. PC-700 Processor with Version 2 Power Supply

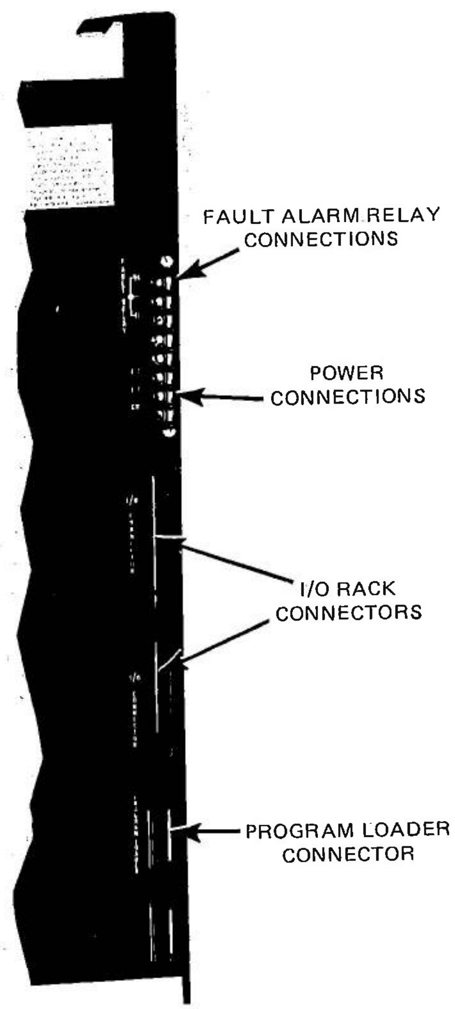


Figure 2-26. PC-700 Connector Identification

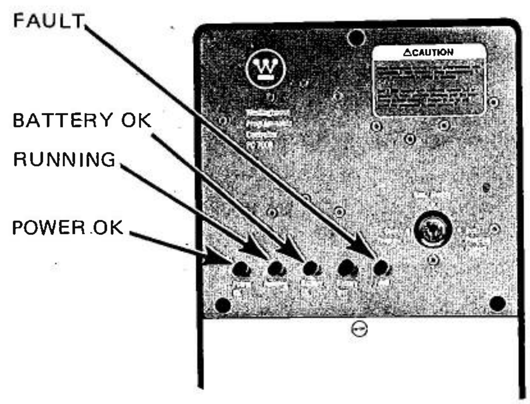


Figure 2-27. PC-700 Indicators

Running.

This LED, when lit, indicates that the PC-700 processor is scanning memory and controlling outputs. All outputs are disabled when this LED is out.

Battery OK

- Version 1 Power Supply Applications — This LED lights when the **Battery Test** pushbutton is pressed while the processor is without power, indicating that the battery is charged. If this LED does not light, the battery has discharged.

- Version 2 Power Supply Application — Unlike the Version 1 application, for Version 2 power supplies, this LED indicates the battery condition with or without processor power. In this application, when the **Battery Test** pushbutton is pressed, the LED will be in one of the following states:

  1. Steadily lit — Indicates that the battery is fully charged.
  2. Flickering — Indicates that the battery needs to be recharged.
  3. Out — Indicates that the battery needs to be replaced.

Fault

- Version 1 Power Supply Applications — The Fault LED lights when the front panel keyswitch is placed in the **Program** position, indicating that the control program is stopped and all outputs are disabled. If the LED lights when the keyswitch is in **Run**, a processor failure has occurred during normal operation. Upon detection of a processor failure, all outputs are disabled and the fault relay is de-energized.

- Version 2 Power Supply Applications — Unlike the Version 1 applications, the LED does not light when the keyswitch is in **Program**. For Version 2 applications, this LED lights in either keyswitch position when a processor failure is detected. Upon detection of a processor failure, the fault relay is de-energized and all outputs are disabled, unless the Last Valid State option is selected. When this option is selected, the processor maintains the outputs in their last valid states, upon detection of a processor failure.

2-21. PC-700 PERFORMANCE DATA

2-22. I/O Reference Numbers

The PC-700 system reference number ranges are given in Table 2-8.

2-23. I/O Parameters

The PC-700 system I/O parameters are given in Table 2-9.

2-24. Memory Capacity

The PC-700 Progammable Controller optionally contains the following memory sizes:

- 256 words (1/4 K)*
- 512 words (1/2 K)*
- 1024 words (1 K)*
- 2048 words (2 K)
- 3072 words (3 K)*
- 4096 words (4 K)
- 6144 words (6 K)*
- 8192 words (8 K)

***Note**

These memory sizes are no longer available for PC-700 applications.

All PC-700 memory is composed of CMOS RAM with a 16-bit word length.

TABLE 2-8. REFERENCE NUMBER RANGES

I/O Module Types	I/O Rack Switch Selectable Groups			
	Group 1	Group 2	Group 3	Group 4
Discrete Inputs	1 to 64	65 to 128	129 to 192	193 to 256
Discrete Outputs	1 to 64	65 to 128	129 to 192	193 to 256
Analog/Register Inputs	1 to 8	9 to 16	17 to 24	25 to 32
Analog/Register Outputs	1 to 8	9 to 16	17 to 24	25 to 32

TABLE 2-9. I/O PARAMETERS

Processor Type	Memory Size	I/O Capability
*PC-700 Standard Functions, Software 2.X	256 512 1024 2048 and up	Group 1 Groups 1, 2 Groups 1, 2, 3 All Groups
*PCX-700 Extended Special Functions, Software 1.X	All Sizes	All Groups
*PCX-700 Advanced Functions, Software 3.X	All Sizes	All Groups
*PCX-700 Extended Special Functions, Software 5.X	All Sizes	All Groups
PC-700 Advanced Functions II, Software 6.X	All Sizes	All Groups

*No longer offered for PC-700 applications.

2-25. PC-700 Programmable Functions

The programmable functions available for each PC-700 programming package are listed in Table 2-10 and are designated by a (•). A description of each programmable function is given in Section 4, with the exception of the Loop Controller (LC) function, which is described in Section 5.

2-26. PC-700 Scan Rate

- PC-700 A: 10 msec/1 K words
- PC-700 B: 8 msec/1 K words

2-27. PC-700 Battery Parameters

- Type: Sealed lead-acid
- Charge: Trickle charged by PC-700 processor
- Life: See Table 2-11

2-28. PC-700 Environmental Specifications

- Temperature: 0 to 60°C (32 to 140°F)
- Humidity: 0 to 95%, non-condensing through 0 to 60°C range.

2-29. PC-700 Input Power

Version 1 Power Supply

100 to 130 Vac, 60 Hz;
200 VA maximum.

Version 2 Power Supply

- User Selectable 120: 102 to 128 Vac, 57/63 Hz or 102 to 132 Vac, 49/57 Hz at 200 VA maximum.
- User Selectable 240: 204 to 276 Vac, 57/63 Hz or 204 to 264 Vac, 49/57 Hz at 200 VA maximum.

TABLE 2-10. PC-700 PROGRAMMABLE FUNCTIONS

Function Name	Function Mnemonic	PC-700 Software *2.X Standard Functions	*1.0-1.6 Extended Special Functions	*1.7-1.8 and 5.X Extended Special Functions	*3.X Advanced Functions	6.X Advanced II Functions
Add/Subtract	AD/SB		•	•	•	•
AND Matrix	AM				•	•
Ascending Sort	AS					•
ASCII Transmit	AT					•
Bit Follow	BF			•	•	•
Bit Operate	BO				•	•
Block Transfer	BT				•	•
Comparisons	EQ/GE		•	•	•	•
Complement Matrix	CM				•	•
Continuous Group Select	CG					•
Continuous Select	CS				•	•
Control Relay	CR	•	•	•	•	•
Conversions	BD/DB		•	•	•	•
Counters	UC/DC	•	•	•	•	•
Divide	DV		•	•	•	•
Drum Controller	DR		•	•	•	•
First In Stack/First Out Fetch	FI/FO				•	•
First In Stack/Last Out Fetch	FI/LO				•	•
Latches	BS/BC	•	•	•	•	•
Loop Controller	LC					•
Master Control Relay	MR	•	•	•	•	•
Move	MV		•	•	•	•
Multiple	MP		•	•	•	•
N-Bit Serial Shift Registers	NR/NL				•	•
Open Table/**Close Table	OT/CT					•
OR Matrix	OM				•	•
Register to Table Move	RT				•	•
Search Matrix	SM				•	•
Shift Registers	SR/SL	•	•	•	•	•
Skip	SK	•	•	•	•	•
Square Root	SQ					•
Table Look Up/Table Look Up Ordered	TL/TO					•
Table to Register Move	TR				•	•
Timers	TS/TT	•	•	•	•	•
Update Immediate	UI					•
Update Select	US					•
XOR Matrix	XM				•	•

*No longer offered for PC-700 applications.
**Not in Version 6.0.

TABLE 2-11. PC-700 BATTERY LIFE

	PC-700 A Battery Life (in Days)		PC-700 B Battery Life (in Days)	
Memory Size	Typical*	Minimum**	Typical*	Minimum**
1K	208	80.1	207	80.1
2K	116	51.3	115	51.3
4K	61.3	31.6	61.3	31.6
6K	41.7	23.4	41.7	23.4
8K	31.6	18.7	31.6	18.7

*Figures based on manufacturer's typical power consumption data at 25°C (77°F).
**Figures based on manufacturer's worst case power consumption data.

2-30. Communications Protocol

- Type: Up to two RS-232-C ports
- Baud Rate: Jumper-selectable from 150 to to 9600 baud.

2-31. Fault Relay

- Load: Resistive
- Contact Rating: 120 Vac at 1 A

2-32. PC-700 APPLICATION NOTES

CAUTION

Do not remove any processor modules with a-c power applied.

2-33. Keyswitch Positions

- **Run/Program Protect:** With the keyswitch in this position, the processor scans the memory and controls outputs. Also, the program loader is used to monitor and force I/O and make register data changes.
- **Stop/Program:** With the keyswitch in this position, the processor stops scanning and disables all outputs. Before the program loader can alter circuit connections or delete lines, the keyswitch must be in this position or the **Run/Modify** position.
- **Run/Modify:** With the keyswitch in this position, the existing program is modified or edited while the processor continues to scan. New logic is not acted upon until a complete and logical line has been entered. This keyswitch position is available on optional online programming processors only.

CAUTION

Do not use an NLPL-780 CRT Program Loader with a software version less than 2.3 to make program changes when the keyswitch is in the optional Run/Modify position. For online programming, use only an NLPL-780 CRT Program Loader that has a software version equal to or greater than 2.3. Failure to do so causes a processor fault.

2-34. Processor Power-Up and Power-Down Sequences

On **Power-Up**, all outputs are held disabled until the processor's front panel **Running** LED lights. Prior to this action, the following must happen:

1. The **Power OK** condition must exist.
2. The processor must verify the contents of memory, maintained during the previous Power-Down sequence.
3. The processor performs an initial Power-Up scan to set the output states to logic 0 (OFF) and to update the inputs to the I/O image memory.

Note

Forced I/O retains its forced state and register I/O retains its previous state.

4. The processor performs a logic scan while maintaining all outputs disabled (OFF). Following this scan, the front panel **Running** LED lights. At this point, the outputs are enabled according to the logic

scan, and normal processor operation begins, scanning memory and controlling outputs.

When the processor senses a **Power-Down**, all outputs are disabled. On Power-Down detection, the processor calculates and stores checksums which are used to verify memory during a subsequent Power-Up.

CAUTION

Do not lay the CPU/Memory module on a metal surface. This practice can short out the battery and cause processor failure due to electrostatic discharge damage.

2-35. Processor Modules

The PC-700 processor houses a variety of modules which provide individual functions for system processor control.

- **User Memory Module:** Stores ladder diagram instructions and holding register information.

CAUTION

PC-700B user memory modules are interchangeable only with other PC-700B modules. Placing a PC-700B user memory module in a processor other than a PC-700B can cause circuit damage and loss of user memory. Placing a user memory module other than a PC-700B in a PC-700B processor defeats battery test circuitry and can cause loss of memory.

- **CPU Module:** Contains the microprocessor which maintains executive control over the processor and special functions.
- **I/O Image/Line Solver/Real-Time Clock Module:** Uses the current input/output status information stored in the I/O image memory to execute the ladder diagram instructions stored in the user memory.
- **I/O and Loader Interface:** Provides the interface between the processor and both the I/O system and program loader.
- **Optional Computer Interface Module:** Implements a second (lower) RS-232-C port.

CAUTION

Removing the user memory module or the I/O image module or both destroys the information in the I/O image memory. If this occurs, the processor must be reinitialized and reloaded.

2-36. Fuses

CAUTION

Processor failure can result from electrostatic discharge damage due to improper handling of components. Handle modules and components only in a static-safe environment.

Version 1 Power Supply

Two fuses protect this internal power supply. To replace these fuses, follow these instructions:

1. Ensure that the input a-c power is removed from the PC-700 processor.
2. Loosen the three black quarter-turn fasteners on the upper front panel and slide the power supply module from the processor housing.
3. Remove the blown fuse.
4. Replace the blown fuse with a 4 A, 250 V, 3 AG fuse.
5. Slide the power supply module back into the processor housing and lock the front plate in place, via the three quarter-turn fasteners.

The user memory module's 1/2 A, 8 AG battery backup fuse is replaced by simply removing the blown fuse from the module and inserting a new one into fuse holder FU1.

Version 2 Power Supply

Two fuses protect this internal power supply. To replace these fuses, follow these steps:

1. Ensure that the input a-c power is removed from the PC-700 processor.
2. Loosen the three black quarter-turn fasteners on the upper front panel and slide the power supply module from the processor.
3. Remove the blown fuse(s). Figure 2-28 shows the fuse locations.
4. Both sides of the line (L1 and L2) are fused. Replace the blown fuse as follows:
   - For 120 Vac operation, use a 4 A, 250 V, 3 AG fuse.
   - For 240 Vac operation, use a 2 A, 250 V, 3 AG fuse.
5. Slide the power supply module back into the processor housing and lock the front plate in place, via the three quarter-turn fasteners.

2-37. Power Supply

The processor's internal power supply supports the d-c power requirements of the processor and a portion of its I/O modules. When the capacity of the processor's internal power supply is exceeded (650 primary units or 32 output units), an optional I/O expander power supply is required.

CAUTION

The PC-700B Version 2 power supply is interchangeable only with other PC-700B Version 2 power supplies.

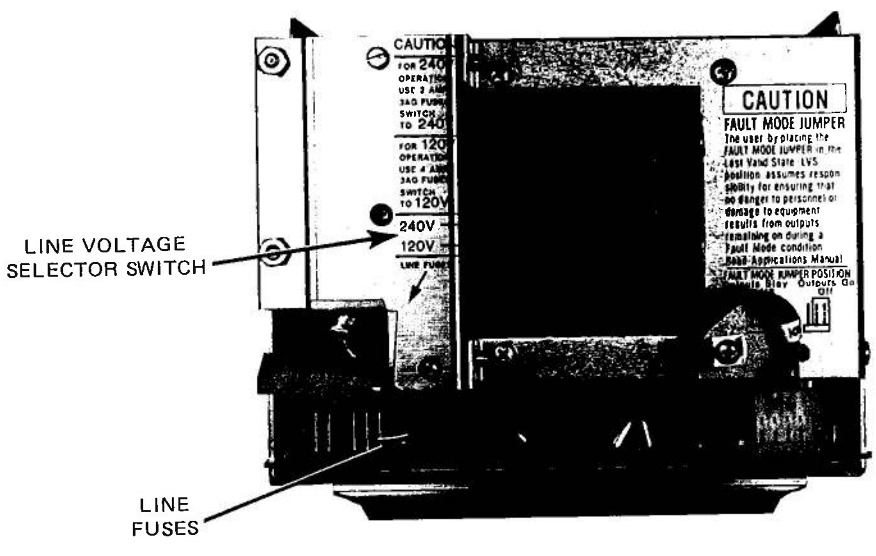


Figure 2-28. Version 2 Power Supply, Rear View

2-38. Connectors

- **I/O Connectors:** Either or both of the 50-pin connectors marked "I/O Connector" (see Fig. 2-26) are used for I/O cable connection between the processor and the I/O racks.
- **Program Loader:** The D-type connector marked "Program Loader" (see Fig. 2-26) is used to connect the processor to the program loader.
- **Computer Interface Port:** The D-type connector, located below the program loader connector (see Fig. 2-26), is used to connect the processor to a computer, or an RS-232-C device. This port is active only if the optional computer interface module is installed.
- **Power Connections:** Power connections for the processor's internal power supply are made to the terminals marked L1, L2, and GND (see Fig. 2-26). The Form C Fault Relay contacts are also available on this terminal strip.

2-39. PC-700 SET-UP NOTES

User Memory Module Fuse

In PC-700 processors equipped with Version 1 power supplies, the user memory module is shipped with its battery backup fuse removed or with the battery unplugged to prevent battery drain during transit. During installation, this 1/2 A, 8 AG fuse must be inserted before applying power to the processor. To do so, insert this fuse into the fuse holder marked FU1 on the user memory module.

Last Valid State/All OFF Jumper

In PC-700 processors equipped with Version 2 power supplies, when a fault occurs, the processor stops scanning and the fault relay de-energizes. The state of all outputs in the system during this fault condition is determined by the Last Valid State/All OFF jumper. This jumper is located on the rear of the Version 2 power supply, as shown in Figure 2-28. This power supply is shipped from the factory with this jumper installed in the All OFF position. Therefore, in the event of a fault, all outputs turn OFF. At the user's option, this jumper can be changed to the Last Valid State position, so that all outputs remain in their last valid states when the processor enters a fault.

240 V Operation

In PC-700 processors equipped with Version 2 power supplies, to select 240 V operation, locate the selector, as shown in Figure 2-28, and make the desired selection. Before applying power, ensure that 2 A, 250 V, 3 AG fuses are installed in place of the 4 A, 250 V, 3 AG fuses used for 120 V operation.

Battery Activation, PC-700B

The user memory backup battery is located in the lower left-hand corner of the PC-700 processor housing, as shown in Figure 2-29. Locate the battery cable and connect it to the connector on the user memory module.

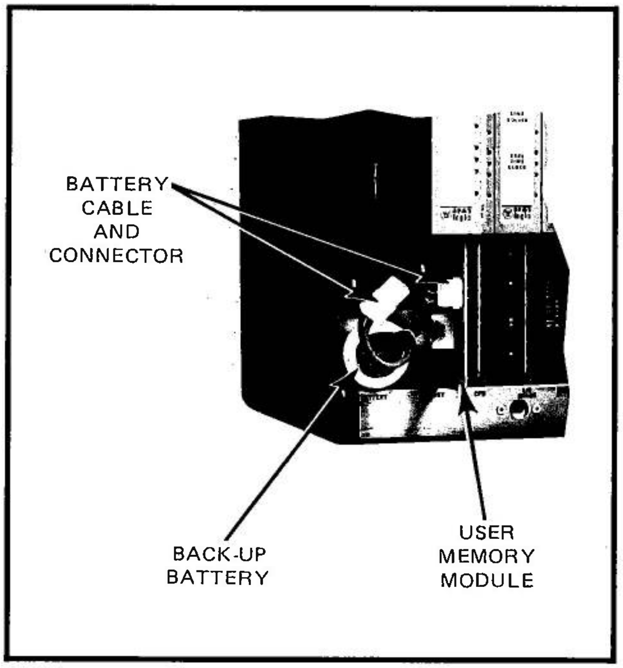


Figure 2-29. PC-700B Backup Battery

Battery Safety

Observe the following warnings for the safe handling and operation of the PC-700's lead acid or nickel cadmium backup batteries.

WARNING

DO NOT DISPOSE OF BATTERIES IN A FIRE. THIS PRACTICE CAN RESULT IN CHEMICAL BURNS TO PERSONNEL. POTASSIUM HYDROXIDE BURNS MAY RESULT FROM NICKEL CADMIUM BATTERIES AND SULFURIC ACID BURNS MAY RESULT FROM LEAD ACID BATTERIES. ALSO, THIS PRACTICE MAY CAUSE BATTERIES TO EXPLODE, FURTHER INJURING PERSONNEL.

WARNING

DO NOT PUNCTURE THE BATTERY CASING. THIS CAN RESULT IN INJURIES TO PERSONNEL FROM CHEMICAL BURNS.

WARNING

DO NOT ALLOW ANY METAL OBJECT (I.E., TOOLS, RINGS, WATCH BANDS, I.D. BRACELETS, ETC.) TO COME IN CONTACT WITH BATTERY TERMINALS. IF THE BATTERY TERMINALS ARE ALLOWED TO BECOME SHORTED TOGETHER, A LARGE AMOUNT OF CURRENT WILL FLOW THROUGH THE SHORTING OBJECT. THIS EXCESSIVE CURRENT WILL MAKE THE TERMINALS AND THE SHORTING OBJECT EXTREMELY HOT, POSSIBLY RESULTING IN THERMAL BURNS TO PERSONNEL. THE LEAD ACID BATTERY PRODUCES UP TO 130 AMPERES, AND THE NICKEL CADMIUM BATTERY PRODUCES UP TO 45 AMPERES WHEN SHORTED.

WARNING

DO NOT OPERATE BATTERIES IN AIR- OR GAS-TIGHT CONTAINERS. HYDROGEN AND OXYGEN ARE VENTED FROM BATTERIES DURING HEAVY CHARGE OR DISCHARGE PERIODS. WITHOUT PROPER VENTILATION, THIS MAY RESULT IN AN EXPLOSION, INJURING PERSONNEL.

2-40. PC-900 PROCESSOR SPECIFICATIONS

2-41. GENERAL

As in the case of the PC-700, the PC-900 Programmable Controller also houses printed-circuit modules to store programs, monitor inputs, and control outputs (see Fig. 2-17). This processor also houses an internal power supply and a backup battery. The power supply provides operating power for the processor and its associated input and output modules. The NLB-900 backup battery provides memory retention during loss of power. Figure 2-30 shows the PC-900 processor.

2-42. PC-900 TERMINATION

The input a-c power and fault relay connections are made to 300 V terminals located on the top-rear of the PC-900 enclosure (see Fig. 2-30). I/O rack connections are made to a 50-pin edge connector located on the side at the bottom of processor enclosure. I/O-rack-to-PC-900 connections are made via I/O flat cables. Program loader connection to the PC-900 processor is made on a front panel-mounted D-type connector via the program loader communications cable.

Note

The program loader connector may optionally be used to provide an interface for a hierarchical computer, without the need for additional logic modules.

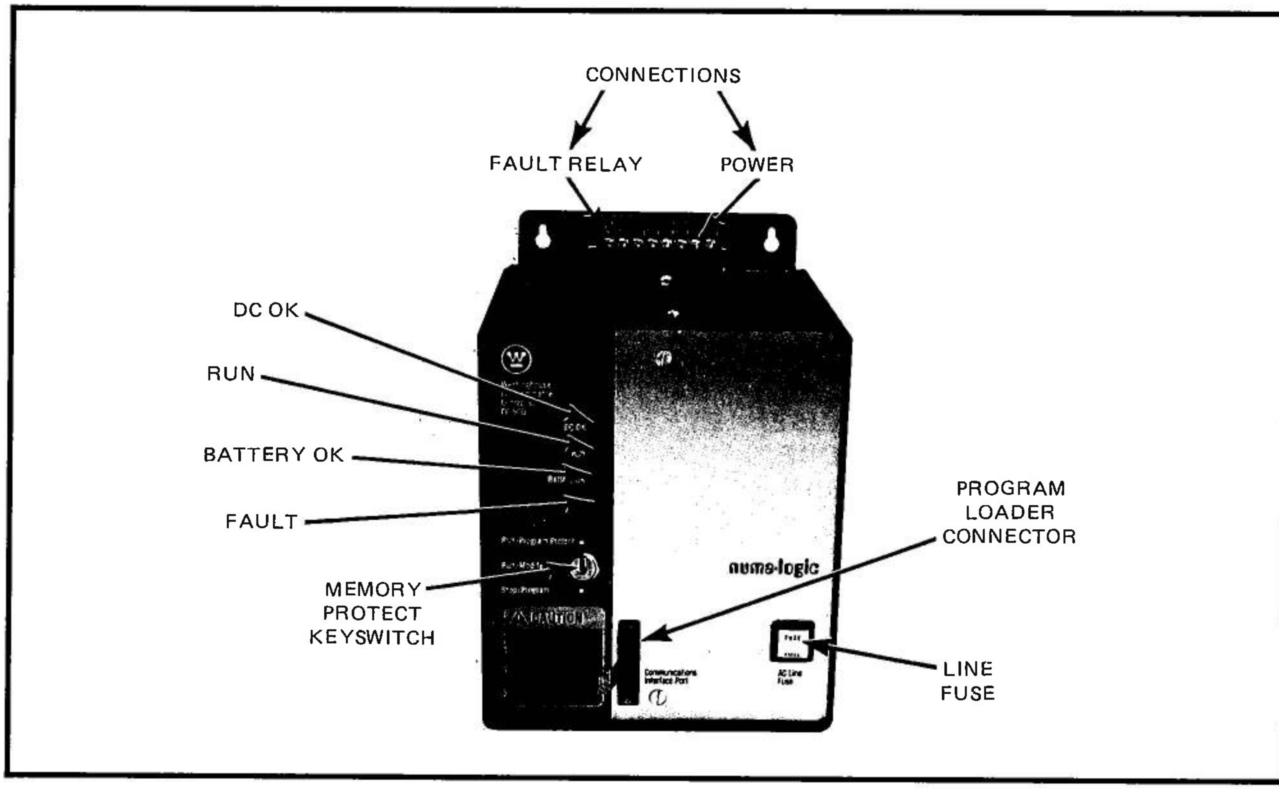


Figure 2-30. PC-900 Processor

2-43. PC-900 INDICATORS

The PC-900 Programmable Controller's front panel indicators are previously shown in Figure 2-30. A description of each follows.

DC OK

When lit, this LED indicates that the PC-900 processor's internal power supply is operating within limits. All outputs are disabled when this LED is out.

Run

When lit, this LED indicates that the PC-900 processor is scanning memory and controlling outputs. All outputs are disabled when this LED is out, except when the Last Valid State operation is selected.

Battery OK

When lit, this LED indicates that the PC-900 processor's backup battery has sufficient charge to retain memory. When this LED is out, the battery needs to be replaced.

Fault

When lit, this LED indicates that the PC-900 processor has failed. Upon detection of a processor failure, the fault relay also de-energizes. All outputs are disabled (All OFF) or optionally held at their last valid states, depending on the state of the Last Valid State/All OFF jumper.

2-44. PC-900 PERFORMANCE DATA

2-45. I/O and Memory Parameters

The PC-900 system's I/O and memory parameters are given in Table 2-12.

2-46. PC-900 Programmable Functions

The programmable functions available for each PC-900 programming package are listed in Table 2-13 and are designated by a (•). A description of each programmable function is given in Section 4.

TABLE 2-12. PC-900 I/O AND MEMORY PARAMETERS

Parameter	*PC-900 A	PC-900 B
Discrete Input	128 Maximum	128 Maximum
Discrete Output	127 Maximum	127 Maximum
Logic Coils	0	128 Maximum
Battery Status Coil	1 Maximum	1 Maximum
Analog/Register Input	8 Maximum	16 Maximum
Analog/Register Output	8 Maximum	16 Maximum
Memory Size	CMOS RAM: *256 Words *512 Words 1024 Words 1536 Words	CMOS RAM: *256 Words *512 Words 1024 Words 1536 Words 2560 Words CMOS RAM/EPROM: 512/1024 Words 512/2048 Words 1536/1024 Words
Programming	*1. Standard Functions 2. Extended Special Functions	*1. Standard Functions *2. Extended Special Functions 3. Advanced Functions

*No longer offered.

TABLE 2-13. PC-900 PROGRAMMABLE FUNCTIONS

Function Name	Function Mnemonic	PC-900 Software		
		**Standard	**Extended Special	*Advanced
Add/Subtract	AD/SB		•	•
AND Matrix	AM			•
ASCII Transmit	AT			•
Bit Follow	BF	•	•	•
Bit Operate	BO			•
Block Transfer	BT			•
Comparisons	EQ/GE		•	•
Complement Matrix	CM			•
Continuous Group Select	CG			•
Control Relay	CR	•	•	•
Conversions	BD/DB		•	•
Counters	UC/DC	•	•	•
Divide	DV		•	•
Drum Controller	DR	•	•	•
First In Stack/First Out Fetch	FI/FO			•
First In Stack/Last Out Fetch	FI/LO			•
Latches	BS/BC	•	•	•
Master Control Relay	MR	•	•	•
Move	MV		•	•
Multiply	MP		•	•
N-Bit Serial Shift Registers	NR/NL			•
OR Matrix	OM			•
Register to Table Move	RT			•
Reset Watchdog Timer	RW			•
Restore Program Counter	RP			•
Save Program Counter	SP			•
Search Matrix	SM			•
Shift Registers	SR/SL	•	•	•
Skip	SK	•	•	•
Table to Register Move	TR			•
Timers	TS/TT	•	•	•
Update Immediate	UI	•	•	•
XOR Matrix	XM			•

*Available for PC-900B applications only.
**No longer offered.

2-47. PC-900 Scan Rate

- PC-900 A: <25 msec/1 K words
- PC-900 B: <20 msec/1 K words

2-48. PC-900 Battery Parameters

- Type: Mallory PX-21, Ray-O-Vac RPX-21, or equivalent
- Voltage: 4.2 Vdc
- Charge: Non-rechargeable
- Life:

  Typically 1 year from ship date with power continually applied to the processor.

  Minimum of 90 days from ship date with power outage during memory retention periods.

  Typically 1 week warning period before memory loss after the **Battery OK** LED goes out and CR0128 energizes.

2-49. PC-900 Environmental Specifications

- Temperature: 0 to 60°C (32 to 140°F)
- Humidity: 0 to 95%, relative, non-condensing through 0 to 60° C range.

2-50. PC-900 Input Power

- Standard 120 Vac operation — 108 to 132 Vac, 50/60 Hz at 80 VA maximum. Front mounted 4 A, 250 V, 3 AG fuse.
- Optional 240 Vac operation — 216 to 264 Vac, 50/60 Hz at 80 VA maximum. Front mounted 2 A, 250 V, 3 AG fuse.
- Optional 24 Vdc operation — 20 to 26 Vdc at 5 A maximum. Front mounted fuse.

2-51. Communications Protocol

- Type: One RS-232-C port
- Baud Rate: PC-900 A fixed at 9600 baud; PC-900 B switch-selectable at 1200, 2400, 4800, or 9600 baud.

2-52. Fault Relay

- Load: Resistive
- Contact Rating: 120 Vac at 1 A

2-53. PC-900 APPLICATION NOTES

CAUTION

Do not remove any processor modules with a-c power applied.

2-54. Keyswitch Positions

- **Stop/Program:** When the keyswitch is in this position, the processor turns OFF all outputs and does not scan memory. In this keyswitch position, reference ladder diagram lines can be entered, deleted, and altered. Also, register data can be modified.
- **Run/Program Protect:** When the keyswitch is in this position, the processor scans memory and controls outputs. A program loader is used to monitor and force I/O and make register data changes.
- **Run/Modify:** When the keyswitch is in this position, the processor is in the online programming mode. Reference ladder diagram lines are entered, deleted, and altered while the processor is scanning. Also, register data can be modified. This keyswitch position is available on optional online programming processors only.

CAUTION

Do not use an NLPL-780 CRT Program Loader with a software version less than 2.3 to make program changes when the keyswitch is in the optional Run/Modify position. For online programming, use only an NLPL-780 CRT Program Loader that has a software version equal to or greater than 2.3. Failure to do so causes a processor fault.

2-55. Processor Power Up and Power Down Sequences

On **Power-Up**, all outputs are disabled until the front panel **Run** indicator lights. For this LED to light, the following must occur:

1. The **DC OK** condition must exist.
2. The processor must successfully perform self-checks and must verify the contents of the memory maintained during the previous Power-Down sequence.
3. The processor must perform an initial Power-Up scan, during which discrete outputs are set to logic 0 (OFF) and the status of the inputs in the I/O image memory is updated. Also, both registers and forced inputs and outputs retain their states.
4. The processor must perform a logic scan while all discrete outputs are disabled (OFF). Upon completion of this scan, the front panel **Run** indicator lights. At this point, outputs turn ON according to the logic scan, and the processor performs its normal operations, scanning memory and controlling outputs.

When the processor detects a **Power-Down**, all outputs are turned OFF. On this loss of power, the processor calculates and stores checksums to be used for verifying memory during a subsequent Power-Up.

2-56. Processor Modules

The PC-900 processor houses a variety of modules which provide individual functions for system process control.

CAUTION

PC-900A and PC-900B modules do not interchange.

- **CPU/Memory Module:** This module contains the microprocessor that maintains executive control over the processor and executes reference ladder programs. Additionally, this module contains the user memory, I/O image memory, and the executive memory. This module's user memory stores the reference ladder programs and the holding registers. The I/O image memory stores the current status of inputs and outputs. The executive memory contains the instructions that control the microprocessor. The CPU/Memory module also contains the backup battery that maintains the memory in the absence of power. Therefore, a user program can be transferred from one PC-900 processor to another simply by exchanging CPU/Memory modules.

  Note

  This module is easily identified by the four LED's and the keyswitch mounted on its front edge.

  CAUTION

  Do not lay the CPU/Memory module on a metal surface. This practice can short out the battery and cause processor failure due to electrostatic discharge damage.

- **I/O and Loader Interface Module:** This module provides the interface between the processor and both the I/O system and program loader.

Note

This module is easily identified by the 25-pin, D-type connector mounted on its front edge.

2-57. Fuses

One fuse protects the PC-900 internal power supply. To replace this fuse:

1. Ensure the input a-c power is removed from PC-900 processor.
2. Press the front of the fuse holder on the processor cover.
3. Remove the blown fuse.
4. Replace the blown fuse with the appropriate fuse, depending on input power requirements (see paragraph 2-50).

2-58. Power Supply

The PC-900 processor's internal power supply supports the d-c power requirements of the processor and a portion of the I/O modules. The PC-900 power supply provides 500 units of primary power and 20 units of output power. When either of these limits is exceeded in large I/O module configurations, an NLE-770 I/O Expander Power Supply is required.

2-59. Last Valid State/All OFF Jumper

In PC-900 applications, when a fault occurs, the processor stops scanning and the fault relay de-energizes. The states of all outputs in the system during this fault condition are determined by the Last Valid State/All OFF jumper. This jumper is located on the motherboard behind the processor's modules, just under the CPU/Memory and Interface module connectors (see Figure. 2-31). The PC-900 processor is shipped from the factory with this jumper installed (All OFF selection). Therefore, in the event of a fault, all ouptuts turn OFF. At the user's option, this jumper can be removed, so that all outputs remain in their last valid states when the PC-900 processor enters a fault.

2-60. I/O MODULE POWER REQUIREMENTS

Power requirements for the **Numa-Logic** 700 Series Input/Output Modules are given in Table 2-14.

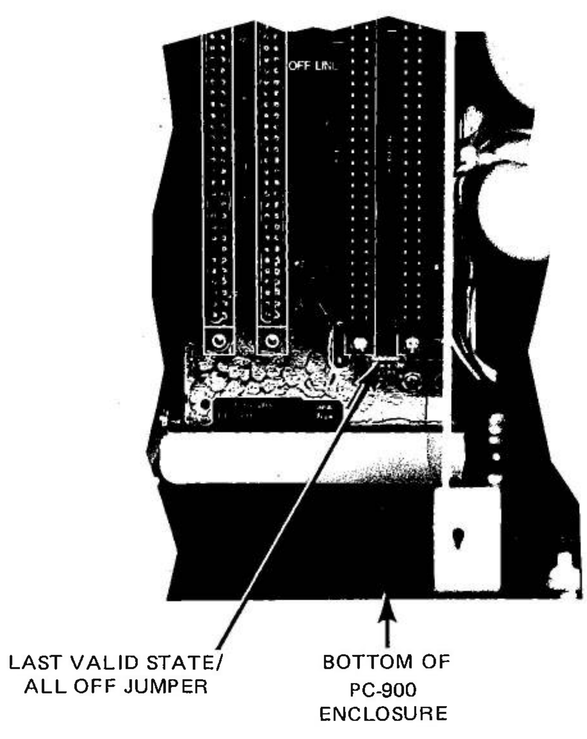


Figure 2-31. Last Valid State/All OFF Jumper Location

TABLE 2-14. SERIES 700 MODULE POWER REQUIREMENTS

Module Catalog Number	Primary Power Units	Output Power Units	External Power Supplies
NL-701	1	0	——
NL-705	1	0	——
NL-707-H	4	0	——
NL-708-H	4	0	——
NL-709-H	4	0	——
NL-710-H	4	0	——
NL-711-H	4	0	——
NL-715-H	5	0	——
NL-720	1	1	——
NL-722	1	1	——
NL-723	1	1	0.14 A at 5.7 Vdc*
NL-728	1	1.5	——
NL-729	1	3	——
NL-731-H	1	4	——
NL-732-H	4	4	300mA at 12 Vdc
NL-733-H	4	4	——
NL-735-H	4	4	250 mA at 12 Vdc
NL-736-H	2	2	——
NL-737-H	2	6	——
NL-738-H	2	4	——
NL-739-H	2	6	——
NL-740A-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12.0 Vdc
NL-740B-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12.0 Vdc
NL-740C-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12.0 Vdc
NL-740D-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12 Vdc
NL-740E-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12 Vdc
NL-740F-H	1	0	0.4 A at 5.8 Vdc and 0.4 A at 12 Vdc
NL-742A-H	9	0	190 mA at 15.8 Vdc and 190 mA at -15.8 Vdc
NL-742B-H	9	0	190 mA at 15.8 Vdc and 190 mA at -15.8 Vdc
NL-742C-H	9	0	190 mA at 15.8 Vdc and 190 mA at -15.8 Vdc
NL-742D-H	9	0	190 mA at 15.8 Vdc and 190 mA at -15.8 Vdc
NL-742E-H	9	0	190 mA at 15.8 Vdc and 190 mA at -15.8 Vdc
NL-743-H	3	0	0.4 A at 5.7 Vdc*
NL-744-H	120	0	0.14 A at 5.7 Vdc*
NL-750A-H	220	0.1	——
NL-750B-H	220	0.1	——
NL-750C-H	320	0.1	——

TABLE 2-14. SERIES 700 MODULE POWER REQUIREMENTS (Cont'd)

Module Catalog Number	Primary Power Units	Output Power Units	External Power Supplies
NL-751-H	4	1	150 mA at 15.8 Vdc and 150 mA at −15.8 Vdc
NL-752-H	4	1	±15.8 V or +24 V**, −15.8 V: 110 mA for 4 to 20 mA and 0 to 20 mA ranges; 230 mA for 10 to 50 mA and 0 to 50 mA ranges
NL-753-H	1	4.5	0.3 A at 5.7 Vdc*
NL-754-H	120	1	0.335 A at 5.7 Vdc*
NL-771-H	80	0	––
NL-772-H	175	0	––

*These values are for the module only, excluding load.
**With the 24 Vdc power supply, the 4 to 20 mA output can be used with loads up to 900Ω, and the 10 to 50 mA output can be used with loads up to 360Ω.

Note

The values for output power consumption are maximums, determined on the basis of all module outputs ON. In a typical system where 50% or less of the outputs are ON simultaneously, the PC-900 power supply has sufficient output power to support all 127 discrete outputs without an optional I/O expander power supply.