SECTION 7. INSTALLATION AND START-UP

PC-700/900 Programmable Controllers

7-1. INSTALLATION OVERVIEW

The PC-700 or PC-900 Programmable Controllers and associated equipment (I/O racks and modules) are normally installed on a subplate (panel), which is mounted into a NEMA-12 (or other customer-supplied protective enclosure suitable for application). Construction of a **Numa-Logic** PC-700 or PC-900 based system on this panel is more simple than construction of its relay counterpart. Panel construction is best done by using a **Build and Test Technique**, recommended by Westinghouse. This technique enables construction to be done in stages, with each stage tested before the next one is started. Using this technique prevents or minimizes potential time and labor losses by identifying equipment problems early in the fabrication process. Also, this technique prevents physical mounting and fitting conflicts during panel construction.

7-2. PANEL FABRICATION AND MOUNTING

7-3. GENERAL

The Build and Test Technique is used to install a PC-700 or PC-900 Programmable Controller system in three stages:

1. Processor installation and test.
2. I/O rack installation, setup, and test.
3. Field wiring, module installation, and test.

This three-stage method of installation ensures that the processor is operating correctly at the earliest possible time. After processor installation, this procedure ensures that the I/O racks are properly installed and working with the processor before additional components are added. In this way, the panel is pretested prior to field wiring and I/O module installation.

Using this procedure, the I/O cable is in place and tested before field wiring is installed, thereby, circumventing physical conflicts between the I/O cable and field wiring. The I/O modules are installed into the appropriate rack positions after field wiring is completed. Module inputs are verified and outputs are tested for proper operation by using the programs provided in Section 8.

This recommended technique results in a significantly easier fabrication and start-up period. If problems are encountered during the installation and application of the PC-700 or PC-900 systems, contact your Westinghouse Service Representative. At additional cost, **Numa-Logic** provides system design, programming, drawing documentation, panel assembly, and system start-up assistance.

7-4. UNPACKING INSTRUCTIONS

7-5. Delivery Inspection

Numa-Logic Programmable Controllers and associated equipment are extensively tested and carefully packed at the factory prior to shipment. On delivery of equipment, the user should:

- **Inventory** the equipment against the order and/or packing list to ascertain that both the quantities and types of components ordered have been received.
- **Inspect** the equipment for visible damage incurred during shipment.
- **Test** the equipment to ensure that the key components are operational.
- Complete and return the warranty card.

NOTICE

Any claim for damage should be filed with the carrier or his agent. Also, notify the factory so that corrective action can be taken at the earliest time.

Unpack the processor and any peripheral equipment (e.g., program loader, tape loader, printers, etc.) to conduct power tests. Testing at this time ensures that the processor and peripherals are operational and allows early corrective action in the event of a malfunction. The I/O racks, modules, and cables are unpacked and tested at a later time during construction; their shipping containers should only be inspected for obvious damage.

During this unpacking and inspecting process, the processor and peripheral equipment serial numbers should be located and recorded for future reference.

7-6. Electrostatic Discharge

Numa-Logic Programmable Controllers and their associated hardware are constructed, tested, and packed at the factory for shipment in a static safe environment. Units and modules requiring individual protection are shipped in anti-static, sealed bags. The sealed bag shown in Figure 7-1 should be intact when the module is received. If this is not the case, consult your Westinghouse distributor for replacement.

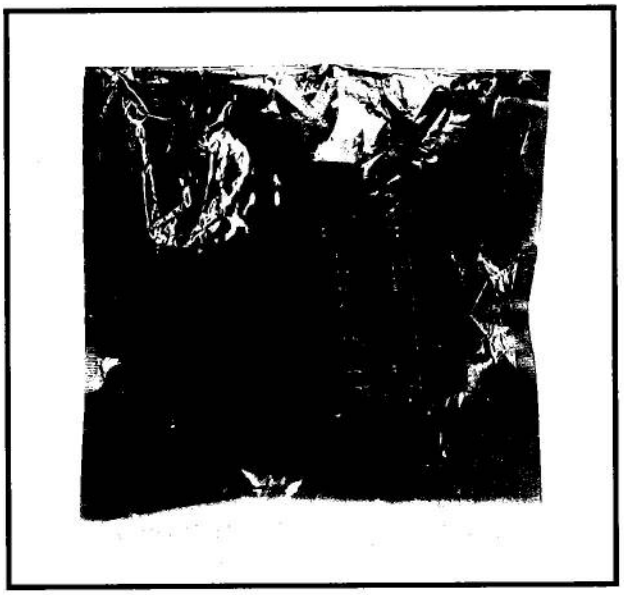


Figure 7-1. Anti-Static Bag Seal

Units not packed in anti-static bags are adequately protected as long as they remain assembled. Disassembly (i.e., removal of CPU modules) should be accomplished only in a static safe environment.

The 3M Type 8005 portable field service grounding kit (or equivalent) is recommended for static safe unit disassembly.

A minimum level of static protection for handling modules is provided by the use of 3M Type 2064 wrist straps (or equivalent).

CAUTION

Processor failure can result from electrostatic discharge damage due to the improper handling of components. Handle modules and components only in a STATIC SAFE environment.

7-7. PC-700 PROCESSOR POWER UP CHECK

Information

The PC-700 processor power up checkout procedure is completed after unpacking and prior to processor installation onto the panel. This checkout procedure requires the use of a program loader. Retain the processor and program loader packing materials for possible equipment storage prior to installation, or in case further shipment is required.

Precheck Procedure

1. After the PC-700 processor is unpacked, inspected for damage, and inventoried, place it on a flat surface (e.g., table top, bench, etc.).

2. Remove the PC-700 processor's lower front cover plate by turning the two 1/4 turn fasteners (colored black) counterclockwise until the plate releases.

Battery Voltage Test (Version 1 Power Supply only)

PC-700 processors with Version 1 power supplies are shipped with the backup battery installed in one of two methods: hardwired or plugged-in. (Version 1 can be recognized by the absence of a specific label; Version 2 is clearly labelled. Version 1 has no suffix (i.e., PC-700) on the

faceplate of the power supply, while Version 2 has a suffix (i.e., PC-700B)). Figure 7-2 shows both the hardwired and plugged-in methods. The voltage test for each method follows:

- Hardwired Battery

  These units are shipped with the memory backup fuse removed from the memory module. (See Figure 7-2 for the fuse location.) This hardwired battery is checked with the fuse removed. To check this battery:

  1. Check to see that the fuse is removed.
  2. Measure the battery's open circuit voltage between the black (−) battery lead and the red (+) battery lead on the memory module's circuit board.
  3. See Table 7-1 for battery readings and the meaning of each reading.

- Plugged-In Battery

  Unlike the hardwired type, these units are shipped with a battery plug that connects to a socket on the memory module circuit board. See Figure 7-2 for the plug and socket location. This plugged-in battery is checked with the plug disconnected. To check this battery:

  1. Measure the battery's open circuit voltage between the black (−) battery lead and the red (+) battery lead on the disconnected plug.
  2. See Table 7-1 for battery readings and the meaning of each reading.

In both cases, if the battery measured voltage indicates that the battery needs charged, continue with the checkout procedure. On completion of this checkout procedure, leave the unit ON for 48 hours and then recheck. This should have recharged the battery. If this does not recharge the battery, continue charging for an additional 12 hours and recheck again. If the battery does not adequately recharge (remains below 4.2 Vdc) or if the measured voltage is below 3.6 Vdc, contact your Westinghouse Service Representative for a replacement battery.

Battery Activation

The method of activation for the memory backup battery depends on the type (A or B) of PC-700 processor used. Instructions for connecting each type follows:

- **PC-700A, Hardwired**

  As shown in Figure 7-2, this battery is hardwired to and mounted on the memory module. The fuse protecting the memory circuits has been removed to prevent discharge during shipping. This fuse is taped to the back of the lower front cover panel previously removed. **To activate the battery, insert this 0.5 A, 8 AG fuse into the fuse holder marked FU-1.** FU-1 is located on the left side at the front of the memory module.

- **PC-700A, Plug-In**

  As shown in Figure 7-2, this battery is also mounted on the memory module. However, this battery plugs into a socket also mounted on the memory module. In these plug-in units, the fuse has been installed, but the units are shipped with the battery unplugged. **To activate the battery, locate the plug and insert it into the socket on the memory module.** This socket is located on the left side at the front of the memory module.

- **PC-700B**

  As shown in Figure 7-3, this battery is mounted on the PC-700 case (enclosure) and also plugs into a socket on the memory module. This unit is shipped with the battery unplugged to prevent discharge. **To activate the battery, locate the plug and insert it into the socket on the memory module.**

CAUTION

It is not necessary to remove the memory module to install the fuse or to connect the battery plug. Damage to the user memory can occur if the module is removed without observing proper static handling precautions, as described in paragraph 7-6.

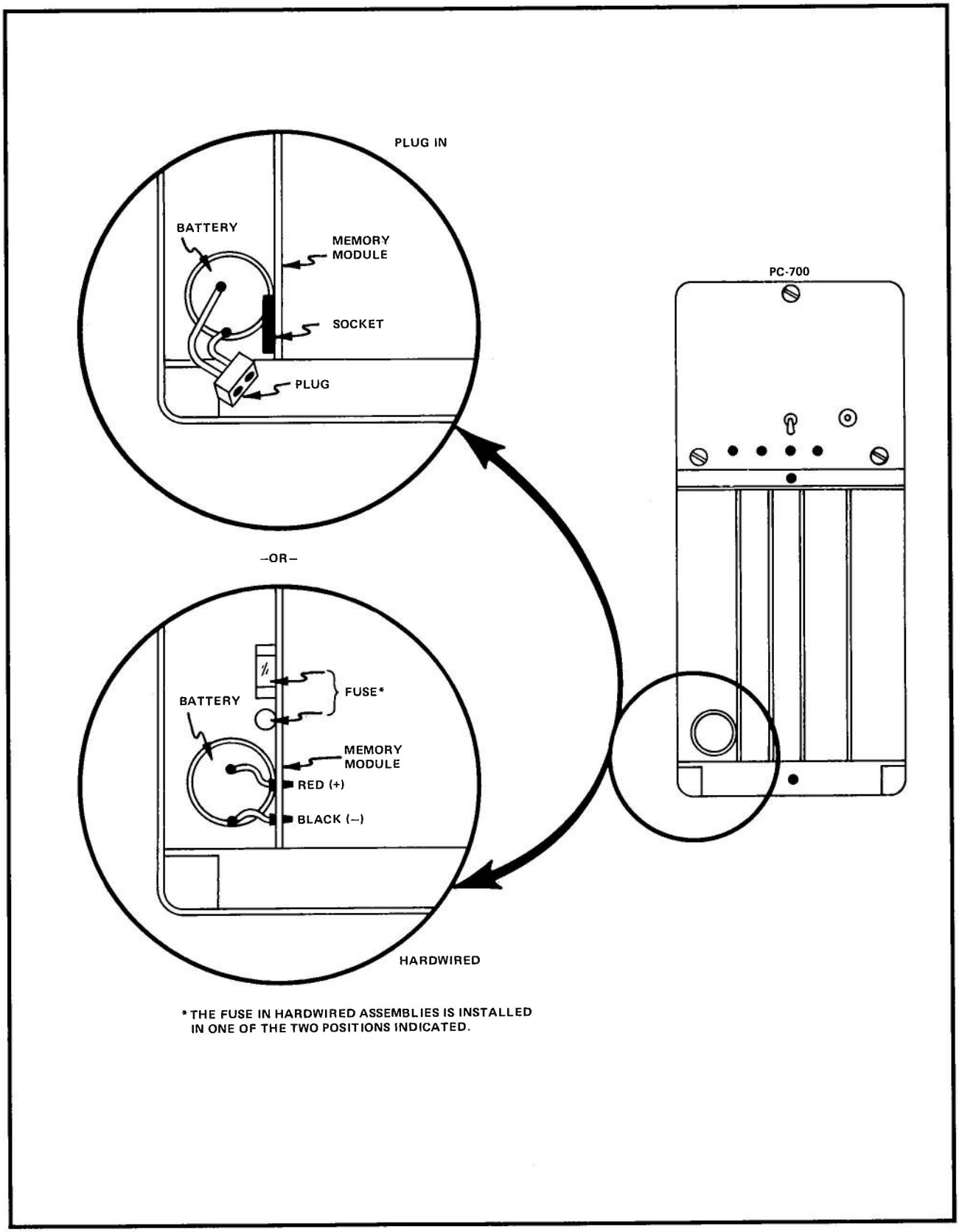


Figure 7-2. Version 1 Battery and Fuse Locations

TABLE 7-1. BATTERY VOLTAGE TEST READINGS

Reading	Meaning
4.3 Vdc and up	Battery is adequately charged for backup operation.
3.6 through 4.2 Vdc	Battery requires charging.
Below 3.6 Vdc	Battery failed and needs replaced.

Operating Voltage Selection

The PC-700 Version 1 power supply is shipped to operate at 120 Vac. The optional 240 Vac operation of this power supply is not user-selectable. If 240 Vac operation is desired, it must be specified when ordering the equipment to ensure that it is installed at the factory prior to shipment. The Version 1 and Version 2 power supplies are shown in Figure 7-4.

The PC-700 Version 2 power supply is also shipped to operate at 120 Vac. However, unlike the Version 1 power supply, the Version 2 power supply's 240 Vac operation is user-selectable. If 240 Vac operation is desired, locate the selector switch on the back of the power supply and change its setting to 240 Vac. It is also necessary to replace the 4 A, 3 AG fuse (120 Vac operation) with a 2 A, 3 AG fuse for 240 Vac operation. The Version 2 power supply fuse and switch locations are shown in Figure 7-5.

PC-700 Module Seating

Check to see that all modules and the power supply assembly are firmly seated in the corresponding sockets of the mother board within the PC-700 enclosure.

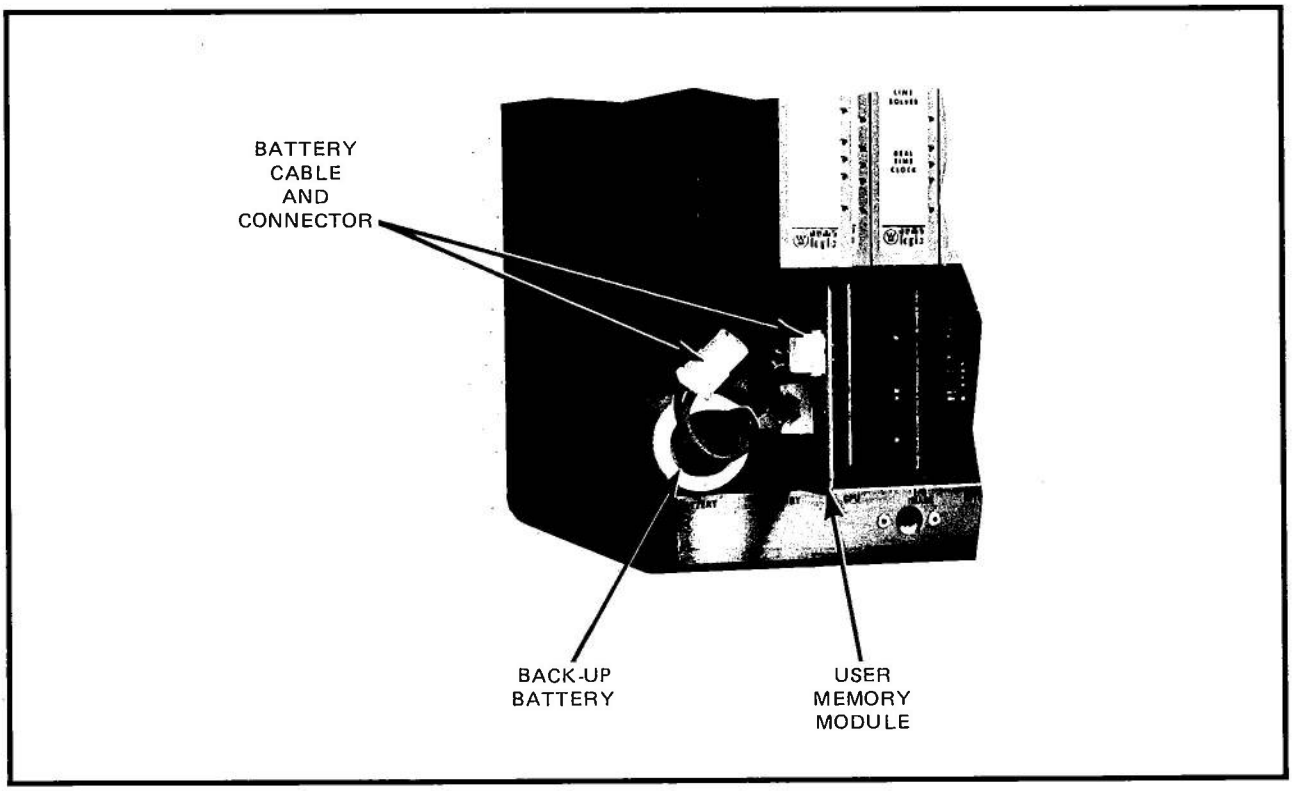


Figure 7-3. PC-700B Battery and Plug Locations

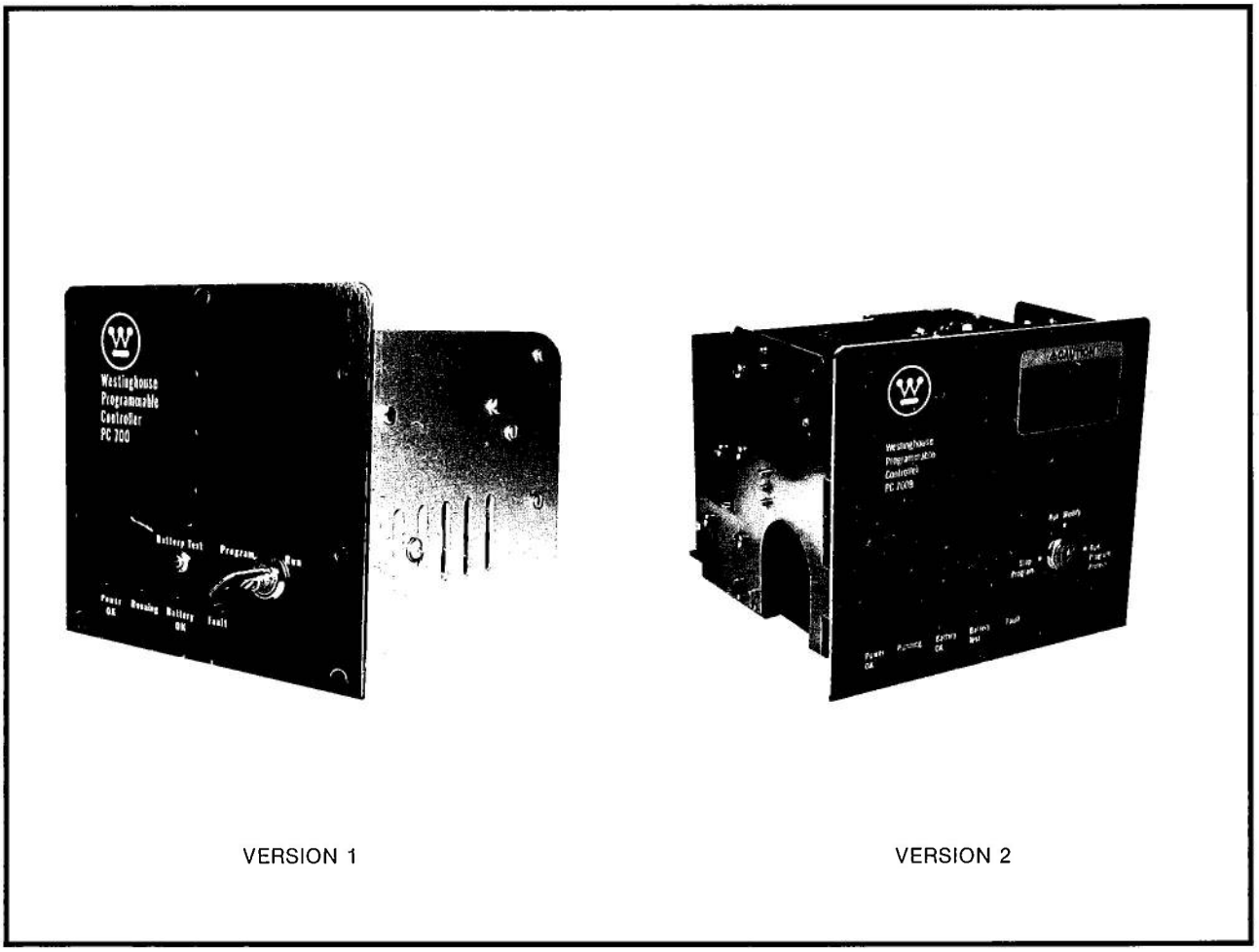


Figure 7-4. PC-700 Power Supplies

Battery Test Switch Check

In both the Version 1 and Version 2 power supplies, the **Battery Test** switch (upper front panel) indicates that the battery is adequately charged to maintain user memory. To verify the switch's operation and to further check the battery:

1. Press the **Battery Test** switch and observe that the **Battery OK** LED lights.
2. If this is a Version 1 power supply application and the power is OFF, this LED remains OFF if the battery is discharged or needs replaced. In either case, complete this checkout procedure and attempt to recharge the battery before contacting the Westinghouse Service Representative. With the power ON, a Version 1 power supply battery light indicates that the battery charging circuit is operational.

If this is a Version 2 power supply application, this LED flickers if the battery needs recharged and is OFF when the battery needs to be replaced. When the LED flickers, attempt to recharge the battery after completing these checkout procedures. When the LED is out, contact the Westinghouse Service Representative for a replacement. In either case, complete these checkout procedures. With the Version 2 power supply, this procedure is valid if the power is ON or OFF.

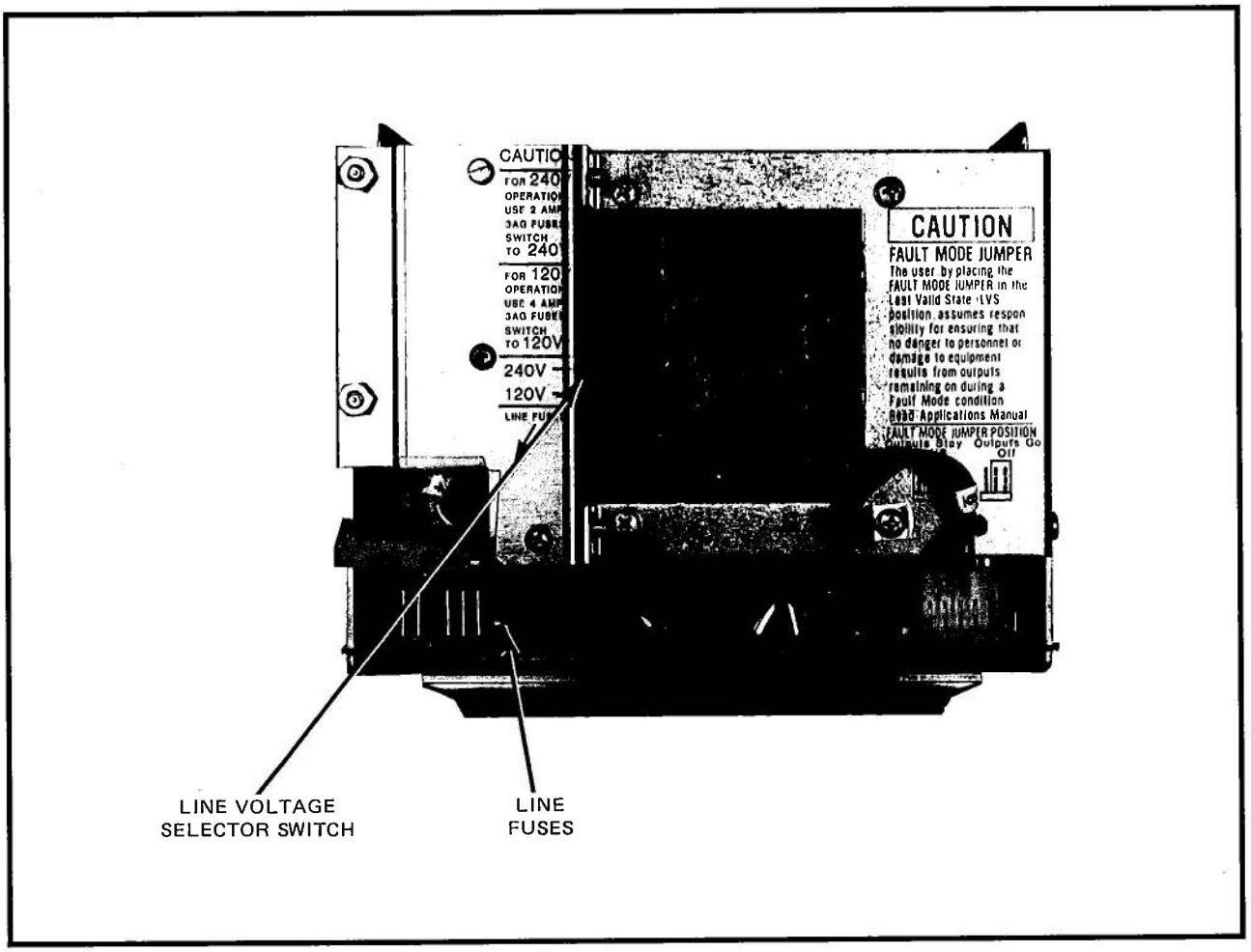


Figure 7-5. Version 2 Power Supply, Rear View

A-C Line Cord Connection

Connect a three-wire, a-c line cord to Terminals 6, 7, and 8 of the processor terminal strip, as shown in Figure 7-6. (Proper phasing and a ground connection for the three-wire cord are required.) After making this connection, place the front panel keyswitch in the **Program** position, and plug in the processor. Observe the four front panel LEDs, which should indicate as follows:

- **Power OK** — lights
- **Fault** — lights
- **Battery OK** — OFF
- **Running** — OFF

If the **Power OK** LED remains OFF, check to see that fuses are installed and are not blown, recheck the a-c line cord connections, and make sure that processor is plugged into an active a-c outlet. If these three checks are okay, and this LED remains OFF, or if the other three LED displays are improper, see Section 9.

PC-700 Processor Initialization

The program loader is used to initialize the PC-700 processor (i.e., erase CPU memory). Like the processor, the program loader must be carefully unpacked, inspected, inventoried, and tested prior to its use. After the program loader is checked okay, it should be placed on a flat surface, close to the processor, for ease of connection. Refer to the program loader's "programming manual" for program loader checkout and operating instructions for initializing the processors. Also, the PC-700 and the program loader must be connected to the same power source and properly phased.

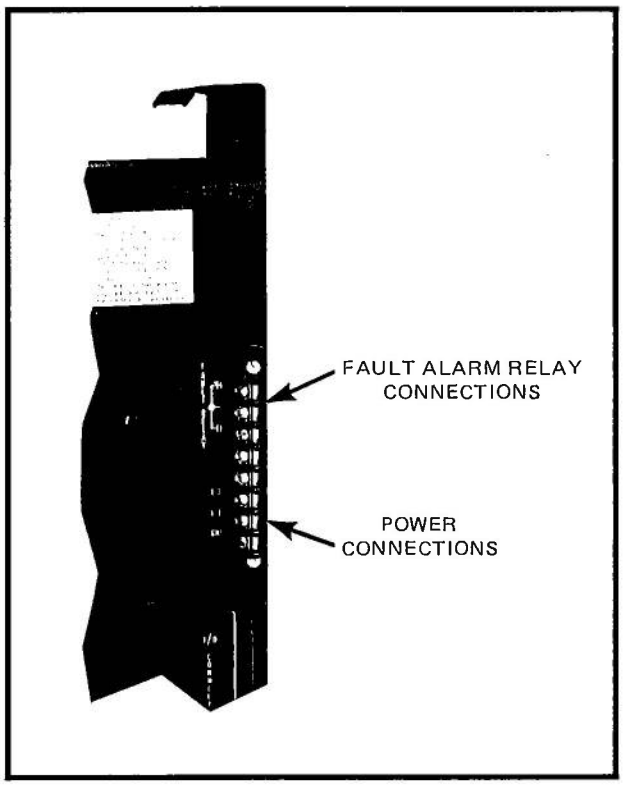


Figure 7-6. PC-700 Processor Terminal Strip

Run Mode Verification

After the processor has been initialized in the preceding step, place the processor's front panel keyswitch in the **Run** position. Observe the four front panel LEDs, which should indicate as follows:

- **Power OK** — lights
- **Fault** — OFF
- **Battery OK** — OFF
- **Running** — lights

If the **Fault** LED remains lit, or if the other LEDs indicate improper display, see Section 9.

Conclusion

The successful completion of this checkout procedure indicates that both the PC-700 processor and the program loader are functioning normally, and are ready for installation. Since the program loader is connected and the processor has been initialized, the memory size and software version can be verified by displaying the processor status. If the processor and program loader will not be used immediately, disconnect them and repack the equipment in the saved shipping containers.

CAUTION

If the processor is to be stored for a period longer than several days, remove the memory module fuse or unplug the battery. Failure to do this allows the battery to discharge unnecessarily during storage.

7-8. PC-900 PROCESSOR POWER UP CHECK

Information

The PC-900 processor power up checkout procedure is completed after unpacking and prior to processor installation onto the panel. This checkout procedure requires the use of a program loader. Retain the processor and program loader packing materials for possible equipment storage prior to installation, or in case further shipment is required.

Precheck Procedures

1. After the PC-900 processor is unpacked, inspected for damage, and inventoried, place it on a flat surface (e.g., table top, bench, etc.).

2. Remove the PC-900 processor's faceplate by turning the two black, 1/4 turn fasteners counterclockwise until the faceplate releases. GENTLY push on the upper right-hand corner of the faceplate, while grasping the lower left-hand corner to lift away the faceplate.

3. Check to see that all modules are firmly seated into the corresponding sockets of the mother board within the PC-900 enclosure.

4. If this unit is to be immediately placed into service, activate the backup battery. To activate the battery, locate the plastic tab under the end of the battery. See Figure 7-7. Pull this tab to remove it, thus, activating the battery.

CAUTION

If the processor is to be stored for an extended period (several days), DO NOT activate the battery. Activating this battery prior to storage allows it to discharge unnecessarily.

5. Re-install the PC-900 faceplate and tighten the screws in a clockwise direction until the faceplate is securely in place.

Operating Voltage Selection

The PC-900 processor is shipped to operate at 120 Vac. The optional 240 Vac or 24 Vdc operation of this processor is not user-selectable. If either of these options is desired, it must be specified when ordering the equipment (to ensure that it is installed at the factory prior to shipment).

Depending on which operating voltage is selected, check to see that the appropriate fuse (listed in Table 7-2) is installed in the front panel fuse holder marked **AC LINE FUSE**. (See Figures 7-7 and 7-8.)

TABLE 7-2. PC-700 LINE FUSES

Input Voltage	Required Fuse
120 Vac	4 A, 250 V, 3 AG
240 Vac	2 A, 250 V, 3 AG
24 Vdc	7 A, 250 V, 3 AB

A-C Line Cord Connection

Locate the PC-900 processor terminal strip at the top rear of the enclosure (see Figure 7-8). Unsnap the protective cover and fold it down to expose

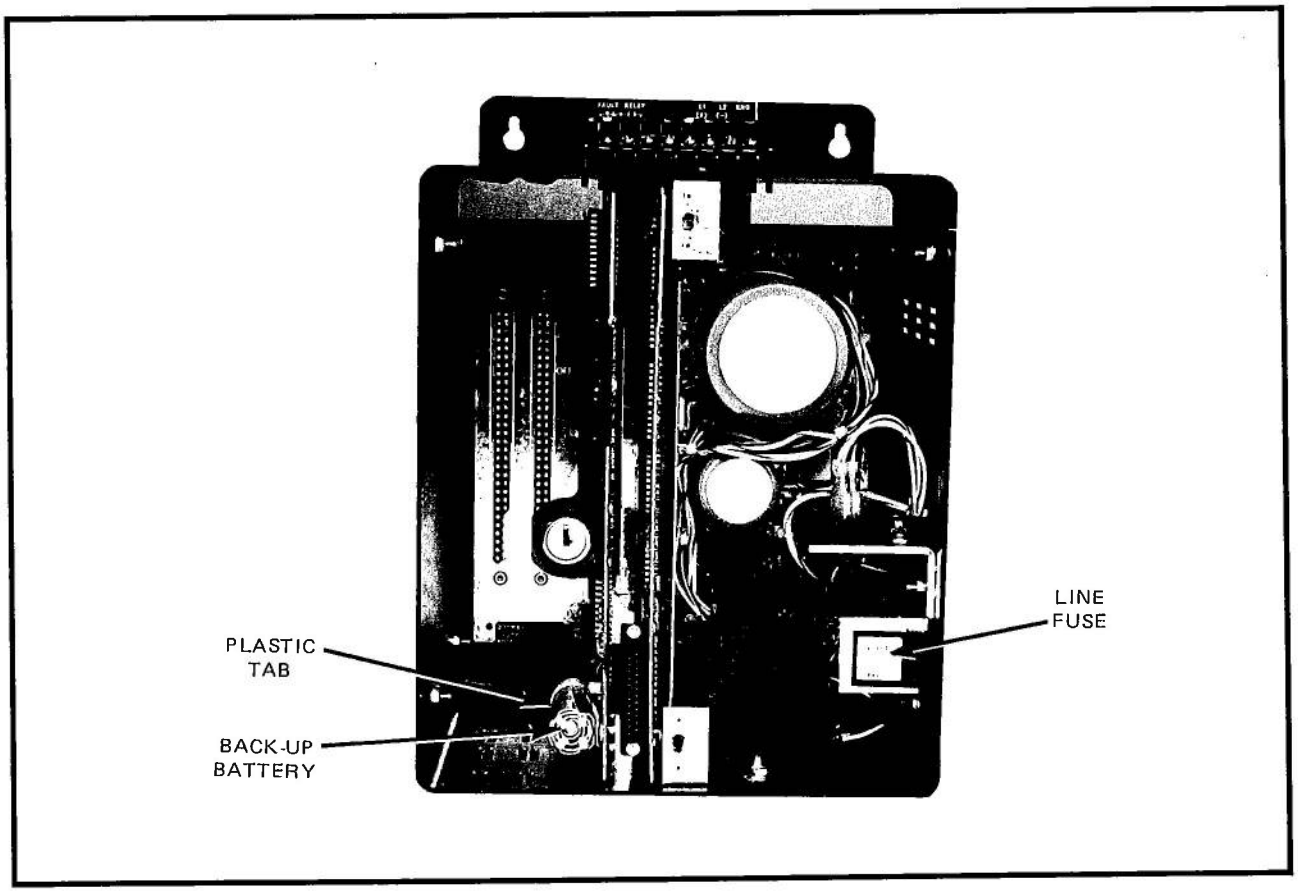


Figure 7-7. PC-900 Processor without Faceplate

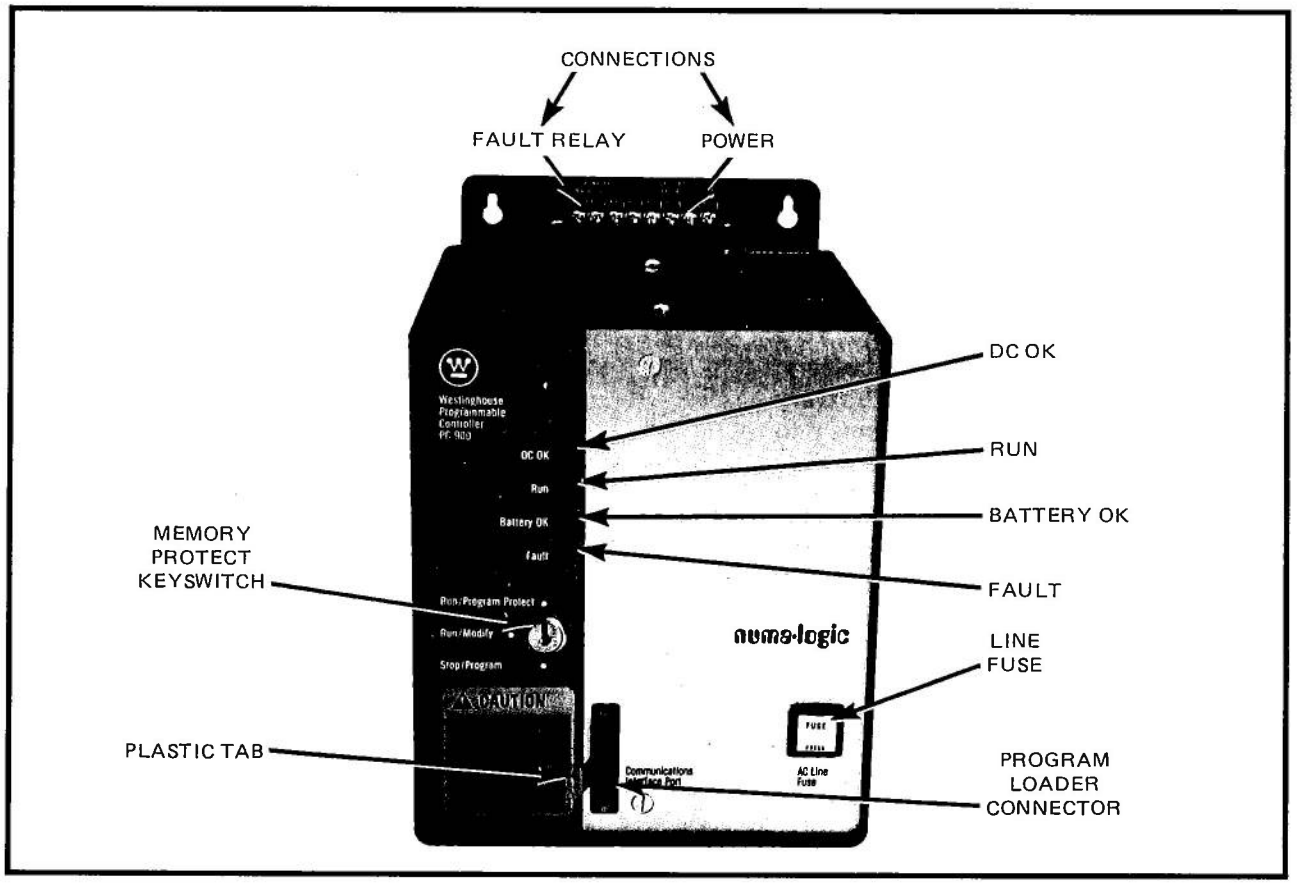


Figure 7-8. PC-900 Processor with Faceplate

the terminals. Connect a three-wire, a-c line cord to Terminals L1, L2, and GND. The cord must be properly phased by connecting the L1 terminal to the power (hot) wire, the L2 terminal to the neutral wire, and the GND terminal to the ground wires.

WARNING

IF POWER IS APPLIED TO THE PC-700 PROCESSOR WITH THE PROTECTIVE COVER UNSNAPPED, THE TERMINALS ARE EXPOSED. THIS MAY RESULT IN PERSONNEL COMING IN CONTACT WITH APPLIED POWER, RESULTING IN INJURY TO PERSONNEL.

After making this connection, place the front panel keyswitch in the **Stop/Program** position and plug in the processor. Observe the four front panel LEDs, which should indicate as follows:

- **DC OK** — lights
- **Fault** — lights
- **Battery OK** — lights if activated
  — OFF if not activated
- **Run** — OFF

Note

On standard, two-keyswitch position PC-900 processors, the **Stop/Program** position is fully clockwise. On optional online programming, three-keyswitch position PC-900 processors, the **Stop/Program** position is fully counterclockwise. Both keyswitch types are shown in Figure 7-8.

If the **DC OK** LED remains OFF, make sure that the fuse is installed and not blown; recheck the a-c line cord connections; and make sure that the processor is plugged into an active a-c outlet. If these three checks are satisfactory and this LED remains OFF, or if the other three LED displays indicate errors, see Section 9.

PC-900 Processor Initialization

The program loader is used to initialize the PC-900 processor (i.e., erase CPU memory). Like the processor, the program loader must be carefully unpacked, inspected, inventoried, and tested prior to it use. After the program loader is found to be operational, it should be placed on a flat surface, close to the processor, for ease of connection. The processor and loader must be plugged into the same power source and properly phased. Refer to the program loader's "programming manual" for program loader checkout and operating instructions for initializing the processor.

Run Mode Verification

After the processor has been initialized in the preceding step, place the processor's front panel keyswitch in the **Run/Program Protect** position. Observe the four front panel LEDs, which should indicate as follows:

- **DC OK** — lights
- **Fault** — OFF
- **Battery OK** — lights if activated
  — OFF if not activated
- **Run** — lights

If the **Fault** LED remains lit, or if the other LEDs indicate improper display, see Section 9.

Conclusion

The successful completion of this checkout procedure indicates that both the PC-900 processor and the program loader are functioning normally, and are ready for installation into the system. Also, at this point, the memory size and software version can be verified by calling up the processor status on the program loader. If the processor and program loader will not be used immediately, disconnect the equipment and repack it in the saved shipping containers.

7-9. PANEL SELECTION AND MOUNTING

7-10. GENERAL

Before panel fabrication is started, the type of enclosure layout, wire routing, and ducting must be considered. In most applications, a free standing NEMA-12 enclosure is used. A typical NEMA-12 enclosure is shown in Figure 7-9. Both the PC-700 and PC-900 processors are designed to be mounted on a subplate within this enclosure (or equivalent). The I/O racks are also designed for this type of installation.

A minimum clearance of eight inches is required between the enclosure's top panel and the top-most system component to be mounted. A minimum clearance of 12 inches is required between the lowest system component and the enclosure's bottom. Both clearances provide adequate cooling for a programmable controller system installed in this type of enclosure. The PC-700 processor requires adequate clearance on its right-hand side for power and cable connection to the I/O racks and the program loader. This clearance specification is not necessary for the PC-900 since the PC-900 has the power connections on the top, the I/O cable connections on the bottom, and the program port on the front.

CAUTION

These clearances are satisfactory for most applications. However, if internal enclosure temperatures periodically exceed 60°C (140°F), fans or purge air systems should be used to increase the air flow and eliminate "hot spots" within the enclosure. In extreme conditions, air conditioning of the enclosure may be required.

Numa-Logic Programmable Controllers are designed and constructed to minimize the effect of harsh industrial environments. However, when any control system operates under extreme conditions, additional measures must be taken to completely isolate the control system. A variety of techniques, depending on the application, is presented in the following paragraphs. Use these recommended techniques as a quide for the most effective use of the **Numa-Logic** Programmable Controllers.

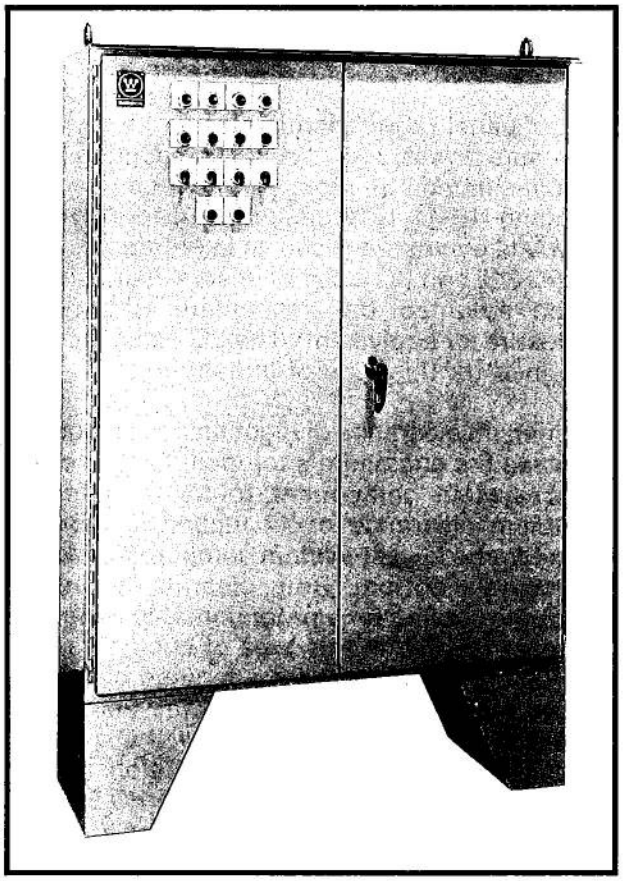


Figure 7-9. Typical NEMA-12 Enclosure

7-11. LAYOUT CONSIDERATIONS

CAUTION

Protect the programmable controller hardware from metal chips and conductive particles which could cause short circuits. Failure to observe this precaution may cause subsequent system failure when power is applied, and may void the warranty.

I/O Cables

The I/O cables used to interconnect the I/O racks and processors are supplied by the factory in standard lengths. The length of each I/O cable within a system should be held to a minimum. The total I/O cable length, measured between the processor and the furthermost I/O rack, should not exceed 20 feet. The same restriction applies between the I/O expander power supply and the most distant racks connected to it. Also, no attempt should be made to modify these cables. All excess cable length must be positioned away from a-c field wiring connections.

CAUTION

Do not remove cable from a rack or programmable controller port by pulling directly on flat cable. This can damage the cable. To remove a cable, gently lift the tab on the body of the connector to loosen it; then, remove the cable.

I/O Rack Separation

Vertical separation between vertical I/O racks should be a minimum of four inches. This clearance maintains the proper cooling around system components. Additional rack separation may be required for the installation of the wire duct and panel hardware.

A minimum clearance of 1.75 inches should be provided around the entire horizontal I/O rack assembly (four or eight modules) to maintain proper cooling.

CAUTION

Do not install the I/O racks directly above the processor, I/O expander power supply, or other high-heat-dissipation device. This practice increases the temperature, which can cause improper operation.

Auxiliary Components

Do not install auxiliary components in a position where the free flow of air over the processor or power supply is impeded. Additionally, all electromagnetic devices (e.g., control transformers, etc.) are installed at least 18 inches from the processor.

Communications Cable

The communications cable, which interconnects the program loader and processor, is supplied as a standard six-foot cable.

Temperature

The ambient temperature around the equipment should not exceed 60°C (140°F).

Wire Routing

Most **Numa-Logic** equipment meets NEMA and IEEE noise specifications. However, as a precaution, the processor power supply wiring, the processor to the I/O racks' cables, and the field wiring to the input and output modules should be kept separate from wires carrying more than 230 Vac. The high a-c voltage wiring should be shielded or placed in a metallic cable duct, separating it from the low d-c voltage level wiring. When high a-c voltage wiring is run outside the programmable controller's enclosure to control heavy machinery, it should be enclosed in its own metallic duct. Also, an external high voltage wiring should not be routed adjacent to any 120 V control wiring connected to the input and output modules. All ducts should be solidly grounded to the chassis.

As a precaution, 120 and 240 Vac wiring should be routed separately from the d-c field wiring to input and output modules. Separate a-c output wiring from a-c input wiring. These wires may be separately bundled or placed loosely in the wiring duct. Input and output wiring (d-c or a-c) should not be routed in parallel with the I/O flat cable connecting the processor to the racks or to the program loader.

Sample programmable controller system layouts are shown in Figures 7-10 through 7-12.

7-12. GROUNDING CONSIDERATIONS

CAUTION

Proper grounding is essential to the trouble free operation of the programmable controller system. Unwanted shutdowns and control failures may occur if this system is improperly grounded.

The PC-700 or PC-900 processors and I/O racks are mounted to the enclosure's subplate by using star washers to ensure proper electrical contact. The ground service lug on the subplate is connected to the electrical service ground with a No. 10 AWG wire or larger. All system components must use the subplate as the ground reference.

A typical programmable controller power wiring scheme is shown in Figure 7-13. As shown, power to the processor and peripherals is isolated by a 500 VA control transformer (T2). The X2 end of this transformer's secondary, the ground pin of the 115 Vac peripheral's receptacles, and the processor's ground terminal are all connected to the subplate. This T2 transformer is a Westinghouse Type MTC (or equivalent), 500 VA transformer used to isolate the power supply from I/O-generated switching transients in normal applications. In applications where particularly "dirty" a-c supply lines exist, change T2 to a high isolation transformer or line conditioner.

CAUTION

Serious damage can result to the programmable controller and related system peripherals (i.e., program loader and printers) if the same ground is not common to all components.

Figure 7-14 illustrates two recommended methods of mounting components and making electrical service ground connection to the enclosure's subplate. The top method uses a tapped subplate hole and is the preferred mounting technique. The bottom method is the alternate through-bolt mounting technique.

7-13. FIELD WIRING

7-14. I/O Screw Terminal Connections and Wire Routing

Field wiring connections to the input and output modules are made to 300 V, captive screw terminals located on a stationary terminal strip. As shown in Figure 7-15, this terminal strip is mounted adjacent to each module, along with a corresponding terminal identification strip. This figure also shows the rack's self-contained wiring duct for field wire runs.

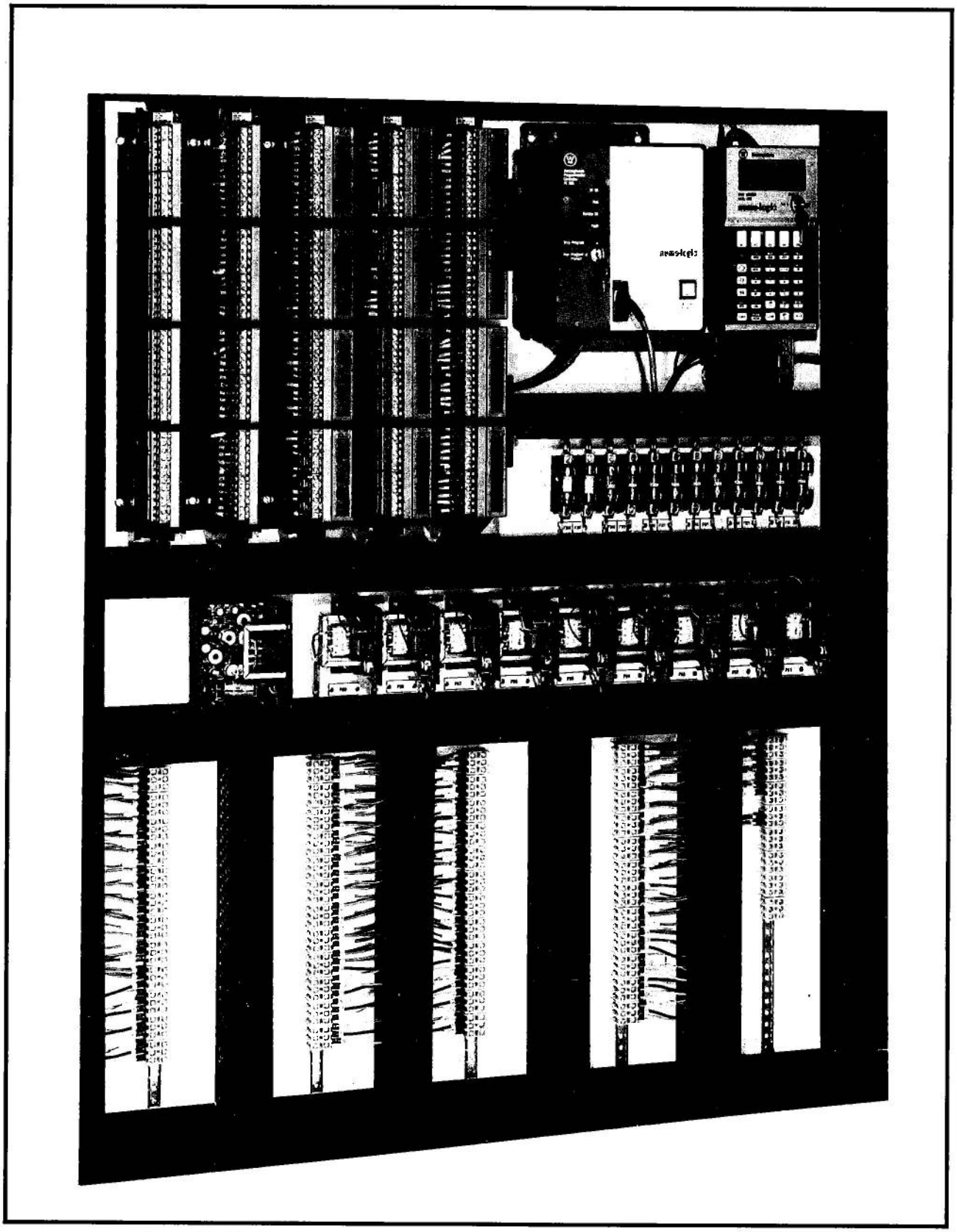


Figure 7-10. System Layout, PC-900 and I/O Racks in NEMA Enclosure

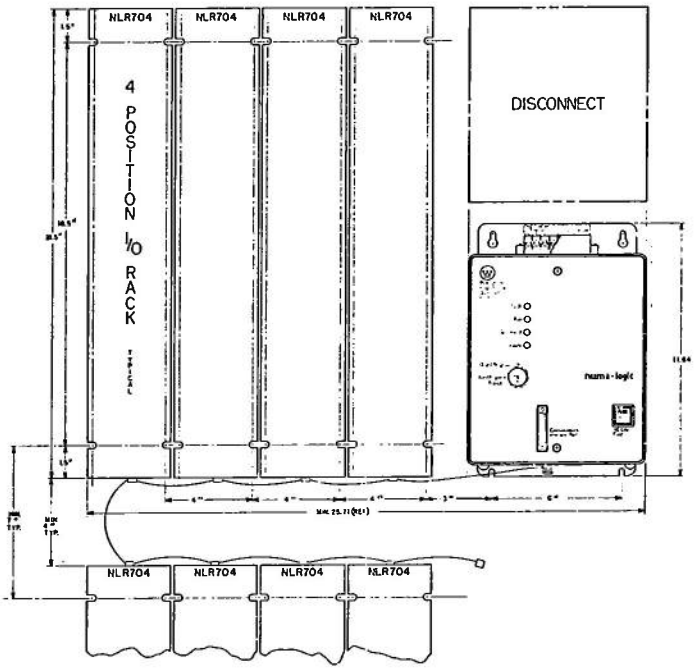


Figure 7-11. System Layout, PC-900 and I/O Racks

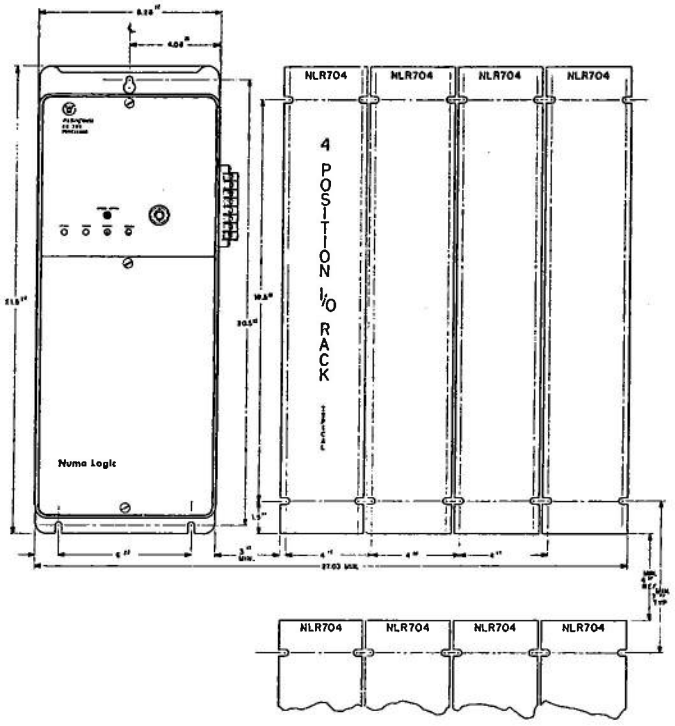


Figure 7-12. System Layout, PC-700 and I/O Racks

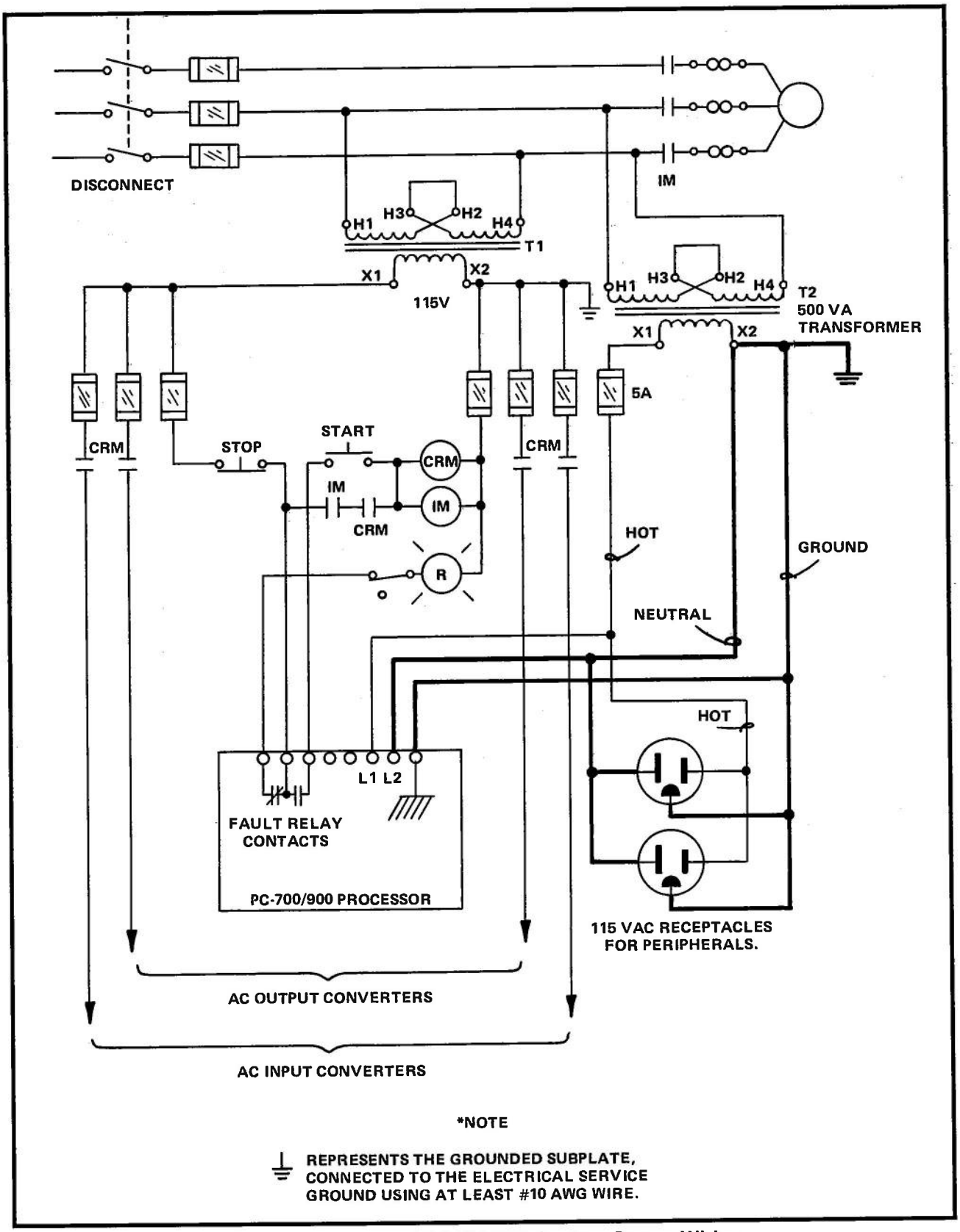


Figure 7-13. Typical PC-700/900 System Power Wiring

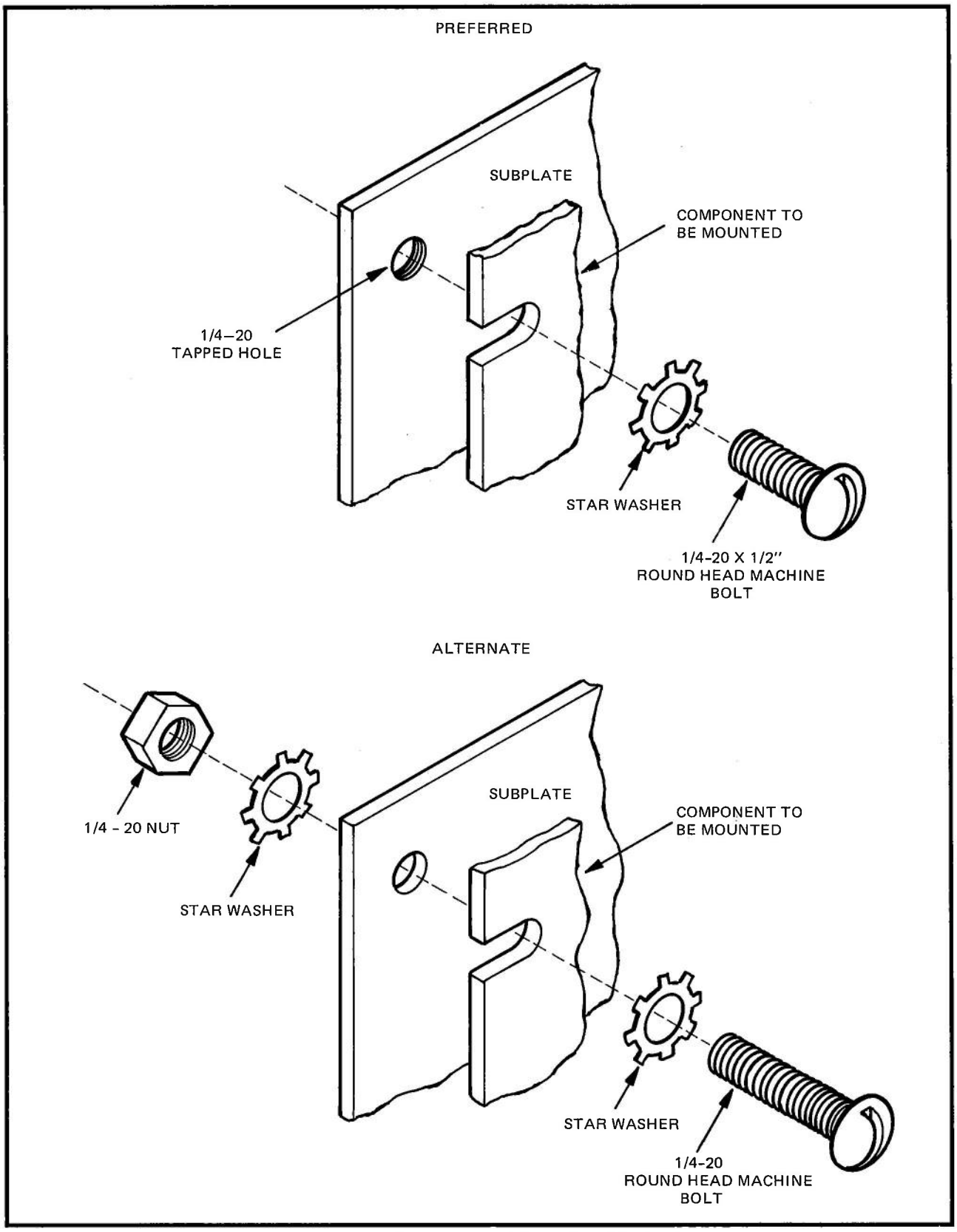


Figure 7-14. Component Mounting Methods

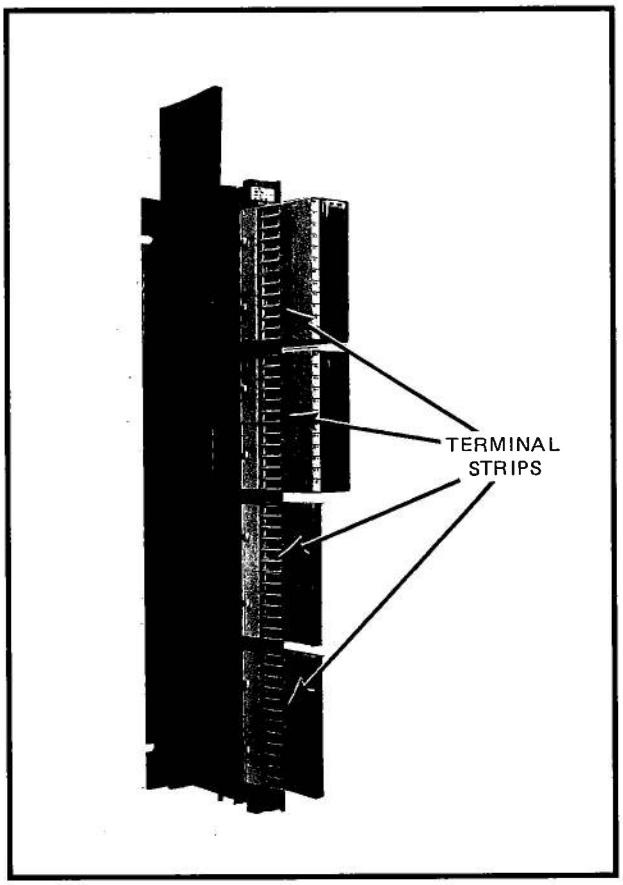


Figure 7-15. I/O Rack Terminal Strip Location

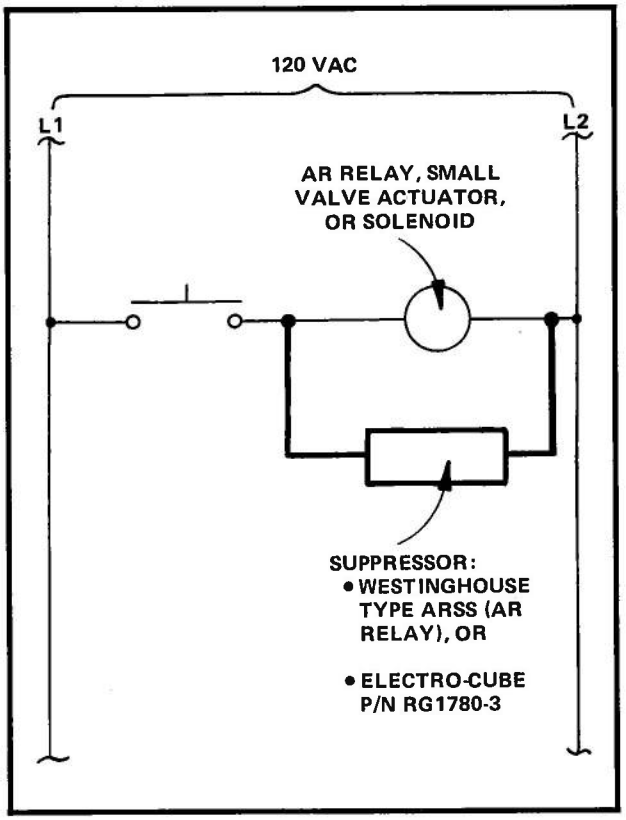


Figure 7-16. Relay, Valve, and Solenoid Suppression Example

7-15. Suppression Requirements and Techniques

The recommended installation procedures given previously in this section are intended to enhance the system's inherent resistance to electrical interference. It is also recommended that additional steps be taken to suppress major sources of interference, should interference become a problem. Inductive devices (e.g., relays, solenoids, motor starters, etc.) operated by "hard contacts" are one source of this interference. Figure 7-16 shows a suppression technique which can be used for AR relays, small inductively-activated valves, or solenoids.

Note

Normally adding suppressors to each motor, solenoid, or relay is not required. However, if problems arise, some devices could require suppression.

This section indicates what is available in the remote possibility that problems are encountered.

Figure 7-17 shows a suppression technique used for an A200 starter or large inductive device. A suppression technique used for motors is shown in Figure 7-18.

When the controlled equipment near this system contains commutating d-c motors or generators, large a-c motors, and/or high frequency or plasma arc welders, an unusually severe noise environment is produced. To eliminate interference within this environment, all possible noise sources should be investigated and suppressed, as necessary.

Note

Noise suppression techniques and components are most effective when the suppressor is closely mounted to the device.

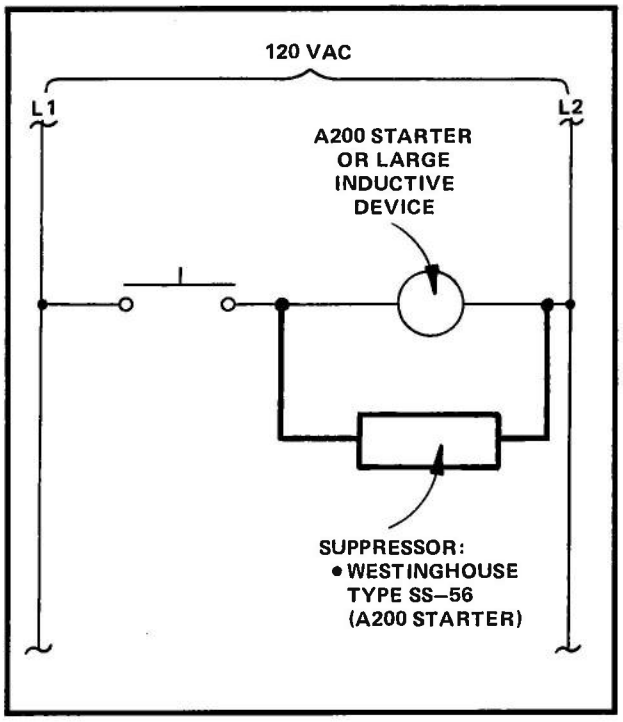


Figure 7-17. A200 Starter and Large Inductive Device Suppression Example

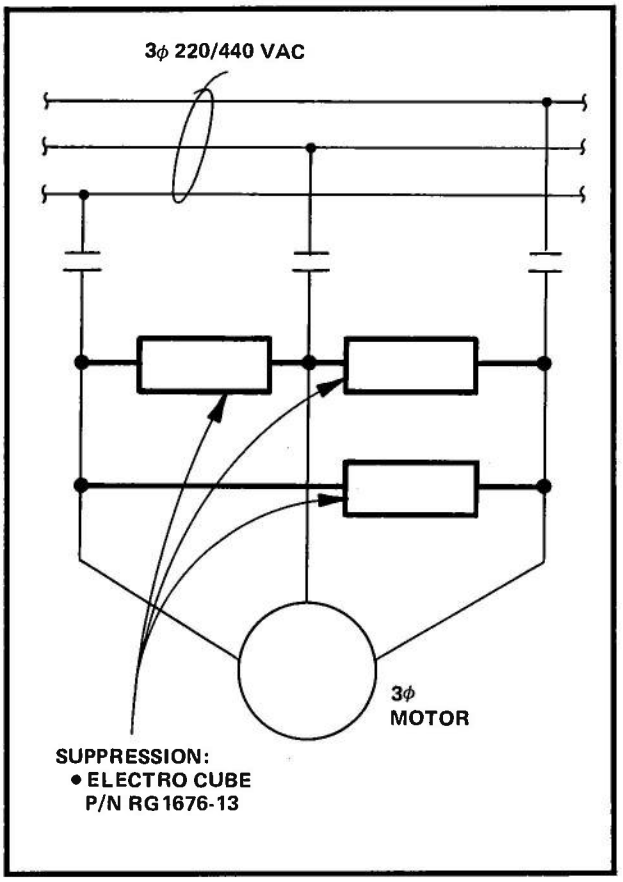


Figure 7-18. Motor Suppression Example

If the a-c power line to the programmable controller system is in poor condition or is subject to extreme disturbance, use a constant-voltage or isolation transformer.

Noise suppression is recommended when an inductive load is wired in parallel with an input converter. The load is also suppressed whenever a "hard contact" is wired in parallel with an a-c output circuit. Figure 7-19 shows a suppression technique for each of these conditions.

7-16. Fault Condition Relay Interlock

The terminal strip located on the top right side of the PC-700 processor or the top rear of the PC-900 processor contains the terminals of the Fault Condition relay. This relay and the corresponding terminals permit the Master Control relay to be hard-wired. The Master Control relay is hard-wired to initiate a controlled shut-down of the system or process upon detection of a controller fault. This terminal strip makes the Fault Condition relay's normally-open (NO) and normally-closed (NC) contacts available for field wiring. A recommended wiring scheme for the Fault Condition and Master Control relays is shown in Figure 7-13. This figure shows an a-c application. A similar wiring scheme should be used for d-c applications.

The Fault Condition relay energizes whenever the programmable controller is in the **Run** mode, and the program is running with no detected fault. Should a fault be detected by the checking circuitry, the relay de-energizes. This opens the NO contact and breaks the external circuit attached to these contacts. The Fault relay contacts should never be wired to a circuit controlled by an output of the programmable controller. These relay contacts are not power contacts and are rated at 1 A, 120 Vac maximum.

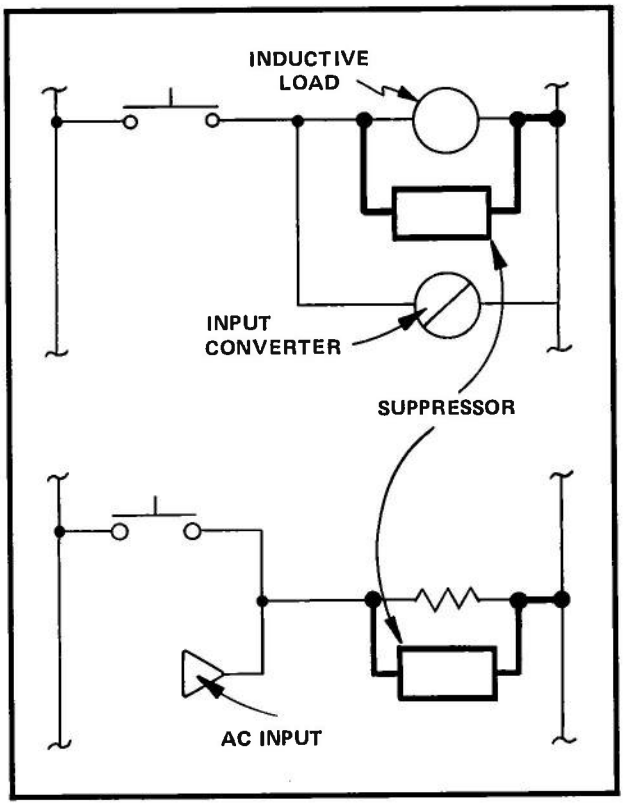


Figure 7-19. Input Converter and A-C Output Suppression

7-17. I/O STRUCTURE AND SETUP

7-18. GENERAL

The available memory sizes and I/O capabilities for each type of processor are given in Table 2-9 of Section 2. Table 7-3 illustrates the way in which the system's I/O is structured. As shown, if a particular rack is identified as being in Group 2, the discrete input or output in that rack is either an input (IN) number from 65 through 128, or an output (CR) number within this same range of I/O addressing.

TABLE 7-3. PC-700/900 I/O STRUCTURE

Group Number	Discrete Input or Output	Analog/Register Input or Output
1	1 through 64	1 through 8
2	65 through 128	9 through 16
*3	129 through 192	17 through 24
*4	193 through 256	25 through 32
*PC 700 Only		

Likewise, analog/register inputs in Group 1 communicate with corresponding input registers (IR) from 1 through 8. Also, as shown, analog/register outputs in Group 1 communicate with corresponding output registers (OR) within this same range of I/O addressing, etc.

To further select an input or output for operation within a rack location (group), the processor identifies (addresses) I/O by type and number. To do this, the processor selects discrete inputs, discrete outputs, input registers, and output registers on a time-sharing basis. This enables the processor to select a desired input or output, within a module type, during its time-shared period. This time-sharing feature allows each I/O rack to contain a mixture of I/O module, since only one designated module responds at any one time.

In addition to this time-sharing of module types within a group, a small set of I/O locations is addressed at one particular time. For example, discrete I/O is identified by the group type and number, where: IG = input group, and OG = output group. Specifically, Discrete Inputs 1 through 16 form IG1, and Discrete Outputs 1 through 16 form OG1. Discrete inputs or outputs are updated in groups of eight (e.g., IN1 through IN8, CR1 through CR8, IN9 through IN16, or CR9 through CR16).

System I/O can be configured by using either the standard vertical I/O racks or the optional horizontal I/O racks. In either case, rack address setting is made in accordance with system drawings. However, some situations occur that require further definition. For example, if two inputs are assigned the same address number, these inputs form a logical "OR" and either input in its active state controls the circuit. In the case where two outputs have the same address number, both are activated at the same time.

CAUTION

Do not parallel two similar outputs to increase capacity. This practice can cause damage to I/O modules.

After the processor has been installed onto the panel, the I/O racks can be mounted. Since all racks within a system are identical, there is no need to identify a particular rack configuration prior to mounting. However, the following **cautions** must be observed.

CAUTION

Do not install the I/O racks directly above the processsor, I/O expander power supply, or other high-heat-dissipation device. This practice increases temperatures, which can cause improper operation.

CAUTION

The minimum clearances for both vertical or horizontal I/O rack separation are given in paragraph 7-11. These clearances must be observed. During rack installation, shorter intervals make access difficult, while longer intervals may exceed the length of supplied I/O cables.

Installation, setup considerations, and the addressing scheme for the vertical racks are provided in paragraphs 7-19 through 7-24. Installation, setup considerations, and the addressing scheme for the horizontal racks are provided in paragraphs 7-25 through 7-27.

After the racks are panel-mounted, the I/O cables should be installed. Figure 7-20 shows the different styles of I/O cables available to vertical or horizontal rack applications.

Upon completion of rack installation and I/O cable connection, the processor should be turned ON and tested before installing I/O modules into racks. For PC-700 systems, use the checkout procedures of paragraph 7-7 for this testing. For PC-900 systems, use the checkout procedures of paragraph 7-8. These tests verify that the I/O racks and cables are installed and functioning properly.

The ideal sequence of installation and testing is as follows:

1. Lay out, mark, pre-drill, and tap the panel.
2. Mount the PC-700 or PC-900, I/O racks, wire duct, etc.
3. Install the I/O cables.
4. Wire the panel (i.e., processor power, peripheral outlets, commons on I/O, input and output wires that connect terminals, power supplies for register and analog I/O, etc.).
5. Power up for voltage checks.
6. Remove the power, install the I/O modules, and check the rack and module addressing.
7. Power up and check the I/O modules for proper operation (with a dummy load on outputs). Monitor to assure that no rack or module is double-addressed and that the I/O cables are functional (not opened or shorted).
8. Connect the field wiring.
9. Load the program in the PC-700 or PC-900.
10. Check the system.

7-19. VERTICAL RACK SETUP (NLR-704)

The standard NLR-704 vertical I/O rack is shown in Figure 7-21. The vertical I/O rack uses a rack rocker switch assembly to identify the input and output position in each rack. As shown, this 12-segment switch assembly is located at the top of the rack, and is attached to the rack's mother board. Figure 7-22 illustrates this switch assembly. The Group Select **(GSEL)**, Top Select **(TOP)**, and Bottom Select **(BOTT)** segments each use four segments of this switch assembly.

When four-point, single-height modules are installed into an I/O rack, each module takes up one rack location and no additional user address selection is necessary.

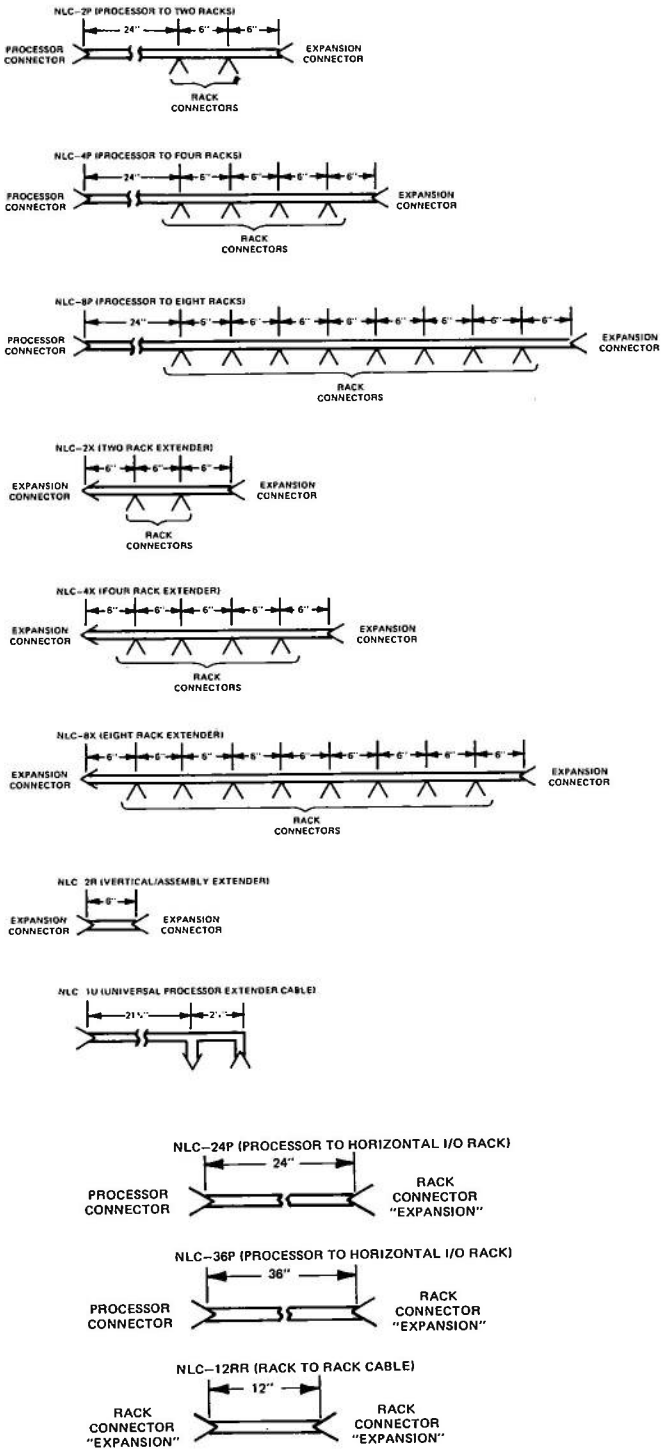


Figure 7-20. I/O Cables

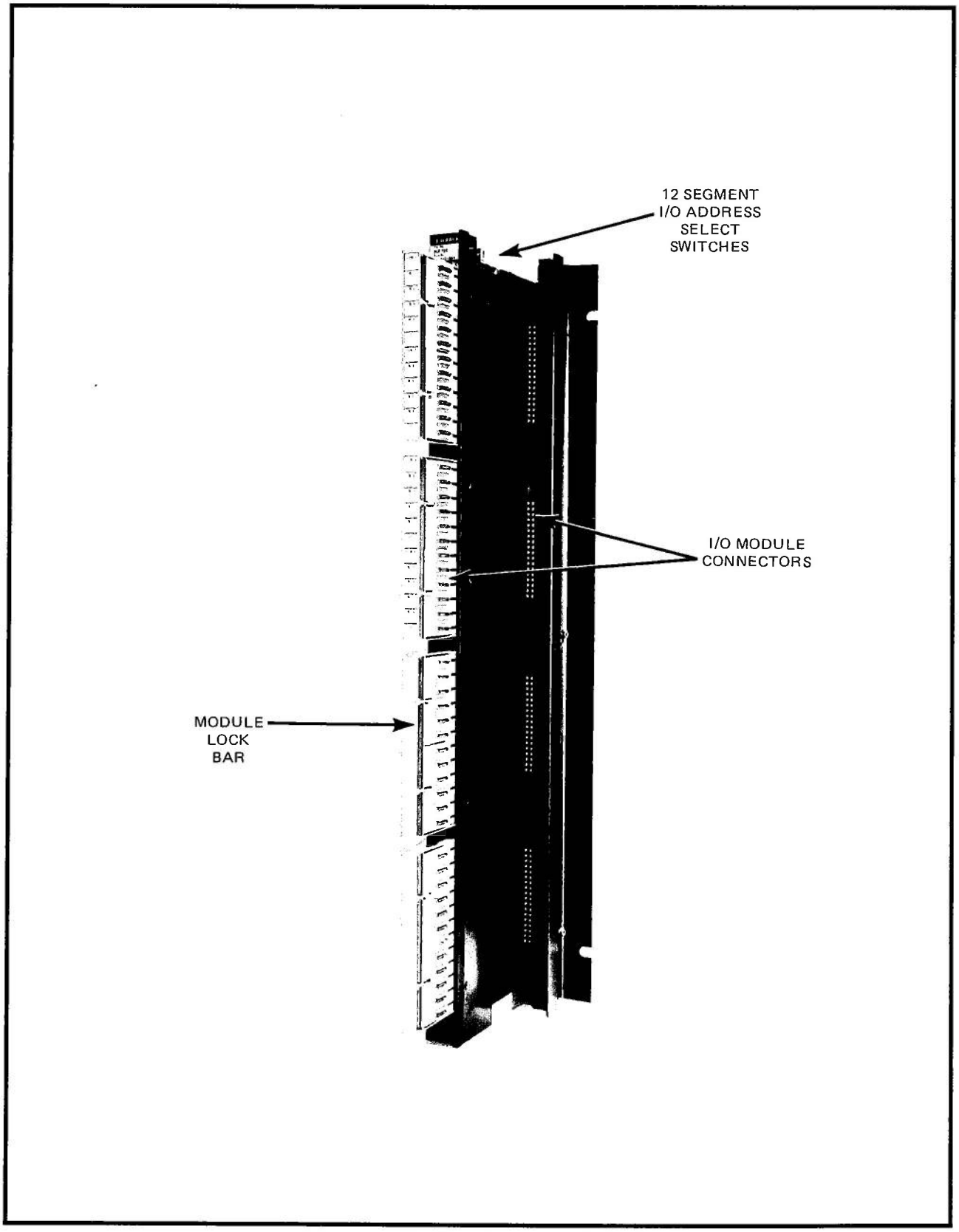


Figure 7-21. NLR-704 Vertical Rack

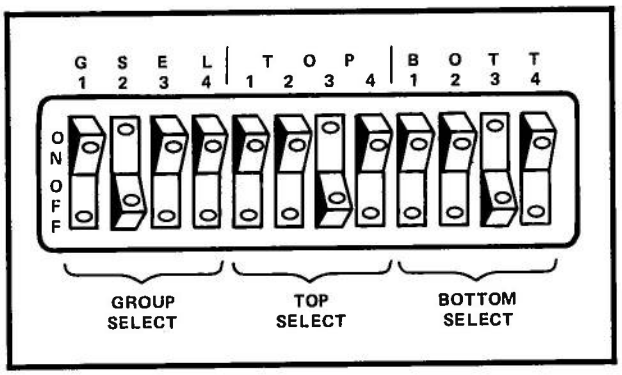


Figure 7-22. Vertical Rack Rocker Switch Assembly

Four-point module addresses are selected by the position of the rack switches and the position of the module in the rack. The "A" rack position is always addressed to the first four I/O addresses; the "B" rack position is always addressed to the second four I/O addresses, etc. The four-point, single-height module cannot be used with a horizontal rack. See Table 7-4 for addressing discrete four-point modules.

However, when 16-point discrete modules are used, each module takes up two rack locations and provides twice as many input or output positions. In this case, an additional five-segment I/O module switch assembly is provided at the back of each module. Figure 7-23 shows this I/O module switch assembly. The four low order segments (1 through 4) of this switch assembly are used to identify the discrete input or output address of the 16-point module.

When the 16-point module is addressed to discrete I/O, any of the four 16-bit input or output groups selected by the **GSEL** switch on the rack can be addressed in either rack location.

WARNING

ONLY ONE SWITCH IN THE FIRST FOUR MAY BE SET AT A TIME. WITH MORE THAN ONE SWITCH SET, INDICATIONS OF SHORTED I/O CABLES COULD BE NOTED. IF A FOUR-POINT MODULE IS ADDRESSED BY THE RACK SWITCH, ONE GSEL AND ONE ASSOCIATED TOP OR BOTT SWITCH MUST BE ON. DO NOT POWER UP WITH THESE SWITCHES OFF.

7-20. Four-Point Discrete I/O Module Addressing

Table 7-4 gives the rack rocker switch settings for addressing four-point discrete input or output modules.

7-21. 16-Point Discrete I/O Module Addressing

Addressing 16-point modules requires the use of both the rack rocker switch assembly and the I/O module switch assembly (see Figure 7-23). To set this module's I/O addressing scheme, complete the following steps:

1. Select the desired group number by setting the appropriate **(GSEL)** switch segment of the rack rocker switches.

Note

16-point discrete modules can be addressed by discrete I/O (IG or OG) by using the selection on the module switch or by input/output registers (IR/OR).

Segment	Group/Numbering
1	Group 1/ 1 through 64
2	Group 2/ 65 through 128
3*	Group 3/ 129 through 192
4*	Group 4/ 193 through 256

*Groups 3 and 4 are not used in PC-900 applications.

2. If the 16-point module is installed into the top two rack positions (AB), the **TOP** switch segments of the rack rocker switch assembly are set OFF. Further, input or output position addressing is accomplished by the module's switch assembly, as shown in Table 7-5.

Note

In the case where no module is installed into position CD, the **BOTT** switch segments are also set OFF. When a different type of module(s) is installed, set the switches per the specific module type requirements.

TABLE 7-4. DISCRETE FOUR-POINT ADDRESSING

Group Select (GSEL)	1				2				3 (PC-700 ONLY)				4 (PC-700 ONLY)				
Top Select (TOP)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	IG or OG Bit Number
Rack Position	1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	1
A	2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	2
I/O Terminal	3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	3
Number	4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	4
Rack Position	5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	5
B	6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	6
I/O Terminal	7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	7
Number	8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	8
Bottom Select (BOTT)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Rack Position	9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	9
C	10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	10
I/O Terminal	11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	11
Number	12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	12
Rack Position	13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	13
D	14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	14
I/O Terminal	15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	15
Number	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	16
I/O Group (IG/OG)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

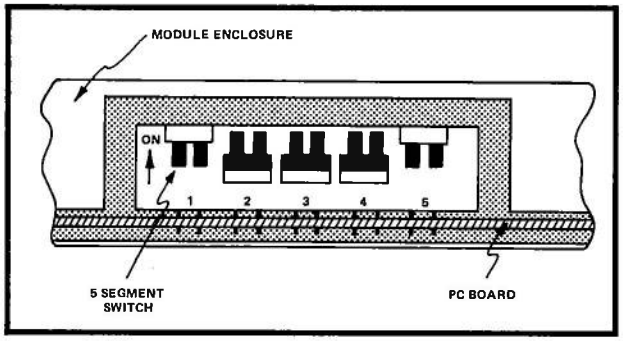


Figure 7-23. Double-Height I/O Module Switch Assembly

3. If the 16-point module is installed into the bottom two rack positions (CD), the **BOTT** select switch segments are set OFF. As in Step 2, further addressing is selected by the module switch assembly.

Note

When no module is installed into Position AB, the **TOP** switch segments are set OFF. When a different type of module(s) is installed, set the switch segments per the specific module type requirements when using a different type module(s).

4. Set the I/O module switch assembly's Segment 5 to ON.

5. Set Switch Segments 1 through 4 of the I/O module switch assembly per Table 7-5.

TABLE 7-5. 16-POINT DISCRETE I/O MODULE ADDRESS NUMBERING

GSEL	I/O Module Switch Settings (See Fig. 7-23)			
	1 and 5	2 and 5	3 and 5	4 and 5
1	1 through 16	17 through 32	33 through 48	49 through 64
2	65 through 80	81 through 96	97 through 112	113 through 128
3**	129 through 144	145 through 160	161 through 176	177 through 192
4**	193 through 208	209 through 224	225 through 240	241 through 256

All segments of the respective rack rocker switch assembly (TOP** or **BOTT**) are turned OFF.

**Groups 3 and 4 are not used in PC-900 applications.

7-22. 16-Bit, Single Register I/O Module (NL-743 and NL-753) Addressing

Table 7-6 gives the rack rocker switch settings for addressing the double-height, 16-point single register input or output modules.

In 16-point I/O module addressing (i.e., NL-707, NL-708, NL-709, and NL-731) for single register operation, all five segments of the I/O module switches are set to the OFF position. The module's register address is determined by the rack rocker switches. Table 7-7 lists the settings for both the register and discrete addressing of the 16-point modules.

7-23. Multiplexed Register I/O Address Numbering

When multiplexed register I/O modules (NL-744 and NL-754) are installed in a rack, the rack rocker switch assembly is not used for input or output position addressing. For multiplexed register modules, the **TOP** segments are set OFF if this module is in Position AB, or the **BOTT** segments are set OFF if the module is in Position CD. Each multiplexed register module contains a set of four dip switches that determine the addresses of the input or output registers to be multiplexed. This module's dip switches determine the I/O addressing. Figure 7-24 shows the six valid dip switch positions and lists the corresponding address numbering of each.

The **GSEL** rack switch setting is determined by the module address and type in the other rack position. If unused, or if another multiplexed register module is used, set all rack switches OFF (i.e., **GSEL** = 0; **TOP** = 0; **BOTT** = 0).

7-24. Analog I/O Address Numbering

The analog I/O modules do not use the **TOP** or **BOTT** segments of the rack rocker switch assembly. Depending on module installation (AB or CD), the appropriate segment should be set OFF for analog module operation. Each analog I/O module contains two circuits. The **GSEL** segments of the rack rocker switch assembly are used in conjunction with a pair of thumbwheel switches on the analog module. (This is for two-channel analog modules; four and eight-channel modules are also available.) Together, these switches provide analog I/O module address numbering. Each thumbwheel switch is selectable from 0 through 9. Table 7-8 lists the analog I/O address numbering.

TABLE 7-6. 16-BIT, SINGLE REGISTER I/O MODULE

	GSEL 1				GSEL 2				GSEL 3				GSEL 4			
TOP Select	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Module Register in A-B Position	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31
BOTT Select	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Module in C-D Position	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32

NL-704 Rack

A B	Can only address odd registers
C D	Can only address even registers

Note

Groups 2, 3, and 4 are not used in PC-900A applications.
Groups 3 and 4 are not used in PC-900B applications.

The NL-742, NL-751, and NL-752 analog modules have special address numbering schemes not documented here. The address numbering scheme for the NL-760 counter modules is also not documented here. For the specific address numbering information used for installation of the modules, refer to the appropriate Instruction Leaflet:

Module	Instruction Leaflet Number
NL-742	IL-15729
NL-751	IL-15726
NL-752	IL-15727
NL-760	IL-15742

CAUTION

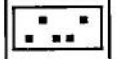
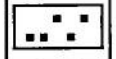
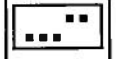
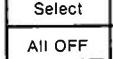
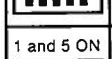
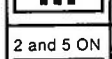
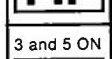
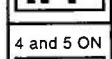
Do not set either thumbwheel to 0 or 9. Also, do not set both thumbwheels to the same number. If either of these conditions occurs, improper addressing results.

CAUTION

Upon completion of rack installation and I/O cable connection, the processor should be turned ON and tested before installing I/O modules into racks. For PC-700 systems, use the checkout procedures of paragraph 7-7 for this testing. For PC-900 systems, use the checkout procedures of paragraph 7-8. Before powering up the system with the module installed, make sure that all racks and modules are properly addressed. If outputs are not addressed, the possibility exists that they could turn ON with no way to turn them OFF, except powering down the system.

7-25. HORIZONTAL RACK SETUP (NLRH-704 P/R, NLRH-708 P/R)

The optional horizontal I/O racks are high-density racks which provide a compact and economical enclosure for **Numa-Logic** double-height I/O

	GSEL 1					GSEL 2					GSEL 3					GSEL 4				
	Discrete	IR-OR Register				Discrete	IR-OR Register				Discrete	IR-OR Register				Discrete	IR-OR Register			
*TOP Select	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
All OFF 	X	1	3	5	7	X	9	11	13	15	X	17	19	21	23	X	25	27	29	31
1 and 5 ON 	1 through 16	X	X	X	X	65 through 80	X	X	X	X	129 through 144	X	X	X	X	193 through 208	X	X	X	X
2 and 5 ON 	17 through 32	X	X	X	X	81 through 96	X	X	X	X	145 through 160	X	X	X	X	209 through 224	X	X	X	X
3 and 5 ON 	33 through 48	X	X	X	X	97 through 112	X	X	X	X	161 through 176	X	X	X	X	225 through 240	X	X	X	X
4 and 5 ON 	49 through 64	X	X	X	X	113 through 128	X	X	X	X	177 through 192	X	X	X	X	241 through 256	X	X	X	X
**BOTTOM Select	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
All OFF 	X	2	4	6	8	X	10	12	14	16	X	18	20	22	24	X	26	28	30	32
1 and 5 ON 	1 through 16	X	X	X	X	65 through 80	X	X	X	X	129 through 144	X	X	X	X	193 through 208	X	X	X	X
2 and 5 ON 	17 through 32	X	X	X	X	81 through 96	X	X	X	X	145 through 160	X	X	X	X	209 through 224	X	X	X	X
3 and 5 ON 	33 through 48	X	X	X	X	97 through 112	X	X	X	X	161 through 176	X	X	X	X	225 through 240	X	X	X	X
4 and 5 ON 	49 through 64	X	X	X	X	113 through 128	X	X	X	X	177 through 192	X	X	X	X	241 through 256	X	X	X	X

Notes

1. X = Illegal Switch Setting
2. This table shows both discrete and register addressing for 16-point discrete modules NL-731 output and NL-707, NL-708, NL-709 and NL-710 inputs.

*Module Switch Setting for Module in A-B Position.
**Module Switch Setting for Module in C-D Position

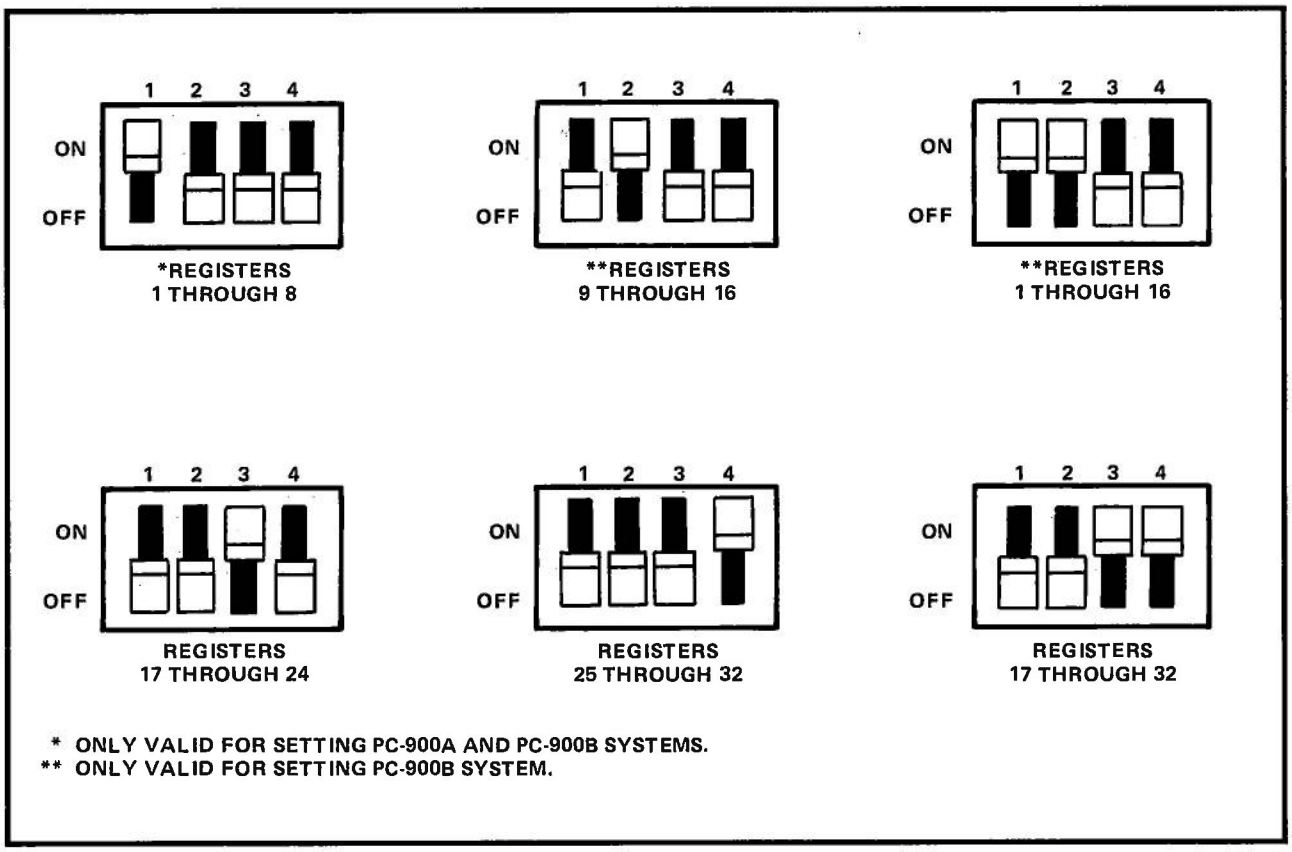


Figure 7-24. Valid Multiplexed Register Module Dip Switch Settings

modules. Horizontal racks are available for panel (P) or rack (R) mounting, and contain four or eight modules. The panel-mountable NLRH-704P is shown in Figure 7-25. The rack-mountable NLRH-708R is shown in Figure 7-26.

Note

These horizontal racks accept only Series H double-height modules. Table 7-10 lists the double-height modules that may be used with these racks.

Terminal Raceway Assembly

A terminal raceway assembly (NLRH-TRA) is supplied for each module within a four- or eight-module horizontal rack.

The terminal raceway assembly is shown in Figure 7-27. Wiring to each module's terminal blocks is laid in this terminal raceway's wire guide, one on the other. The bottom terminal's conductor is installed first, and then each subsequent conductor (from the bottom to the top).

I/O Cables

There are two I/O cables available for horizontal rack configurations: the two foot NLC-24HP and the three foot NLC-36HP. A system contains one of these cables for each rack. Figure 7-28 shows simplified I/O cabling in a horizontal rack systems configuration.

Rack Density Considerations

The high-density horizontal I/O racks allow a greater density of I/O points within a given area than the less dense vertical racks. During system planning and installation, it is possible to exceed the power capabilities of either the processor or I/O expander power supply in a single rack. Attention must be given to the total power

TABLE 7-8. TWO-CHANNEL ANALOG 12-BIT RESOLUTION

	PC-700			
	PC-900B			
	PC-900A			
Module Thumb-wheel Setting (One Per Channel)	GSEL Rack Switch Setting			
	1	2	3	4
1	1	9	17	25
2	2	10	18	26
3	3	11	19	27
4	4	12	20	28
5	5	13	21	29
6	6	14	22	30
7	7	15	23	31
8	8	16	24	32

Note

Register Reference No. 1 through 32 must be defined.

TABLE 7-9. HORIZONTAL RACK TYPES

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

requirements (in units) for all modules within each rack of a system's configuration. The specific power requirements for each module are given in "Instruction Leaflets" shipped with each module. Table 7-11 lists the processor and I/O expander power supply power capabilities. **If power capabilities are exceeded, use additional NLE-770 I/O expander power supplies, as required.**

When using a horizontal I/O rack completely filled with output modules, each of which is operating at 100 percent load, the ambient air temperature must be derated to 50°C (122°F). One quick solution to this situation is to replace an output module with an input module. To maintain proper operating temperatures, do not exceed the following guidelines:

- Operate a maximum of 75 percent of the output circuits at full current,

  or

- Operate all output module circuits at 75 percent of load.

Rack and Module Placement

During module and I/O rack installation, maintain a minimum of six inches separation between the a-c and high-voltage d-c conductors, and the low-level d-c and signal conductors. Group together the TTL, multiplexing, A/D module, and D/A module I/O wires. Keep these wires separate (as much as possible) from the a-c or high-voltage d-c module wiring. Never run the field wiring conductors over the top-left edge of the rack where the I/O cable enters.

The NL-740 A/D module, NL-750 D/A module, NL-771 local unit, and the NL-772 remote unit are double-width modules. These modules occupy a two-slot area. **Do not try to insert another module in the slot immediately to the right of these modules.**

Horizontal Rack Applications

Typical horizontal I/O rack applications are shown in Figures 7-29 and 7-30.

7-26. Horizontal Rack I/O Addressing

Prior to installation, a list of I/O rack switch and module switch settings should be made for each specific application. Refer to the system design drawings for rack placement, module location, and these switch settings.

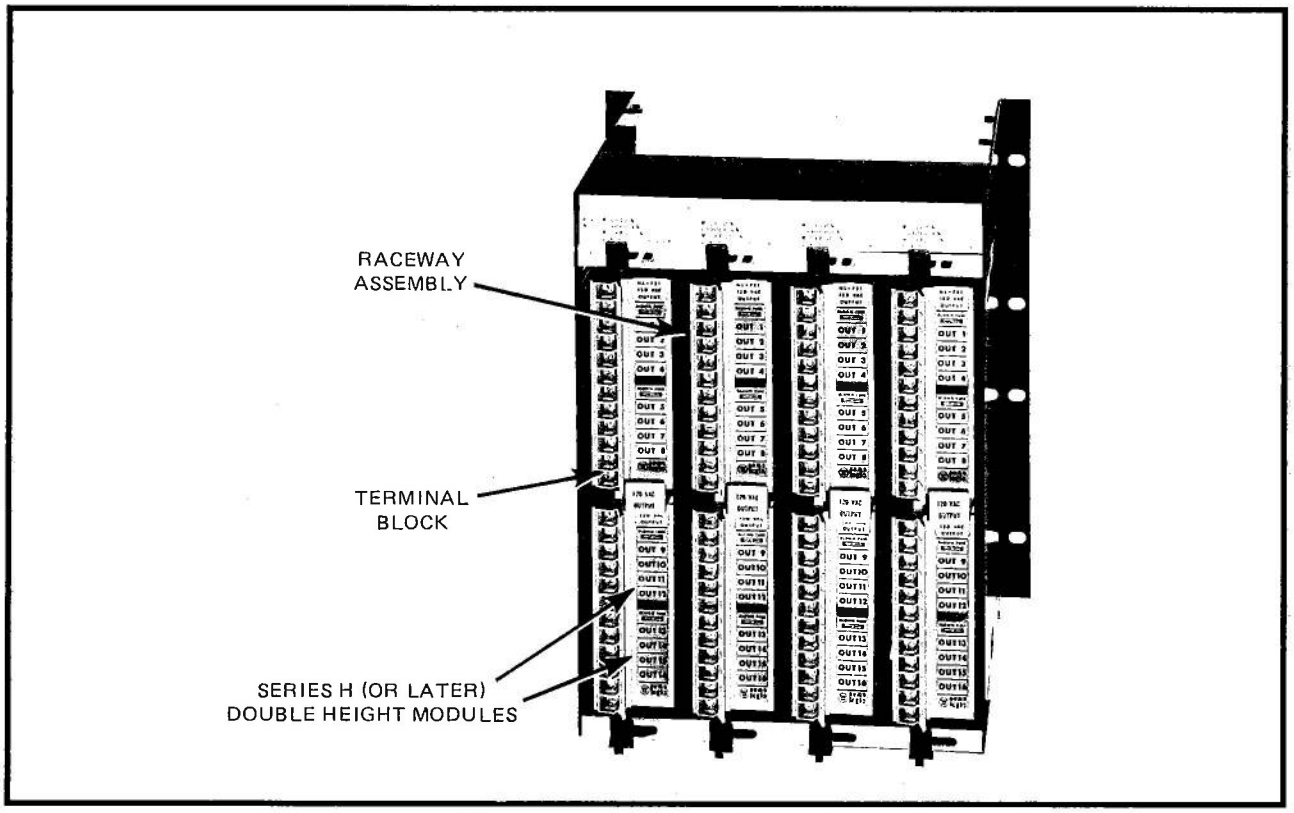


Figure 7-25. NLRH-704P, Four-Module Horizontal Rack (Panel Mount)

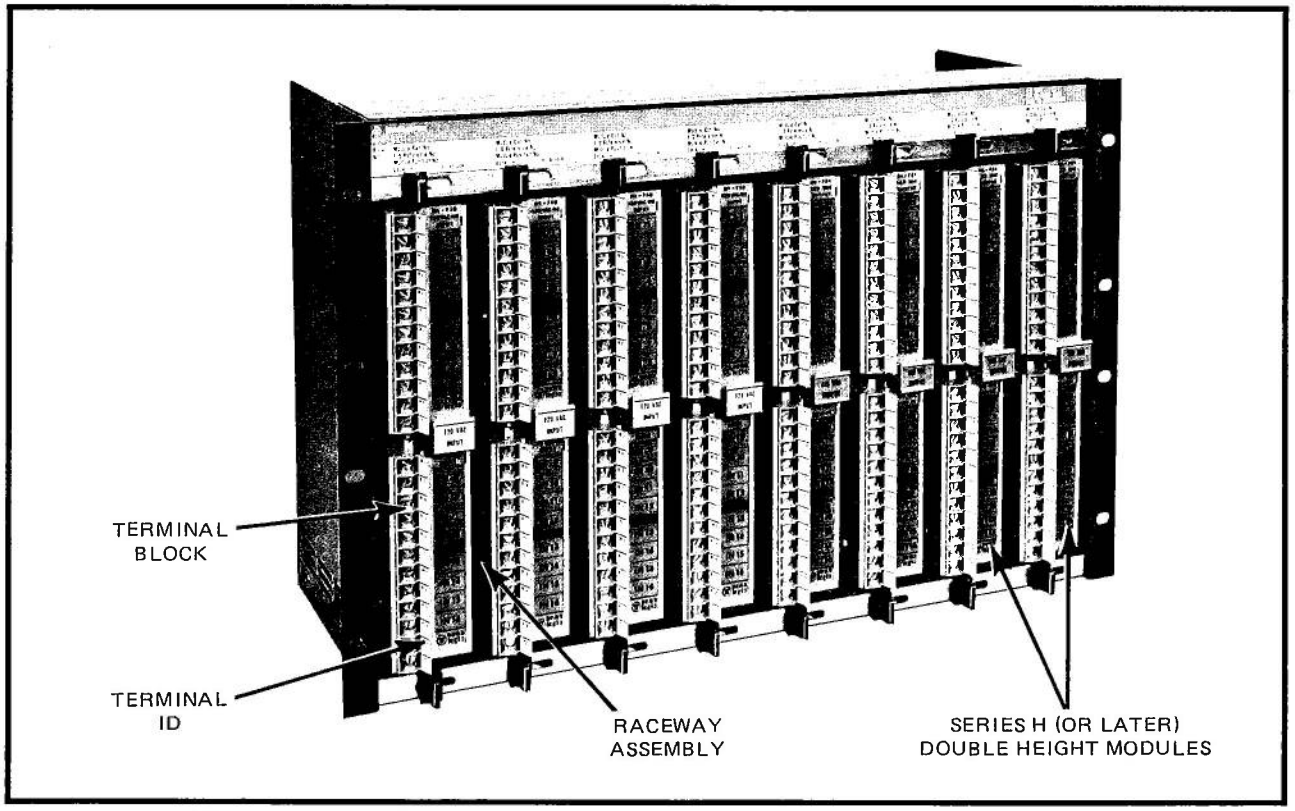


Figure 7-26. NLRH-708R, Eight-Module Horizontal Rack (Rack Mount)

TABLE 7-10. ACCEPTABLE DOUBLE-HEIGHT MODULES

Module	Type*
NL-707H	16-point, discrete input module - 12 Vac/dc
NL-708H	16-point, discrete input module - 24 Vac/dc
NL-709H	16-point, discrete input module - 48 Vac/dc
NL-710H	16-point, discrete input module - 120 Vac/dc
NL-711H	16-point, discrete input module - 240 Vac/dc
NL-715H	8-point (isolated), discrete input module - 120 Vac/dc
NL-731H	16-point, discrete output module - 120 Vac/dc
NL-732H	16-point, discrete output module - 12 to 125 Vdc
NL-733H	16-point, discrete output module - 240 Vac
NL-735H	16-point, discrete output module - 12 to 125 Vdc
NL-736H	8-point, discrete output module - 120 Vac
NL-737H	8-point, discrete output module - Form C Relay
NL-738H	8-point, discrete output module - Form C Relay
NL-739H	8-point, discrete output module - Form C Relay
NL-740H	12-bit, analog-to-digital module
NL-750H	12-bit, digital-to-analog module
NL-743H	Register input module
NL-753H	Register output module
NL-744H	Multiplexed register input module
NL-754H	Multiplexed register output module
NL-771H	Local unit
NL-772H	Remote unit
NL-742H	10-bit, analog-to-digital converter
NL-751H	10-bit, digital-to-analog converter
NL-752H	10-bit, digital-to-analog converter

To support I/O addressing, the horizontal I/O racks contain selector-type rotary rack switches. This four-position switch assembly is illustrated in Figure 7-31. This switch enables group selection within the horizontal rack system. The four module rack contains only one switch assembly, while the eight-module rack contains two switch assemblies, providing group selection to both halves of the larger rack. These horizontal rack group select switches are located on the inside surface of the backplane (mother board).

WARNING

DISCONNECT THE MAIN POWER BEFORE SETTING THE RACK SWITCHES. FAILURE TO DO SO CAN CAUSE SEVERE INJURY OR DEATH.

Unlike the vertical rack applications, horizontal racks only accept Series H, double-height modules. The 16-point discrete I/O modules provide an additional five-segment I/O module switch at the back of each module. This switch assembly is previously shown in Figure 7-23 and provides for input/output location identification within a rack (group).

For register module applications in the horizontal racks, all registers are automatically assigned to rack slots (addresses). Figure 7-31 shows the horizontal rack **GSEL** switch assembly. Module switches are addressed as they were for the vertical rack. The position in the rack automatically makes the selection that the vertical rack **TOP** or **BOTT** switches would have made.

In analog module applications, I/O address numbering is provided in the same manner described in paragraph 7-24 for vertical rack applications. The analog points are selected via the thumbwheel switches; within each group, they are selected by the four-position horizontal rack switches.

CAUTION

Although the I/O rack switches may be set for as many as 32 registers, the individual processor may not actually provide them. Only the switch settings permitted by the hardware capabilities should be selected. Check the processor's nameplate for capabilities.

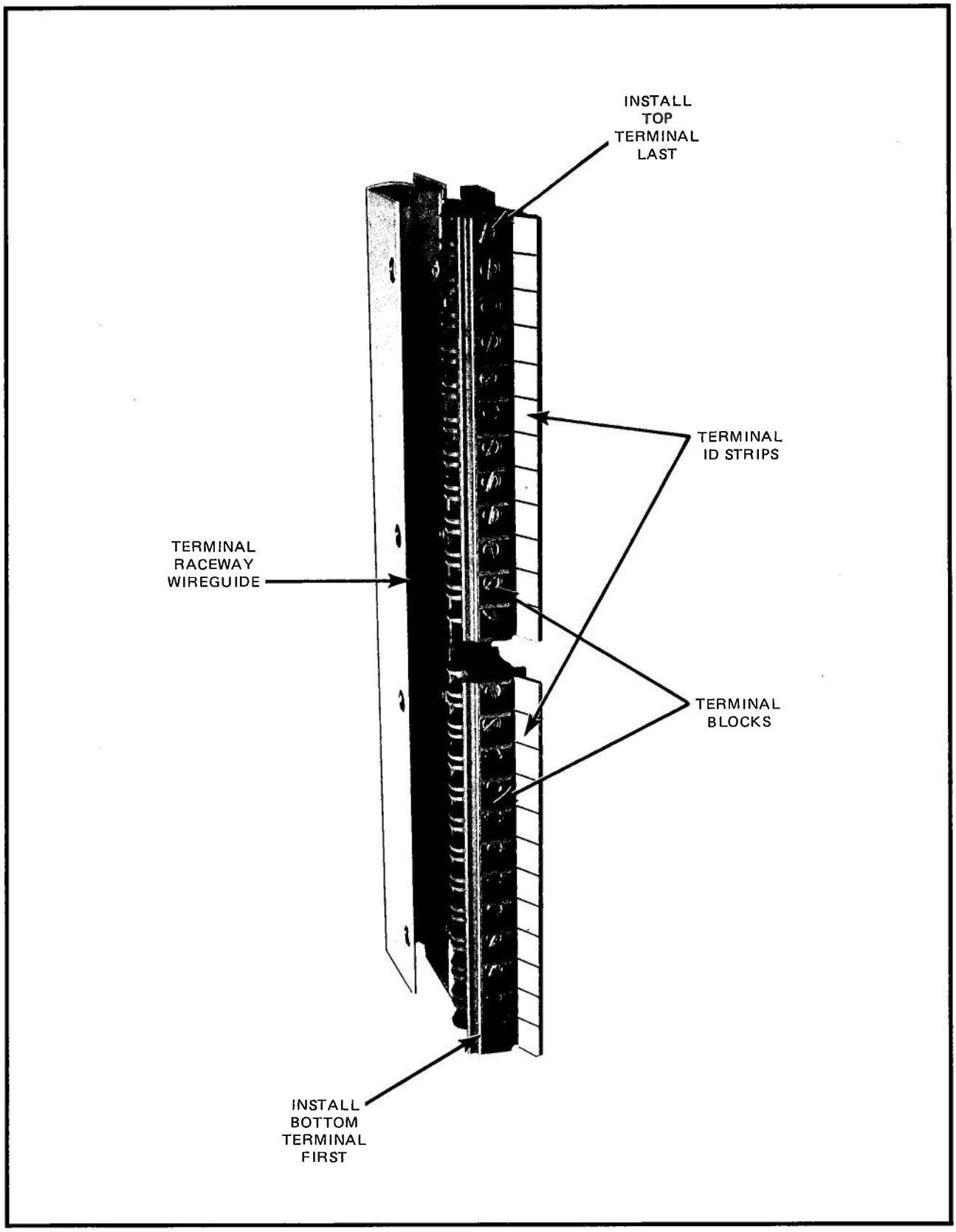
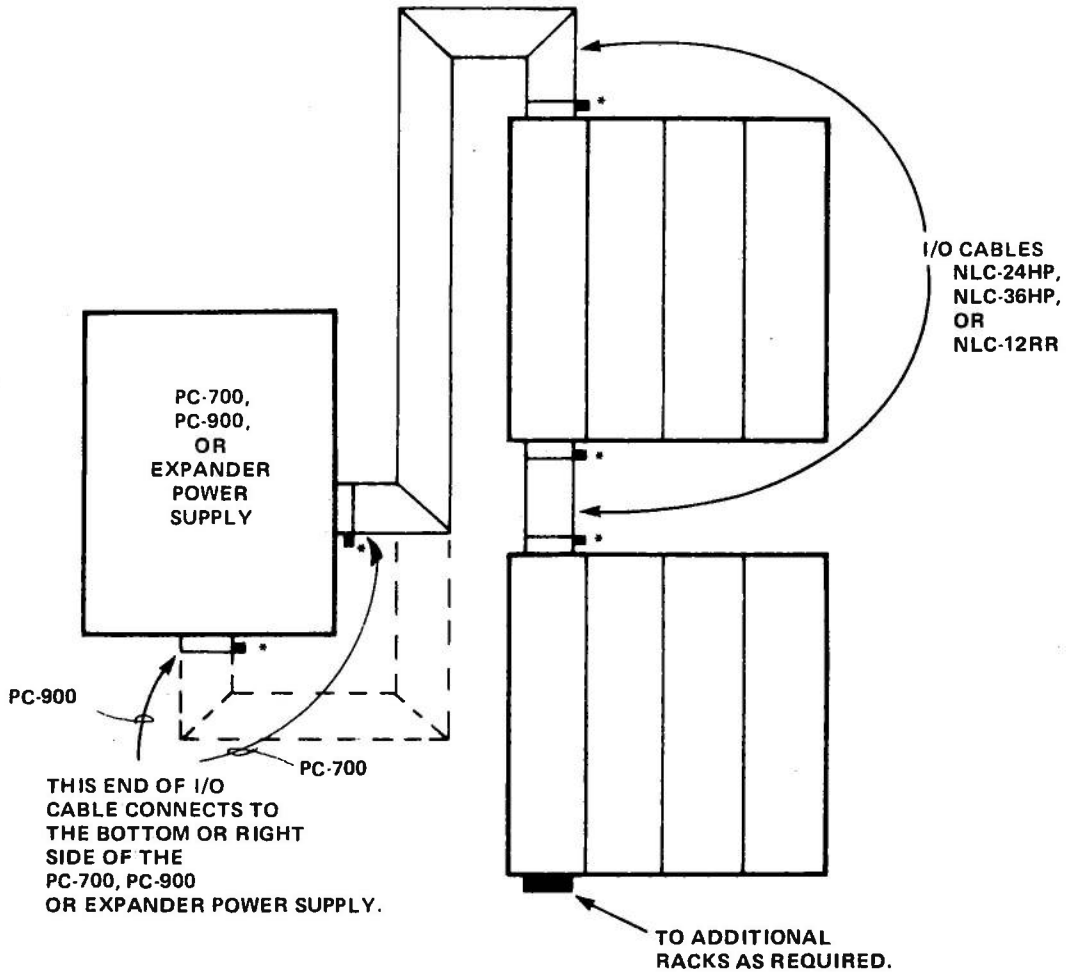


Figure 7-27. Terminal Raceway Assembly



*NOTE

ALL CONNECTORS ARE KEYED
FOR AUTOMATIC CONNECTOR ORIENTATION.

Figure 7-28. Simplified I/O Cabling for Horizontal Rack Applications

TABLE 7-11. POWER CAPABILITY

Device	Logic Power (Units)	Output Power (Units)
PC-700	650	32
PC-900	500	20
I/O Expander Power Supply	650	32

Configuration Planning

When planning the configuration of a horizontal rack system layout, group all register modules together in the I/O racks. Group the discrete I/O modules together in the remaining rack slots that have proper **GSEL** switch settings, or number the discrete I/O to the addresses available.

Discrete I/O Module Addressing

Table 7-12 gives the **GSEL** rack switch and module switch settings for addressing discrete I/O modules in a horizontal rack configuration. Assign discrete I/O reference numbering by using this table. Slot selection and/or input/output type identification is provided by the module's rear five-segment switch assembly. For example, a 120 Vac input module, placed in any slot of a four-module rack is to be assigned discrete I/O reference numbers of IN0017 through IN0032. To select this addressing, the rack switch is set to Position 1, and the module switch segments are set with 2 and 5 ON only. If Position 2 (group) had been selected, the discrete I/O reference numbers would be IN0081 through IN0096.

Table 7-12 represents both the four-module and eight-module rack addressing schemes. The apparent repetition of reference numbers would not exist in real applications. For example, a system layout which contains two eight-module racks might have the rack switch set for Groups 1 and 2 in the first unit, and Groups 3 and 4 in the second unit. This would provide a total of 256 discrete reference numbers.

Use Table 7-12 to construct a list of the specific rack and module switch settings related to user-specified application. This list is to be used during the installation procedures of paragraph 7-27.

Register I/O Module Addressing

The horizontal rack has only one **GSEL** switch for every four rack slots. Backplane wiring sets up the slots as permanently-connected top and bottom select addresses; therefore, no **TOP** or **BOTT** select switches are required. Any module that requires the **TOP** or **BOTT** switches of a vertical rack must be plugged into the appropriate slot to make the proper selection. (See Figure 7-32.)

Most modules are addressed with **GSEL** and module switches. The 16-point discrete modules addressed to register I/O, and NL743 and NL753 single 16-bit registers are the only ones that are addressed by position in the **GSEL** group.

Table 7-13 gives the **GSEL** rack switch settings for addressing register modules in a horizontal rack configuration. Assign internal processor register numbering by using this table. This provides register numbering, which is equivalent to reference numbers (e.g., Register 0001 is equal to reference number IR0001 or OR0001). For example, the register module in Slot 1 of the first I/O rack would be assigned Register No. 0001, although it could be assigned Register No. 0009, 0017, or 0025.

For 16-point discrete modules addressed to registers, the user should make up a list of the specific rack switch settings from Table 7-13 which are related to his application. This list is to be used during the installation procedures of paragraph 7-27. Set each register module's dip switches to OFF. I/O module addressing for analog and multiplexed systems requires the module switch setting as in the vertical rack applications.

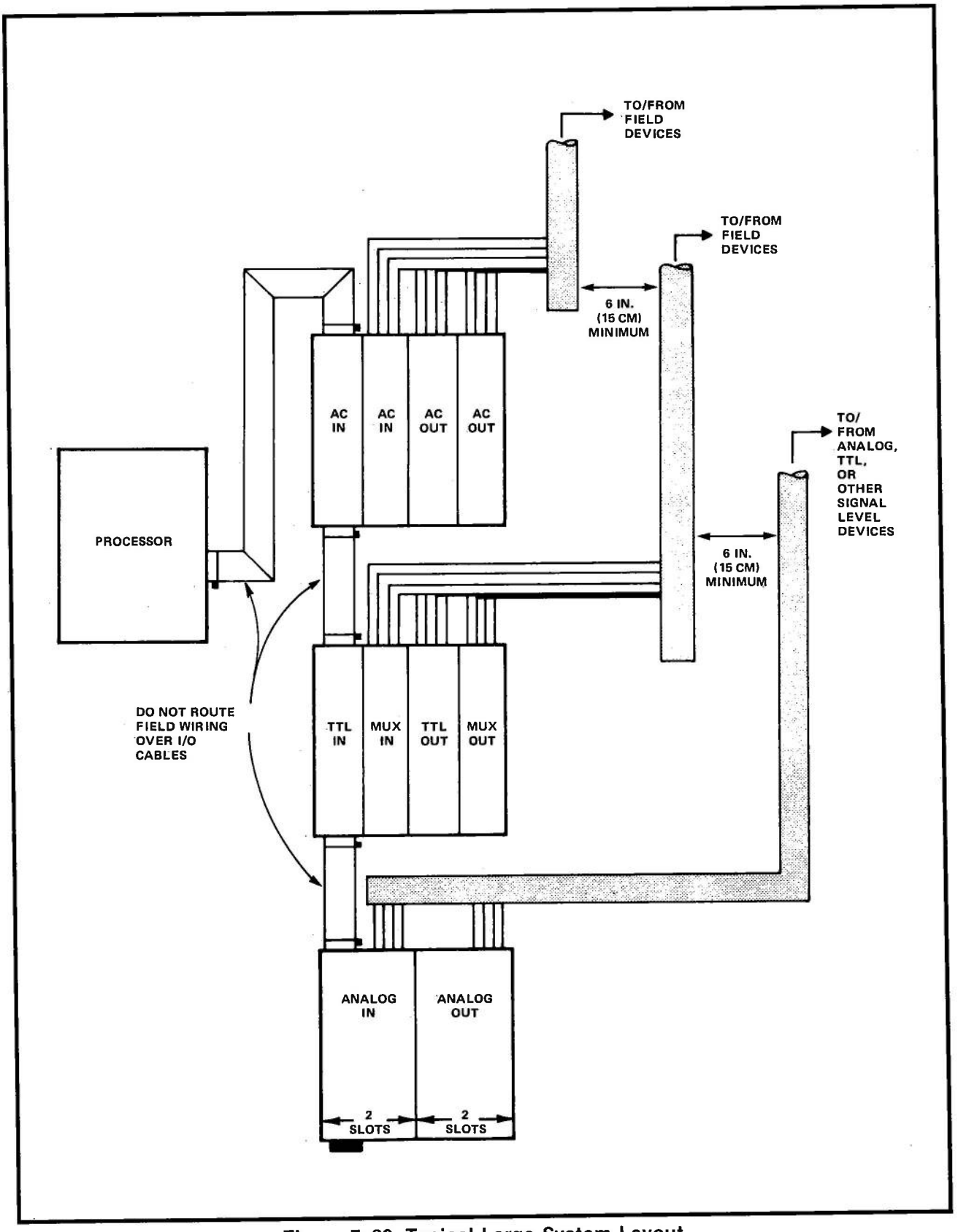


Figure 7-29. Typical Large System Layout

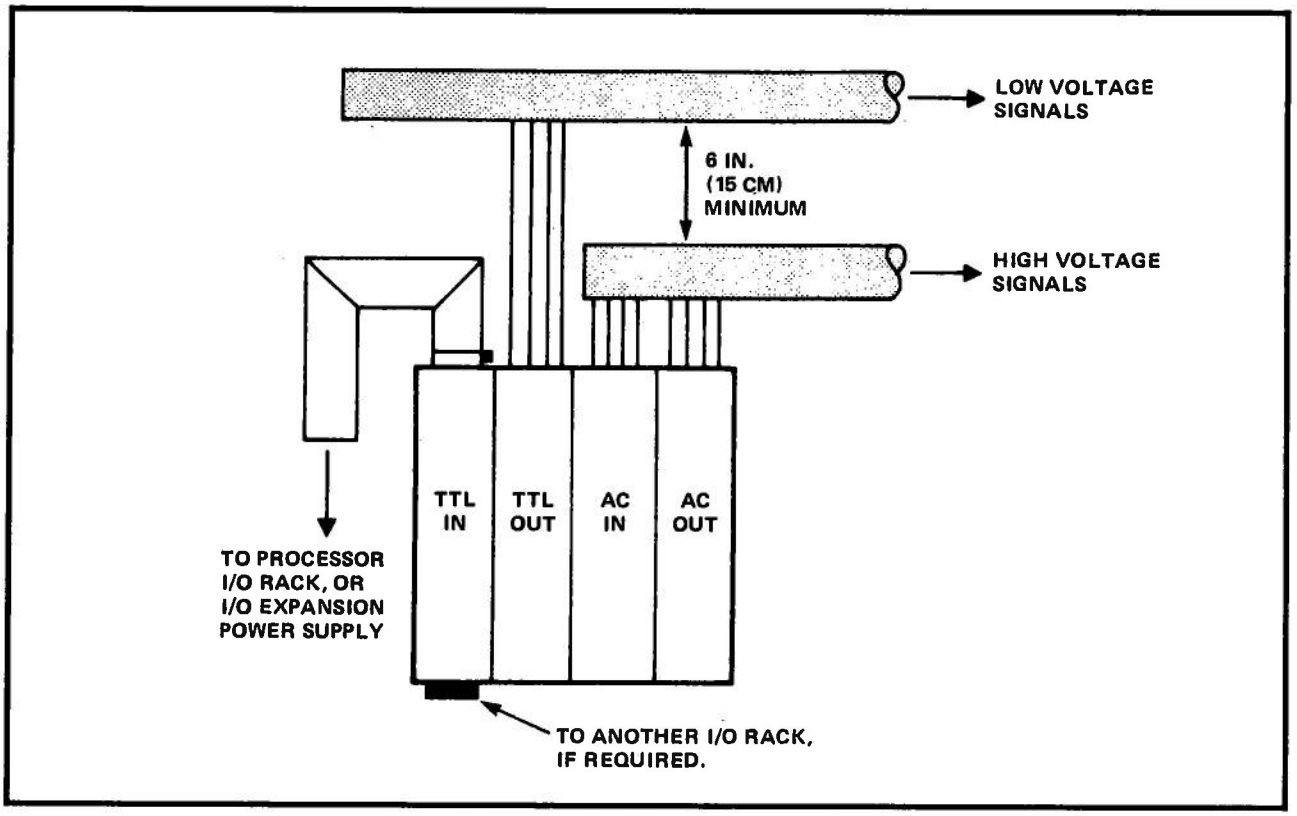


Figure 7-30. Typical Small System Layout

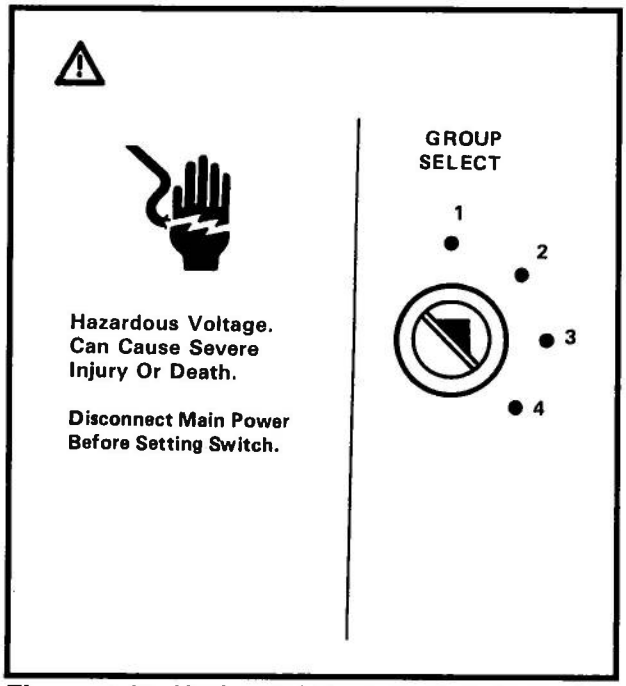


Figure 7-31. Horizontal Rack Switch Assembly

7-27. Horizontal Rack Installation Procedures

The following step-by-step procedures are for mounting and assembling the high density horizontal I/O racks. **During these procedures, use the I/O address numbering lists prepared in paragraph 7-26, "Horizontal Rack I/O Addressing," to set the appropriate switches.** As with the vertical rack procedures, use the following sequence:

1. Mount the components.
2. Install the I/O cables.
3. Wire the panel or rack.
4. Install the modules (set the switches).
5. Test the panel.
6. Add the field wiring.
7. Debug and test the system.

TABLE 7-12. DISCRETE I/O ADDRESS NUMBERING

Eight-Module Rack									
Four-Module Rack					Right Rack Switch Settings	Module Switch Settings (ON segments shown)			
Left Rack Switch Settings	Module Switch Settings (ON segments shown)								
	1 and 5	2 and 5	3 and 5	4 and 5		1 and 5	2 and 5	3 and 5	4 and 5
Group 1	00001 through 0016	0017 through 0032	0033 through 0048	0049 through 0064	Group 1	0001 through 0016	0017 through 0032	0033 through 0048	0049 through 0064
Group 2	0065 through 0080	0081 through 0096	0097 through 0112	0113 through 0128	Group 2	0065 through 0080	0081 through 0096	0097 through 0112	0113 through 0128
*Group 3	0129 through 0144	0145 through 0160	0161 through 0176	0177 through 0192	*Group 3	0129 through 0144	0145 through 0160	0161 through 0176	0177 through 0192
*Group 4	0193 through 0208	0209 through 0224	0225 through 0240	0241 through 0256	*Group 4	0193 through 0208	0209 through 0224	0225 through 0240	0241 through 0256

*Groups 3 and 4 are not used in PC-900 applications.

Notes

I/O reference numbers prefixed by IN are inputs. Output I/O reference numbers are prefixed by CR, TT, UC, EQ, etc. Discrete I/O reference numbers are not related to rack position, but are established by module switch settings. Observe that the reference numbers shown here are both inputs and outputs. Thus, an input and output module with identical settings can be mounted in the same rack.

Rack Assembly

1. If the rack flanges are improperly oriented for mounting, remove the side panels and rotate each panel 180° for proper flange positioning.

2. Horizontal rack mounting dimensions are shown in Figure 7-33.

3. Locate the **GSEL** rotary rack switch (an eight-module rack contains two) on the inside surface of the backplane. This switch is illustrated in Figure 7-31. Set each rack's switch(es) per the I/O numbering lists or system drawings.

WARNING

DISCONNECT THE MAIN POWER BEFORE SETTING THESE RACK SWITCHES. FAILURE TO DO SO CAN RESULT IN SEVERE INJURY OR DEATH.

TABLE 7-13. REGISTER I/O ADDRESS NUMBERING

Eight-Module Rack									
Four-Module Rack									
Left Rack Switch Settings	Rack Slot Location (ON segments shown)				Right Rack Switch Settings	Rack Slot Location (ON segments shown)			
	1	2	3	4		1	2	3	4
Group 1	00001	0002	0003	0004	Group 1	0005	0006	0007	0008
Group 2	0009	0010	0011	0012	Group 2	0013	0014	0015	0016
*Group 3	0017	0018	0019	0020	*Group 3	0021	0022	0023	0024
*Group 4	0025	0026	0027	0028	*Group 4	0029	0030	0031	0032

*Groups 3 and 4 are not used in PC-900 applications.

Notes

Register module addressing is automatically assigned. Place all module dip switches in the OFF position for 16-point discrete modules when addressed to registers. This also applies to NL-743 and NL-753.

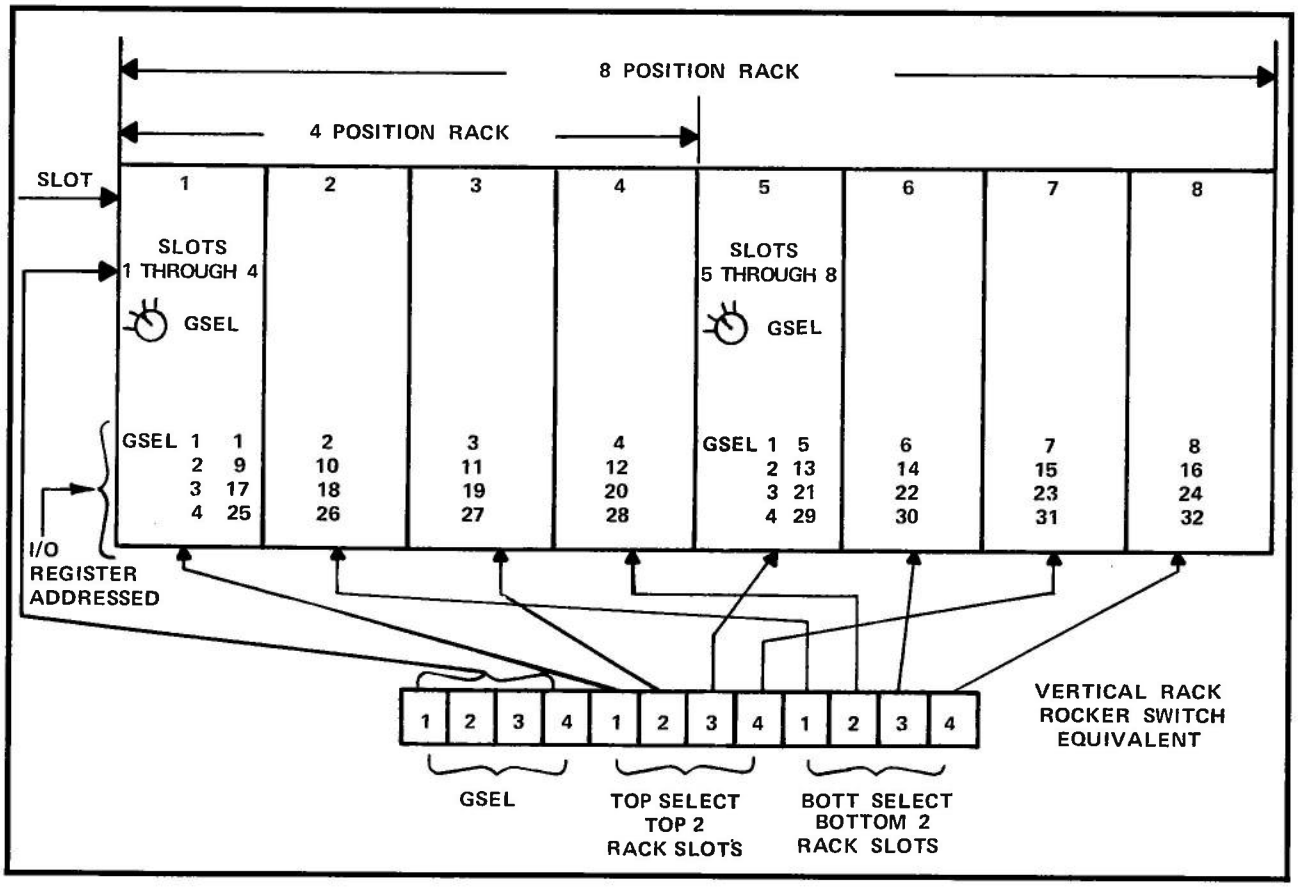
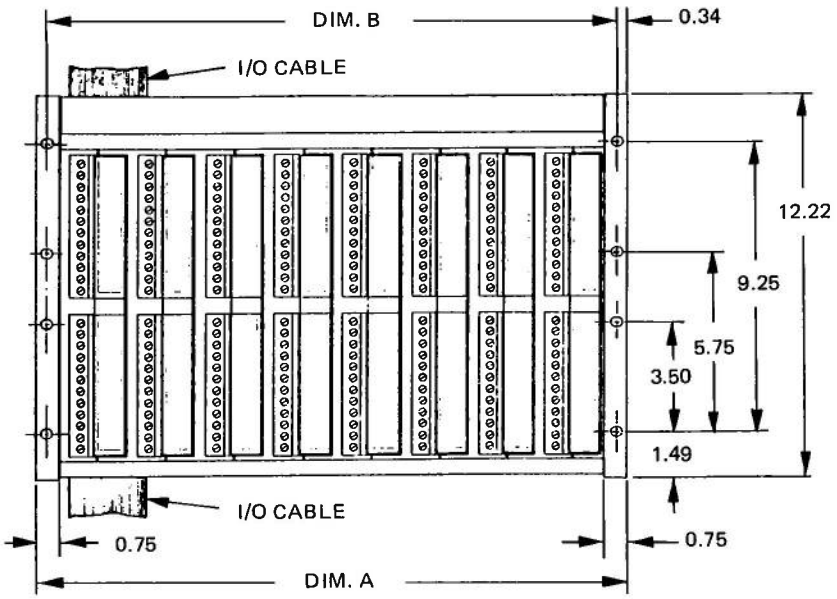


Figure 7-32. Correlation Between Horizontal and Vertical Rack Register Selection



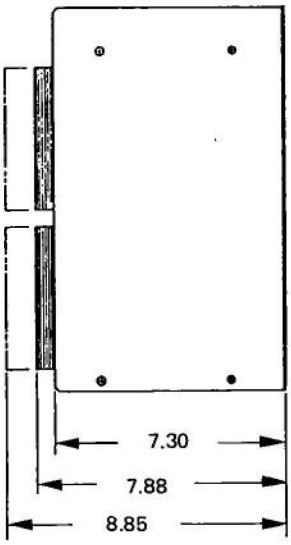
(8 CARD RACK SHOWN)

I/O RACK SIZE	DIM. A	DIM. B
4 CARD	10.28	9.60
8 CARD	19.00	18.32

RECOMMENDED HARDWARE

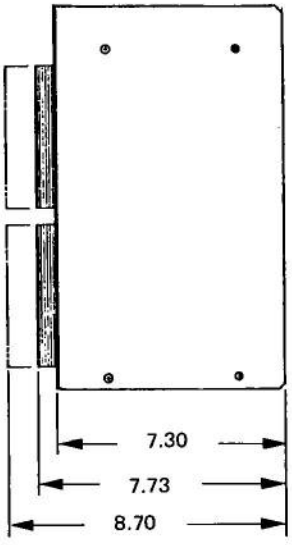
10–32 x .50 CLASS UNF-2B MACHINE SCREW.

PANEL MOUNT



(EXTRACTED TERMINAL PROFILE)

RACK MOUNT (STANDARD 19in RACK MOUNT, 8 CARD ONLY)



(EXTRACTED TERMINAL PROFILE)

Figure 7-33. Horizontal Rack Mounting

4. Locate each of the terminal raceways to be installed into the rack's plastic guides. Figure 7-27 shows the terminal raceway assembly. Determine each raceway assembly's position in the rack for the system drawings. These raceway assemblies are captive-on-installation. Figure 7-34 shows a raceway assembly installed into a rack.

Note

Terminal raceway removal is possible by **carefully** pressing the retaining tangs on the plastic guides. However, care should be exercised so as not to damage guides or tangs.

5. To install the terminal raceway assembly, move the upper and lower slide latches (see Fig. 7-34) of the desired slot to the full-right position **(UNLOCK)**. Line up the terminal raceway assembly in front of the desired slot's plastic guide openings. Firmly press the raceway assembly into the guides until it slides freely back and forth. This process is shown in Figure 7-35.

6. After inserting the terminal raceway into the rack's slot, draw it back out until it stops. Push the slide latches to the left **(LOCK)** so that they are behind the raceway assembly.

7. Apply the terminal identification strip(s) supplied with each module to the surface of its corresponding raceway assembly terminal block. See Figure 7-27.

Rack Wiring

The terminal raceway assembly's terminals accept two 14 AWG stranded wires. However, the smallest size wire consistent with the application's requirements should be used. Prior to connection, strip only 0.25 inch (0.6 cm) of insulation from each wire.

1. Install the supplied tie wraps onto the mounting cradle at the top of the rack. Begin the loop, thereby permitting each cable to be run easily through the tie wrap loops. These tie wraps are to be tightened only when all wiring is complete and checked. These tie wraps are shown in Figure 7-36.

2. Draw individual field wires through the tie wrap loops and then through the oval-shaped grommet at the top of the rack, running each wire down into the raceway's wire guide. Begin with the conductor to be attached to the lowest terminal. See Figure 7-36.

3. Insert this first conductor into the bottom terminal collar and tighten the terminal screw to 15 in.-lb. When two conductors connect to a terminal, insert both conductors before tightening the screw. Lay this first conductor at the rear of the terminal raceway's wire guide. See Figure 7-34.

4. Subsequent field wiring is installed in this manner. Working from the bottom terminals up, each conductor is drawn through the tie wrap loops, oval-shaped grommet, into the raceway wire guide, and is connected to its corresponding terminal. Each subsequent conductor should neatly build on each other within the raceway wire guide.

5. During this process, use plastic tie wraps (as required) to keep the wire bundles neat. Figure 7-37 illustrates bundled wires within the raceway wire guide.

CAUTION

During wiring, ensure that enough slack remains in the wire bundle to enable the terminal raceway to be pulled out.

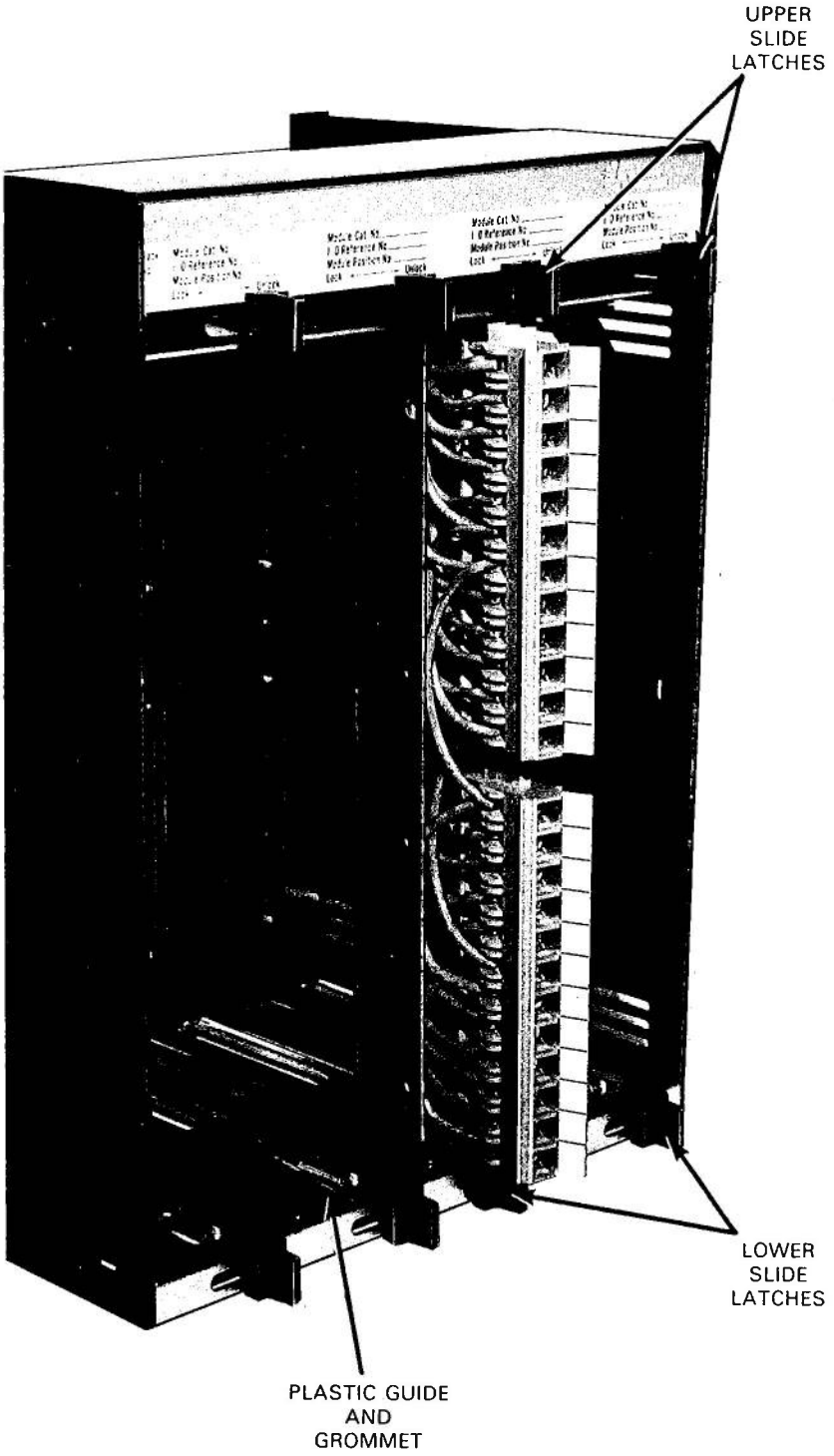


Figure 7-34. Horizontal Rack with Terminal Raceway Assembly Installed

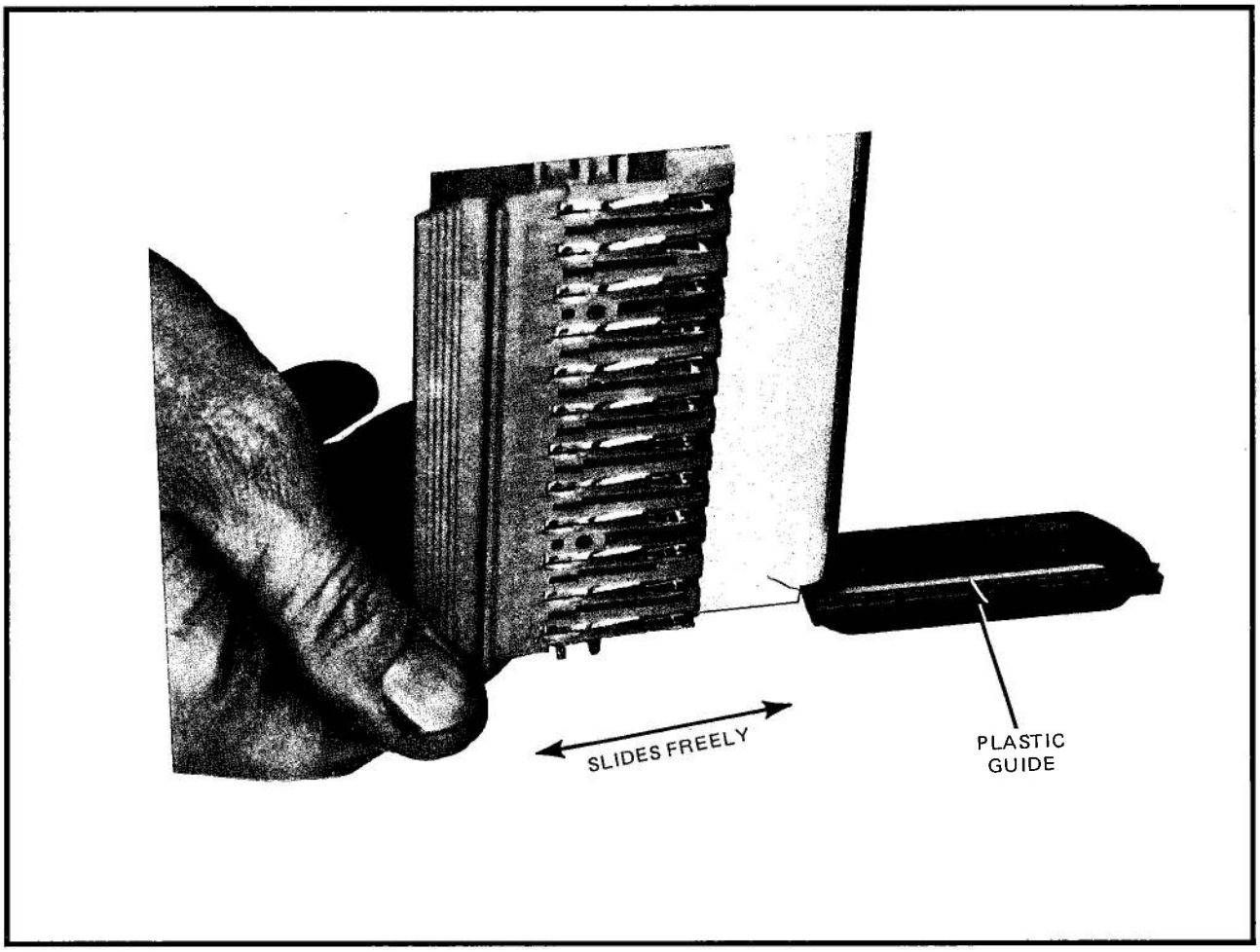


Figure 7-35. Terminal Raceway Assembly Installation

6. After the wiring to the terminal raceway is complete and the proper slack is provided, tighten the previously installed cradle-mounted tie wraps, securing the wire bundles to the horizontal rack enclosure.

7. Install the field wiring for each terminal raceway assembly in this manner.

CAUTION

External wire routing is important to proper system operation. Do not run all levels of a-c and d-c voltage next to, or near, each other. As previously shown in Figures 7-29 and 7-30, maintain a minimum separation of at least six inches (15 cm) between 120/240 Vac and 12 to 48 Vdc bundles. If possible, allow larger separations.

8. Locate the modules to be used in the rack being installed. Identify each module's rack slot. Install the I-shaped plastic removal handles at the center of each module's faceplate. Add the supplied colored identification labels to each corresponding handle.

Note

Follow the system drawings for correct module location.

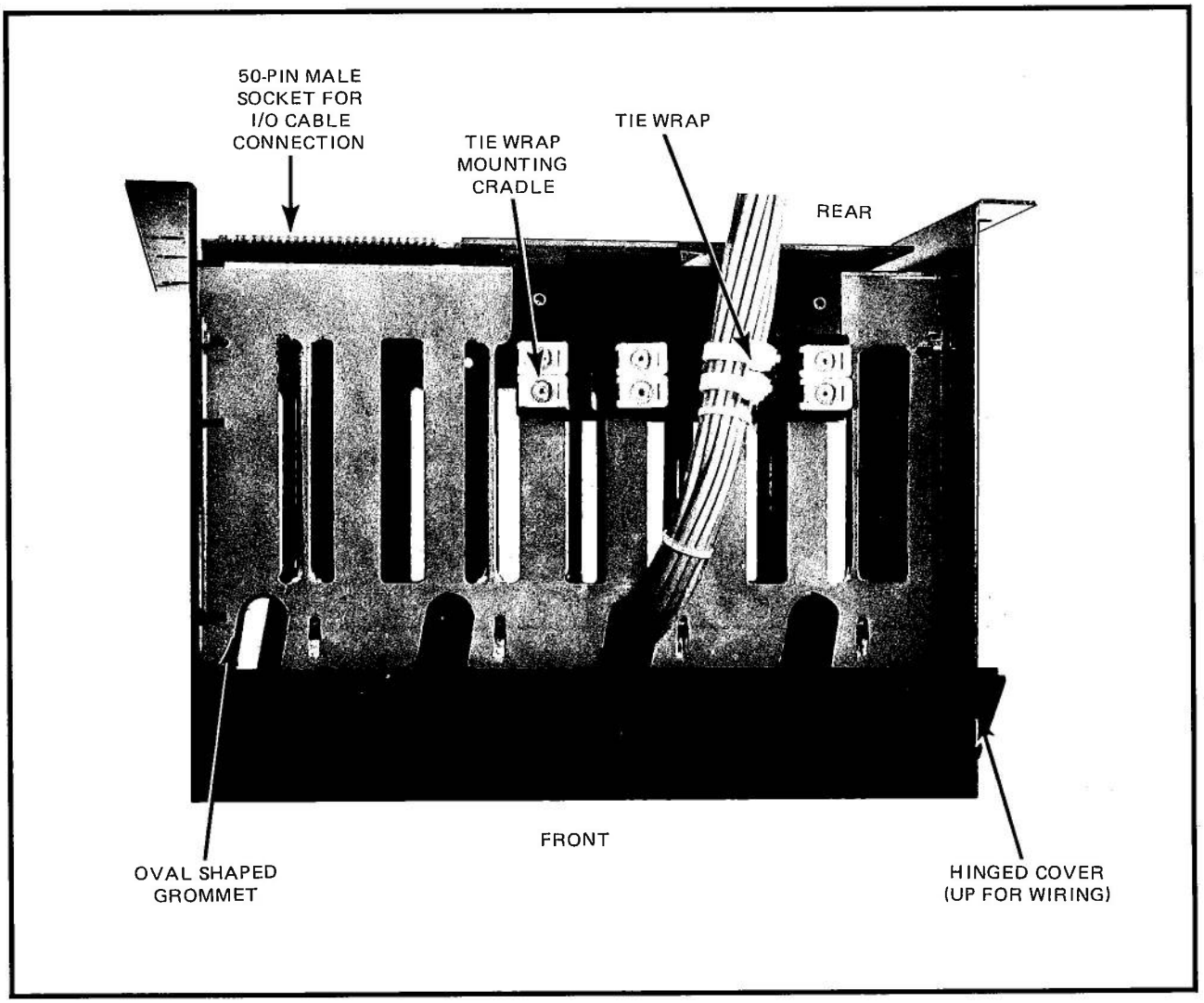


Figure 7-36. Horizontal Rack Field Wiring

9. Prior to module installation, set each module's switches per the system drawings or the I/O numbering lists prepared in paragraph 7-26, "Horizontal Rack I/O Addressing."

10. To install a module, pull out and lock the terminal raceway assembly at the desired location. Without using excessive force, insert the module into its corresponding backplane connector. Push in the terminal raceway assembly so that it now mates with the module. Lock the assembly into place with the slide latches.

11. Connect the incoming NLC-24HP or NLC-36HP I/O cable to the 50 pin male socket at the top of the rack (see Fig. 7-36). Correct orientation is provided by a keyed connector.

12. Connect the opposite end of this I/O cable to the appropriate I/O bus connector on the processor. Again, the connector is keyed for proper orientation.

13. When a second I/O rack is to be installed in series, connect a second I/O cable between the first rack's bottom connector and the second rack's top connector. Again, connectors are keyed.

14. When no further connection is made, use high temperature tape to cover exposed I/O connectors and to guard against shorting.

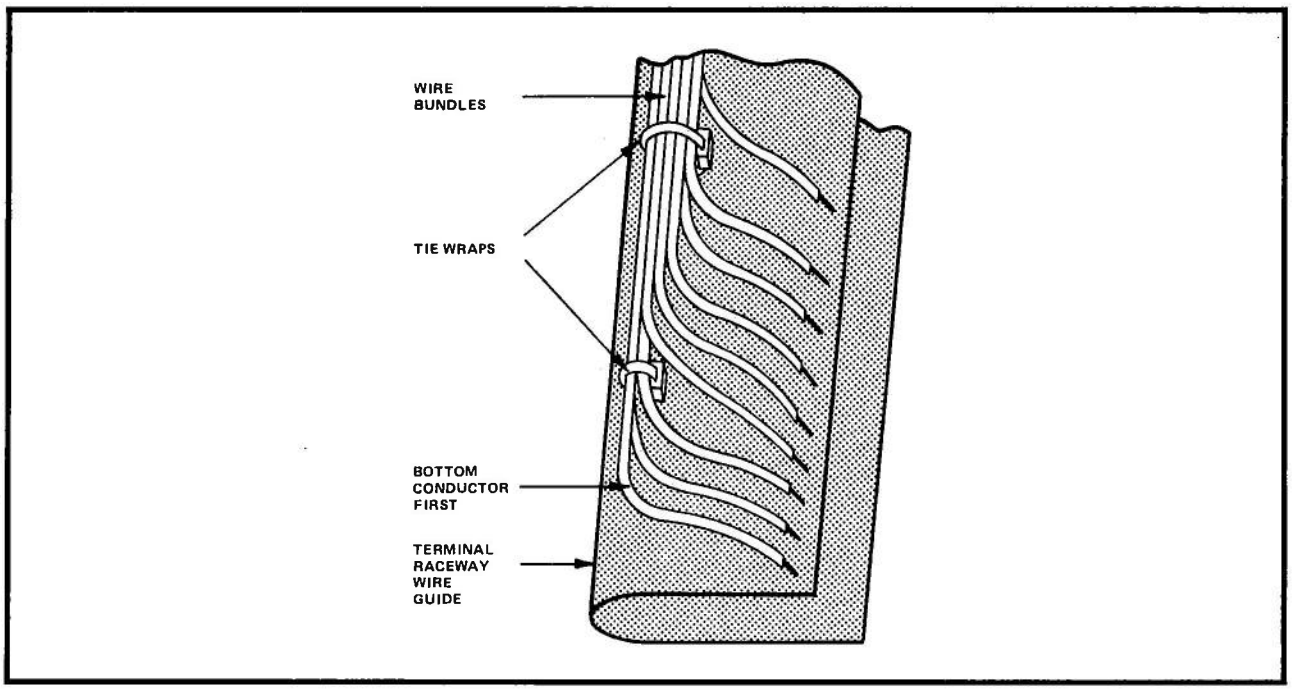


Figure 7-37. Bundled Wires within Wire Guide