SECTION 3. INSTALLATION AND STARTUP

3-1. INSTALLATION OVERVIEW

The PC-1100/1200 programmable controller and associated I/O rack(s) and module(s) are normally installed on a subplate or panel. This mounting surface is then usually placed in a NEMA Type 12 enclosure. It may also be placed in some other customer supplied protective enclosure suitable for the specific application. Construction of a PC-1100/1200 based system on this panel is simpler than construction of its relay counterpart. Panel construction is best done by using a build-and-test technique recommended by Westinghouse. This technique constructs in stages. Each stage is tested before the next one is started. Using this technique prevents, or at least 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.

3-2. Recommended Installation Technique

The build-and-test technique is used to install a PC-1100/1200 programmable controller system in three distinct stages:

1. Controller test

2. I/O rack installation, setup, and test

3. Module installation, field wiring, and test

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

The I/O modules are installed in the appropriate rack positions prior to field wiring. Module inputs are verified, and outputs are tested for proper operation by means of the special programs provided.

This recommended technique results in a significantly easier fabrication and startup period. If problems are encountered during the installation and application of the PC-1100/1200 System, contact your Westinghouse Service Representative. Optionally, Westinghouse provides system design, programming, drawing documentation, panel assembly and system startup assistance.

3-3. UNPACKING INSTRUCTIONS

Westinghouse 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 packaging list to determine that the correct quantities and types of components have been received.
- Inspect the equipment for any visible damage incurred during shipment.
- Test the equipment to assure 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 POSSIBLE TIME.

Unpack the controller and any peripheral equipment (e.g., program loader, tape loader, printers, etc.) to conduct power tests. Testing at this time assures that the controller and peripherals are operational and allows early corrective action in the event of a malfunction. The I/O rack(s), modules, and I/O rack expansion cable (if used) are unpacked and tested at a later time during installaiton. However, their shipping containers should be inspected at this point for obvious damage.

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

3-4. Electrostatic Discharge

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

CAUTION

Controller failure can result from electrostatic discharge damage due to the improper handling of components. Any work done with the controller's cover off should only be attempted in a static-safe environment.

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

3-5. Controller Power-Up Check

The PC-1100/1200 power-up checkout procedure is completed after unpacking but prior to controller installation onto the I/O rack. This checkout procedure requires the use of a program loader. Retain the controller and program loader packing materials against the possibility of equipment storage prior to installation, or in case further shipment is required.

CAUTION

Do not remove any controller modules with AC power applied. Improper system operation can result.

Precheck Procedure

1. After the PC-1100/1200 controller is unpacked, inspect it for damage. Once inventoried, place it on a flat surface (e.g., table top, bench, etc.).

2. Remove the controller's front cover plate by turning the two quarter-turn fasteners counterclockwise until the plate releases.

Battery Backup Activation

PC-1100/1200 controllers incorporate battery backup for RAM memory.

For the PC-1100, three Type AA alkaline cells are used. Figure 3-1 shows the location of the plugged-in batteries. PC-1100 units are shipped with the batteries in place; however, the connecting wire is not attached. To activate the batteries, attach the connector as shown in Figure 3-1.

The PC-1200 uses a single Type AA lithium battery (protected by a PICO fuse). Figure 3-2 shows the location of the plugged-in batteries. PC-1200 units are shipped with the battery in place. To activate the battery, set the battery enable jumper JS1 to the enable (ENA) position, as shown in Figure 3-2.

Operating Voltage Selection

The standard power supply for the PC-1100/1200 operates at 120/240 VAC. (Alternately, a 24 VDC version may be used with the PC-1100.) Locate the terminals on the front of the controller. After the bench top checkout, it will be necessary to wire the incoming AC line appropriately. (See Figure 3-3.)

AC Line Cord Connection

For the bench top checkout, connect a temporary three-wire AC line cord to the terminals indicated in Figure 3-4. (Proper phasing and a ground connection for the three-wire cord are required.)

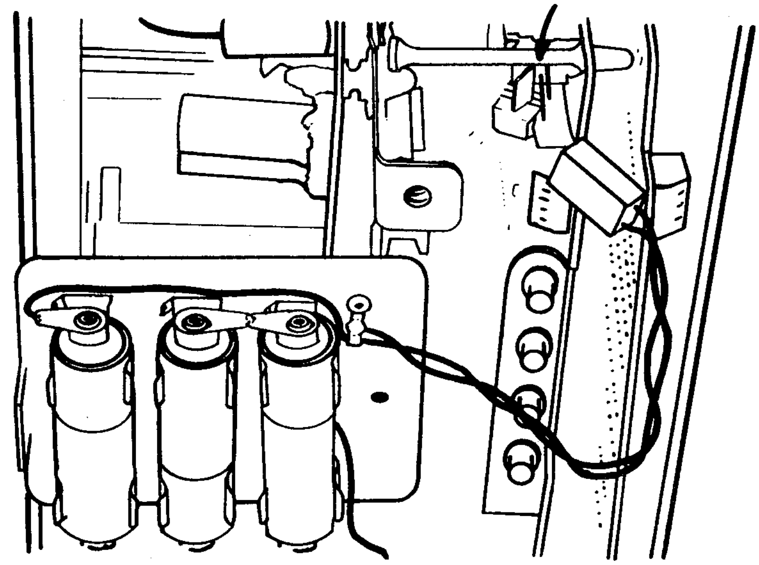

Figure 3-1. PC-1100 Battery Backup Activation

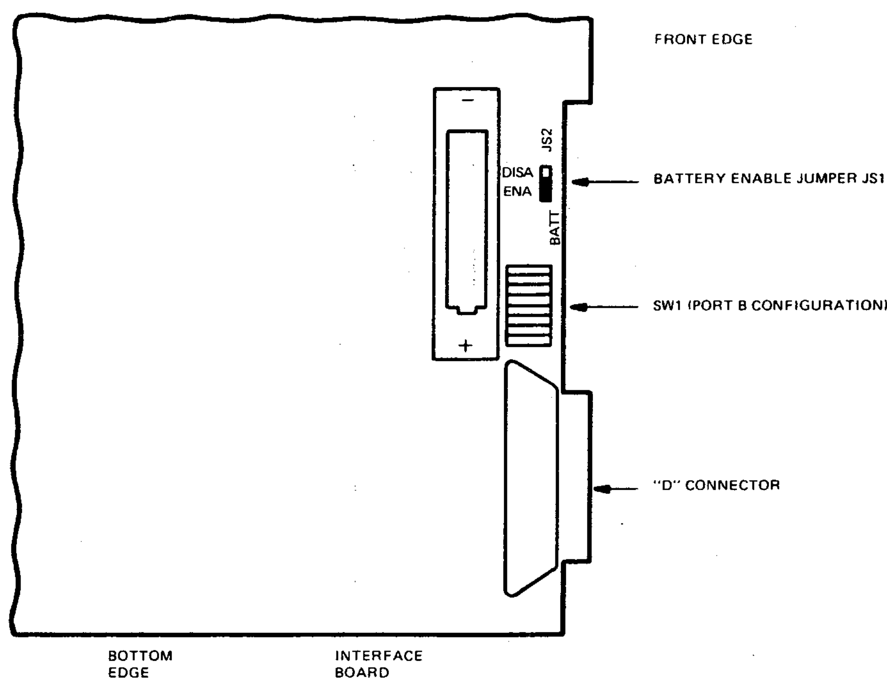

Figure 3-2. PC-1200 Battery Backup Activation

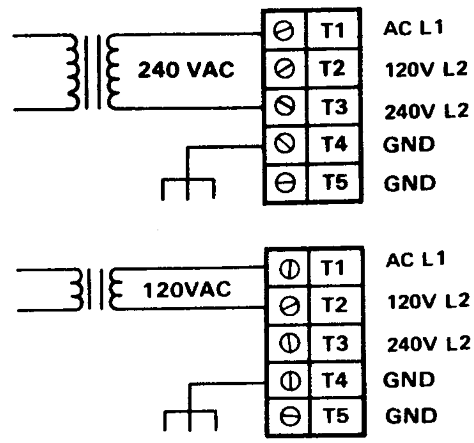

Figure 3-3. Selection of 240 VAC Operation

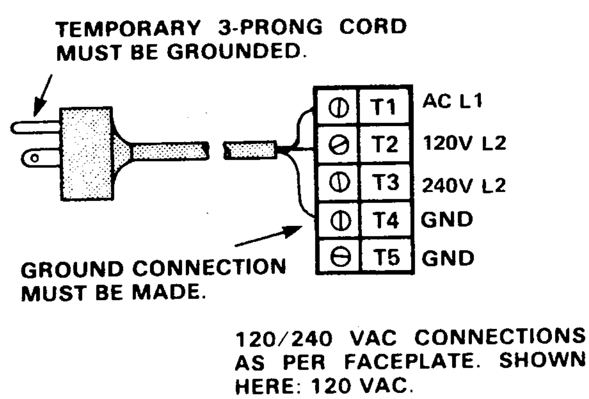

Figure 3-4. Temporary AC Line Cord Connection

After making this connection, place the front panel keyswitch in the STOP position, and plug the cord into a wall socket. Observe the four front panel LEDs, which should indicate normal operation as follows:

- DC OK - Lights
- RUN - OFF
- BATTERY OK - Lights, if activated
  - OFF, if not activated
- FAULT - Lights

If the DC OK LED remains OFF, check to see that a fuse is installed and is not blown. Then recheck the AC line cord connections and make sure that the controller is plugged into an active AC outlet. If these three checks do not locate the problem, and the LED remains OFF, see Section 6.

If any of the other three LED displays are not correct, refer to Section 6.

DC Line Cord Connection

If the 24 VDC version of the controller is being used, connect DC power to the terminals, as indicated in Figure 3-5. Then follow the procedures outlined above for AC checkout.

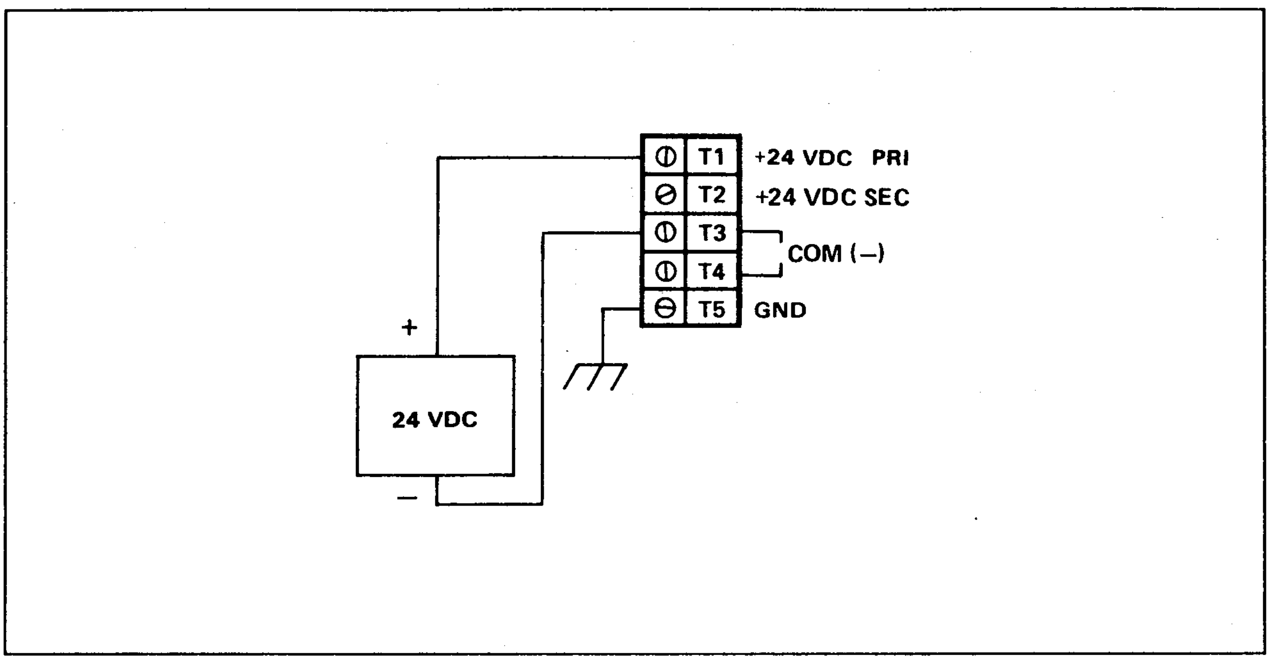

Figure 3-5. Temporary DC Line Cord Connection

PC-1100/1200 Controller Initialization

Because the PC-1100/1200 is shipped with the battery back-up disconnected, the unit will power up with its memory in a random state. This results in a fault condition. The program loader is used to initialize the controller (i.e., clear the memory).

Like the controller, the program loader must be carefully unpacked, inventoried and tested prior to its use. After the program loader is found to be operating normally, it should be placed on a flat surface, close to the controller, for ease of connection. Refer to the program loader's programming manual for checkout and operating instructions and for initializing the controller.

Note

The PC-1100/1200 and the program loader must be connected to the same power source and properly phased.

Run Mode Verification

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

- DC OK - Lights
- RUN - Lights
- BATTERY OK - Lights
- FAULT - Off

If the Fault LED remains lit, or if the other LED indications are not correct, see Section 6.

The successful completion of this checkout procedure indicates that both the PC-1100/1200 controller and the program loader are functioning normally and ready for installation. Since the program loader is connected and the controller has been initialized, the memory size and software version can be verified by displaying the controller status. If the controller and program loader will not be used immediately, disconnect them and replace the equipment in the shipping containers.

CAUTION

If the controller is to be stored for a period longer than several days, disable the battery (see Figure 3-1 for the PC-1100 or Figure 3-2 for the PC-1200). Failure to do this allows the batteries to discharge unnecessarily during storage.

3-6. ENCLOSURE AND PANEL SELECTION

Before panel fabrication is started, the type of enclosure layout, wire routing and ducting must be considered. In most applications, a free standing NEMA Type 12 enclosure is used. A typical NEMA Type 12 enclosure used in PC-1100/1200 applications is shown in Figure 3-6.

The 1000 Series I/O racks and modules are designed to be mounted on a subplate within this enclosure, or its equivalent. All system components will fit in an 8-in. deep panel when mounted on a standard subplate (including the base controller unit with keyswitch inserted and program loader connected; I/O rack(s) and modules; and external power supplies, if applicable). The 8-in. depth allows the door, with a drawing pocket, to be closed. Mounting in a 6-in deep panel is possible if there is no drawing pocket and if the keyswitch is not inserted. A controller and 4-module I/O rack are easily installed in a 15x7x13 in. (HDW) panel.

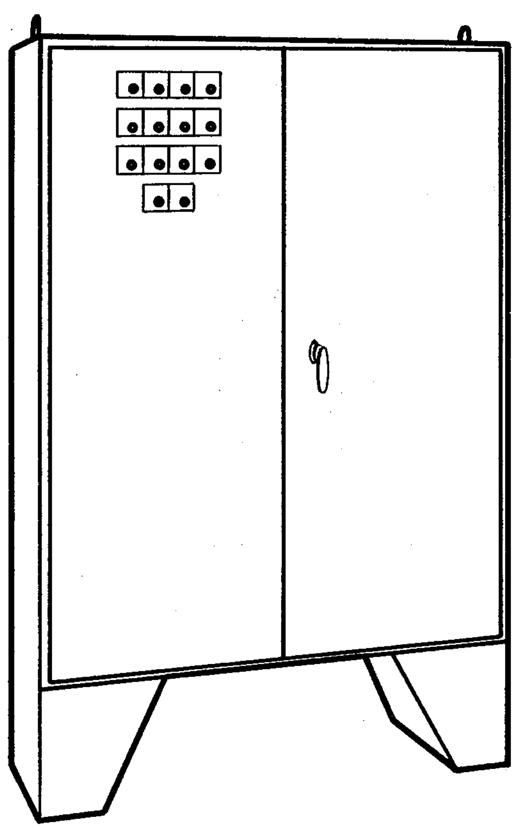

Figure 3-6. Typical NEMA Type 12 Enclosure Used with PC-1100/1200

A minimum clearance of 2 in. is required between the enclosure's top panel and the top of the primary rack. A minimum clearance of 2 in. 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.

CAUTION

The above noted 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.

Westinghouse programmable controllers are designed and constructed to minimize the effects of harsh industrial environments. However, when any control system operates under extreme conditions, additional measures must be taken to completely isolate that system. A variety of techniques are presented in the following paragraphs. Depending on the application, follow these recommended techniques as a guide for the most effective use of the Westinghouse programmable controllers.

3-7. 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 Rack Expansion Cable

The I/O rack expansion cable (NLC-1074(B) or NLC-1077) is used to interconnect the primary rack to an optional expansion rack (via the Rack Bus Expansion module). The NL-1074(B) is 3 ft in length, while the NLC-1077 is available in a number of lengths. The length of the rack expansion cable within a system should be held to a minimum. All excess cable length must be positioned away from AC field wiring connections. For additional information on the Rack Bus Expansion modules and cables, refer to Paragraph 2-14.

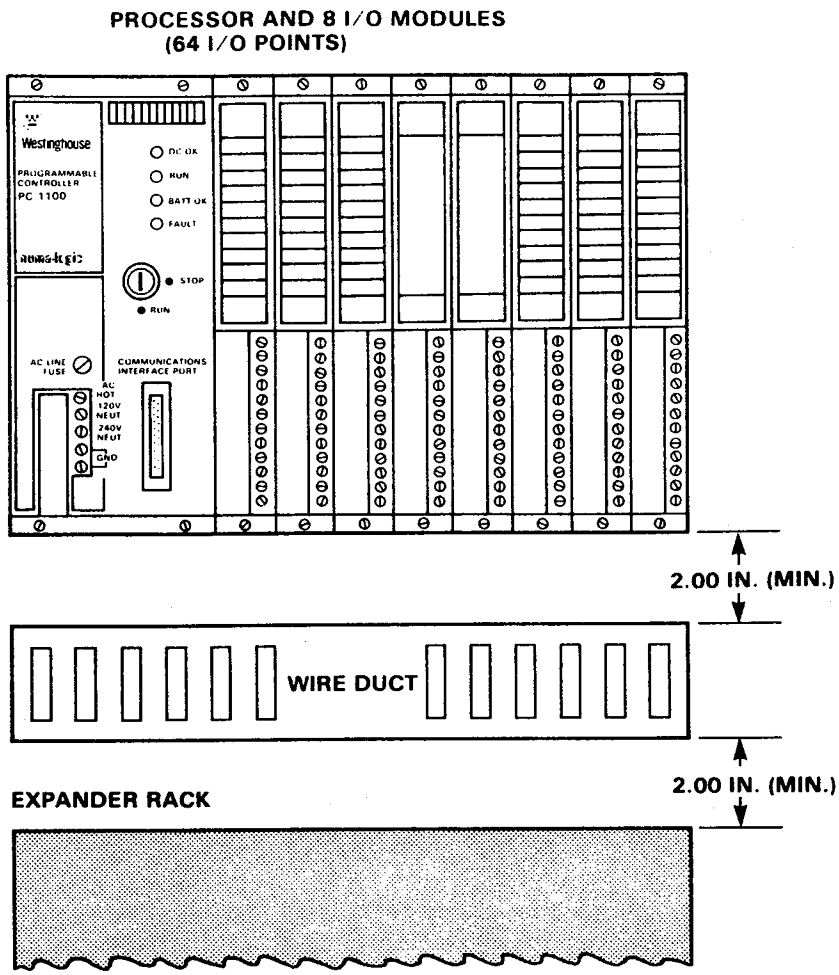

Figure 3-7. Vertical Separation between Primary and Expansion I/O Racks

I/O Rack Separation

The required minimum separation between a primary and expansion I/O rack is shown in Figure 3-7. This clearance maintains the proper cooling around system components. Additional rack separation may be required for the installation of the panel hardware, etc. Note that the maximum separation is dependent on the cable length and system layout.

Caution

Increases in temperature can cause improper operation. Avoid installing the I/O racks in close proximity or directly above high-heat-dissipation devices.

Note that heat is produced by the controller, output modules, and other load-handling devices. When possible, arrange the system components so that these heat-dissipating devices are not underneath critical components.

Auxiliary Components

Do not install auxiliary components in a position where the free flow of air over the controller is impeded. Additionally, all electromagnetic devices (e.g., control transformers, motor starters, etc.) are to be installed at least 18 in. from the controller.

Communications Cable

The communications cable, which interconnects the Advanced Program Loader (APL) and controller, is supplied as a standard six-foot cable. The following cables are available:

- NLC-3PL (for NLPL-780 CRT Program Loader)
- NLC-4PL (for APL with AST CC232)
- NLC-5PL (for APL with 9-pin COM 1)
- NLC-6PL (for APL with 25-pin COM 1)

Please refer to the applicable software manual for details.

Temperature

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

Wire Routing

Most of Westinghouse programmable controller equipment meets NEMA and IEEE noise specifications. However, as a precaution, the controller power supply wiring, along with the field wiring to the input and output modules, should be kept separate from wires carrying more than 230 VAC. The high-voltage AC wiring should be shielded or placed in a metallic cable duct, thereby separating it from the low-level DC voltage wiring. When high-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 120V 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 DC field wiring to input and output modules. Separate AC output wiring from AC input wiring. These wires may be separately bundled or placed loosely in the wiring duct.

A sample programmable controller system layout is shown in Figure 3-8.

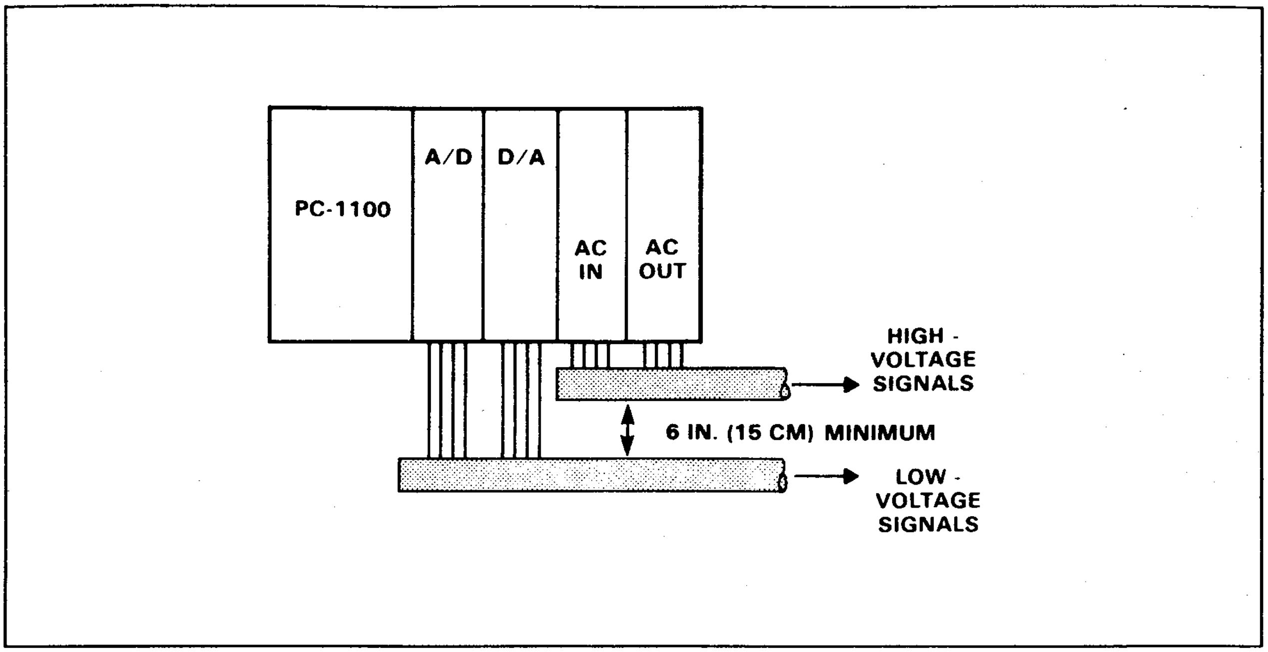

Figure 3-8. System Layout (Typical)

3-8. FIELD WIRING CONSIDERATIONS

The following paragraphs should be reviewed when planning field wiring for the PC-1100/1200 system.

3-9. I/O Screw Terminal Connection And Wire Routing

Field wiring connections to the input and output modules are made to captive screw terminals rated at 300 V. As shown in Figure 3-9, the terminal block is mounted to the face of each I/O module.

3-10. Grounding Considerations

CAUTION

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

The I/O racks should be mounted to the enclosure's subplate with star washers to assure proper electrical contact. The ground service lug on the subplate must be connected to the electrical service ground with a AWG No. 10 (or larger) multistrand wire. All system components must use the subplate as the ground reference.

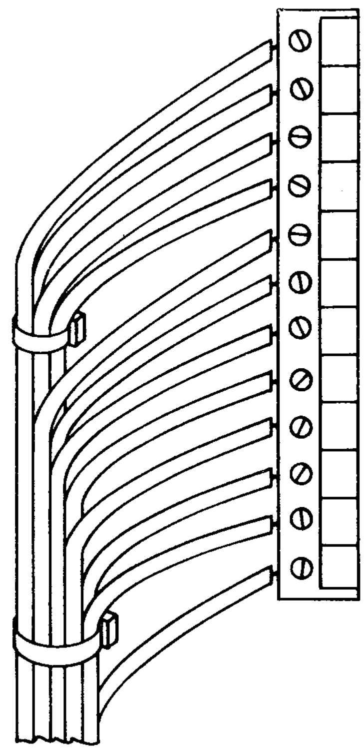

Figure 3-9. Field Wiring to Terminal Block

A typical programmable controller power wiring scheme is shown in Figure 3-10. As indicated, power to the controller 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 controller's ground terminal are all connected to the subplate. The subplate, in turn, is connected to the electrical service-that is, earth-ground.

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" AC 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. Reference the grounds of all system-related units to the subplate.

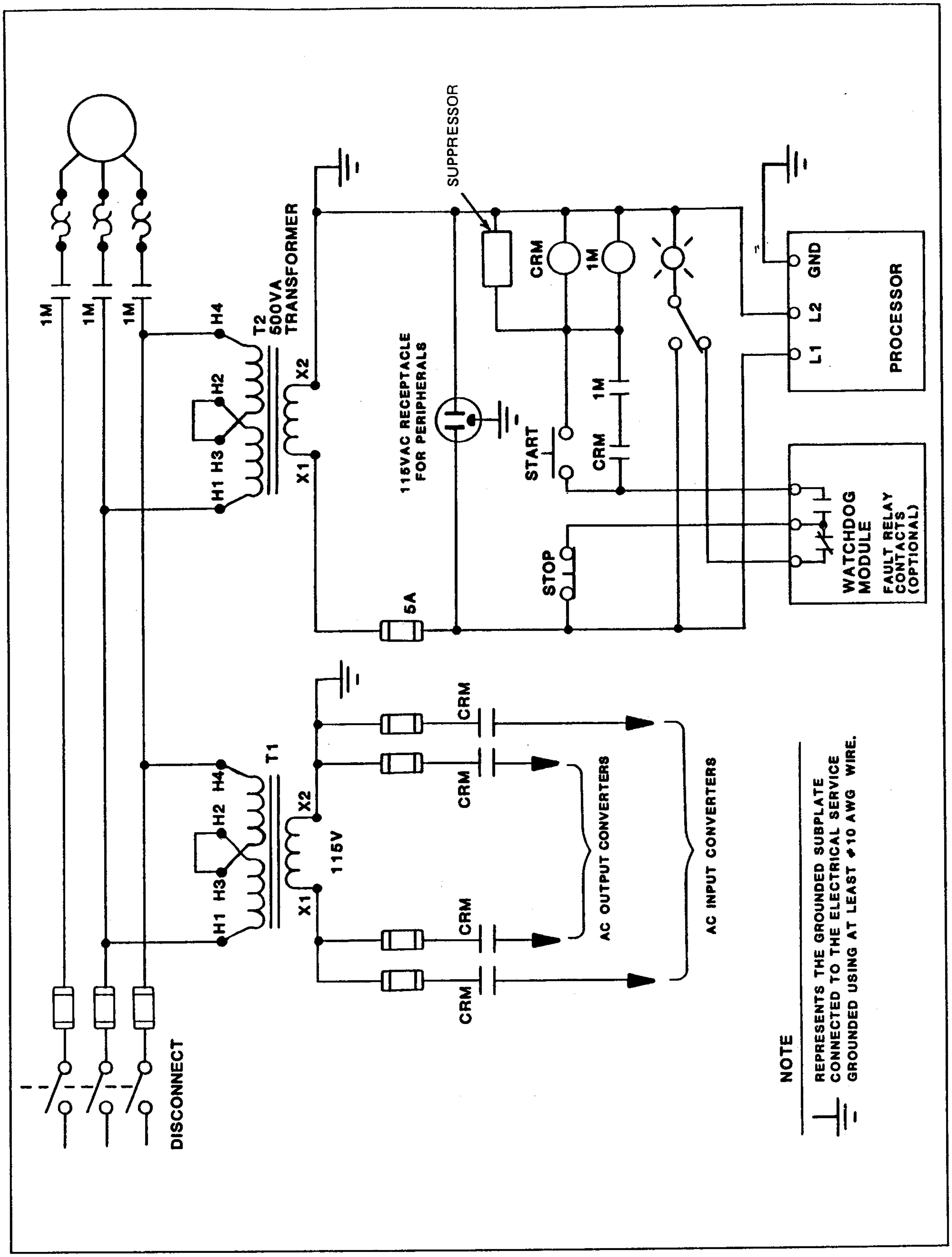

Figure 3-10. Typical PC-1100/1200 System Power Wiring

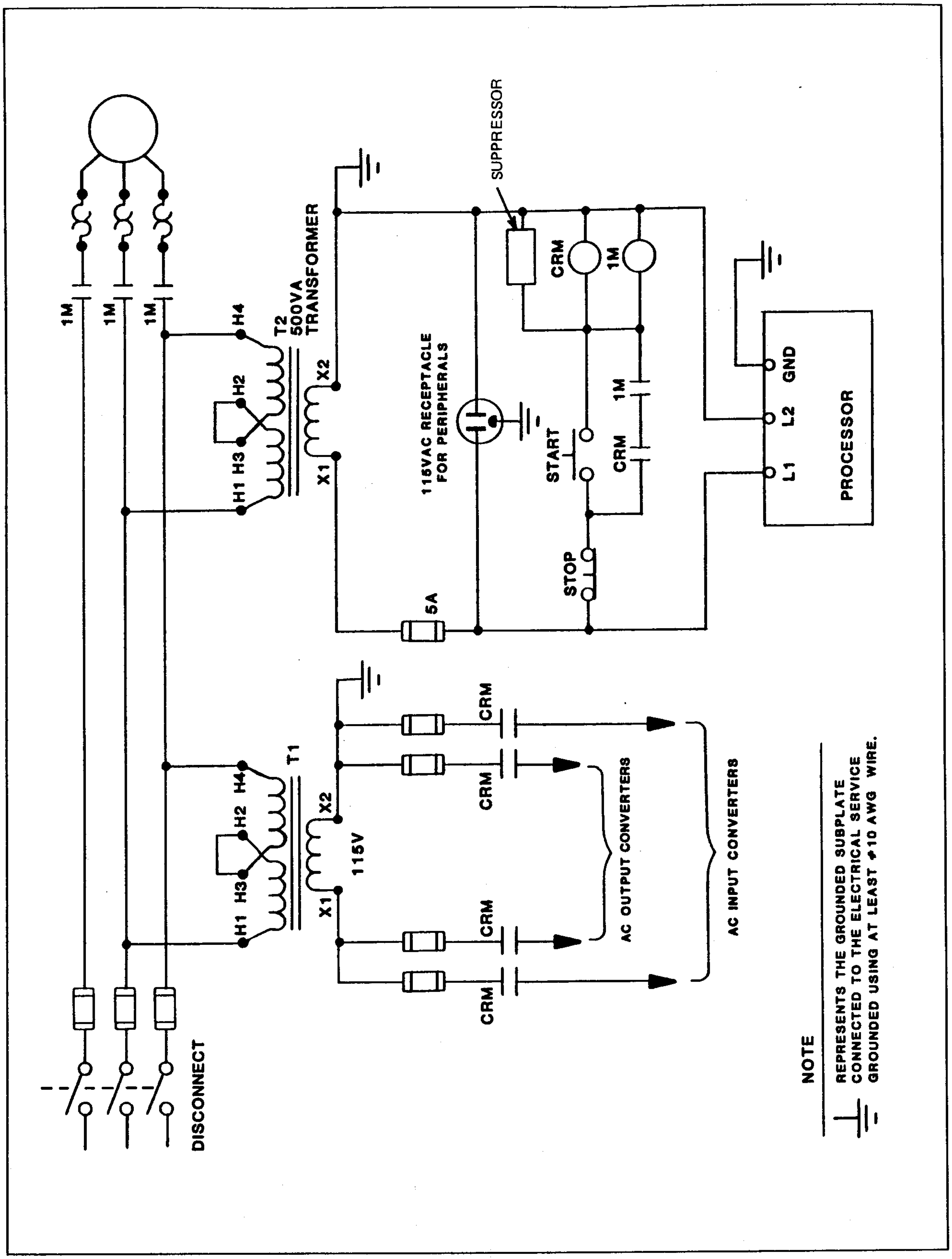

Figure 3-10. Typical PC-1100/1200 System Power Wiring (Cont'd)

Figure 3-11 illustrates the recommended component mounting technique for both tapped-hole and through-bolt mounting. This technique should be used to ground the controller and I/O rack(s) to the subplate. The subplate is in turn grounded to the electrical service ground as mentioned previously.

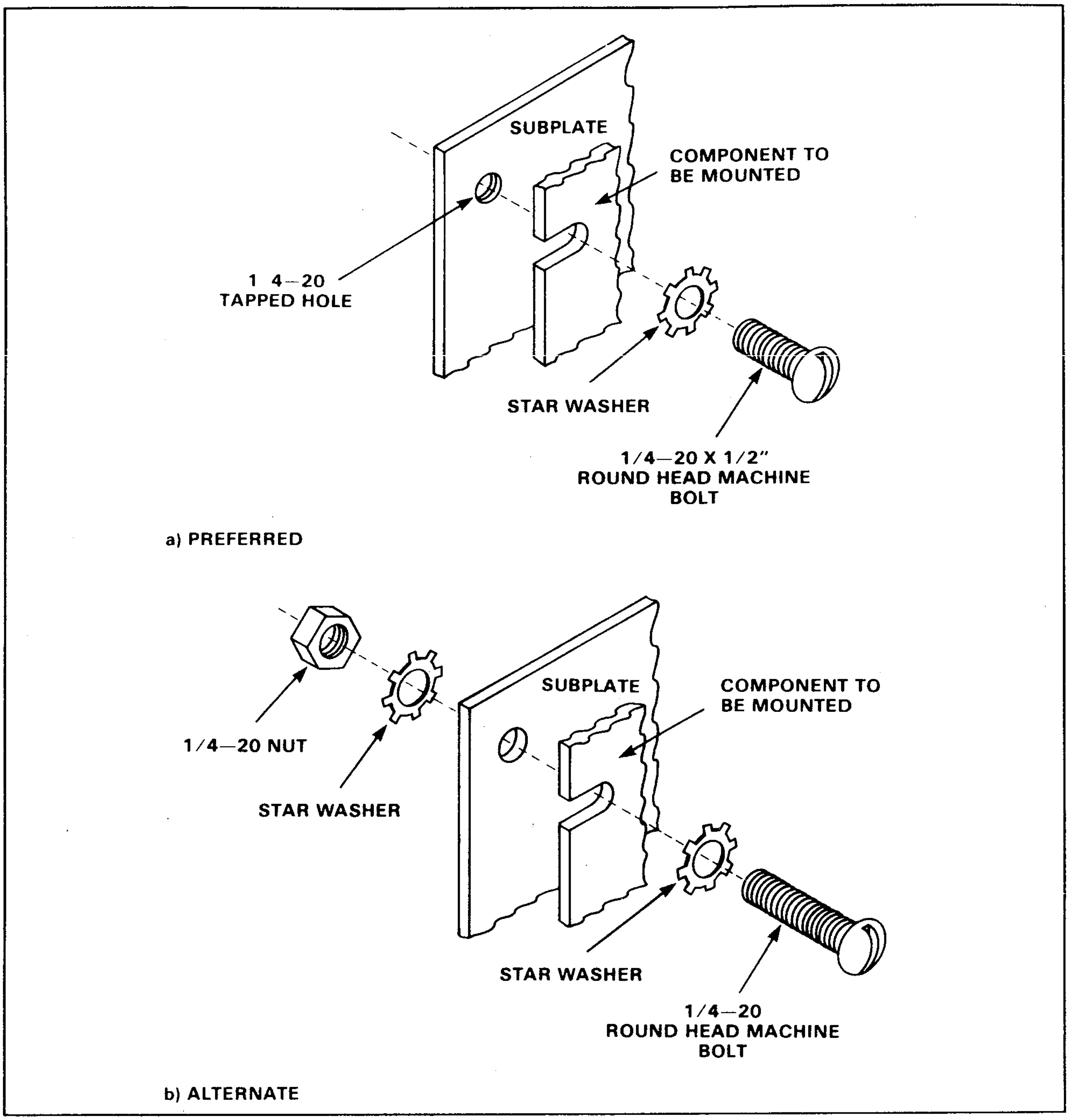

Figure 3-11. Component Mounting Methods

The NLRE-1011, -1011B, -1013, and -1017 expansion racks are shipped with a screw and lockwasher to be used in grounding. The screw and lockwasher are to be attached to the PEM™ nut in the upper left corner of the rack, and connected to earth ground using 10 gage wire. Using this hardware, a series of expansion racks can be grounded in a "daisy-chain" configuration.

3-11. 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 3-12 shows a suppression technique which can be used for AR relays, small inductively-activated valves or solenoids.

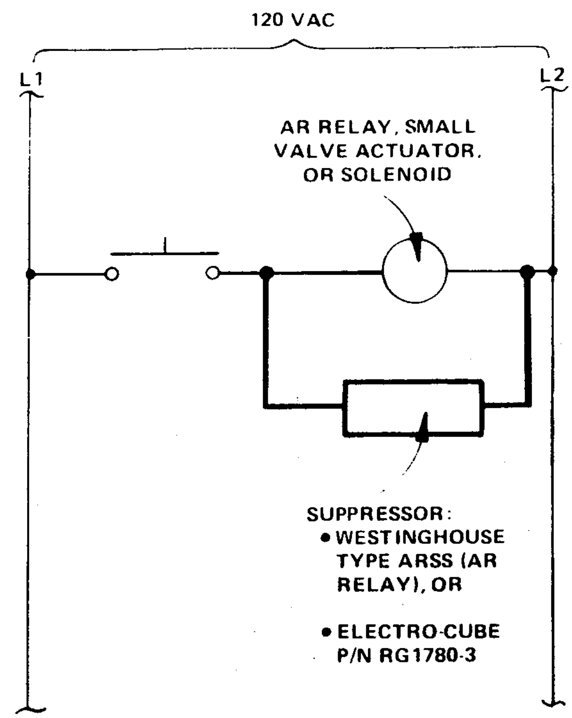

Figure 3-12. Relay, Valve, and Solenoid Suppression Example

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

This paragraph is intended to indicate the options that are available in the remote possibility that problems are encountered.

Figure 3-13 shows a suppression technique used for an A200 starter or large inductive devices A suppression technique used for motors is shown in Figure 3-14.

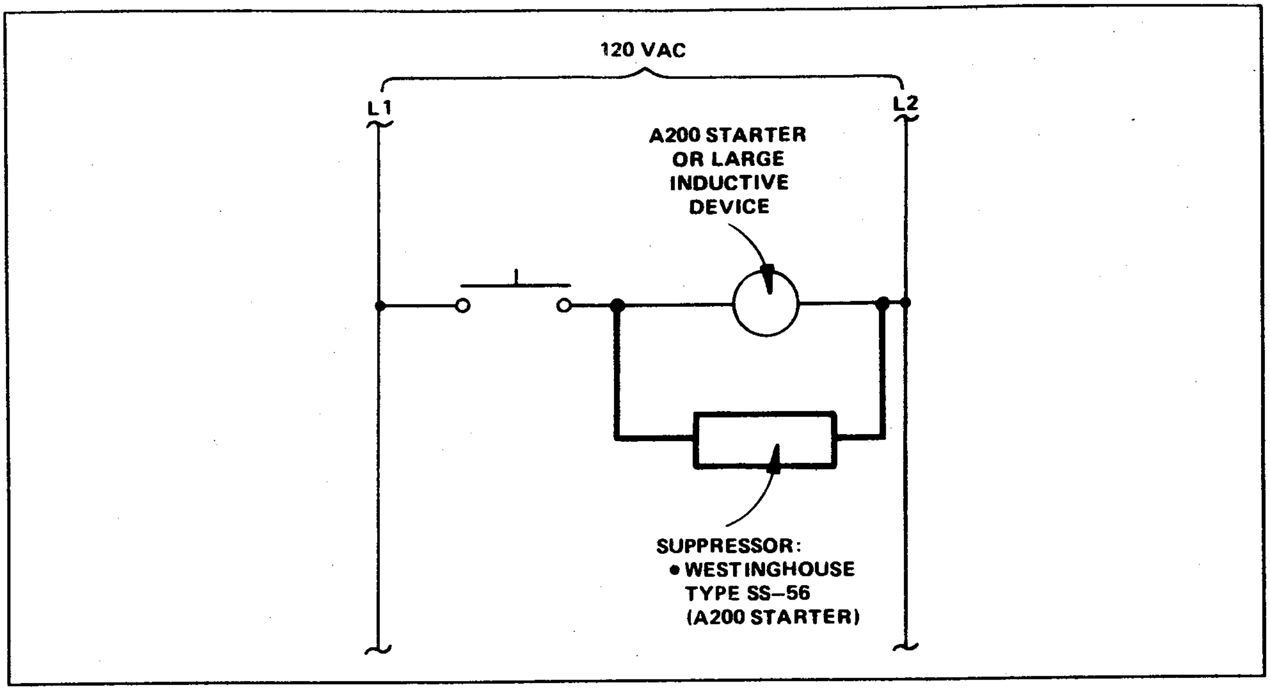

Figure 3-13. A200 Starter and Large Inductive Device Suppression Example

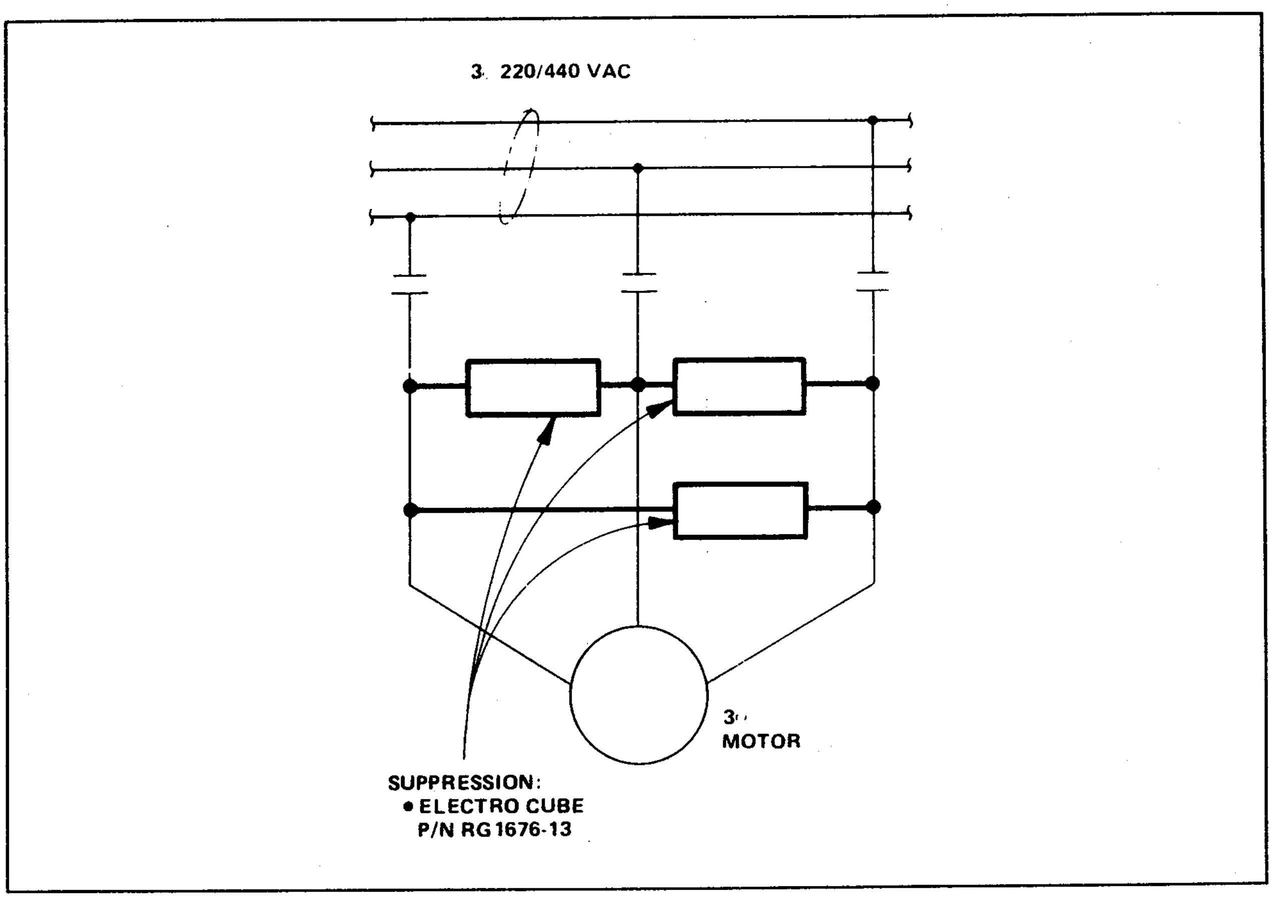

Figure 3-14. Motor Suppression Example

When the controlled equipment near the PC-1100/1200 system contains commutating DC motors or generators, large AC 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 mounted close to the field device.

If the AC 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 AC output circuit. Figure 3-15 shows a suppression technique for each of these conditions.

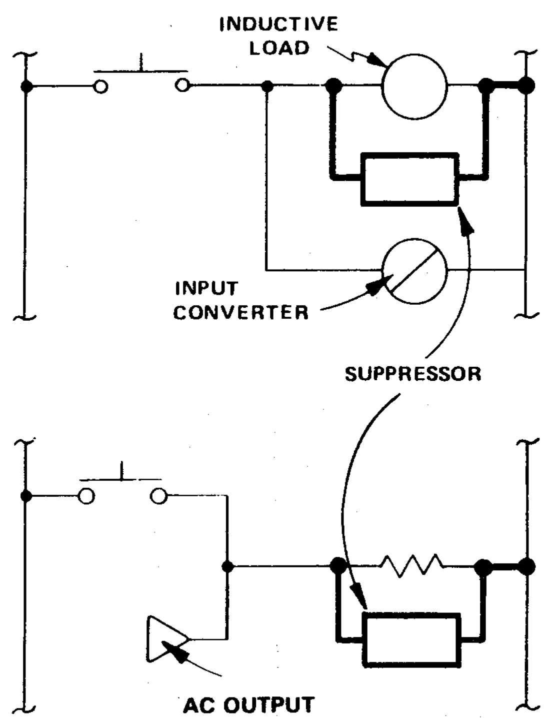

Figure 3-15. Input Converter and AC Output Suppression

3-12. Rack Density Considerations

The I/O racks allow a high density of I/O points within a given area. During system planning and installation, it is possible to exceed the maximum power capabilities of the controller power supply (described in Paragraph 2-16). Attention must be given to the total power requirement for all modules within the system. The specific power requirements for each module are given in Section 2. The power requirement for each module is also given in its respective Instruction Leaflet, which is supplied as standard with each module.

When using a rack completely filled with output modules, each of which is operating at 100% load, the ambient air temperature must be derated to 50°C (122°F). To maintain proper operating temperatures, do not exceed the following guidelines:

- Operate a maximum of 75% of the output circuits at full current, or
- Operate all output module circuits at 75% of load.

Similarly, when using an I/O rack completely filled with input modules which are all ON simultaneously, the ambient temperature specification must be derated to 50°C (122°F). To maintain proper operation temperatures, use the following guideline:

- Operate all input module circuits at 75% load.

3-13. RACK, CONTROLLER, AND MODULE INSTALLATION

The recommended sequence for installing and testing the system is as follows:

1. Lay out, mark, pre-drill, and tap the panel.
2. Mount the I/O rack(s), wire duct, etc.
3. Install the PC-1100/1200 in the primary rack.
4. Apply temporary power to the controller and check for proper operation.
5. Remove power and install modules.
6. Wire the panel (i.e. peripheral outlets, commons on I/O, input and output wires that connect terminals, power supplies for analog I/O, etc.).
7. Power-up for module voltage checks.
8. Remove power and check module addressing.
9. Power-up and check the I/O modules for proper operation (with a dummy load on outputs).

10. Connect the field wiring.

11. Load the program in the PC-1100/1200.

12. Check the entire system for proper operation.

3-14. Rack Mounting

The I/O racks are high-density racks which provide compact and economical support for the PC-1100/1200 and 1000 Series I/O modules. The main rack versions contain the controller and up to sixteen modules. An expansion rack can be used to increase a PC-1100/1200 system (adding as many as 16 additional modules). Each type of horizontal rack is listed in Table 3-1.

TABLE 3-1. I/O RACKS

Catalog Number	Description
NLR-1004	Main Rack (holds controller plus four I/O modules)
NLR-1008	Main Rack (holds controller plus eight I/O modules)
NLR-1012	Main Rack (holds controller plus twelve I/O modules)
NLR-1016	Main Rack (holds controller plus sixteen I/O modules)
NLRE-1009, -1011, 1011B	Expansion Racks (each holds nine I/O modules)
NLRE-1013	Expansion Rack (holds thirteen I/O modules)
NLRE-1017	Expansion Rack (holds seventeen I/O modules)

When mounting the I/O racks, be sure to observe the minimum clearances for I/O rack separation (given in Paragraph 3-7). Note that shorter distances will make access difficult and may cause overheating (by impeding airflow).

Caution
Increases in temperature can cause improper operation. Avoid installing the I/O racks in close proximity or directly above high-heat-dissipation devices.

Also, verify that the distances between the rack will not exceed the length of supplied I/O cables.

The layout dimensions for each rack are shown in Figures 3-16 through 3-19. For additional information on the I/O racks, refer to Paragraph 2-14.

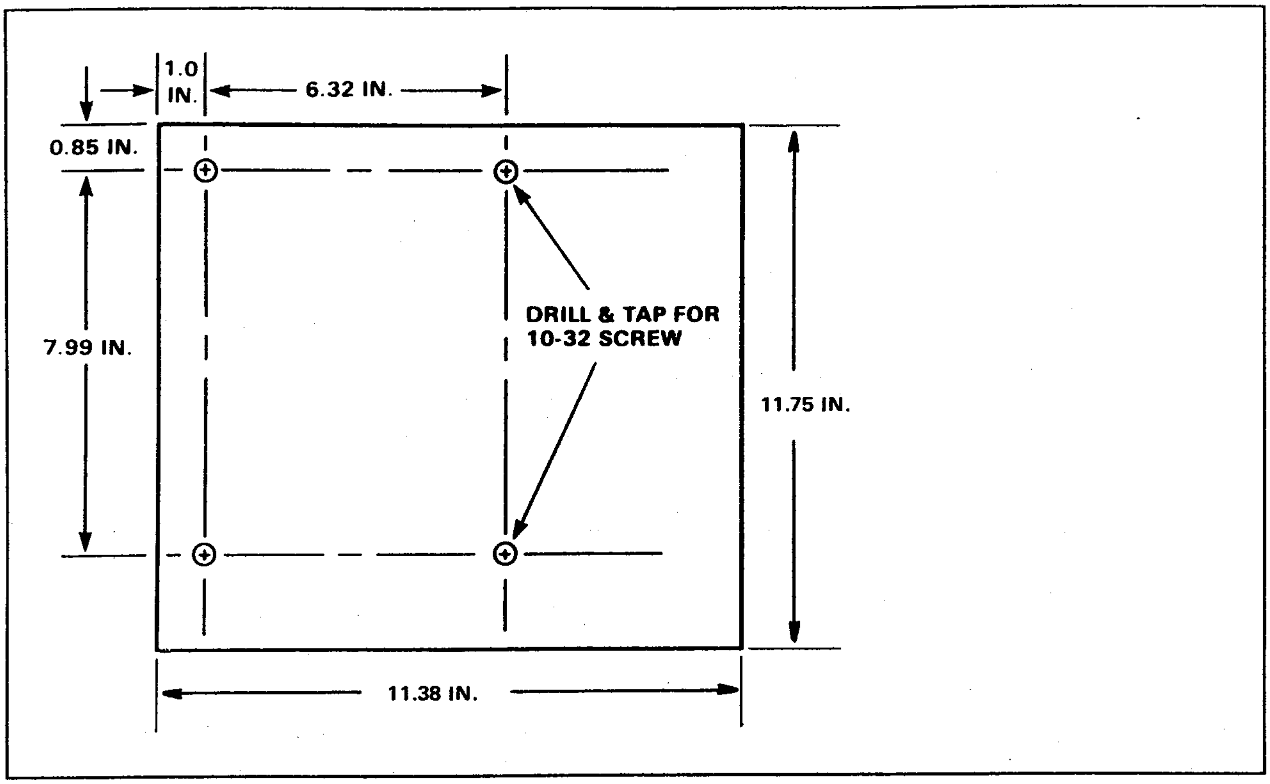

Figure 3-16. Layout Dimensions for 4-Module Rack (NLR-1004)

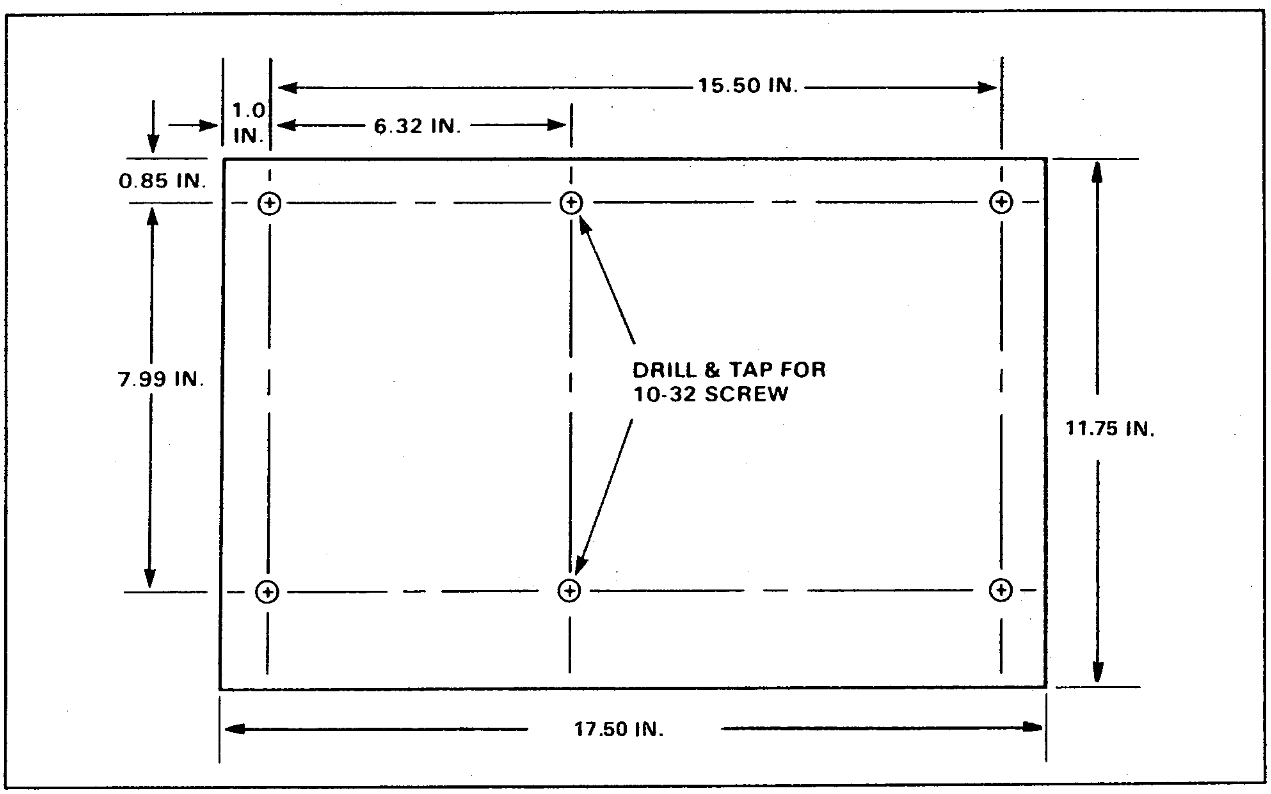

Figure 3-17. Layout Dimensions for 8-Module Rack (NLR-1008) or 9-Module Expansion Rack (NLRE-1009/1011/1011B)

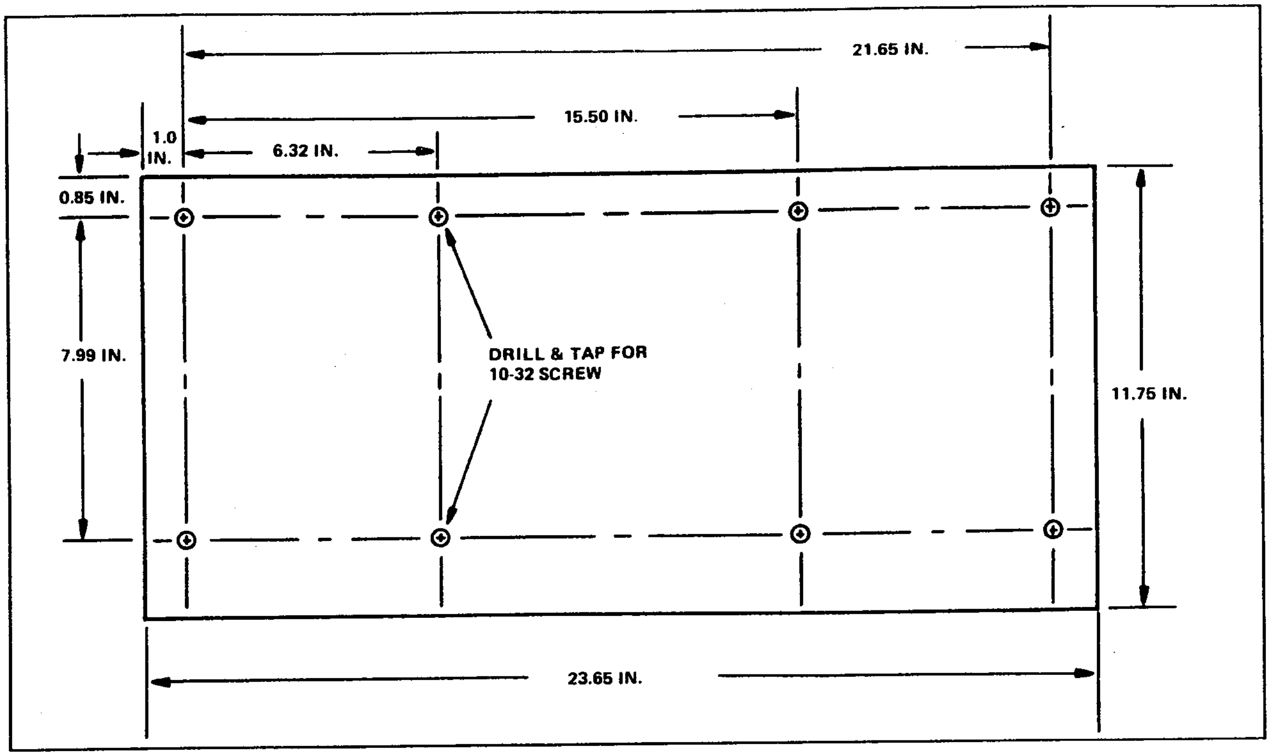

Figure 3-18. Layout Dimensions for 12-Module Rack (NLR-1012) or 13-Module Expansion Rack (NLRE-1013)

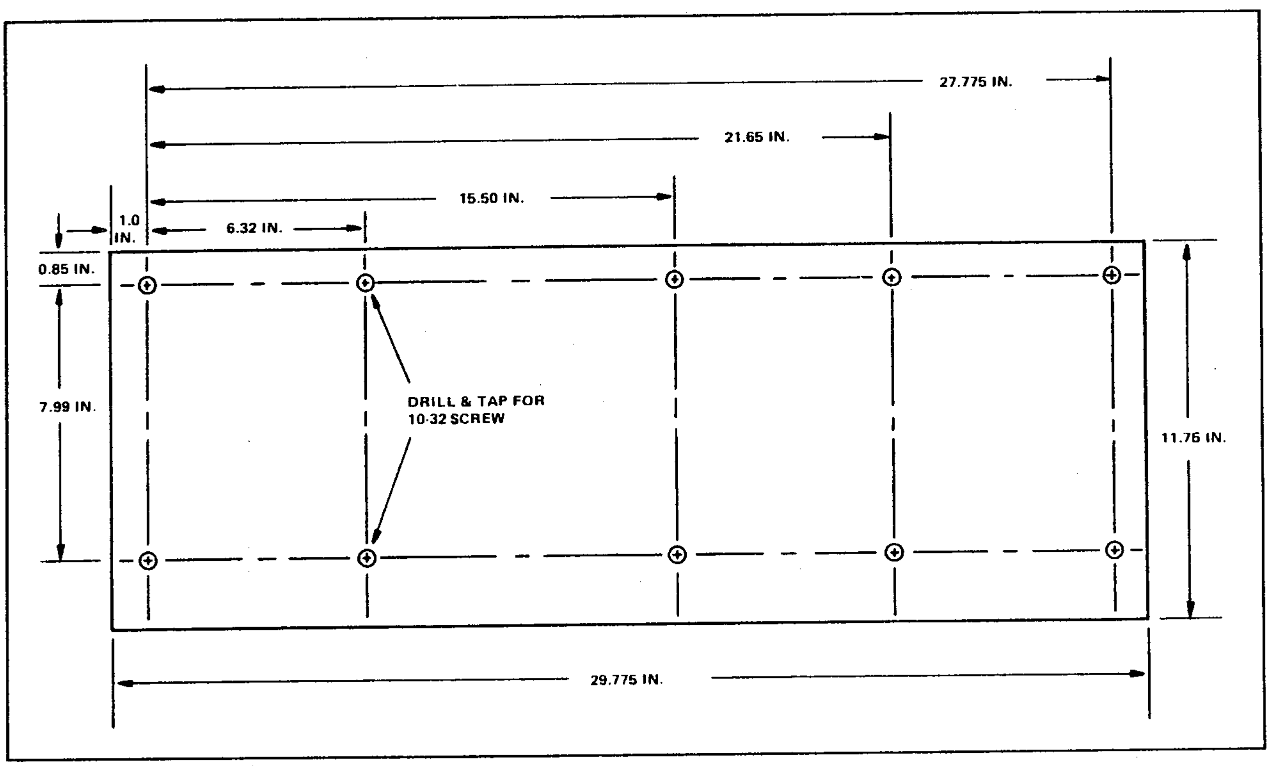

Figure 3-19. Layout Dimensions for 16-Module Rack (NLR-1016) or 17-Module Expansion Rack (NLRE-1017)

When an I/O expansion rack is used in addition to the primary rack, use the I/O rack expansion cable to interconnect the racks. The Rack Bus Expansion module (RBE) must be placed in the primary rack. The rack expansion cable, which interconnects the signals and power between the primary and expansion racks, connects to the RBE and to the left-most position on the expansion rack. (For additional information, refer to the Instruction Leaflet for the expansion rack and RBE.)

3-15. Controller and I/O Module Installation

After the rack(s) are panel-mounted, the controller should be installed. The controller should then be turned on and tested before installing the I/O modules into the rack(s). Use the test procedure given in Paragraph 3-5.

CAUTION

Do not remove any controller modules with AC power applied. Improper system operation can result.

The PC-1100/1200 controller is installed using the following steps:

1. Align the controller's edge pins with the rack's backplane edge connector, as shown in Figure 3-20.

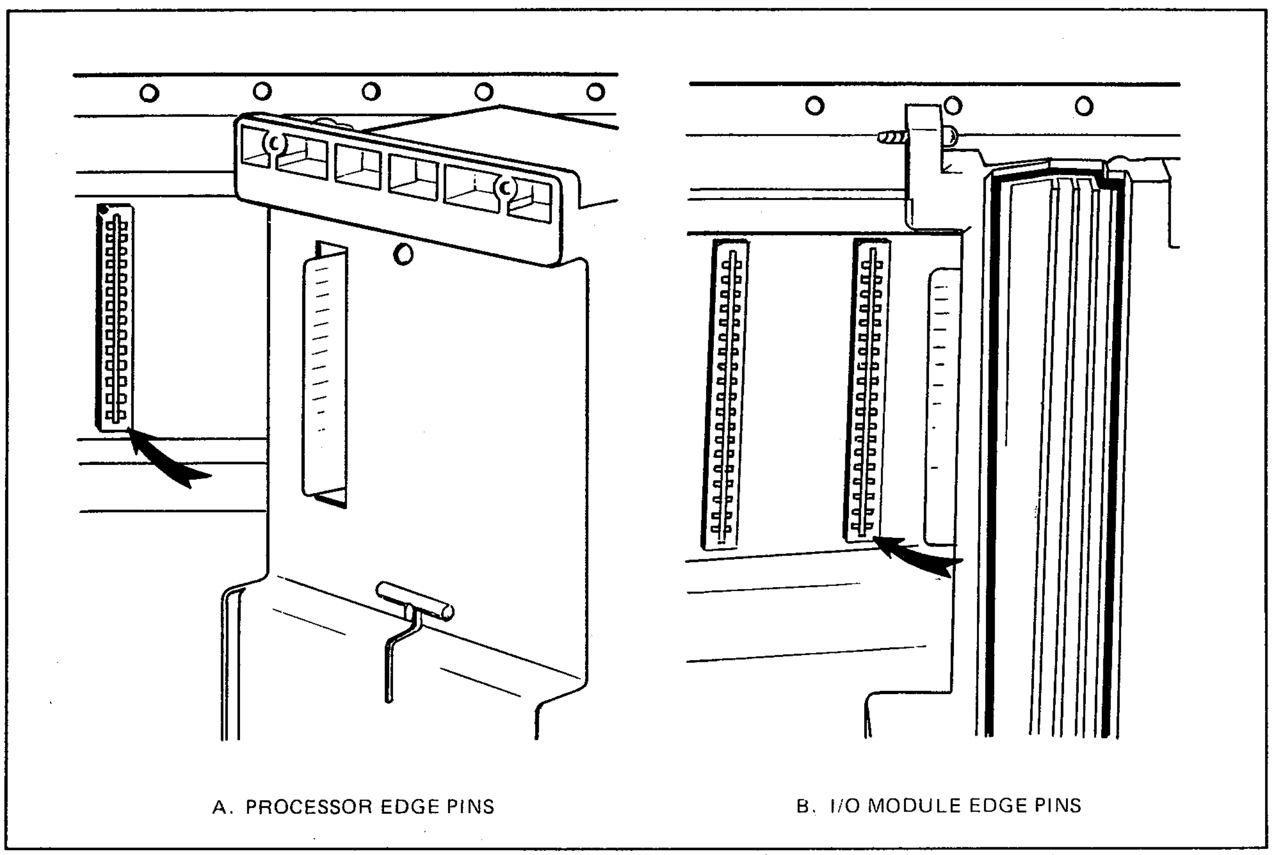

Figure 3-20. Controller and Module Insertion

2. Gently press the controller unit into the edge connector on the rack. Make sure the edge pins on the controller align and mate with the rack's backplane connector.

3. Use a screwdriver to tighten the captive screws on the controller to the threaded holes on the rack. (See Figure 3-21.)

Each of the 1000 Series I/O modules is installed using a similar process, as described below:

1. Align the module's edge pins with the rack's backplane edge connector, as shown in Figure 3-20. (Refer to system drawings to determine in which position in the rack the module is to be placed.)

2. Gently press the module into the edge connector on the rack. Make sure the edge pins on the module align and mate with the rack's backplane connector.

3. Use a screwdriver to tighten the captive screws on the module to the threaded holes on the rack. (See Figure 3-21.)

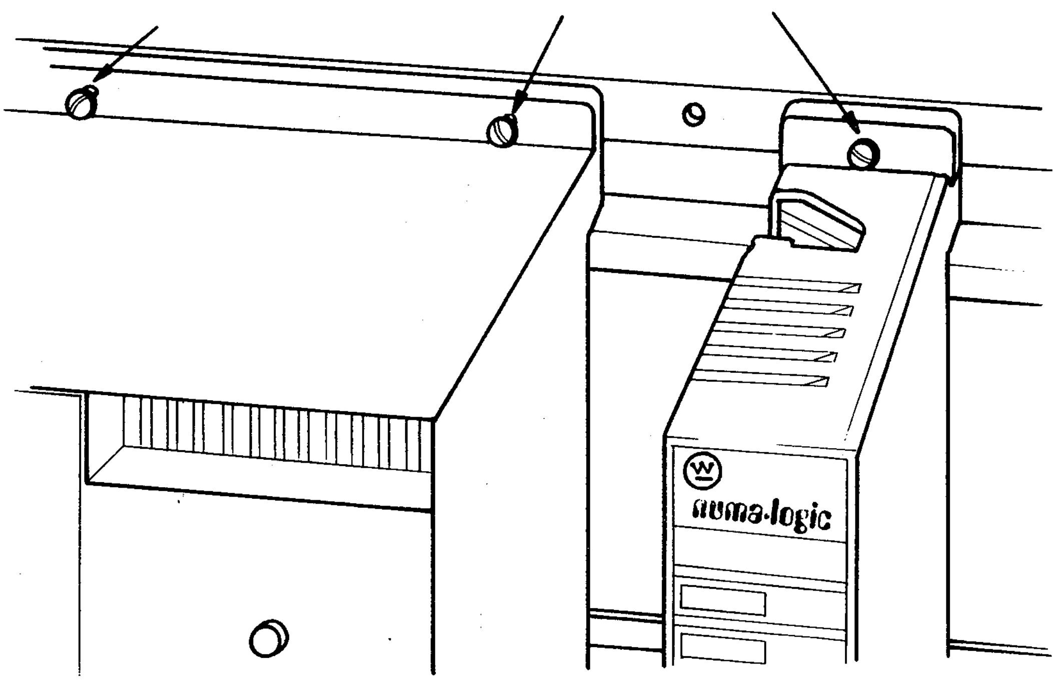

Figure 3-21. Controller/Module Mounting

I/O ADDRESSING CONSIDERATIONS

The controller selects discrete inputs, discrete outputs, register inputs and register outputs on a time-sharing basis. This enables the controller to select a desired input or output, within a rack, during its time-shared period. This time-sharing feature allows each I/O rack to contain a mixture of I/O modules, since only one designated module responds at any one time.

In addition to this time-sharing of module types, a small set of I/O locations is addressed at one particular time. For example, discrete I/O is referenced by "Input Group" or "Output Group" number (discrete inputs 1 through 16 form IG1, discrete outputs 1 through 16 form OG1, etc). The discrete inputs and outputs are updated eight at a time (e.g., IN0001 through IN0008, CR0001 through CR0008, IN0009 through IN0016, or CR0009 through CR0016).

Figure 3-22 represents the controller I/O image memory (or I/O image table). As described in Section 2, this memory area stores input and output values. Input values are read from the input modules before each ladder diagram scan, and stored in I/O image table for use in the ladder logic. During the ladder diagram scan, new output values are stored in the I/O image table, and at the end of the scan, the latest values are sent to the output modules.

As Figure 3-22 illustrates, the I/O image table contains areas which store Input Registers, Output Registers, Input Groups, and Output Groups. Each of these areas is 16 bits wide (that is, a single address can store 16 bits of information). The number of IRs, ORs, IGs, and OGs depends on the model of controller.

Typically, Input Registers (IRs) and Output Registers (ORs) are interpreted as words (for example, converted analog values). Input Groups (IGs) and Output Groups (OGs) are typically used for groups of discrete values. For some modules, the area addressed within the I/O image is switch-selectable. For example, the address for an NL-1030F input module can be either an IR or an IG. For other modules, the I/O image table area is fixed.

The address of each module maps onto the I/O image table, as shown in Figure 3-23. Note that the range of module address settings is the same for the Low bus and High bus. For example, an address setting of IR 0001 can represent image table location IR 0001 (on the Low bus) or IR 0065 (on the High bus). In effect, the High bus address is offset from the address setting on the module (by 64 for IR/OR addresses or 8 for IG/OG addresses).

In fact, the Low bus and High bus are identical except for this mapping. The selection of I/O bus is made at the main rack's NL-1077 module. The other I/O components (including any additional NL-1077's) receive and send their data on a single bus.

To access the High bus, the NL-1077 RBE module must be used (the NL-1076 RBE cannot access the High bus). By setting the NL-1077 toggle switch to the HIGH position, the NL-1077 will transmit the High bus from its top "D" connector to one or more expansion racks (NLRE-1011B, -1013, or -1017).

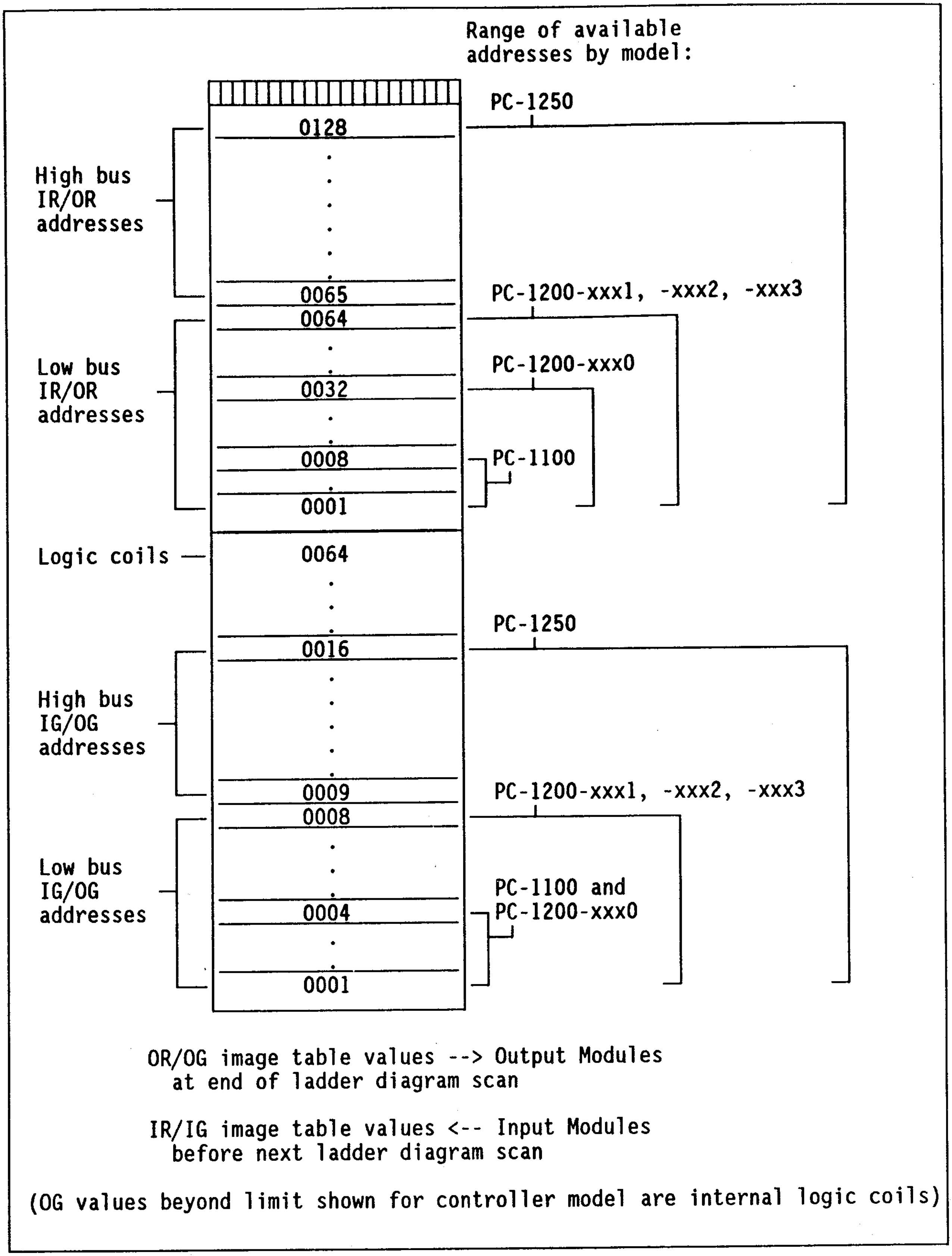

Figure 3-22. Controller I/O Image Table

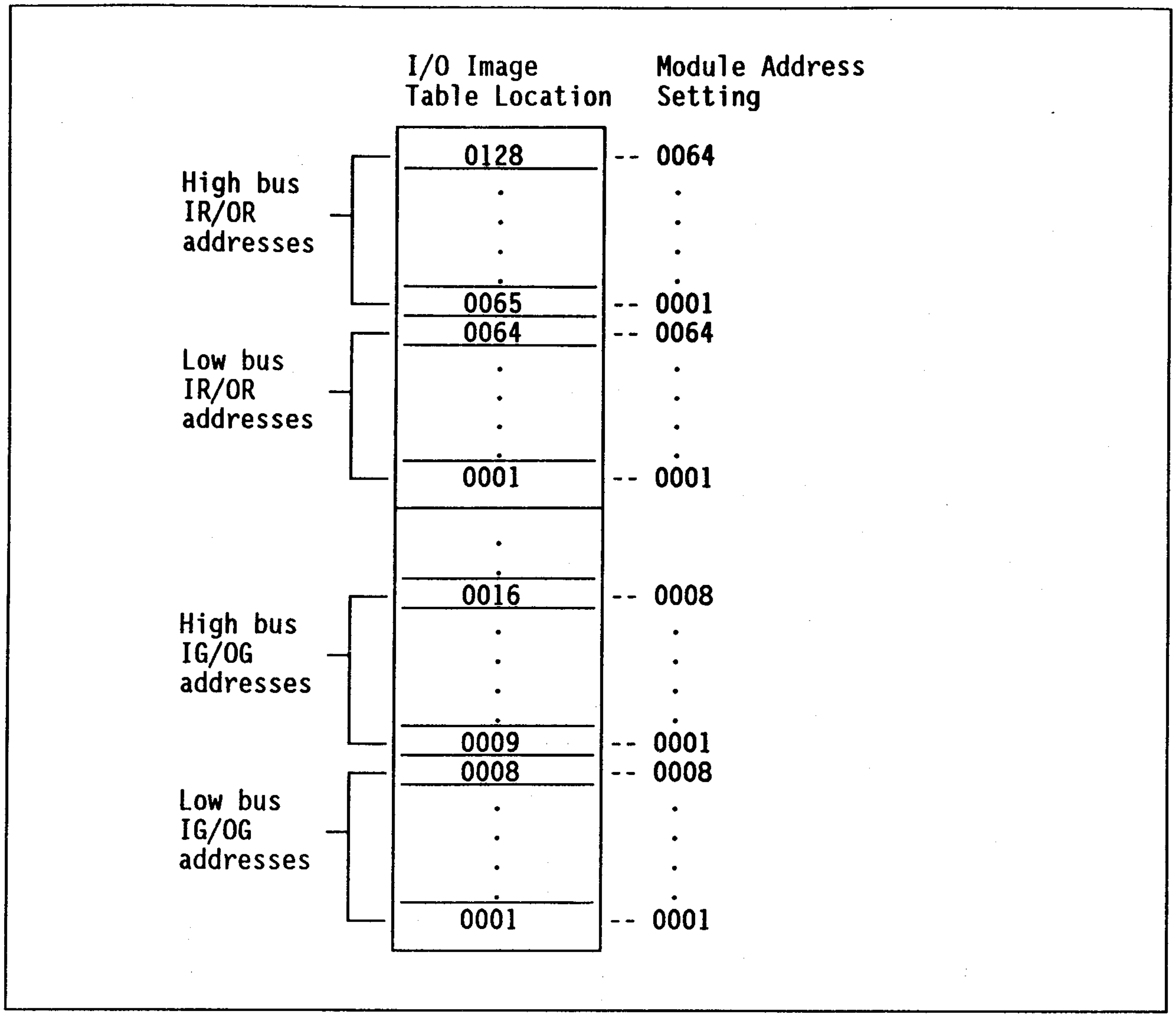

Figure 3-23. I/O Module Addresses and I/O Image Table

Note that when the main rack's NL-1077 toggle switch is set to HIGH, all racks which are serially linked to its top connector will receive the High bus. If the main rack's NL-1077 toggle switch is set to LOW, all racks which are serially linked to its top connector will receive the Low bus. Regardless of toggle switch position, all racks which are serially linked to the main rack's NL-1077 bottom connector will receive the Low bus.

Caution

If using a configuration with multiple NL-1077 modules, the High bus should be selected only at the main rack. For all other NL-1077 modules, leave the toggle switch in the LOW position.

When the High bus is selected for a rack, the addresses of all of the modules in that rack are offset.

Caution

Be certain that the same address is not assigned to more than one input module or to more than one output module. Such duplicate addressing may introduce incorrect data into the system or cause unexpected machine motion.

For module addressing purposes, the 1000 Series I/O modules fall into two categories:

- Addresses for **analog, register, and 16-point discrete I/O modules** depend on the modules' DIP switch settings and the selected I/O bus.
- Addresses for **8-point discrete I/O modules** depend on rack position, Group Select, and I/O bus.

Each of these categories is described below.

Addressing Analog, Register, and 16-point Discrete I/O Modules

The analog, register, and 16-point discrete I/O modules incorporate addressing DIP switches, located on the back edge of the modules. Although the actual switch settings vary depending on the specific module, the following factors determine addressing for all of these modules:

- DIP switch settings
- I/O bus selection

The DIP switches are used to set a IR/OR or IG/OG address. For a PC-1250, if the High bus is selected, the module address is offset, as described previously. Addressing of these modules is not dependent on rack position.

For many of these modules, multiple registers are required. In these cases, the starting address is set using the DIP switches (and the next valid address will depend on the number of registers used). For example, the NL-1046 input module uses four registers. If the address IR 0001 is assigned as the starting address of an NL-1046 module, it will use registers IR 0001 through 0004. In this example, the next available input register address will be IR 0005.

While the Instruction Leaflets for the modules provide basic DIP switch and addressing information, additional switch settings are required to access the extended I/O in the PC-1200. For detailed information on the DIP switch settings for each module, refer to Appendix C.

Addressing 8-Point Discrete I/O Modules

Addressing of 8-point discrete input and output modules is dependent on rack position (there are no address switches on the 8-point discrete I/O modules). To determine the address of an 8-point module, three factors must be considered:

- Rack position (slot)
- Group Select (or "G Select")
- I/O bus selection

Each slot on every I/O rack is associated with a particular address. For some racks, a Group Select strap or switch is provided. This G Select control provides a choice between two different address ranges (for the 8-point discrete modules), as described below. The final factor, I/O bus selection, applies only to the PC-1250. When using the NL-1077 Rack Bus Expander (RBE) module with the PC-1250, another range of addresses can be accessed on the expansion rack(s) by using the HIGH bus setting.

Figure 3-24 illustrates the addressing of the NLR-1004 and NLR-1008 main I/O racks and the NLRE-1009 expansion racks. Note that these racks do not provide a G Select switch. Also, none of these racks can express the PC-1250's High bus (since main racks always use the Low bus and the NLRE-1009 is not compatible with the NL-1077). Thus, in these three racks, the addresses associated with each slot will not vary.

Note that the NLRE-1009 expansion rack uses the same range of addresses as the NLR-1008 main rack. When using this type of configuration, the same address may be used for an 8-point discrete input in one rack and for an 8-point discrete output in the other rack.

Note that when a multiple-rack system is used, the first module position on the primary rack is typically used for the RBE module. However, the first slot on the expansion rack can provide a duplicate of that address range (in effect, replacing the slot taken by the RBE). For example, in the NLR-1008 plus NLRE-1009 configuration (shown in Figure 3-24), the user may still have both a discrete input and a discrete output module with reference numbers 0001-0008, since the first two positions on the expansion rack are assigned discrete I/O reference numbers 0001-0008.

To provide a wider selection of addresses, the G Select option is provided on the NLR-1012 and NLR-1016 main racks and on the NLRE-1011, NLRE-1011B, NLRE-1013, and NLRE-1017 expansion racks.

Note

The rack "Group Select" switch(es) define ranges of discrete addresses (for the 8-point discrete modules), and should not be confused with the DIP switches used to set specific IG/OG addresses on the analog, register, and 16-point modules.

G Select affects the addressing of 8-point discrete modules only. The addresses of analog, register, and 16-point modules (set by the modules' DIP switches) will not be affected by the G Select setting.

Figures 3-25 and 3-26 show the addresses available using G Select 1 and 2 *on the Low bus only*. These addresses are accessable without using the PC-1250's dual I/O bus.

Note

G Select 2 is not valid for the PC-1100 Series, the PC-1200-1020, or the PC-1200-1040.

When using the PC-1250 controller, the range of available addresses is doubled by the dual I/O bus. As described previously, the NL-1077 module is used to select the High bus for one or more expansion racks. Figure 3-27 shows the addresses available for 8-point discrete I/O when using the dual I/O bus.

Figures 3-28 through 3-30 show example system configurations and addressing of 8-point discrete I/O.

RACK SLOT: 1 2 3 4

	1	2	3	4
PC-1100 OR PC-1200	0001 TO 0008	0009 TO 0016	0017 TO 0024	0025 TO 0032
	IG/OG 1		IG/OG 2	

<— DISCRETE ADDRESSES WITHIN EACH SLOT

A. NLR-1004 ADDRESSES

RACK SLOT: 1 2 3 4 5 6 7 8

	1	2	3	4	5	6	7	8
PC-1100 OR PC-1200	0001 TO 0008	0009 TO 0016	0017 TO 0024	0025 TO 0032	0033 TO 0040	0041 TO 0048	0049 TO 0056	0057 TO 0064
	IG/OG 1		IG/OG 2		IG/OG 3		IG/OG 4	

DISCRETE ADDRESSES

B. NLR-1008 ADDRESSES

RACK SLOT: 1 2 3 4 5 6 7 8

	1	2	3	4	5	6	7	8
PC-1100 OR PC-1200	RBE	0009 TO 0016	0017 TO 0024	0025 TO 0032	0033 TO 0040	0041 TO 0048	0049 TO 0056	0057 TO 0064
		IG/OG 1	IG/OG 2		IG/OG 3		IG/OG 4	

DISCRETE ADDRESSES

NOTE: FOR THE NLRE-1009, THE NL-1076 RBE MODULE MUST BE USED.

RACK SLOT: 1 2 3 4 5 6 7 8 9

	1	2	3	4	5	6	7	8	9
	0001 TO 0008	0001 TO 0008	0009 TO 0016	0017 TO 0024	0025 TO 0032	0033 TO 0040	0041 TO 0048	0049 TO 0056	0057 TO 0064
	IG/OG 1			IG/OG 2		IG/OG 3		IG/OG 4	

C. NLRE-1009 ADDRESSES (SHOWN WITH NLR-1008)

Figure 3-24. 8-Point Discrete I/O Addressing for the NLR-1004, NLR-1008, and NLRE-1009

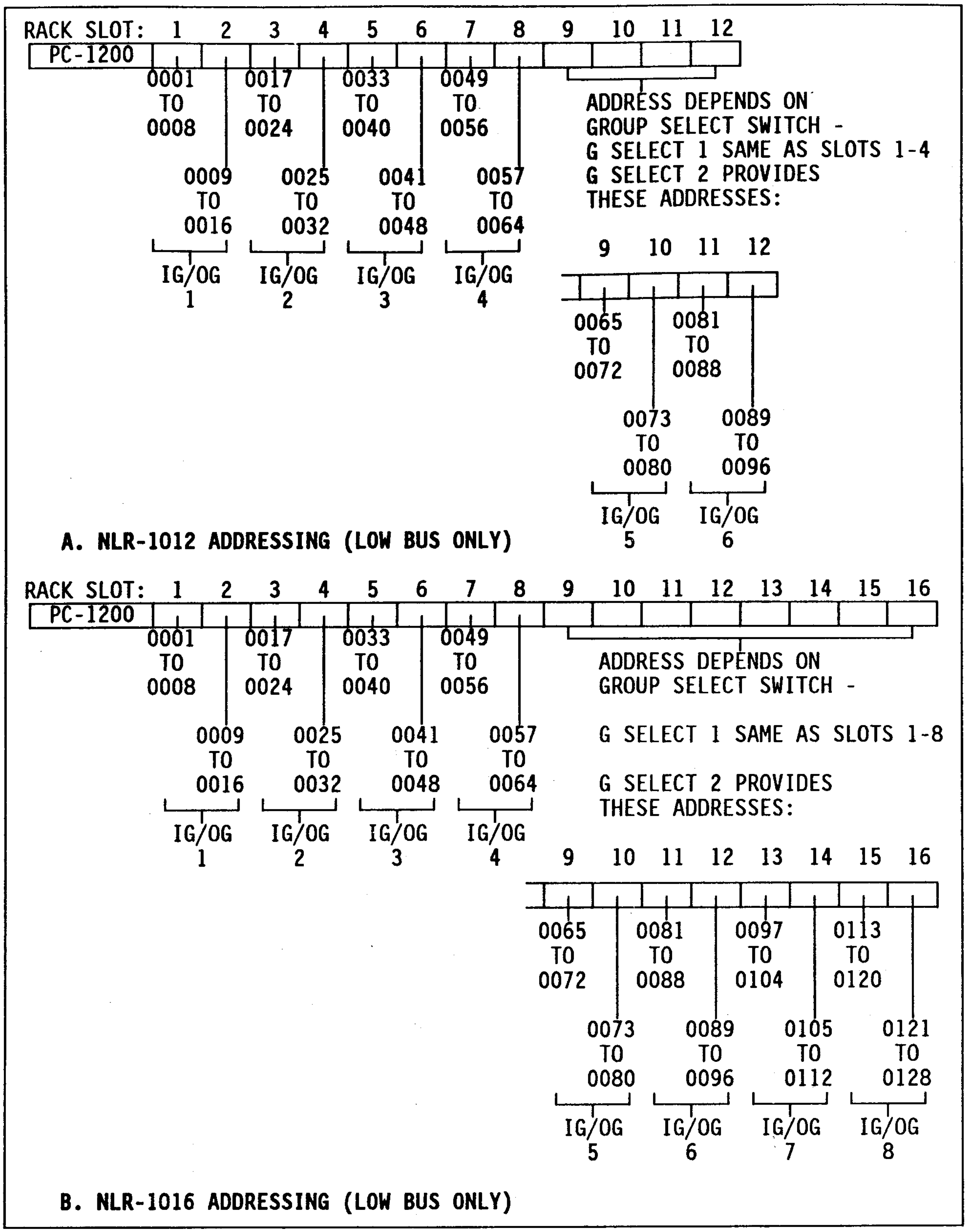

Figure 3-25. 8-Point Discrete I/O Addressing for the NLR-1012 and NLR-1016 (Low Bus Only)

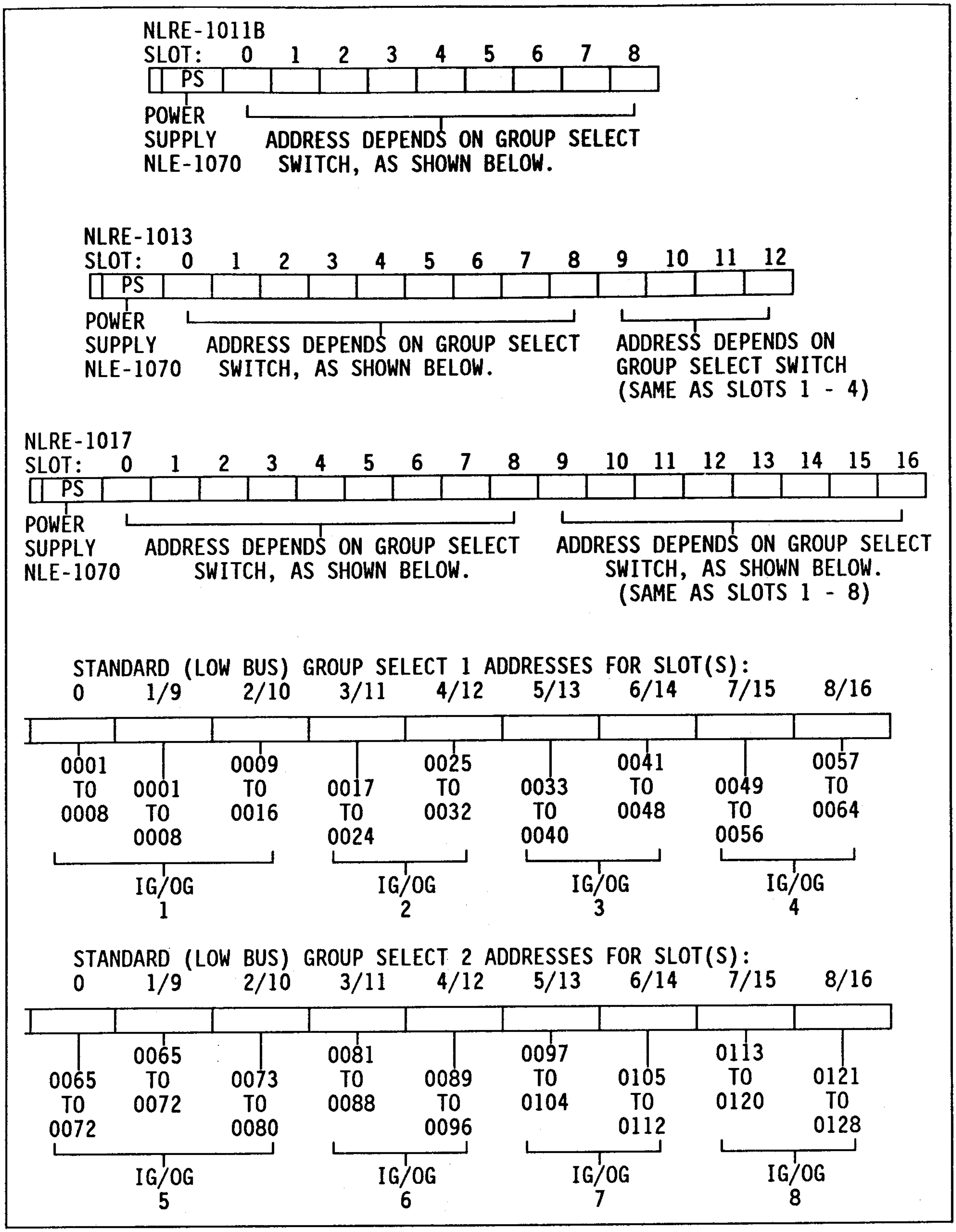

Figure 3-26. 8-Point Discrete I/O Addressing for the NLRE-1011B, -1013 and -1017 (Low Bus Only)

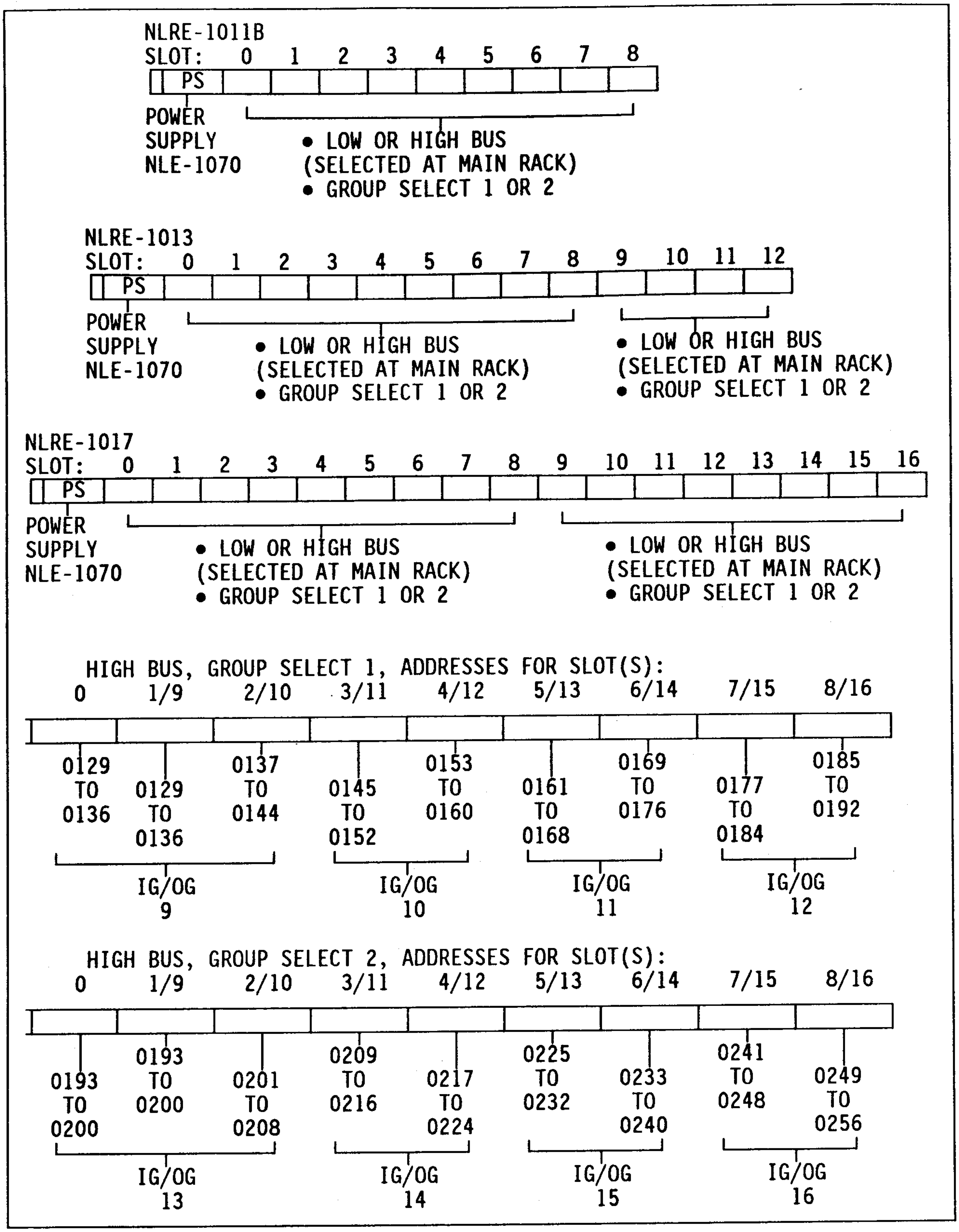

Figure 3-27. 8-Point Discrete I/O Addressing for the NLRE-1011B, -1013 and -1017 (High Bus)

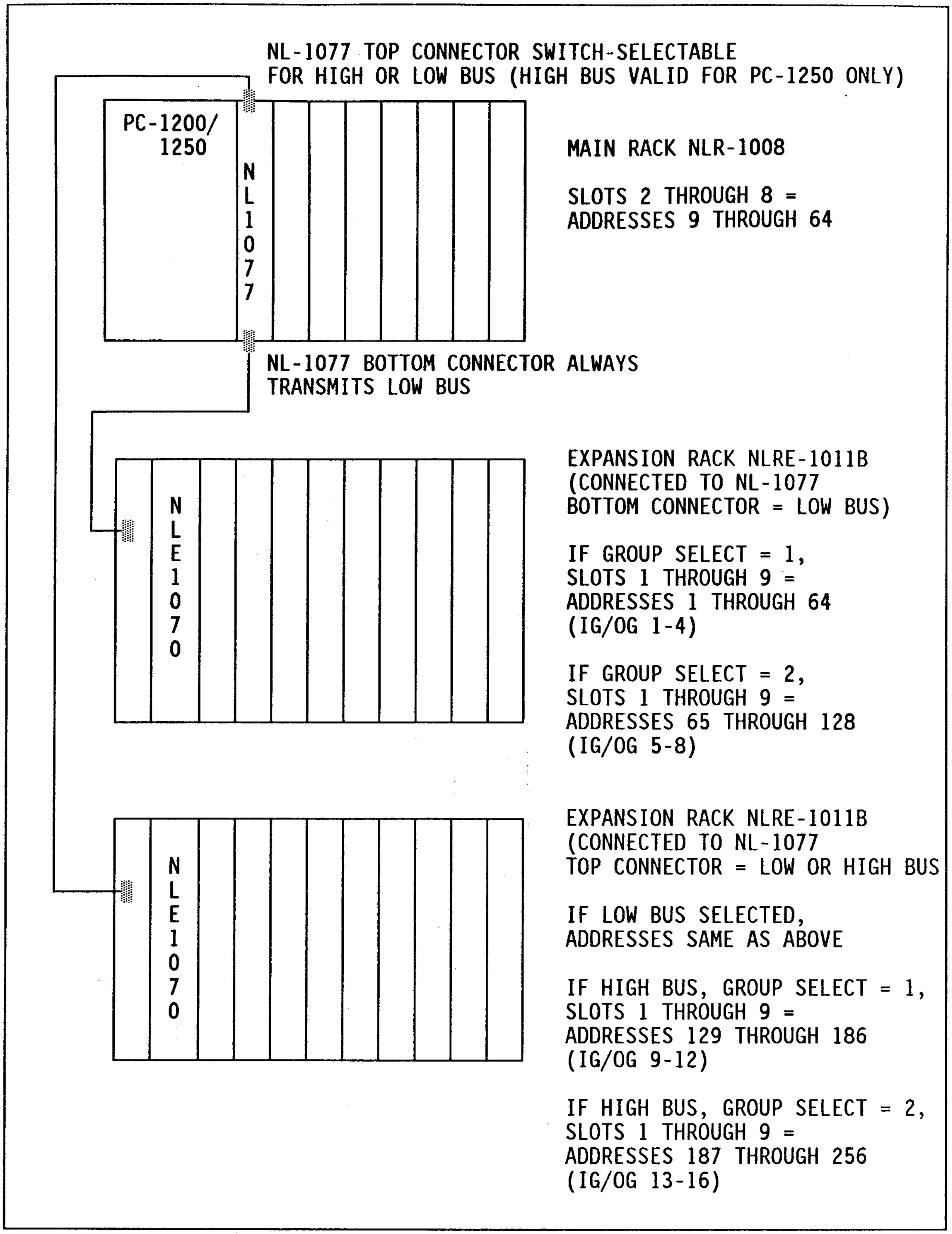

Figure 3-28. Example PC-1200/1250 Addressing (Using NLR-1008 and Two NLRE-1011Bs)

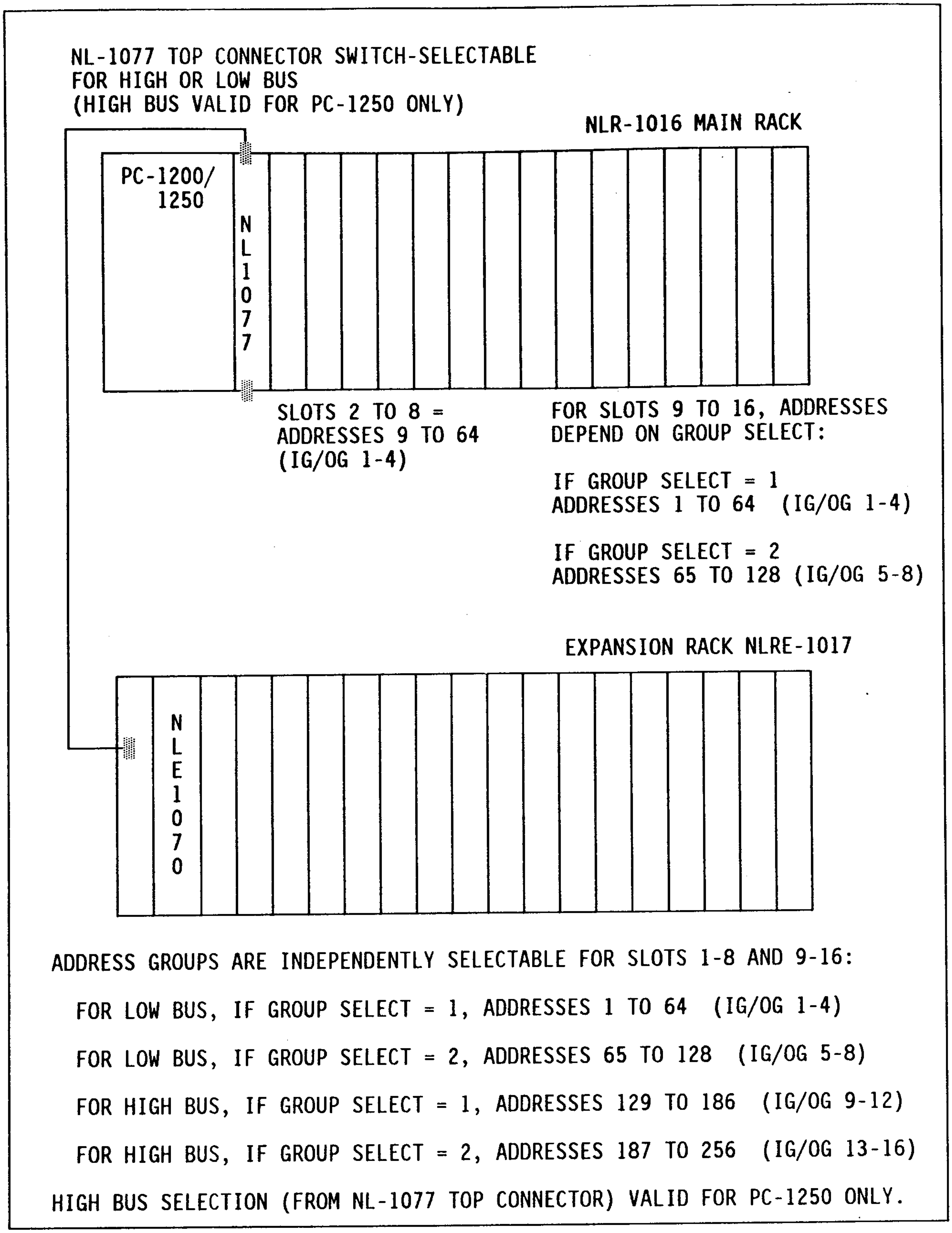

Figure 3-29. Example PC-1200/1250 Addressing (Using NLR-1016 and NLRE-1017)

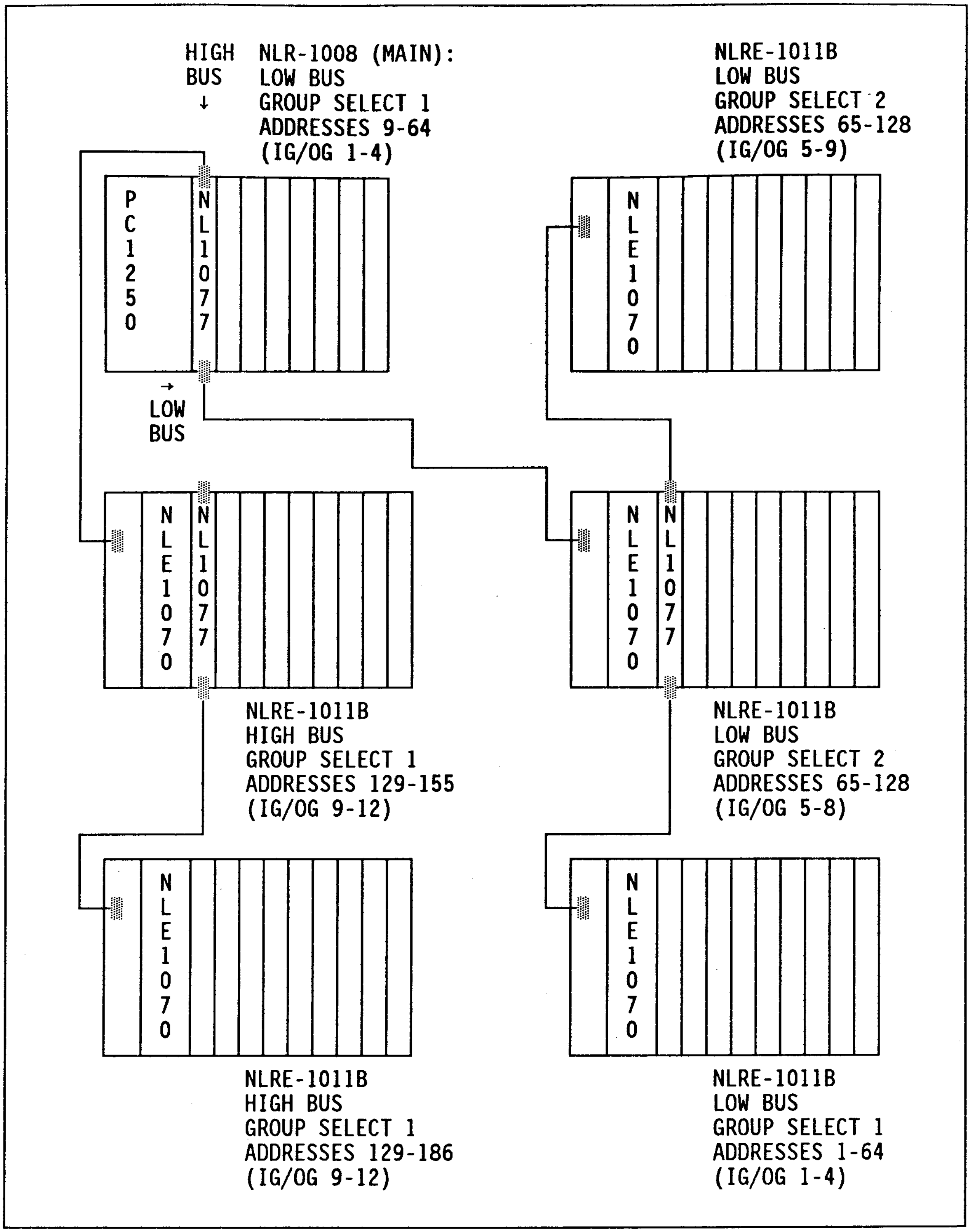

Figure 3-30. Example PC-1250 Addressing (Using NLR-1008 and Five NLRE-1011Bs)

3-16. I/O Module Wiring

Most of the 1000 Series I/O modules use a single 12-position terminal block. The NL-1030F and -1060F, however, use two 10-position Phoenix-style terminal blocks. The 12-position terminals will accept two AWG No. 14 stranded wires, while the 10-position terminals will accept only one.

In both cases, the smallest size wire consistent with the application's requirements should be used. Prior to connection, strip only 0.25 in. (0.6 cm) of insulation from each wire.

Follow the steps listed below:

1. Remove the terminal block(s) from module. If using the 12-position terminal block, place on extender dowels for easier wiring. (See Figure 3-31.)

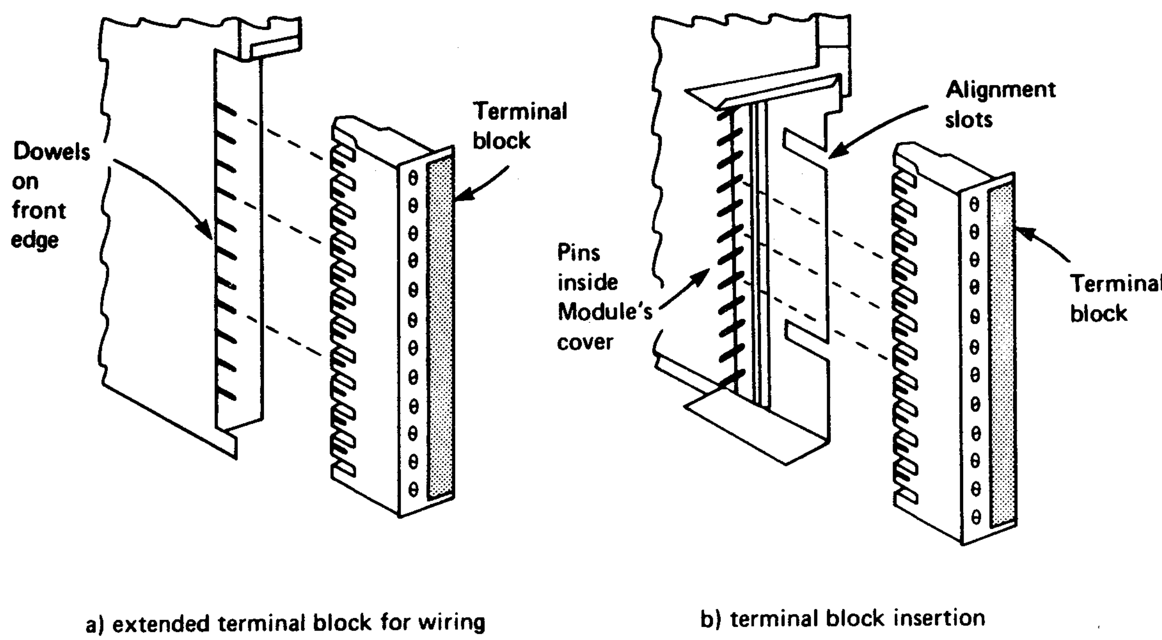

Figure 3-31. 12-Position Terminal Block Extended

2. Insert the first conductor into the bottom terminal of the terminal block and tighten the terminal screw to 15 in-lb. When two conductors connect to a terminal, insert both conductors before tightening the screw. (Module wiring diagrams are given in its associated Instruction Leaflet.)

3. Subsequent field wiring is installed in this manner. Working from the bottom terminals up, each conductor should neatly build on the others, as shown in Figure 3-32.

4. During this process, use plastic tie wraps, as required, to keep the wire bundles neat.

CAUTION

During wiring, ensure that enough slack remains in the wire bundle to enable easy insertion and removal of the terminal block from the associated module.

5. Install the field wiring for each terminal block assembly in this manner.

CAUTION

Recommended external wire routing is important to proper system operation. Do not run high and low levels of AC and DC voltage next to each other.

During installation, maintain a minimum of six-inch separation between AC and high-voltage DC conductors, and the low-level DC and signal conductors. If possible, allow larger separations. Group together the TTL, A/D module, and D/A module I/O wires. Keep these wires separate, as much as possible, from AC or high-voltage DC module wiring.

6. If applicable, remove the terminal block from the extender dowels. Insert the terminal block(s) into the module.

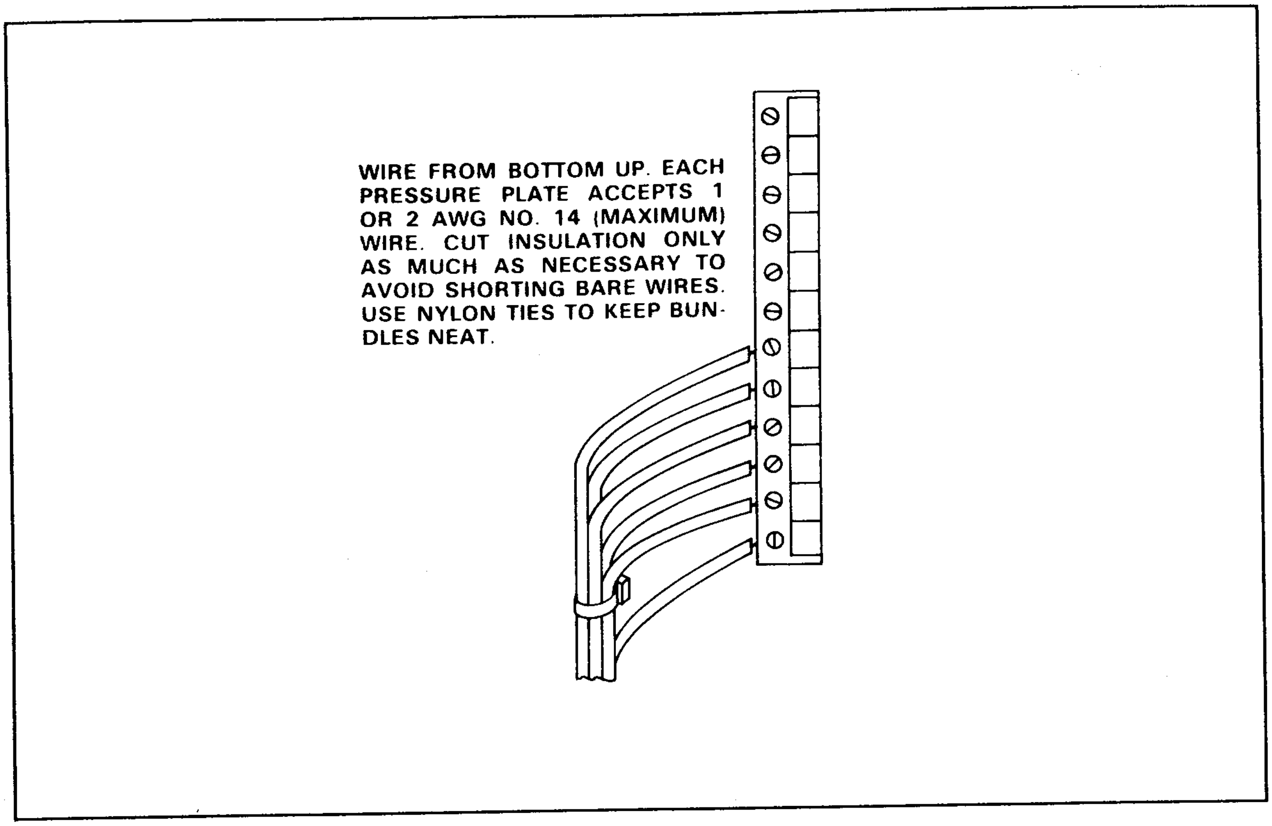

Figure 3-32. Typical Wiring

3-17. CONTROLLER CONFIGURATION

One of the last installation steps involves configuring the controller for the speci- application. In order to do this it is necessary to have specific information availa the setting of certain switches on boards inside the PC-1100/1200. Refer to system c Alternately, contact the design/application engineer or programmer.

CAUTION

The controller cannot be properly set up unless certain switches, located on printed circuit boards, are correctly set according to application needs. Do not attempt to control an application with the PC-1100/1200 until the switches have been set and validated. Improper machine operation may result due to incorrect settings.

To set the switches, follow these steps:

1. Gain access to the inside of the PC-1100 or -1200 by removing the front panel. To do this, use a small Phillips screwdriver (point size of No. 0 or 1). Twist the two captive screws located on the front panel's centerline. (See Figure 3-33.) Make only a one-quarter, counterclockwise turn.

CAUTION

The front panel screws are not threaded.
They are quarter-turn, quick release types.
They can be damaged if turned too far.

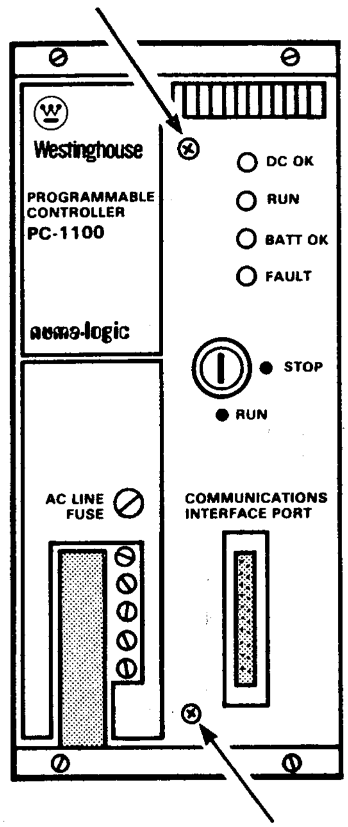

Figure 3-33. Front Panel Screws

2. Locate the DIP switch assemblies. Set the switches according to the system drawings.

In the PC-1100, four switches (MODE, DIS OUT, I/O INH, and LVS) are located at the top of the interface board, just above the four LED indicators. Another four switches (SPARE, BAUD A, PARITY, and OLP) are located at the top of the CPU board (the right-most printed circuit board). The DIP switch locations in the PC-1100 are shown in Figure 3-34. The settings are described in Table 3-2.

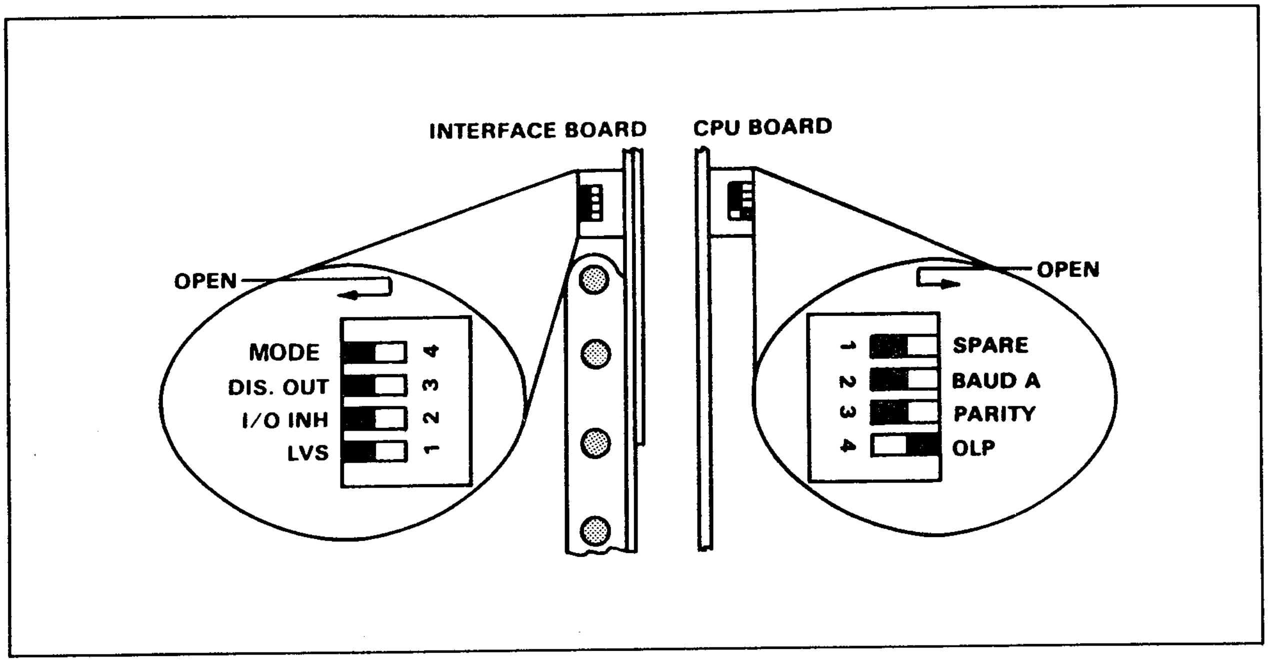

Figure 3-34. PC-1100 DIP Switch Locations

When using Port B for network communications (Advanced PC-1100 only), the switches on the Communications Expansion Board must be set as follows:

- To use the Port B RS-232 interface, all Communications Expansion Board switches must be CLOSED.
- To use the Port B RS-485 interface, the Communications Expansion Board switches must be CLOSED in the controllers which physically terminate the network, and OPEN in the controllers in the middle of the physical link.

Figure 3-35 illustrates the Advanced PC-1100 Communications Expansion Board. For additional information on PC-1100 networking, refer to Paragraph 3-20.

TABLE 3-2. PC-1100 DIP SWITCH POSITIONS

Switch	"Closed" Position	"Open" Position [1]
MODE [2]	MULTI-POINT Port B is to be used for multi-point networking (RS-232 or RS-485). (For additional information, refer to Paragraph 3-20 and to the PT, UA, and CP function descriptions in Section 5.)	SINGLE POINT Port B is to be used for communication with a single program loader.
DIS. OUT	OUTPUTS DISABLED Upon a controller keyswitch transition from STOP to RUN or when lost power is restored to the controller, all outputs will be disabled. The controller continues to scan and solve Ladder Memory based on input statuses.	ENBL Upon entering RUN, the status of all outputs are updated according to the Ladder Memory.
I/O INH	I/O UPDATE INHIBIT STOP: The controller remains in STOP even upon a key transition from STOP to RUN. RUN: Inputs and Outputs are maintained in their last valid states. The controller continues to scan and to solve Ladder Memory. If a power loss occurs, the controller will power up in STOP with all outputs disabled.	NORM Normal position for operation.
LVS	LAST VALID STATE All outputs are maintained in their last valid states in the event of a controller fault (other than a power failure).	ALL OFF In the event of a controller fault, all outputs are disabled.

[1] The switches on the Interface board (MODE, DIS. OUT, I/O INH, and LVS) are factory-shipped in the "Open" position (default setting).

[2] Advanced PC-1100 only.

TABLE 3-2. PC-1100 DIP SWITCH POSITIONS (Cont'd.)

Switch	"Closed" Position [1]	"Open" Position
SPARE	-	-
BAUD A[2]	9600 BAUD Selects this baud rate for the Communications Interface Port (Port A).	1200 BAUD Selects this baud rate for Port A.
PARITY	ODD PARITY The data frame to be transmitted via the Communication Interface Port is formatted with odd parity.	NO PARITY The data frame to transmitted via the Communication Interface Port is formatted without parity.
OLP [3]	ON-LINE Changes to Ladder Memory are allowed when the controller is in STOP or RUN.	OFF-LINE Changes to Ladder Memory are allowed only when the controller is in STOP.

[1] The switches on the CPU board (SPARE, BAUD A, PARITY, and OLP) are factory-shipped in the "Closed" position (default setting).

[2] Other baud rates are software selectable through the program loader. (See the CP special function description in Section 5 and the applicable Programming Manual.)

[3] If the Memory Safe module is used, the OLP switch must be placed in the off-line ("Open") position.

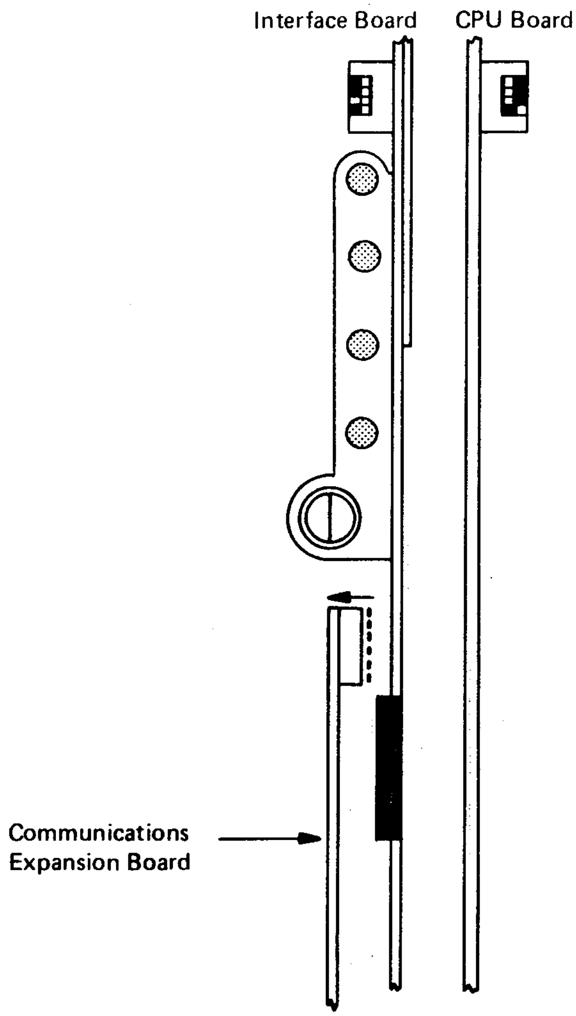

Figure 3-35. PC-1100 Communications Expansion Board

In the PC-1200, the eight main switches (OLP, DIS OUT, I/O INH, LVS, BAUD A, PARITY, MODE, and SPARE) are located on the processor board, as shown in Figure 3-36. The settings are described in Table 3-3.

An additional set of switches on the interface board set the configuration for Port B networking (see Table 3-4). If Port B will not be used, leave these switches in the CLOSED position. For additional information on PC-1200 networking, refer to Paragraph 3-20.

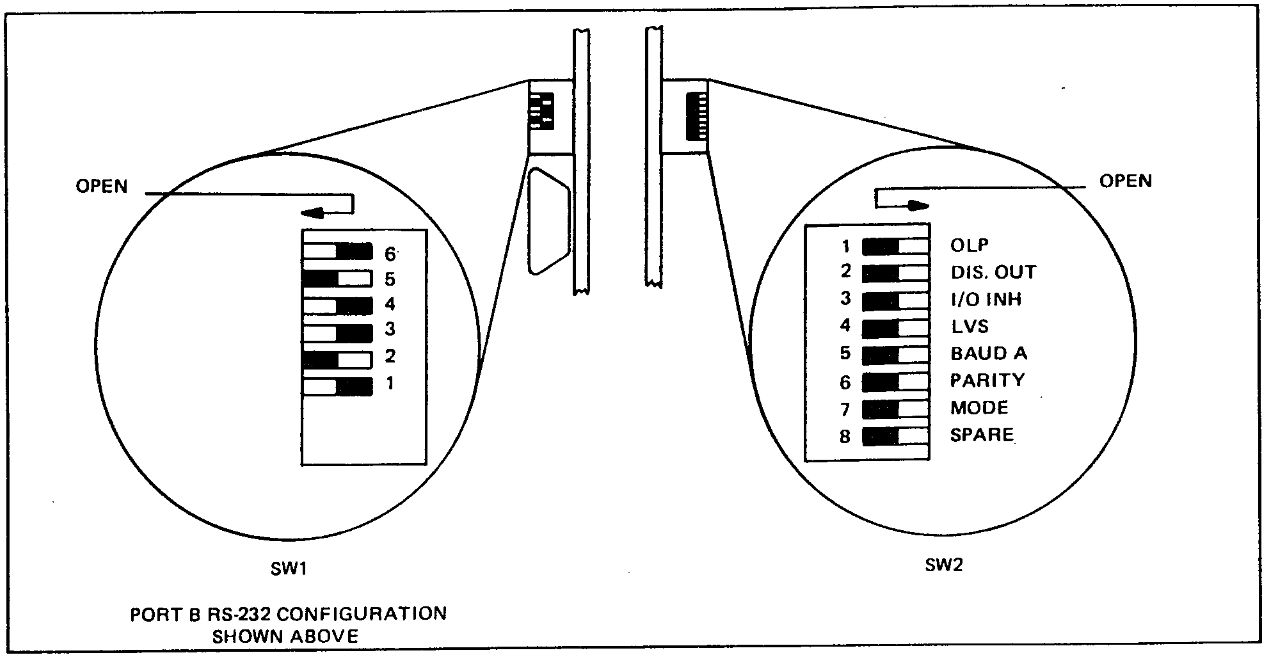

Figure 3-36. PC-1200 DIP Switch Locations

TABLE 3-3. PC-1200 DIP SWITCH POSITIONS

Switch	"Closed" Position [1]	"Open" Position
OLP	ON-LINE Changes to Ladder Memory are allowed when the controller is in STOP or RUN.	OFF-LINE Changes to Ladder Memory are allowed only when the controller is in STOP.
DIS. OUT	ENBL Upon entering RUN, the status of all outputs are updated according to the Ladder Memory.	OUTPUTS DISABLED Upon a controller keyswitch transition from STOP to RUN or when lost power is restored to the controller, all outputs will be disabled. The controller continues to scan and solve Ladder Memory based on input statuses.

1. The switches on the PC-1200 processor board are factory-shipped in the "Closed" position (default setting).

TABLE 3-3. PC-1200 DIP SWITCH POSITIONS (Cont'd.)

Switch	"Closed" Position [1]	"Open" Position
I/O INH	NORM Normal position for operation.	I/O UPDATE INHIBIT STOP: The controller remains in STOP even upon a key transition from STOP to RUN. RUN: Inputs and Outputs are maintained in their last valid states. The controller continues to scan and to solve Ladder Memory. If a power loss occurs, the controller will power up in STOP with all outputs disabled.
LVS	ALL OFF In the event of a controller fault, all outputs are disabled.	LAST VALID STATE All outputs are maintained in their last valid states in the event of a controller fault (other than a power failure or an I/O bus fault[2]).
BAUD A[3]	9600 BAUD Selects this baud rate for the Communications Interface Port (Port A).	1200 BAUD Selects this baud rate for Port A.
PARITY	ODD PARITY The data frame to be transmitted via the Communication Interface Port is formatted with odd parity.	NO PARITY The data frame to transmitted via the Communication Interface Port is formatted without parity.

[1] The switches on the PC-1200 processor board are factory-shipped in the "Closed" position (default setting).

[2] In the PC-1200, an I/O bus fault will cause all outputs to be disabled, regardless of the LVS selection.

[3] Other baud rates are software selectable through the program loader. (See the CP special function description in Section 5 and the applicable Programming Manual.)

TABLE 3-3. PC-1200 DIP SWITCH POSITIONS (Cont'd.)

Switch	"Closed" Position [1]	"Open" Position
MODE	SINGLE POINT Port B is to be used for communication with a single program loader.	MULTI POINT Port B is to be used for multi-point networking (RS-232 or RS-485). (For additional information, refer to Paragraph 3-20 and to the PT, UA, and CP function descriptions in Section 5.)
SPARE	-	-

[1] The switches on the PC-1200 processor board are factory-shipped in the "Closed" position (default setting).

TABLE 3-4. PORT B SWITCH SETTINGS (PC-1200)

Switch No.	RS-232	RS-485 Terminated	RS-485 Unterminated[1]
1	Closed	Closed	Open
2	Open	Closed	Open
3	Closed	Closed	Open
4	Closed	Closed	Open
5	Open	Closed	Open
6	Closed	Closed	Open

[1] For correct operation, a terminated RS-485 cable must be connected to the PC-1200 when these switches are in the open position.

3. Confirm that the optional battery backup unit, if used, is properly connected. (See Paragraph 3-5.)

4. Replace the front panel. Make sure the fuse holder is centered in its cutout or the panel will not properly seat.

3-18. Changing the Watchdog Timer Timeout Period (PC-1200)

The PC-1100/1200 incorporates a hardware watchdog timer, which will reset the controller if it is not updated within a specified timeout period. For the PC-1200, the default timeout period (100 msec) can be changed as described below:

1. Remove the AC line power from the PC-1200 programmable controller.
2. Remove the controller's front panel. (Refer to Paragraph 3-17 and to Figure 3-33.)
3. Locate the interface board. It is the left-most printed circuit board.
4. Refer to Figure 3-37 and locate resistors R68 and R69.
5. Refer to Table 3-5 to determine which resistor(s) to remove.
6. Use a pair of small diagonal cutters and clip both ends of the resistor to be removed. Remove it completely and discard it.
7. Replace the controller's front panel.

Use caution when extending the timeout period. Program loader or peripheral communications throughput may be adversely affected, particularly for programs with long scan times.

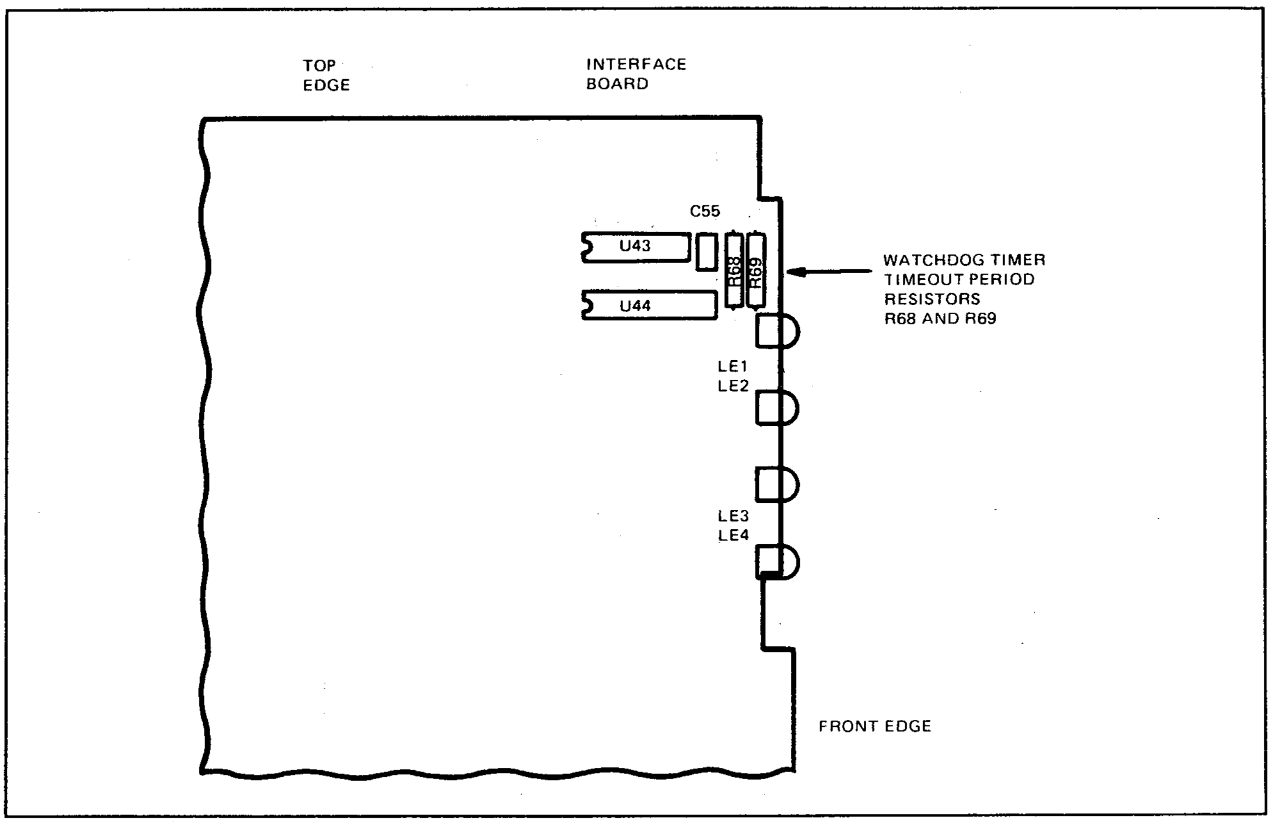

Figure 3-37. Changing the Watchdog Timer Timeout Setting

TABLE 3-5. WATCHDOG TIMER TIMEOUT PERIOD SELECTION

Resistor	Timeout Period (msec)			
	100	150	200	300
R68	In	Out	In	Out
R69	In	In	Out	Out

3-19. Disabling the On-Line Programming Function

The OLP switch on the CPU board has a position that inhibits on-line programming (so that the user program cannot be changed while it is actually controlling a machine or process). (See Tables 3-2 and 3-3.) However, some applications are so critical that the ability to easily enable this capability may be unacceptable. For this reason, the PC-1100/1200 provides a means of permanently disabling the on-line programming function. To do so, follow these steps:

1. Remove the AC line power from the PC-1100/1200 programmable controller.
2. Remove the controller's front panel. (Refer to Paragraph 3-17 and to Figure 3-33.)
3. Locate the CPU (processor) board. (It is the right-most printed circuit board.)
4. If using a PC-1100, carefully draw the board directly out of the controller. (For a PC-1200, leave the board in place.)
5. Refer to Figure 3-38 or 3-39 and locate the on-line programming resistor (R2 in the PC-1100 or R70 in the PC-1200).
6. Use a pair of small diagonal cutters and clip both ends of the resistor. Remove it completely and discard it. The on-line programming function is now disabled.
7. If the board was removed from the controller, carefully slide the board back into its slot. Make sure it is completely seated in the backplane connector.
8. Replace the controller's front panel.

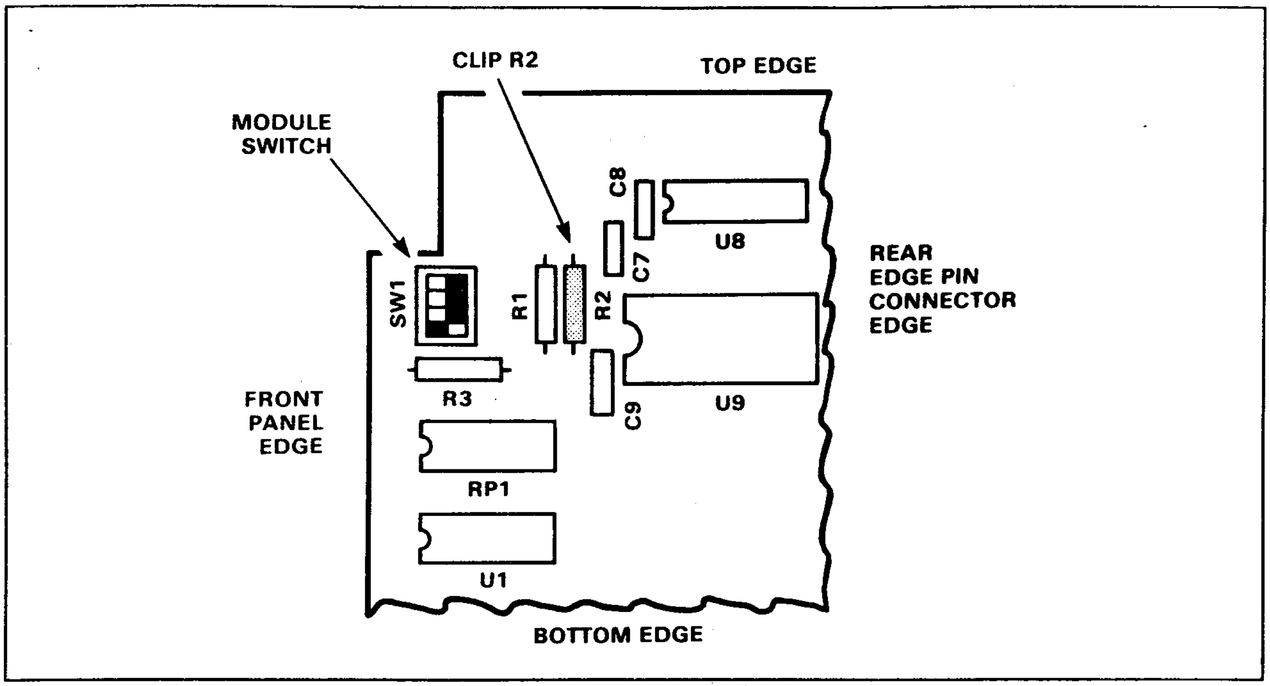

Figure 3-38. Disabling the On-line Programming Function (PC-1100)

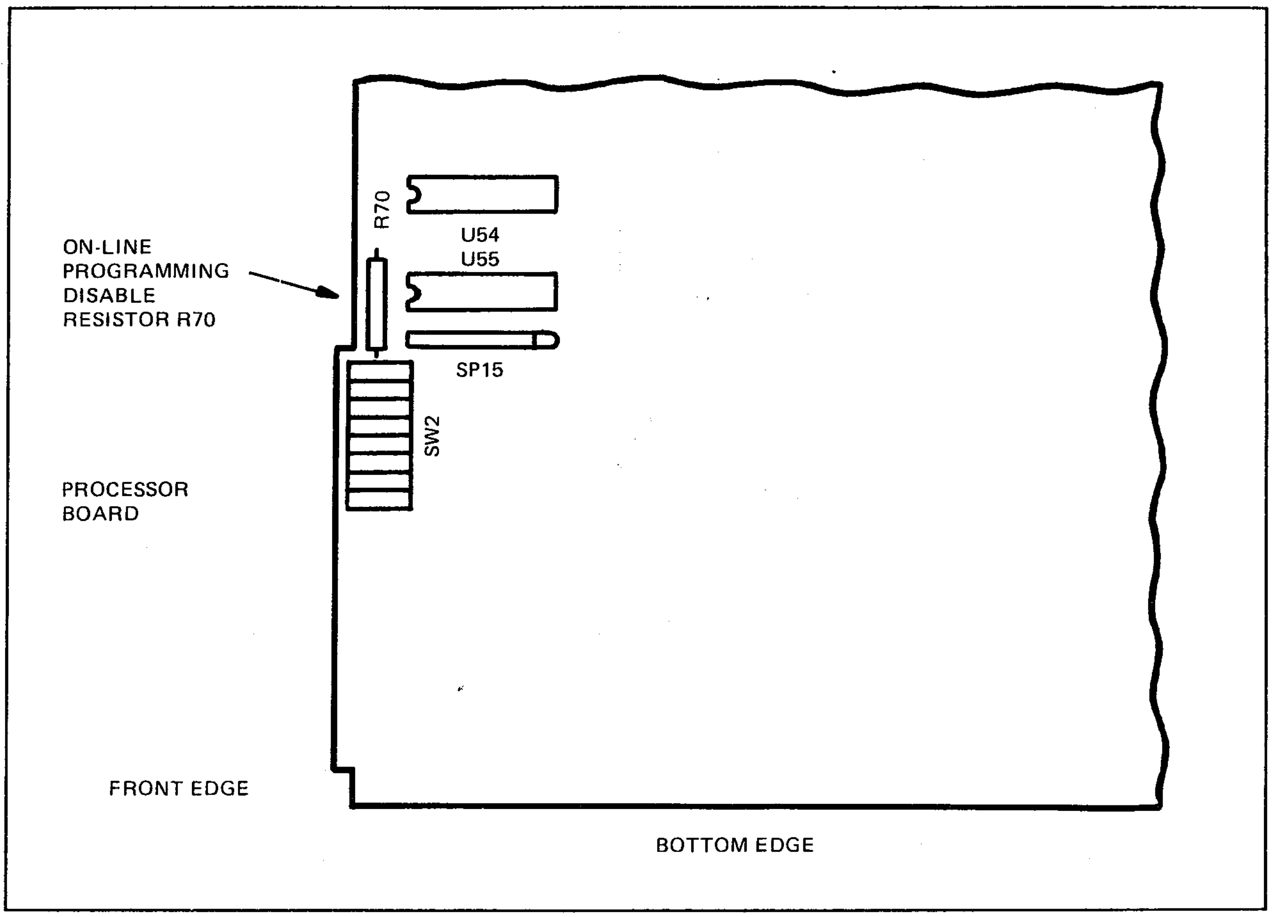

Figure 3-39. Disabling the On-line Programming Function (PC-1200)

3-20. Networking

The Advanced PC-1100/1200 Communications System allows the exchange of register data between a "Master" PC-1100/1200 processor and up to 31 "Slaves" with the built in RS-485 interface, or 255 "Slave" PC-1100/1200 processors via the Port B RS-232 interface and multipoint modems. Block read and block write commands are executed under control of the Port Transmit, Unit Address, and Configure Port functions.

Note

The PC-1100 and PC-1200 are compatible in networks operating at or below 9600 baud. Above 9600, the PC-1100 uses non-standard baud rates.

The PT, CP, and UA special functions were enhanced in the PC-1200 for greater ease of network implementation. These changes may impact program transportability.

For additional information, see the function descriptions in Section 5.

Caution

Program changes to the port communication parameters may disrupt on-going communications.

For example, if Port A is being used for program loader communication and the program changes it to a non-standard speed or data format, program loader communications will be disrupted. Unless the port can be changed back to a standard format through the ladder program or through Port B communications, it will not be possible to re-establish Port A communications without erasing user memory.

Figure 3-40 shows a typical RS-485 network (modem networking is described later in this section). Note that the Master controller may be positioned in any physical location in the link.

NL-1075 Communications Adapter Module

For PC-1100/1200 networking, a Communications Adapter Module (NL-1075 or NL-1075B) is required for each controller. As described in Paragraph 2-9, the program loader port (25 pin D connector) on the front of the Advanced PC-1100 or PC-1200 funnels connections for multiple interface ports. Port A is RS-232 while Port B is either RS-232 or RS-485. The NL-1075/1075B module is a dual port interface device that allows simultaneous access to the two communication channels, Port A and Port B.

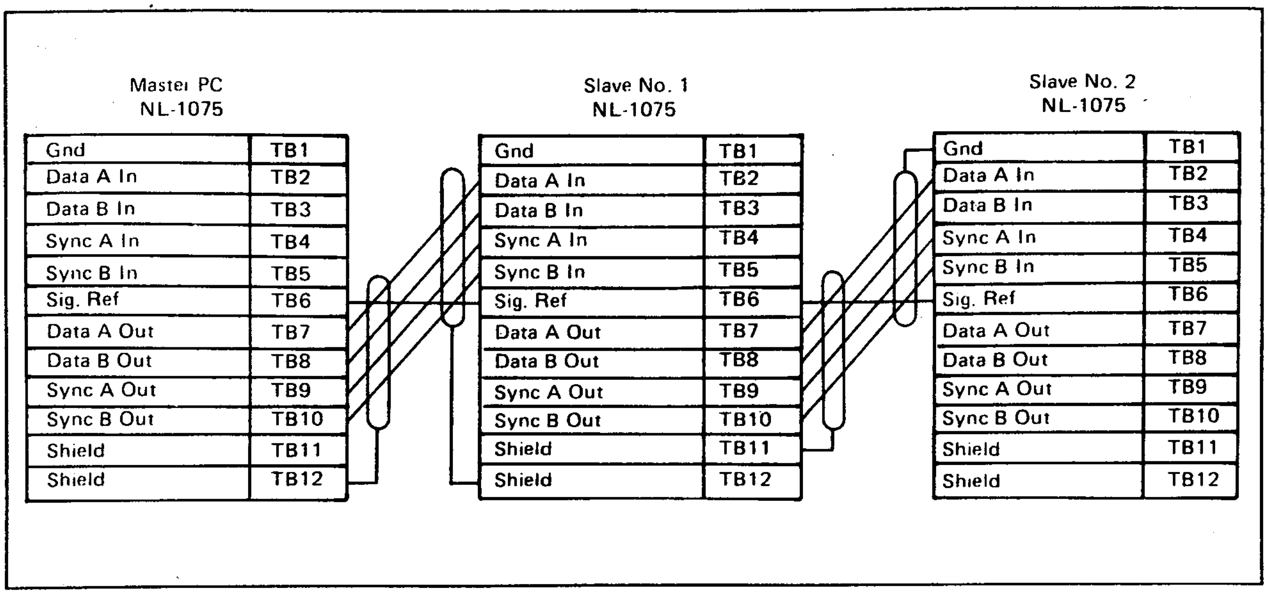

Figure 3-40. Typical PC-1100/1200 RS-485 Network

Connection to the NL-1075 module is via a cable from the loader port on the front of the processor. The NL-1075 does not require connection to the rack I/O bus. All circuitry for communications is contained in the CPU with the module acting as a hardware fan-out for the port connections.

For the PC-1100, the NL-1075/1075B module or similar bus (such as Quartech model 8505) is used to access the PC-1100 communication ports.

The PC-1200, due to electrical isolation between Ports A and B, must use the NL-1075B (or equivalent). The signal ground for the PC-1200's Port B is brought out of the controller's 25 pin D connector on pin 23 (on the PC-1100, both ports use pin 7). A switch on the NL-1075B allows for switching between PC-1100 and PC-1200 configurations.

Additional information on the NL-1075/1075B can be found in IL-15753.

Multi-Point and Single-Point Modes

As noted above, Port B supports two electrical interfaces: RS-232-C and RS-485. The RS-232-C interface permits only one device to be connected to the port, such as a computer or multipoint modem. The RS-485 interface allows multiple connections to be made.

The controller may be configured for Single Point or Multi-Point mode using the MODE switch (see Paragraph 3-17). In Single-Point mode, both ports support RS-232 connections for program loader or other communications. Multi-Point mode enables the processor for network communication on Port B (without affecting Port A). Port B may be configured for network communication via either RS-232-C or RS-485.

Note

> The *Master* PC-1200's mode switch is set to Single Point mode when networking, while the PC-1200 Slaves are placed in Multi-Point mode.

The Advanced PC-1100 (with executive software version 2.1 or greater) incorporates a Communications Expansion Board which is required to support the network (see Paragraph 3-17). The Communications Expansion board allows the PC-1100 to be operated in either Single-Point or Multi-Point Mode. Both modes support two communication ports via the NL-1075 module.

Note

> The Communications Expansion board is required for the PC-1100 only. Both Single Point and Multi-Point modes are supported in the PC-1200 interface card.

When setting up a PC-1100 network, verify the following switch settings:

- Switch 4 (located on the interface card) is the Single-Point/ Multi-Point mode select switch. (See Paragraph 3-17).

- When using the Port B RS-232 interface, all switches on the Communication Expansion Board must be closed.

- When networking via RS-485, the Communication Expansion Board switches must be CLOSED in the controllers which physically terminate the network (e.g., Slave No. 1 and Slave No. 5 in Figure 3-40). In all others (in the middle of the physical link), these swiches are OPEN.

When setting up a PC-1200 network, verify the following switch settings:

- When networking via RS-485, the Port B switches (SW1) must all be CLOSED in the controllers which physically terminate the network, and OPEN for all others.

- For PC-1200's which are configured as Slaves, the Mode switch must be CLOSED. A PC-1200 Master must have the Mode switch OPEN.

Figure 3-41 illustrates the signal connections in a typical RS-485 network. Definitions for the signal lines are provided in Paragraph 3-21.

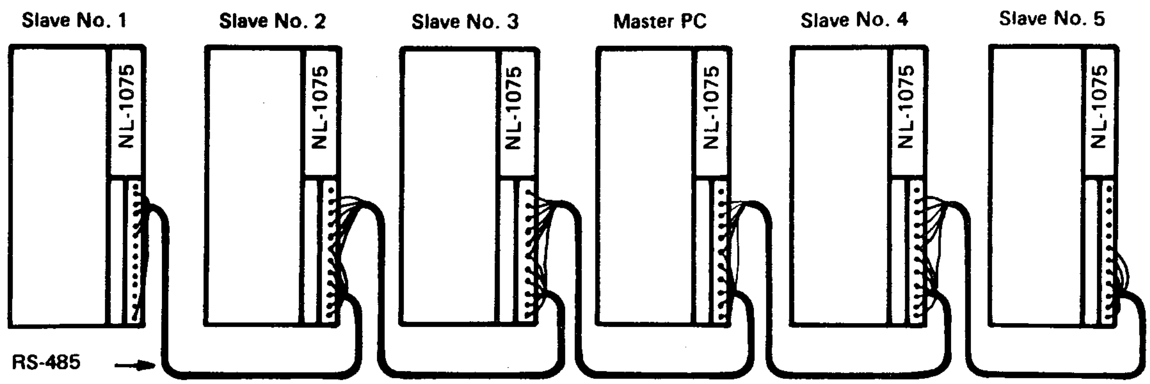

Figure 3-41. Example RS-485 Network Connections

Modem Networking

Figure 3-42 illustrates PC-1100/1200 networking using modems. Table 3-6 shows the cabling for a typical PC-1100/1200-to-modem connection.

Note the following requirements for modem networking:

- For full time operation, a "Bell" 202 T multipoint modem (for leased phone lines) or equivalent should be used.
- For PC-1100's, the CP special function must be set up with Operand 1 programmed as constant value = 3, and the Mode switch must be in the Multi-Point position.
- For PC-1200's, the Mode switch should be set to Multi-Point for Slaves only (the Master PC-1200 must be set to Single Point mode).

Note that the PC-1100/1200 network is not designed to use switched phone lines and Hayes-style modems. However, Westinghouse can provide Application Notes to assist in situations which deviate from the standard dedicated (leased-type) phone lines.

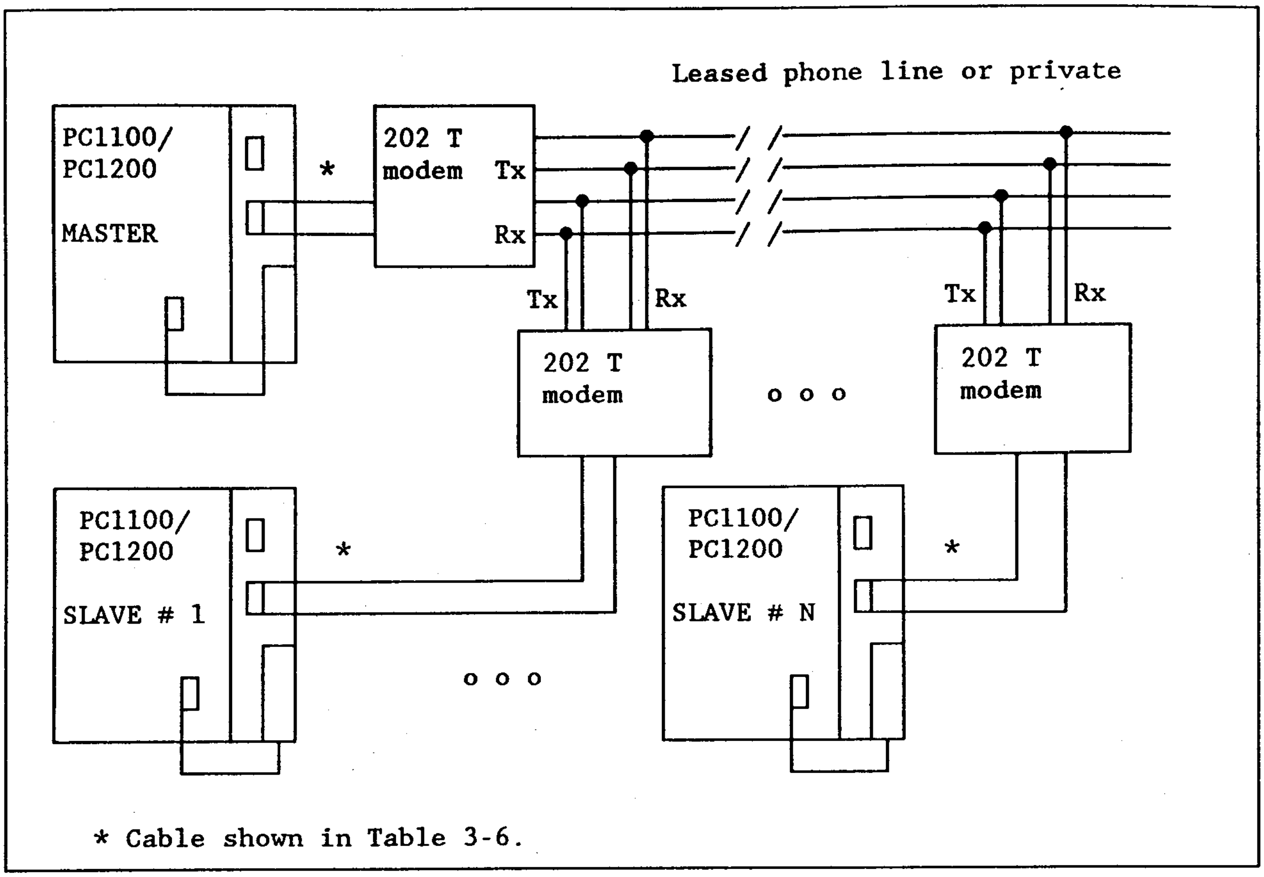

Figure 3-42. Typical Multipoint Modem Setup

NLC-17 Cm

TABLE 3-6. PC-1100/1200 TO AT&T 202T MODEM CABLE

PC-1100/1200 Port B of NL-1075/B (Female 25 pin D-connector)	Modem 202T (Male 25 pin D-connector)
2	2
3	3
4	4
5	5
6	8
7	7
20	20

46 old

3-21. Serial Port Definition

The PC-1100/1200 and NL-1075/1075B serial signal lines are shown in Tables 3-7 through 3-10.

Port A on the NL-1075/1075B is defined for RS-232-C communications and is functionally equivalent to the RS-232-C port on the front of the controller. It will allow communications with a program loader, printer, computer or other RS-232-C device.

Port B has both an RS-232-C and an optically isolated RS-485 interface which share a common data bus. Generally, only one type of interface may be used to communicate at a time, not both. Hybrid RS-232/RS-485 configurations are possible when using the multipoint network (Westinghouse Application Notes are available upon request).

The NL-1075/1075B Port B D-connector accesses the RS-232-C data terminal signals, and its function is dependent on the mode of operation. When in the Single Point mode, the RS-232-C connector on Port B acts in the same way as Port A (described above). In the Multi-Point mode, the RS-232-C port can be used for network communications using modems.

The terminal block on the front of the NL-1075 module provides access to the RS-485 interface. The RS-485 network uses 3 twisted pair, individually shielded RS-485/RS-422 style communication cables. The data transceivers constitute one pair, the Synch transceivers constitute the second, and the common mode reference line uses one line of the third pair. An overall isolated shield may be desirable in addition to each twisted pair's in conditions of severe industrial noise or when running cables outdoors.

The cable should have an impedance between 100 to 120 ohms and a line to line capacitance of 12 to 15 pF/ft. Suggested cables are BELDEN 9863, BELDEN 9730, and BELDEN 9843. Use of cable which meets these specifications is especially critical as the length of the cable run increases.

Note

Maximum cable distance is 4000 feet.

When selecting a cable review the application with your cable supplier. Applications involving environmental extremes (exposure to sunlight or caustic chemicals, outdoor use, under ground or water, etc.) will require special cables.

TABLE 3-7. PC-1100/1200 "D" CONNECTOR SIGNAL LINES

Pin No.	Port A/B	<>[1]	Signal Definition	RS232/485
1	-	-	Chassis Ground	-
2	A	>	Tx - Transmit Data	RS-232
3	A	<	Rx - Receive	RS-232
4	A	>	RTS - Request To Send	RS-232
5	A	<	CTS - Clear To Send	RS-232
6	A	<	DSR - Data Set Ready	RS-232
7	A/B	-	[2]SG - Signal Ground	RS-232
8	A	<	DCD - Data Carrier Detect	RS-232
9	B	<>	TxRx b - Data Transceiver line in	RS-485
10	B	<>	Synch a - Synchronization pulse Transceiver line in	RS-485
11	B	<>	Synch a - Synchronization pulse Transceiver line out	RS-485
12	B	<	DSR - Data Set Ready	RS-232
13	B	<	CTS - Clear to Send	RS-232
14	B	>	Tx - Transmit Data	RS-232
15	B	<>	TxRx b - Data Transceiver line out	RS-485
16	B	<	Rx - Receive Data	RS-232
17	B	<>	TxRx a -Data Transceiver line in	RS-485
18	B	-	Signal Reference	RS-485
19	B	>	RTS - Request To Send	RS-232
20	A	>	DTR - Data Terminal Ready	RS-232
21	B	<>	TxRx a - Data Transceiver line out	RS-485
22	B	>	DTR - Data Terminal Ready	RS-232
23	B	-	[2]SG - Signal Ground	RS-232
24	B	<>	Synch b - Synchronization pulse Transceiver line in	RS-485
25	B	<>	Synch b - Synchronization Pulse Transceiver line out	RS-485

1 > = Driver, < = Receiver, <> = Transceiver line (1 of pair)

2 For the PC-1100, pin 7 provides signal ground for both Ports (A and B). For the PC-1200, pin 7 provides signal ground for Port A and pin 23 provides signal ground for Port B.

The separate signal ground at pin 23 is found in the NL-1075B only (the ground signals are common on the NL-1075). A switch is provided on the NL-1075B to isolate these lines (for PC-1200 use) or keep them common (for PC-1100 use).

When using a PC-1200, the NL-1075B must be used. The PC-1100 may use either the NL-1075 or the NL-1075B.

TABLE 3-8. NL-1075/1075B SIGNAL LINES - PORT A (RS-232)

Pin No.	Signal
1	Chassis Ground
2	Tx
3	Rx
4	RTS
5	CTS
6	DSR
7[1]	SIGNAL GROUND (Digital)
8	DCD
20	DTR

[1] Must be isolated for PC-1200 (use NL-1075B).

TABLE 3-9. NL-1075/1075B SIGNAL LINES - PORT B (RS-232)

Pin No.	Signal
1	Chassis Ground
2	Tx
3	Rx
4	RTS
5	CTS
6	DSR
7[1]	SIGNAL GROUND (Digital)
-	Not Used
20	DTR

[1] Must be isolated for PC-1200 (use NL-1075B).

TABLE 3-10. NL-1075/1075B SIGNAL LINES - PORT B (RS-485)

Pin No.	Signal
1	Chassis Ground
2	TxRx a in
3	TxRx b in
4	SYNC a in
5	SYNC b in
6	SIGNAL REF.
7	TxRx a out
8	TxRx b out
9	SYNC a out
10	SYNC b out
[1] 11	SHIELD
[1] 12	SHIELD

[1] Pins 11 and 12 connected together for shield splicing.

The signals are defined below:

Chassis Ground	Static Shield reference for noise rejection. (Note shields should be connected at one point only to eliminate ground loops.)
Tx	Transmit Data. Data is sent out this driver line.
Rx	Receive Data. Data is received into this receiver line.
RTS	Request To Send. This hand shake line driver goes high before data is transmitted. (RTS and CTS are complementary lines.)
CTS	Clear To Send. This hand shake line receiver waits to be driven high before data is transmitted. It can be used for transmit flow control.
DSR	Data Set Ready. This hand shake line receiver has two purposes: 1. Indicates that device on other end is powered up. (Not important for most applications.) 2. Indicates a Synchronization flag for Multi-point Modem networking on Port B only when DSR goes from low to high. (DSR and DTR are complementary lines.) See the AR special function description for more details.
SG	Signal Ground. Line by which all other RS-232 lines are referenced electrically.
DCD	Data Carrier Detect. This hand shake line receiver exists on Port A only, but is not associated with any function at this time.
DTR	Data Terminal Ready. This hand shake line driver has three purposes: 1. Indicates that the controller processor is powered up. 2. Toggles on Port B during synchronization pulse of network. 3. Is used for buffer full indication in conjunction with the "AR" ASCII Receive special function.
TxRx a TxRx b	Data Tranceiver differential (RS-485) pair which both sends and receives data. The "in" and "out" notation is for cable wiring reference when splicing in a drop.
Synch a Synch b	Synchronization Transceiver differential (RS-485) pair can alternately send or receive a synch pulse depending on configuration as Master or Slave respectively (see PT write up). The "in" and "out" notation is for wiring reference when splicing in a drop.
SR	Signal Reference (RS-485). This is a Common Mode Voltage Reference line which acts to maintain drops within a -7 to +12 Volt common mode range as per IEEE RS-485 specification. Each Transceiver is linked with a 100 ohm series impedance.

For more information, see the Instruction Leaflet for the NL-1075 Communications Adapter Module (IL-15753), and refer to the Port Transmit (PT), Unit Address (UA), and Configure Port (CP) function descriptions in Section 5.

3-22. SYSTEM TESTING

The PC-1100/1200 system as a whole is tested only after all I/O modules are installed and all field wiring is completed. All system components, except for analog inputs, are tested using the Monitor and Force functions of the program loader. The analog input circuits require an additional test circuit to complete testing. (See Figure 3-43.)

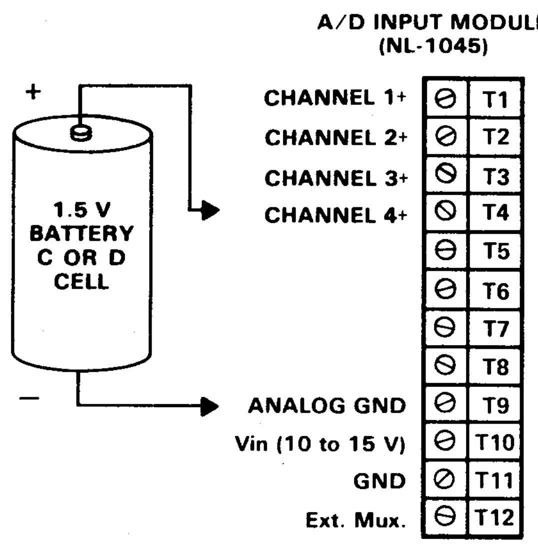

Figure 3-43. Analog Input Testing Circuit

The procedures described in this section assume that the user is familiar with the System, program loader and related peripherals. If this is not the case, the user should study all related system, program loader and peripheral documentation before proceeding with these test procedures.

The PC-1100/1200 system is tested by using the following tests:

- I/O Module testing (See Paragraph 3-23.)
- Peripheral testing (See Paragraph 3-24.)

3-23. I/O Module Testing

Use the following step-by step procedure to test the 1000 Series I/O modules.

1. Initialize the controller according to the procedures given in Paragraph 3-5.

2. After the above initialization is complete, place the controller's keyswitch in the RUN position.

3. This test procedure uses the Monitor mode, which is described in the appropriate program loader's programming manual.

4. Using the Monitor mode, activate each discrete input. Observe that the loader's Monitor function is active and that the LED on the corresponding discrete input module lights.

Note

If the user energizes an input in this test, he should check to see that the controller is reporting only that input ON. The user may verify this by displaying all input groups in binary format on the program loader.

5. Be sure that all inputs are turned OFF when discrete input testing is completed.

6. The discrete outputs of a system are tested by using the Force function in the Monitor mode.

WARNING

THE USER'S OPERATING PERSONNEL ARE RESPONSIBLE FOR ENSURING THAT NO DANGER TO PERSONNEL OR DAMAGE TO EQUIPMENT RESULTS FROM THE ENERGIZATION OF AN EXTERNAL DEVICE THROUGH THE USE OF THE FORCE FUNCTION. BE SURE THE SYSTEM IS IN THE MONITOR MODE BEFORE USING A FORCE FUNCTION AT THIS TIME.

7. Be sure that the devices controlled by the outputs to be tested are properly disabled or in a safe operating condition.

8. Force each discrete output to an ON state. Observe that the LED on the corresponding discrete output module lights; that no other output is ON; and that the controlled device is properly operating. In the case of disabled devices, check to see that the proper operating potential is being applied to the device from the output under test.

Note

For most discrete outputs, the LED indicator is driven by the load circuit, rather than the controller power supply.

9. Be sure that the output under test is forced OFF when each discrete output's test is complete. Also ensure that all forced conditions are deleted after all outputs are tested.

10. Analog output testing is accomplished by loading numerical data in the associated register and checking that the external result is correct.

11. To test the analog outputs, connect a multimeter across the analog output module terminals under test. After the meter is connected and the proper voltage or current range is selected, load the numerical data into the corresponding output register by means of program loader's Register function. Observe that the analog output reading on the meter is appropriate and that the controlled instrumentation device-if one exists-operates properly.

    Example: Assume an NL-1057 (0 to 10V range) with the address switches set so that OR0001 equal to 128 should result in an output of:

    $$\frac{128}{256} \times 10 = 5.0 \text{ V}$$

12. Ensure that all analog outputs are returned to the pretest state and that the meter is disconnected after analog output testing is completed.

13. To test the analog input, a battery test circuit is connected across the analog input module terminals to simulate an analog input. This test circuit consists of a battery and connecting leads. The battery's output should be within the nominal voltage rating of the analog modules.

    Example: Figure 3-43 shows this test circuit for an NL-1045. The battery is shown connected to the analog input module's Channel No.4.

14. After the battery test circuit is connected, monitor the corresponding input register contents for the result of the analog input module's analog-to-digital conversion. This register is monitored by using the program loader's Register function. The result of this conversion can be calculated for each module as follows.

    For 8-bit inputs:

    $$\text{Anticipated value in processor} = \frac{\text{Applied V}}{\text{Analog input circuit's max. V range}} \times 255$$

For 12-bit inputs:

$$\text{Anticipated value in processor} = \frac{\text{Applied V}}{\text{Analog input circuit's max. V range}} \times 4095$$ [1]

Example: If 1.5V is applied to a channel of an NL-1045, the anticipated value would be:

$$\frac{1.5\ V}{5\ V} \times 255 = 77 \text{ (rounded down to nearest integer value)}$$

15. Be sure that the battery test circuit is removed and that all analog inputs are deactivated after analog input testing is completed.

CAUTION

When all I/O module testing is complete, be sure that all inputs are deactivated; that all outputs are forced OFF; and that all Force function commands are deleted.

3-24. Peripheral Testing

Use the procedures below to test the peripheral devices to be used with the PC-1100/1200.

Program Loader

Test procedures for the program loader can be found in the applicable programming manual (see Paragraph 1-5 for a listing of reference manuals).

Tape Loader

Using the program loader, enter the test program shown in Figure 3-44 into the controller. Refer to the appropriate program loader's programming manual for instructions on programming this rung of logic.

After this test program is entered, perform the following test sequence:

1. Record the test program on tape by using the appropriate program loader manual.

Note

This program is recorded on the NLT-782 tape loader when the NLPL-780(P) program loader is used, and on an audio cassette recorder when the NLPL-789 mini loader is used.

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[1] For the NL-1052, full scale = 4000. For details, refer to IL 20005.

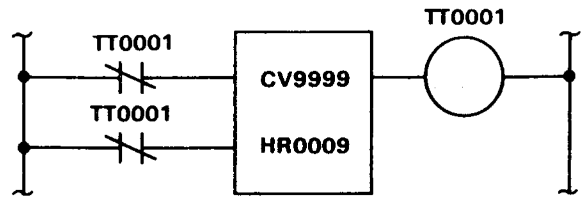

Figure 3-44. Test Program

2. After the test program is recorded, rewind the tape and re-enter the program into the controller from the tape loader or audio cassette recorder.

3. Using the program loader's Monitor mode, verify that the program presently in the controller is the same as that originally entered. (See Figure 3-44.)

This test verifies that the System can write into and read from the tape loader or audio cassette recorder.

Memory Safe Cartridge (PC-1100)

Using the program loader, enter the test program shown in Figure 3-44 into the controller. Refer to the appropriate program loader's programming manual for instructions on programming this line of logic.

After this test program is entered, perform the following test sequence:

1. Execute the test program by placing the controller keyswitch in the RUN position. Verify the operation by using the CRT or mini loader in the monitor mode.

2. Once assured that the test program is operating properly, place the controller keyswitch in the STOP position and attach the Memory Safe to the bottom of the controller. (See Figure 2-20.)

3. Record the test program onto the cartridge. (Refer to the instruction leaflet for details on cartridge use.)

4. Using the CRT loader or mini loader, read contents of HR0009.

5. Using the program loader, erase the program from the controller's memory.

6. Load the test program stored on the cartridge into the controller.

7. Using the program loader's Monitor mode, verify that the program presently in the controller is the same as originally entered. (See Figure 3-44.) Also verify that the contents of HR0009 are identical to that recorded in step No. 4, above.

This test verifies that the system can write to and read from the Memory Safe program cartridge.

Printer

A printer may be used with the Advanced Program Loader or the NLPL-780P version of the CRT Program Loader. (See Paragraph 2-21.) The NLPL-789 mini loader and the NLPL-780 version of the CRT program loader do not support the Print function.

To test printer operation, enter and print a test program (see Figure 3-44 for a sample test program). Refer to the program loader's programming manual for Print instructions. After the program is completely printed, verify that it is the same as that originally entered.

3-25. PROGRAM VERIFICATION

The successful completion of these tests only indicates that the system under test is wired properly and that the system components tested are operational. These tests do not verify that the user program installed in the controller functions correctly. It is the user's responsibility to load the control program to determine if the system has been correctly programmed for specific user applications.

3-26. TEST FAILURES

If any failures are detected during these tests, recheck the system wiring and installation while referring to the system drawings and the installation procedures given in this section. If the wiring and installation are correct, refer to Section 6 or to the documentation of the suspected systems components. If problems continue after these steps are taken, contact your Westinghouse Service Representative.