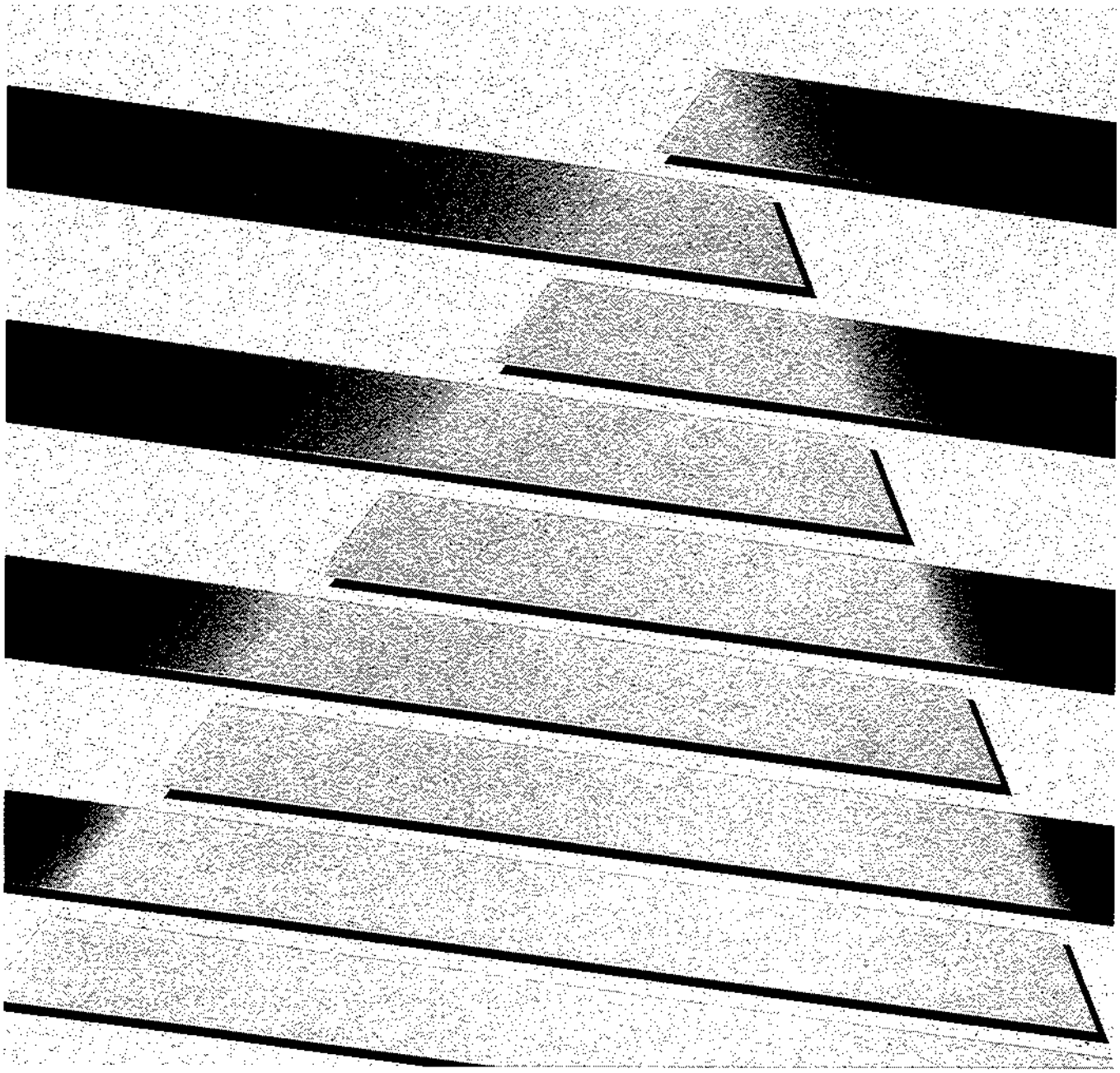
ALLEN-BRADLEY

PLC-3
Programmable Controllers
(Cat. No. 1775-LP1, -LP2, -LP3, -LP4)

Installation and Operation Manual



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Appendix

A

PLC-3 Controller Start-up Procedure

After following all of the installation procedures given in chapter 3, you should start up the PLC-3 controller through the procedure outlined in the following steps:

Step 1 — Raise the power interlock bar and, after checking backplane and module switches, install the minimum configuration of modules into the main chassis. The minimum configuration is 1 Main Processor Module (cat. no. 1775-L1 or -L2), 1 memory module (any size), and 1 I/O Scanner Module (cat. no. 1775-S4A). The main processor module requires two module slots; use the first two slots on the left. Leave the terminal swing arm disconnected from the I/O scanner module. To properly install a module:

- Slide it into the slot until you feel the resistance from the backplane connector.
- Place one thumb on each locking tab at the top and bottom of the module.
- Grip the frame of the chassis with your fingers and firmly push in with your thumbs until you hear and feel the module click into place.

Step 2 — On the memory module and the 1775-S4A I/O scanner module, set the thumbwheel switch to 1.

Step 3 — Check all connections.

Step 4 — While leaving all machine power off, turn on the AC power to the power supplies.

Step 5 — After ensuring all modules are properly seated into the backplane, pull down the power interlock bar firmly to engage the interlock switches.

Step 6 — Toggle the 1775-P1 power supply circuit breaker to the ON position.

Step 7 — With power on, the 1775-P1 power supply indicators should be:

- AC ON — red
- AC OK — green
- DC OK — green
- OVTEMP — off

The function of these indicators is as follows:

- AC ON — The red AC ON indicator illuminates when AC voltage at the input of the power supply is detected and the circuit breaker is set to ON.
- AC OK — The green AC OK indicator illuminates when AC power is within the lower limit of the voltage range and the power Supply is not shut down by either the circuit breaker, the remote shutdown circuit, or the overtemperature detection circuit.
- DC OK — The green DC OK indicator illuminates when all DC voltages are within tolerance. If any power supply DC voltage is not within tolerance after a 1.5 second delay at power turn-on, all DC power circuits are disabled and the DC OK indicator does not illuminate. Even after the source of the fault (possibly a DC short) has been eliminated, DC power circuits remain disabled until power is interrupted. Power can be interrupted at the AC source, with the circuit breaker, or with the remote shutdown circuit.
- OVTEMP — The red OVTEMP indicator is illuminated whenever the DC power circuits are disabled due to a detected overtemperature condition. After the temperature has decreased to an acceptable level, the DC power circuits remain disabled and the OVTEMP indicator remains illuminated until the RESET pushbutton is pressed. By sensing the temperature of output circuit components, the overtemperature detection circuit guards against power supply damage due to exceeding either the current rating or the ambient temperature rating.

Step 8 — Each time power to the processor chassis is turned on, an initialization period occurs. This can take up to 5 seconds. During initialization, many diagnostic checks are performed while the data access panel displays the message:

```
AB PLC-3
```

After initialization is complete, if all diagnostic tests are passed, the display will be cleared. If after 5 seconds the display is not cleared, refer to table A.A which lists initialization faults. When a blank memory is initialized for the first time, after 5 seconds, the data access panel displays the message:

```
MEMORY AT xxxxxx
```

This initialization fault message will be displayed because the blank memory does not have any system pointers. The number in the message has no significance to the user. Press **[ENTER]** on the data access panel to establish a default memory configuration and clear the fault message.

Table A.A

Intializing Faults

Fault Message	Probable Cause
AB PLC-3 [1]	Either no Main Processor Module or no 1775-S4A I/O Scanner Module No. 1 or AC voltage is low. [3]
NOT ONE CPU [2]	2 Main Processor Modules. [3]
NO SYSTEM MEMORY [2]	No Memory Modules. [3]
OUT OF SEQUENCE [2]	Memory Modules are not numbered in sequence. [3]
DUP SCANNER 1 [2]	Two 1775-S4A I/O Scanner Modules set to No. 1. [3]
DUPLICATE MODULE [2]	2 modules of the same type, set to the same number. [3]
PWRUP BACK FLT [2]	Backplane fault at power-up. [4]
BAD MACROINST [2]	Fault likely on Main Processor Module. [4]
PWRUP MEM PAR ER [2]	Memory parity error at power-up. [5]
MSA CREATE ERROR [2]	No room for a status area for an added module. [5]
NO MEM/EXT MSA [2]	Expander or Memory Module status area is too small. [5]
O CPU MOD STAT [2]	No Main Processor Module status area in memory. [5]
BAD CPU MSA SIZE [2]	Not Large enough Main Processor Module status area. [5]
MEMORY AT xxxxxx (xxxxxx=any number) [2]	System Pointers wrong or missing. [5]
CONFIG ERROR [2]	A module cannot function properly. [5]
CONTEXT 0 BAD [2]	Context number is 0. [5]

[1] All Front Panel indicators OFF.

[2] All Front Panel indicators RED.

[3] Raise the Interlock Bar and correct the module configuration .

[4] First try to clear the fault by cycling power OFF, then ON. If the fault remains, try pinpointing the fault through module replacement. Alternately, if there is no program to save, press **[ENTER]**; this will clear any program from memory and establish a default memory configuration.

[5] If the memory contains a program that is worth saving, first try to clear the fault by cycling power OFF, then ON. If the fault remains, or there is no program to save, press **[ENTER]**; this will clear any program from memory and establish a default memory configuration.

Step 9 — After initialization is complete the front panel indicators should be as follows:

- PROCESSOR — green
- OUTPUTS — red or green
- PROGRAM — green or off
- ACCESS — off (with no peripheral connection)

These indicators are described in table A.B.

Table A.B

Front Panel Indicators

Name	Indication	Meaning
PROCESSOR	Green Red OFF	No major faults. Major fault. Power OFF.
OUTPUTS	Green Red OFF	Outputs enabled. Outputs disabled. Backup mode.
PROGRAM	Green Red OFF	Program load mode. Not used. Not in program load mode.
ACCESS	Green Red OFF	A peripheral device with power ON is connected to a peripheral communication channel (channel active). A peripheral device is editing the program. No peripheral communication channels active.

Step 10 — Should any indicator differ, try each of the following actions separately:

- Cycle power by toggling the power supply circuit breaker.
- Reseat all modules.
- Check all switches.
- Replace one module at a time with spares if available.
- Call the local Allen-Bradley sales office for customer service.

Step 11 — On the industrial terminal install the keyboard if separate and connect the AC power line cord to an outlet. Set the AC power switch to off at the industrial terminal. Connect the 1770-CAT cable between the PERIPHERAL CHANNEL 0 and the industrial terminal CHANNEL B. Set the AC power switch to on. The screen should now display rung(s) or an EOP (end of program) rung.

WARNING: When making modifications to the system remove all power from any device being wired, serviced, or repaired. Failure to observe this caution could result in damage to equipment or injury to personnel.

Step 12 — Raise the interlock bar and install any optional modules into the processor chassis. Leave the terminal swing arm disconnected from each I/O scanner module.

Step 13 — Set the thumbwheel switch on the first memory module to 1 and all others in a sequential order (2,3,4...).

Step 14 — Set the thumbwheel switch on the first 1775-S4A I/O scanner module to 1 and all others in a sequential order (2,3,4...).

Step 15 — Set the thumbwheel switch on the first 1775-S4B I/O scanner module to 1 and all others in a sequential order (2,3,4...) if this module is used.

Step 16 — Set the thumbwheel switch on the first 1775-KA module to 1 and all others in a sequential order (2,3,4...) if this module is used.

Step 17 — Repeat steps 5 thru 10.

Step 18 — Connect the terminal swing arm to each I/O scanner module. Then, with all I/O chassis powered up, power up the processor chassis. This should cause an auto configure to list each I/O chassis in the I/O chassis scanning sequence for its channel in LIST.

Step 19 — With all power driven machine motion disabled, test each input and output individually before entering a user program to control the machine or process. To test each input and output, use the data monitor/change function of the industrial terminal (section 5.3.5). For each input terminal, manipulate the corresponding input device while monitoring the display and the corresponding input indicator to verify that the correct state is indicated.

WARNING: Never reach into a machine to actuate a switch since unexpected machine motion can occur and cause injury to personnel. Use a wooden stick. A metal rod could damage the machine and conduct current thru the person holding it.

For each output terminal, manipulate the corresponding output bit while monitoring the corresponding output device and output status indicator to verify that the correct output action occurs.

Appendix

B

Data Access Panel Messages

The data access panel on the main chassis displays many messages which can aid you in operating and troubleshooting the PLC-3 controller. Initialization fault messages are listed in table A.A. Other messages are described in the following.

B.1 Backup Status

When two PLC-3 processors are providing backup for each other, only one PLC-3 processor will be controlling outputs at any one time. The other PLC-3 processor will be in the backup mode. However, when the primary processor detects a major fault, it switches control of the outputs to the secondary processor and displays the message:

```
DEACTIVE
```

B.2 Data Access Panel Input Errors

When using the data access panel, you may cause one of the following messages to be displayed:

- `BAD VALUE` — This message will be displayed if you attempt to enter a value which cannot fit into the data table section which you are addressing.
- `ACCESS VIOLATION` — This message will be displayed if you attempt to write into a memory area for which the data access panel does not have the privilege.
- `LIST UNAVAILABLE` — This message will be displayed if you attempt to access the LIST function through the data access panel while the LIST function is already being accessed through 4 peripheral communication channels.

B.3 Major Fault Messages

Major faults are classified here as one of the following:

- Programming faults
- Memory data faults
- Processor hardware faults
- I/O faults

Unless backup is provided or a fault routine is able to cause a fault recovery, a major fault causes a shutdown of the controller, switches it to the program load mode, and sets a major fault bit in memory. The major fault bit can be reset by pressing the [CLEAR] key on the data access panel or by typing `CSW` [ENTER] at an industrial terminal. If the cause

of the fault is spurious, resetting the fault may allow the controller to be restarted. In many uses, you will have to correct the problem which caused the major fault before the controller can be restarted.

While the initialization faults listed in table A.A can only be detected during the initialization period immediately after powerup, the major faults listed here can be detected at any time.

B.3.1 Programming Faults

Any of the following major fault messages may be displayed due to improper programming:

- STACK FAULT — This message will be displayed when the processor attempts to execute a subroutine which is nested beyond the eighth level or to execute a return from subroutine instruction that is not in a subroutine.
- BAD ADDRESS — This message will be displayed when an attempt has been made to execute one of the following:
  - A missing label
  - Two labels having the same number
  - An instruction referencing a non-existant address
  - A non-existant program
- WATCHDOG TIMEOUT — This message will be displayed when any single program execution scan takes longer than the watchdog preset time established thru the LIST function.
- RT INT. OVERLAP — This message will be displayed when any single real time interrupt subroutine execution scan time takes longer than the real time clock interrupt period established thru the LIST function.

If you try to restart the controller without correcting the problem that caused the programming fault, it may run for a while; however, when program execution again reaches that same point, the same fault will be detected.

When a programming fault message appears, refer to the fault reporting display on the industrial terminal. The rung number given there indicates where the program execution had to stop due to the programming fault. If the message displayed on the data access panel is BAD ADDRESS, that is narrowed down by the industrial terminal displaying one of the following:

- INVALID SECTION IN
- FILE BOUNDRY ERROR
- FILE NOT FOUND IN
- BAD ADDRESS IN

B.3.2 Memory Data Faults

Any of the following major fault messages may be displayed if memory data is found to be faulty:

- MEM PARITY ERROR — This message will be displayed when the processor detects either an uncorrectable error in an error-correcting memory module or a parity error in a non-error-correcting memory module while the processor is reading from memory.
- BAD INSTRUCTION — This message will be displayed when the processor detects an invalid instruction in the program. When this message is displayed on the data access panel, the message, BAD OPCODE, is displayed on the industrial terminal.
- HALT — This message will be displayed when the processor detects a specific invalid instruction in the program.
- CONFIG FAULT — This message will be displayed when the processor detects the absence of a pointer or a necessary section of module status.

When a MEM PARITY ERROR, BAD INSTRUCTION or HALT message appears, refer to the rung number given on the fault reporting display of the industrial terminal for the rung containing the problem. If you can't restart the controller, try reprogramming the indicated rung. If you still can't restart the controller, try replacing a memory module and reloading the program.

When a CONFIG FAULT message appears, if you can't restart the controller, try clearing memory and reloading the program. If you still can't restart the controller, try replacing a memory module and reloading the program.

B.3.3 Processor Hardware Faults

Any of the following major fault messages may be displayed if processor hardware is found to be faulty:

- HARDWARE FAULT — This message will be displayed when one module detects a hardware problem of its own or of another module.
- BACKPLANE FAULT — This message will be displayed when a hardware problem is detected during communication between modules.
- BUSEXTEND FAULT — This message will be displayed when a hardware problem is detected by an expansion module.

The FAIL indicators on the modules may indicate which module detected the fault, not necessarily the module with a problem. If you can't restart the controller, try reseating each module and expansion cable connections. If you still can't restart the controller, try replacing a module or just removing an optional module.

B.3.4 I/O Fault

Either of the following major fault messages may be displayed if an I/O fault is detected:

- `I/O CONFIG FAULT` — This message will be displayed if the I/O configuration does not conform to the rules stated in chapter 2. This fault will only be detected at the time of a reconfigure or an auto configure of the I/O for a scanner module.
- `MAJOR I/O FAULT` — This message will be displayed if a fault is detected at an I/O chassis which has been given the attribute thru the LIST function of having a fault considered to be a major fault. A fault at any I/O chassis without that attribute will be treated as a minor fault.

When a `MAJOR I/O FAULT` message appears, if you can't restart the controller, check the I/O channel indicators on the scanner modules to determine the channel on which the fault occurred. At that point you could check the I/O chassis scanning sequence list thru the LIST function or look at the I/O adapter module indicators along the I/O channel to determine which I/O chassis faulted.

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Introduction

1.0 General

The Bulletin 1775 PLC®-3 Controller is a programmable controller made up of components which are interconnected and mounted in enclosures by the user or original equipment manufacturer.

A PLC-3 programmable controller can have 4,096 standard inputs plus 4,096 standard outputs. Input and output connections are made at I/O chassis which can be located a maximum of 10,000 cable-feet from the PLC-3 processor chassis.

1.1 PC Definition

Programmable controllers interface with input and output devices such as:

- Limit switches
- Pushbutton switches
- Pressure switches
- Analog transducers
- Thumbwheel switches
- Solenoids
- Motor starters
- Alarms
- Indicators
- Solid state devices

The PLC-3 programmable controller is a multiple processor, modular, field expandable industrial controller. Its flexible design allows the capacity and power of the system to be tailored to present machine and process control needs economically, without sacrificing potential expansion. The distributed processing technique provides rapid instruction execution and I/O processing. Each module in the PLC-3 processor chassis performs internal diagnostic checks and provides visual and logical fault indication for ease of troubleshooting.

The user program can include the following types of instructions:

- Relay type
- Timer/counter

- Arithmetic (+, -, x, ÷,√‾)
- Logical (AND, OR, XOR, NOT)
- Comparison (=, >, <, ≥, ≤)
- Data transfer
- Bit Shift register
- Indexed Logic
- Program control
- Communication
- Diagnostic

1.2 PC Installation and Start-up

Throughout this manual, emphasis is placed on certain recommended fundamental procedures which, if followed, help to guard against damage to PLC-3 controller equipment. Protecting the equipment goes beyond these and enters other areas wider in scope.

This manual should be read entirely before any assembly activity is begun. It is strongly recommended that hardware and installation personnel work closely with the programmer prior to and during start-up. The proper operation of a programmable controller is as much a function of the user program as it is the hardware.

Since some of the functions which programmable controllers are capable of are similar to those of relay logic, there is much common information. However, it is strongly recommended that publication SGI-1.1 (Application Considerations for Solid State Controls) be read as general background information.

Chapter

2

Controller Description

2.0 Major Components

A PLC-3 controller is made up of the following major components:

- Power supply
- PLC-3 processor chassis
- I/O hardware

Also, an Industrial Terminal (cat. no. 1770-T4) is needed to program the PLC-3 controller.

Each of these major components and the cables interconnecting them are described in the following paragraphs.

2.1 Power Supply

There are two types of power supplies used:

- Power supply (cat. no. 1775-P1)
- Auxiliary power supply (cat. no. 1771-P2)

A 1775-P1 power supply (figure 2.1) can power a maximum of 1 processor chassis and 3 I/O chassis or a maximum of 2 processor chassis. It can provide 60A maximum of 5V DC power. A minimum load of 7.5A is required for proper operation.

A 1771-P2 power supply (figure 2.2) can power an I/O chassis. However, a 1771-P2 power supply cannot be used to power a processor chassis. It can provide 6.5A maximum of 5V DC power.

For each application, total the current requirements of all modules from the 5-volt supply circuit of each power supply to determine that there is no overload (table 2.A). Also, the load of each I/O chassis must not exceed 6.5A even if powered by a 1775-P1 power supply.

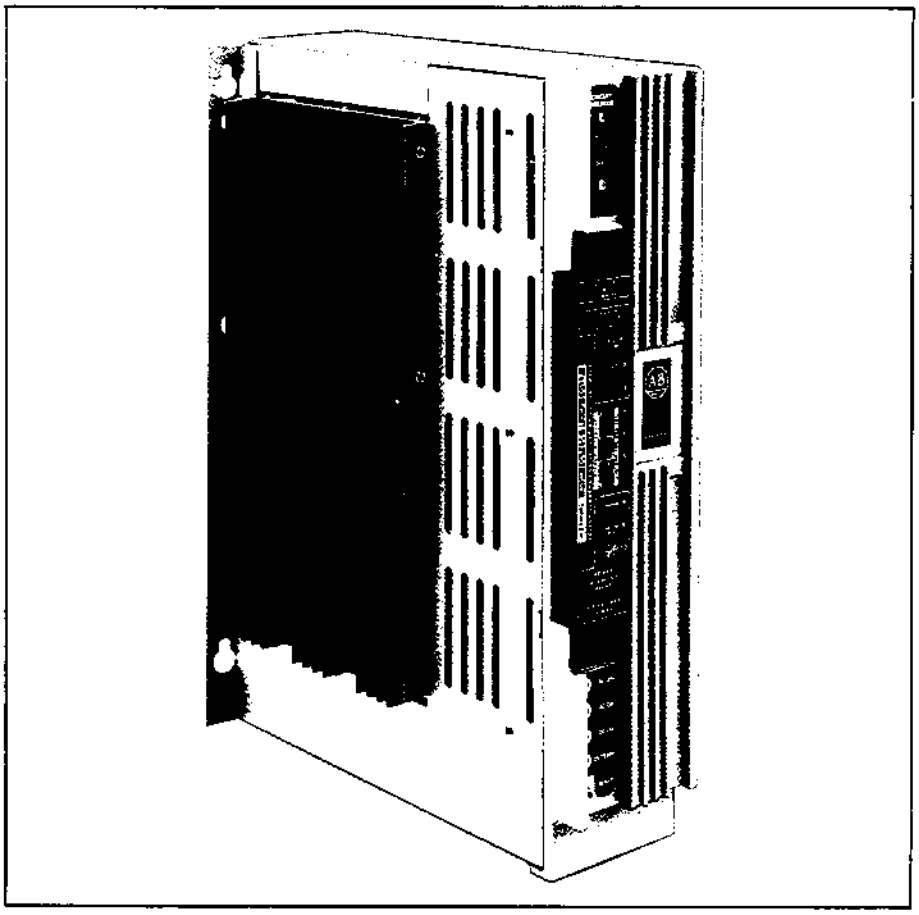


Figure 2.1 — Cat. No. 1775-P1 Power Supply

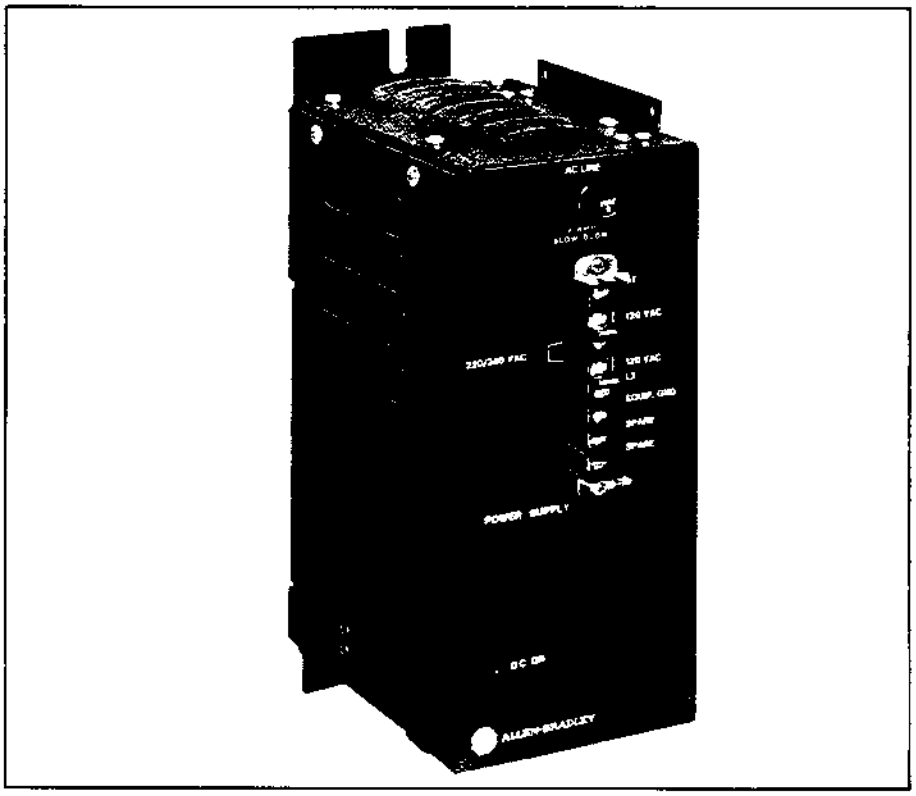


Figure 2.2 — Cat. No. 1771-P2 Power Supply

Table 2.A

Typical Module 5V Current Requirements

Module Type	Cat. No.	Backplane 5V Current Requirement (Typical)
Chassis (backplane)	1775-AC	1.0A
Front Panel (on Main Chassis Door)	1775-AD1	1.0A
Main Processor	1775-L1, L2	9.4A
CMOS RAM Memory	1775-MR4 1775-MR8	2.7A 3.25A
RAM Memory with Error Detection & Correction	1775-ME4 1775-ME8	3.0A 3.5A
Core Memory (first) Core Memory (each additional)	1775-MC4, -MC8 1775-MC4, -MC8	4.0A 2.7A
I/O Scanner	1775-S4A, -S4B	3.6A
Expansion	1775-LX	5.0A
Communication Adapter	1775-KA	2.5A
I/O Adapter	1771-AS	1.2A
Digital Input (AC and DC Input)	1771-IA 1771-IB 1771-IC 1771-IH 1771-IM 1771-IT 1771-IV	74mA 74mA 74mA 74mA 74mA 74mA 74mA
Isolated AC/DC (120V) Input	1771-ID	50mA
Analog (8 bit) Input	1771-IE	400mA
Analog (12 bit) Input	1771-IF	1.3A
Analog (12 bit) Input Expander	1771-E1,-E2,-E3	50ma
TTL Input	1771-IG	122mA
Encoder/Counter	1771-IJ 1771-IK	1.4A 1.4A
Selectable DC (5-30V) Input	1771-IQ	150mA
Multiplex Input	1771-IS	1.5A
Thermocouple Input	1771-IX	2.0A
Thermocouple Expander	1771-IY	500mA
Absolute Encoder Input (8 bit)	1771-DL	120mA
ASCII I/O	1771-DA	1.3A
Proportional/Integral/Derivative	1771-PD	1.2A
Servo Controller	1771-M3	1.75A
Servo (Encoder Feedback) Expander	1771-ES	1.7A
Stepper Controller	1771-M1	1.75A

Table 2.A (Continued)

Typical Module 5V Current Requirements

Module Type	Cat. No.	Backplane 5V Current Requirement (Typical)
Pulse Output Expander	1771-OJ	800mA
AC (120V) Output	1771-OA	210mA
Isolated AC (120V) Output	1771-OD	225mA
DC (12-24) Output	1771-OB	165mA
DC (48V) Output	1771-OC	165mA
TTL Output	1771-OG	165mA
Analog Output Expander	1771-E4	165mA
Analog (12 bit) Output	1771-OF	1.4A
AC (220/240V) Output	1771-OM	225mA
Protected AC Output	1771-OP	350mA
Contact Output	1771-OY	420mA

2.2 Processor Chassis

The PLC-3 Main Chassis (cat. no. 1775-A1) is shown in figure 2.3. It consists of a Chassis (cat. no. 1775-AC), a Main Chassis Door (cat. no. 1775-AD1), a Front Panel Cable (cat. no. 1775-CAK), and a Chassis Power Cable (cat. no. 1775-CAP).

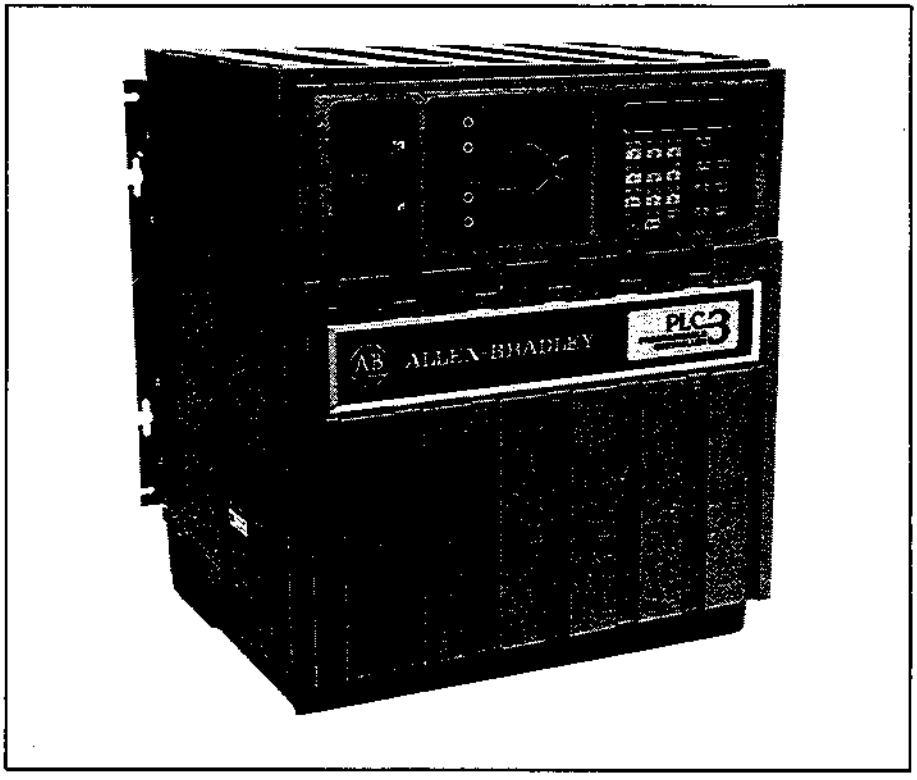


Figure 2.3 — Main Chassis

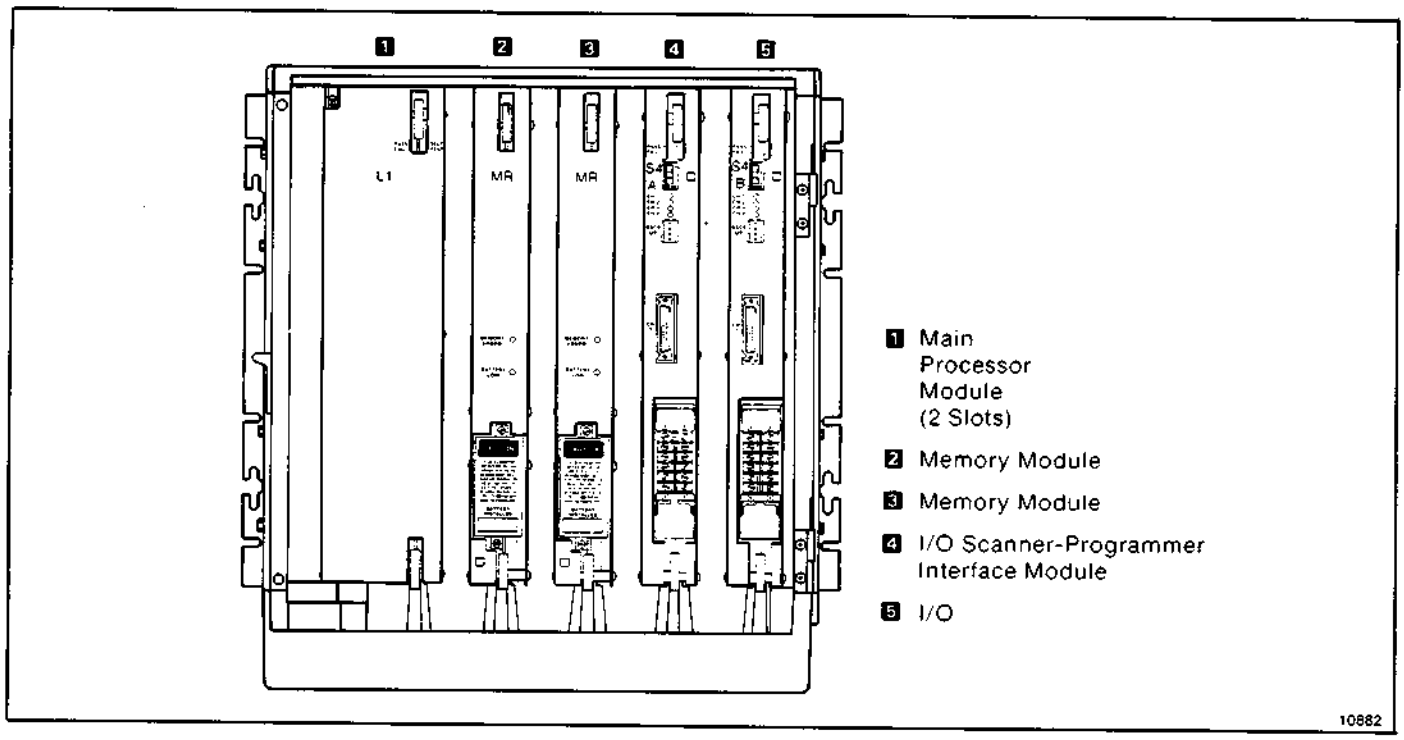


Figure 2.4 — Module Placement in Chassis (Typical)

The PLC-3 main chassis provides six module slots and contains the front panel. The integral backplane distributes power and provides communication channels to all components in the main chassis. The front panel has a 25-pin female D-shell connector for a peripheral communication channel, four LED processor status indicators, a three-position memory protect keyswitch, and a 20-key data access panel with a 16-character alphanumeric display.

Typical module placement in a main chassis is illustrated in figure 2.4. The Main Processor Module (cat. no. 1775-L1, -L2) takes up 2 module slots. Place the main processor module in the first 2 slots on the left for the best heat dissipation. The other modules will work in virtually any module slot. A minimum configuration requires one main processor module, one memory module, and one I/O Scanner-Programmer Interface Module (cat. no. 1775-S4A). Communication Adapter Modules (cat. no. 1775-KA) and additional memory modules and/or I/O scanner modules are optional.

If additional module slots are needed, a maximum of three PLC-3 Expansion Chassis (cat. no. 1775-A2) can be added to supplement the main chassis. An expansion chassis consists of a Chassis (cat. no. 1775-AC) an Expansion Chassis Door (cat. no. 1775-AD2) and a Chassis Power Cable (cat. no. 1775-CAP).

If expansion chassis are used, an Expansion Module (cat. no. 1775-LX) is needed in each chassis.

An expansion chassis is identical to the main chassis except that it does not have a front panel on the door. The 1775-S4A module number 1 provides processing functions for the front panel; therefore, you must place this module in the main chassis.

During the installation procedures you will be required to set backplane switches to number the chassis consecutively, starting with 0. You must place the main processor module in the chassis numbered 0.

All modules are electro-mechanically interlocked to guard against the removal or insertion of modules while power is applied to the chassis.

2.2.1 Thumbwheel Switches

Two or more processor chassis modules of the following types can be used:

- Memory modules
- I/O scanner-programmer interface module
- I/O scanner-message handling modules
- Communication adapter modules

A thumbwheel switch on the front of each of these types of modules designates the number by which that module is distinguished from all other modules of its type. If there is only one module of a type, designate it as number 1. If there are multiple modules of a type, number them consecutively starting with number 1.

2.2.2 Main Processor Module

The main processor module executes the user program instructions as a central processing unit (CPU). It is available in two versions. The Main Processor Module with the Level 1 instruction Set (cat. no. 1775-L1) provides an extensive instruction set. The Main Processor Module with the Level 2 Instruction Set (cat. no. 1775-L2) provides an even more extensive, full instruction set. For specific information of the instruction sets, refer to the Programming Manual (publication 1775-801).

2.2.3 Memory Module

Core and CMOS RAM memory modules are available in sizes of 16K and 32K words (K = 1024), including single-bit error correcting (CMOS RAM) memory modules. Table 2.B lists the types of memory modules availble.

Table 2.B

Memory Modules

Memory Module Type	Size	Cat. No.
CMOS RAM (Non-Error Correcting)	16K	1775-MR4
	32K	1775-MR8
Error Correcting CMOS RAM	16K	1775-ME4
	32K	1775-ME8
Core	16K	1775-MC4
	32K	1775-MC8

2.2.4 I/O Scanner Module

The number 1 I/O Scanner-Programmer Interface Module (cat. no. 1775-S4) can provide either 4 I/O channels or 3 I/O channels plus an industrial terminal compatible peripheral communication channel through a 25-pin female D-shell connector on the front of the module. Additionally, it provides processing functions for the front panel; this includes providing an industrial terminal compatible peripheral communication channel through the 25-pin female D-shell connector mounted on the front panel. The PLC-3 controller will not function without a 1775-S4A module number 1 in the main chassis.

Each additional 1775-S4A module can provide 4 additional I/O channels plus an additional industrial terminal compatible peripheral communication channel.

Each I/O Scanner-Message Handling Module (cat. no. 1775-S4B) can provide 4 additional I/O channels plus an RS-232-C compatible peripheral communication channel. Message procedure storage, retrieval and execution can be performed thru a data terminal connected to an RS-232-C compatible peripheral communication channel connector.

I/O channel connections are thru screw terminals on a detachable Terminal Swing Arm (cat. no. 1775-WA) on the front of the module. An I/O scanner module can interface with 2048 inputs plus 2048 outputs maximum. Two or more I/O scanner modules can interface with a total of 4096 standard inputs plus 4096 standard outputs maximum.

2.2.5 Communication Adapter Module

Each Communication Adapter Module (cat. no. 1775-KA) has 2 communication port connectors:

- A 15-pin connector for an Allen-Bradley data highway communication port.
- A 25-pin connector for a MODEM interface port which provides communication with an intelligent RS-232-C compatible device directly or through a MODEM link.

2.2.6 Expansion Module

If expansion chassis are used, an Expansion Module (cat. no. 1775-LX) is needed in the main chassis and in each expansion chassis to provide backplane communication between the chassis.

2.3 I/O Hardware

The I/O hardware needed to interface with a machine or process consists of (figure 2.5):

- An I/O chassis assembly
- A Remote I/O Adapter Module (cat. no. 1771-ASC) which communicates with an I/O scanner module
- Various I/O modules which provide interfacing between the external input/output device signals and the internal logic signals of the PLC-3 controller

2.3.1 Remote I/O Adapter Module

The Remote I/O Adapter Module (cat. no. 1771-ASC) provides communication between an I/O scanner module in a PLC-3 processor chassis and I/O modules contained in the I/O

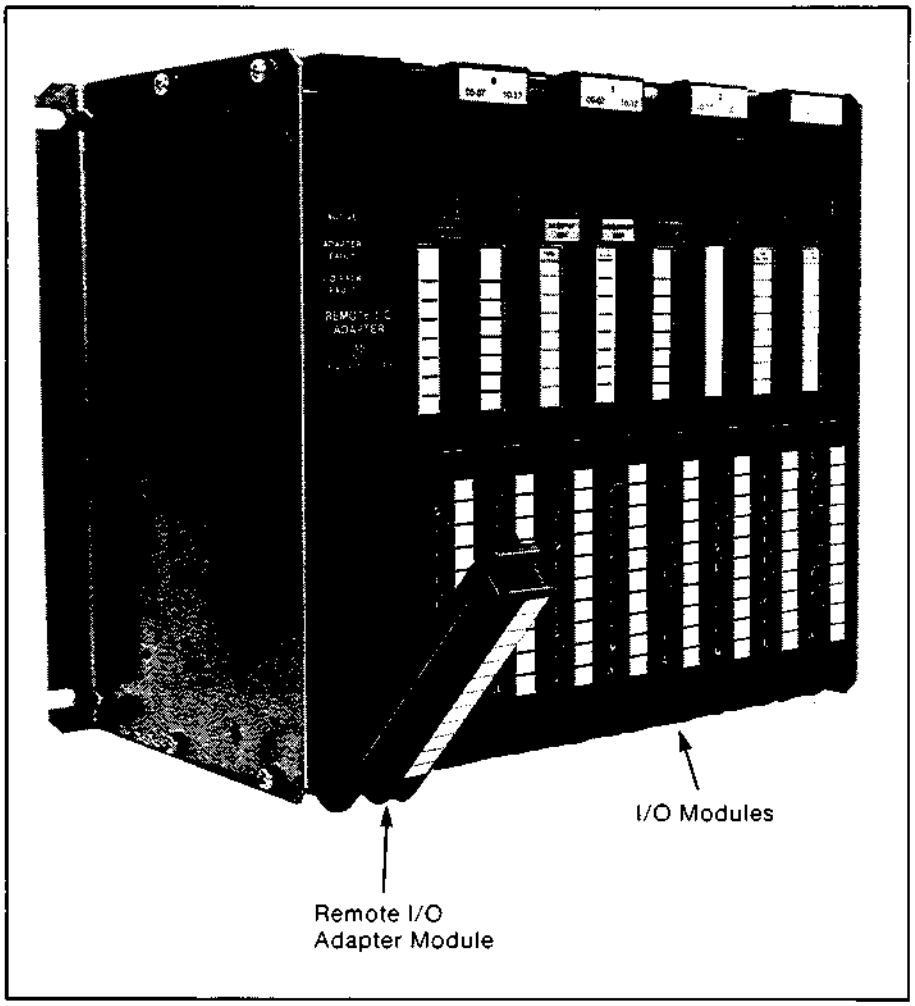


Figure 2.5 — 1771 I/O Chassis Assembly with Modules Inserted

chassis. The remote I/O adapter module also provides diagnostic checks on the I/O channel communication. A Remote I/O Adapter Module Assembly (cat. no. 1771-AS) consists of a remote I/O adapter module, a Field Wiring Arm (cat. no. 1771-WB), and an I/O Module Group Label Set (cat. no. 1771-XL).

2.3.2 I/O Chassis

An I/O module can provide up to 8 inputs or outputs which correspond to 8 bits in the I/O image table of the PLC-3 memory. However, the basic unit of data is a 16-bit word. Therefore, the arrangement of I/O modules in a 1771 I/O chassis is by I/O module groups of 2. Each I/O module group corresponds to a word in the input or output image table. I/O terminal numbering is from 00 thru 07 and 10 thru 17 within the I/O module group which corresponds to the numbering of the bits within the corresponding word(this is octal numbering).

A 1771-A1 I/O Chassis Assembly is made up of a 1771-AA I/O Chassis and four 1771-WA field wiring arms (for I/O connections). A 1771-A1 I/O chassis assembly can contain a 1771-AS remote I/O adapter module (in the left most slot) and a maximum of 2 I/O module groups (words) for a maximum of 32 I/O.

A 1771-A2 I/O Chassis Assembly is made up of a 1771-AB I/O Chassis and eight 1771-WA field wiring arms. A 1771-A2 I/O chassis assembly can contain a remote I/O adapter module and a maximum of 4 I/O module groups (words) for a maximum of 64 I/O.

A 1771-A4 I/O Chassis Assembly is made up of a 1771-AD I/O Chassis and sixteen 1771-WA Field Wiring Arms. A 1771-A4 I/O chassis assembly can contain a remote I/O adapter module and a maximum of 8 I/O module groups (words) for a maximum of 128 I/O.

2.3.3 I/O Modules

There are many different types of input and output modules. Some provide AC input or output terminals. Some provide DC input or output terminals. Others are for specialized applications. Many I/O modules are listed in table 2.C. Details and specifications for these modules are listed on various product data publications (1771-900 series) which are available upon request from Allen-Bradley. A typical I/O module is shown in figure 2.6.

The input and output modules are clearly identified with a color coded label. The label color for each I/O module is shown in table 2.C. Each major category of module has a unique label color, assigned according to module function. These label colors are listed in table 2.D. The type of module is identified by black printing on each colored label.

Many of the I/O modules are to be used with the 1771-WA field wiring arms which are a part of the I/O chassis assemblies. For those I/O modules which require a wiring arm other than a 1771-WA arm, the required arm is sold together with the module as an I/O module assembly.

For most I/O modules, indicators are provided. For input modules with indicators, each indicator is in parallel with an input terminal; the indicator is on when the input is closed.

On most output modules, output status indicators and FUSE BLOWN status indicators are provided. Each output status indicator is in parallel with an output terminal; the indicator is on when the circuit for that output terminal is energized.

Each FUSE BLOWN status indicator corresponds to a group of 8 output fuses; the indicator is on when any one of the 8 fuses is blown.

Plastic keys, shipped with each I/O chassis, provide an easy method for you to key each I/O slot to accept only one type of I/O module. Each type of I/O module is slotted in two places at its rear edge. The position of the keys on the backplane connector must correspond to these slots to allow insertion of a particular type of module.

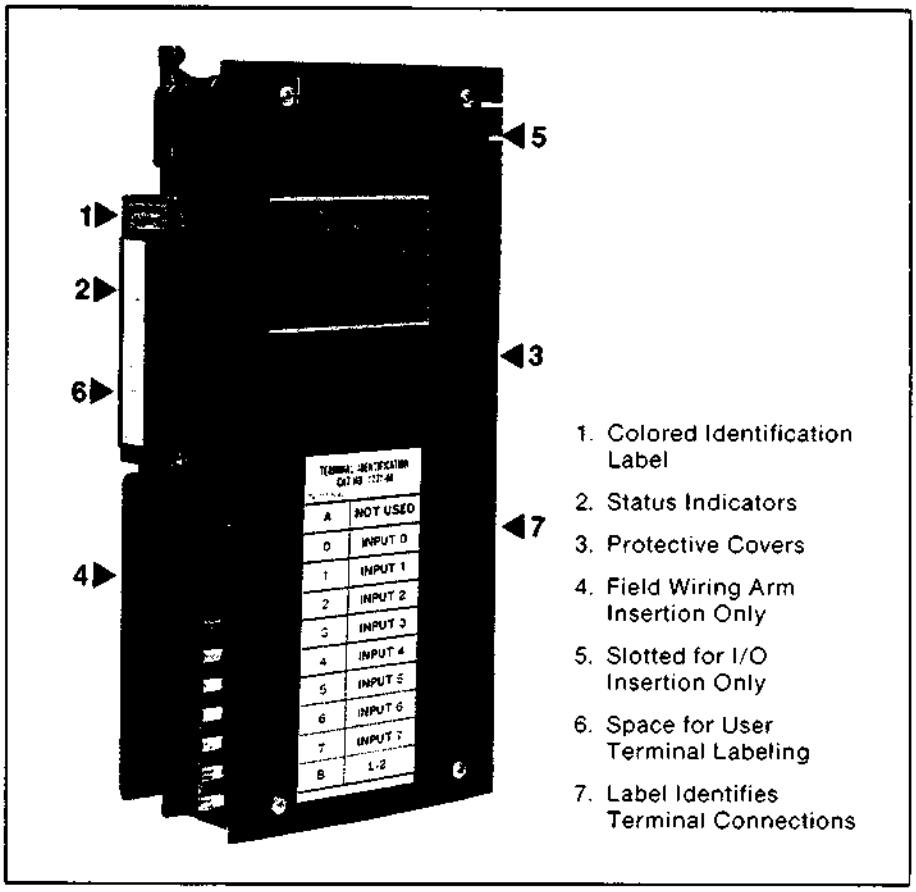


Figure 2.6 — Typical 1771 Output Module

Table 2.C

1771 I/O Modules

Module	Cat. No.	Keying Positions Between Nos. (Top Connector)	Field Wiring Arm (Cat. No.)	Color Coded Label
DC (12-24V) Input	1771-IB	4-6, 14-16	1771-WA	Blue
DC (48V) Input	1771-IC	4-6, 16-18	1771-WA	Blue
DC (24-48V) Input	1771-IH	4-6, 16-18	1771-WA	Blue
Selectable DC (5-30V) Input	1771-IQ	6-8, 24-26	1771-WC	Blue
Fast Response DC (12-24V) Input	1771-IT	6-8, 32-34	1771-WA	Blue
DC (12-24V) Logic Input	1771-IV	8-10, 12-14	1771-WA	Blue
AC/DC (120V) Input	1771-IA	4-6, 10-12	1771-WA	Red
AC/DC (220/240V) Input	1771-IM	6-8, 30-32	1771-WA	Red
Isolated AC Input	1771-ID	4-6, 28-30	1771-WD	Red
DC (12-24V) Output	1771-OB	4-6, 18-20	1771-WA	Green
DC (48V) Output	1771-OC	4-6, 20-22	1771-WA	Green
Proportional/Integral/Derivative	1771-PD	8-10, 18-20	1771-WF	Green
AC (120V) Output	1771-OA	4-6, 12-14	1771-WA	Orange
Isolated AC Output	1771-OD	4-6, 30-32	1771-WD	Orange
AC (220/240V) Output	1771-OM	6-8, 28-30	1771-WA	Orange
Protected AC (120V) Output	1771-OP	6-8, 26-28	1771-WA	Orange
Contact Output	1771-OY	6-8, 16-18	1771-WD	Orange
Analog (8 bit) Input	1771-IE	4-6, 26-28	1771-WB	Pink
Analog (12 bit) Input	1771-IF	6-8, 22-24 4-6, 32-34	1771-WB	Pink
Analog (12 bit) Input Expander	1771-E1	8-10, 24-26	1771-WF	Pink
	1771-E2	2-4, 12-14	1771-WF	Pink
	1771-E3	2-4, 22-24	1771-WF	Pink
Thermocouple Input	1771-IX	8-10, 18-20 8-10, 20-22	1771-WE	Pink
Thermocouple Expander	1771-IY	8-10, 20-22	1771-WE	Pink
Multiplex Input	1771-IS	8-10, 26-28	1771-WE	Pink
TTL Input	1771-IG	4-6, 34-36	1771-WC	Pink
TTL Output	1771-OG	6-8, 10-12	1771-WC	Gray
Analog (12 bit) Output	1771-OF	2-4, 6-8 4-6, 32-34	1771-WB	Yellow
Analog Output Expander	1771-E4	7-9, 27-29	1771-WB	Yellow
Encoder/Counter (5V)	1771-IJ	6-8, 18-20 4-6, 32-34	1771-WB	Brown
Encoder/Counter (12-24V)	1771-IK	6-8, 20-22 4-6, 32-34	1771-WB	Brown
Absolute Encoder Input (8 bit)	1771-DL	4-6, 24-26	1771-WB	Brown
Stepper Controller	1771-M1	2-4, 8-10	none	Brown
Pulse Output Expander	1771-OJ	8-10, 22-24	1771-WB	Brown
Servo Controller	1771-M3	2-4, 8-10	none	Brown
Servo (Encoder Feedback) Expander	1771-ES	2-4, 14-16 4-6, 32-34	1771-WB	Brown

Table 2.D

1771 I/O Module Type Color Codes

Color	Function
Red	AC Input
Orange	AC Output and Contact Output
Blue	DC Input
Green	DC Output
Pink	Analog Input and TTL Input
Yellow	Analog Output
Gray	TTL Output
Brown	Encoder/Counter

2.4 Industrial Terminal

The Industrial Terminal System (cat. no. 1770-T4) can be used to enter or edit program instructions in easily understood ladder diagram format. It can also be used to monitor the program in operation or for troubleshooting purposes. In the alphanumeric mode, it can be used to input report generation commands and to display message outputs of report generation procedures.

The industrial terminal is portable and can be disconnected from the PLC-3 controller when not being used. Therefore, one 1770-T4 industrial terminal system can be used for several PLC-3 controllers.

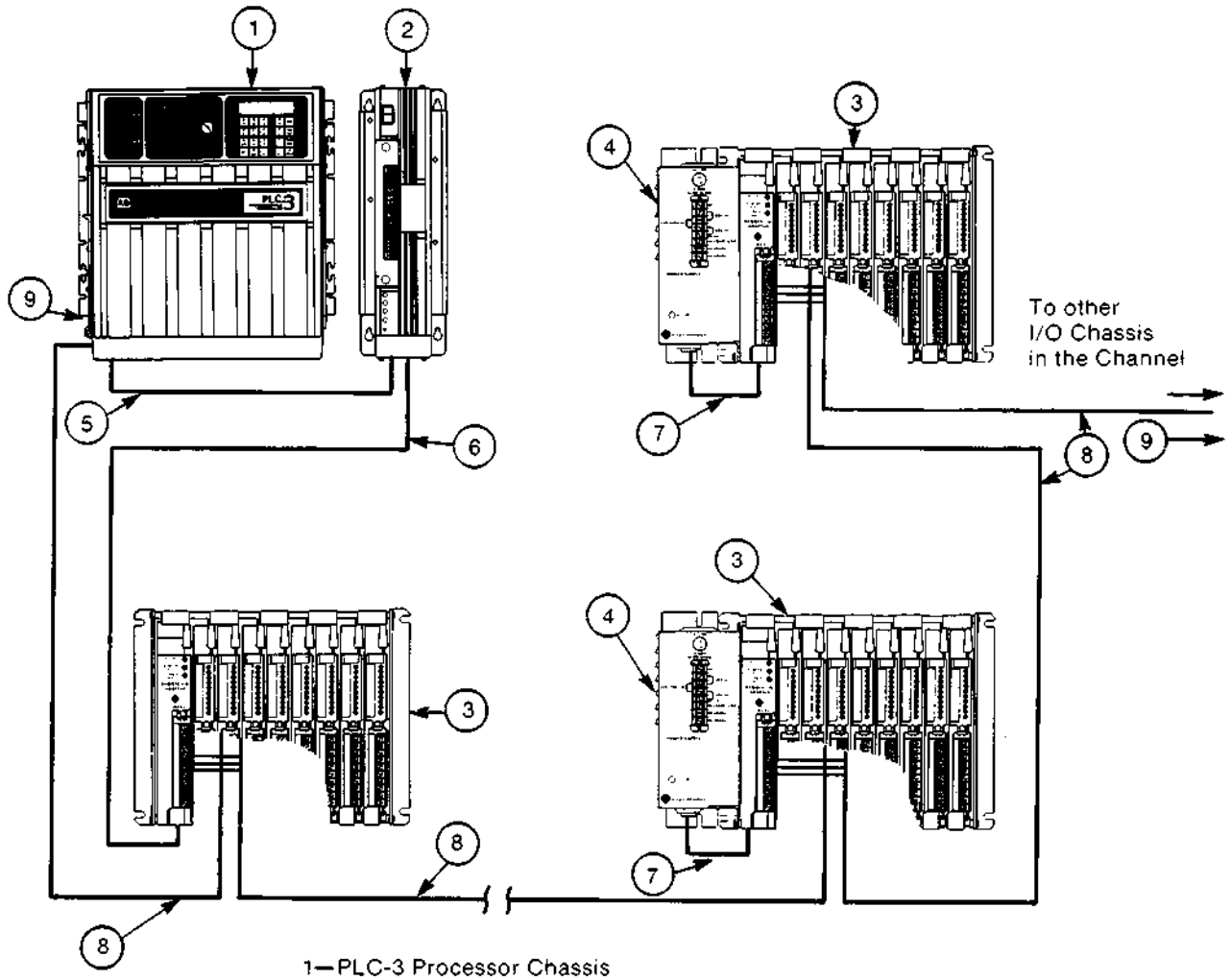
2.5 Cables

Cables and related items are listed in table 2.E. Figure 2.7 illustrates a single I/O channel configuration. Although I/O scanner modules can provide 4 I/O channels each, this figure illustrates a single I/O channel to clearly show the use of power cables and twinaxial cable.

A 1775-CAP Chassis Power Cable (6 ft.) provides power connections between a 1775-P1 power supply and a PLC-3 processor chassis. A 1771-CH I/O Power Cable (7 ft.) provides power connections between a 1775-P1 power supply and a 1771 I/O chassis. A 1771-CD (5 ft.) or 1771-CE (1 ft.) I/O Power Cable provides power connections between a 1771-P2 power supply and a 1771 I/O chassis.

The 1770-CD Twinaxial Cable (10,000 ft. max. total for each I/O channel) provides I/O channel communication connections between the I/O scanner module and each I/O chassis on the I/O channel. I/O scanner module connections are through screw terminals on a detachable swing arm on the front of the module. I/O chassis connections are through screw terminals on a wiring arm on the front of the adapter module. Connections are in a serial (daisy-chain) fashion from one I/O chassis to the next within each I/O channel.

On each I/O channel, at both the I/O scanner and the last I/O chassis at the opposite end of the I/O channel, a 1770-XT Terminator must be connected across the terminals. Alternately, a trunkline/dropline wiring configuration can be used as described in the Data Highway Cable Assembly and Installation Manual (publication 1770-810).



1—PLC-3 Processor Chassis

2—1775-P1 Power Supply

3—1771 I/O Chassis

4—1771-P2 Power Supply

5—1775-CAP Chassis Power Cable, 6ft.

6—1771-CH I/O Power Cable, 7ft.

7—1771-CE I/O Power Cable, 1ft.

8—1770-CD Twinaxial Cable, 10,000 ft. Max. total each I/O Channel

9—1770-XT Terminator - Connect one at each end of the I/O Channel

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Figure 2.7 — Configuration of a Single I/O Channel Showing Power Cables and Twinaxial Cable

Table 2.E

PLC-3 Cables and Related Items

Cat. No.	Description	How Obtained
1775-CAP	Chassis power cable (6 ft, 182 cm) — 1775-P1 power supply to PLC-3 processor chassis.	1 supplied as standard with processor chassis. Additional quantities ordered separately.
1771-CH	I/O power cable (7 ft, 214 cm) —1775-P1 power supply to 1771 I/O chassis	Ordered separately.
1771-CD	I/O power cable (5 ft, 152 cm) —1771-P2 power supply to 1771 I/O chassis	Ordered separately.
1771-CE	I/O power cable (1 ft. 30.5 cm)—1771-P2 Power supply to 1771 I/O chassis	Ordered separately.
1775-CAK	Front panel cable (15 in, 38.0 cm) — main chassis door to chassis	1 supplied as standard with main chassis. Additional quantities ordered separately.
1772-TH	Digital cassette recorder cable (10 ft, 305 cm) — data cartridge recorder to industrial terminal	1 supplied as standard with cat. no. 1770-SB recorder. Additional quantities ordered separately.
1775-CAT	PLC-3 industrial terminal cable (10 ft, 305 cm)	1 supplied as standard with cat. no. 1770-T4 industrial terminal. Additional quantities ordered separately.
1770-CD	Twinaxial cable (10,000 ft, 3,050 m max. total per I/O channel)	Order separately or user supplied.
1770-XT	Terminator — each end of each I/O channel	Order separately.
1775-WA	Terminal Swing Arm — provides I/O channel connection points for each I/O scanner module.	1 supplied as standard with each I/O scanner module (cat. no. 1775-S4A, -S4B). Additional quantities ordered separately.
1775-CXD	Expansion Distribution Panel —provides a central connection point between processor chassis for backplane signals when 3 or 4 chassis are used.	Ordered separately.
1775-CX	Expansion Cable Set (4 cables, 10 ft, 305 cm each) — expansion module to expansion module or expansion module to expansion distribution panel.	Ordered separately.
1775-CXT	Expansion Terminator Set (4 terminators) — provides termination for unused connectors of an expansion distribution panel.	Ordered separately.

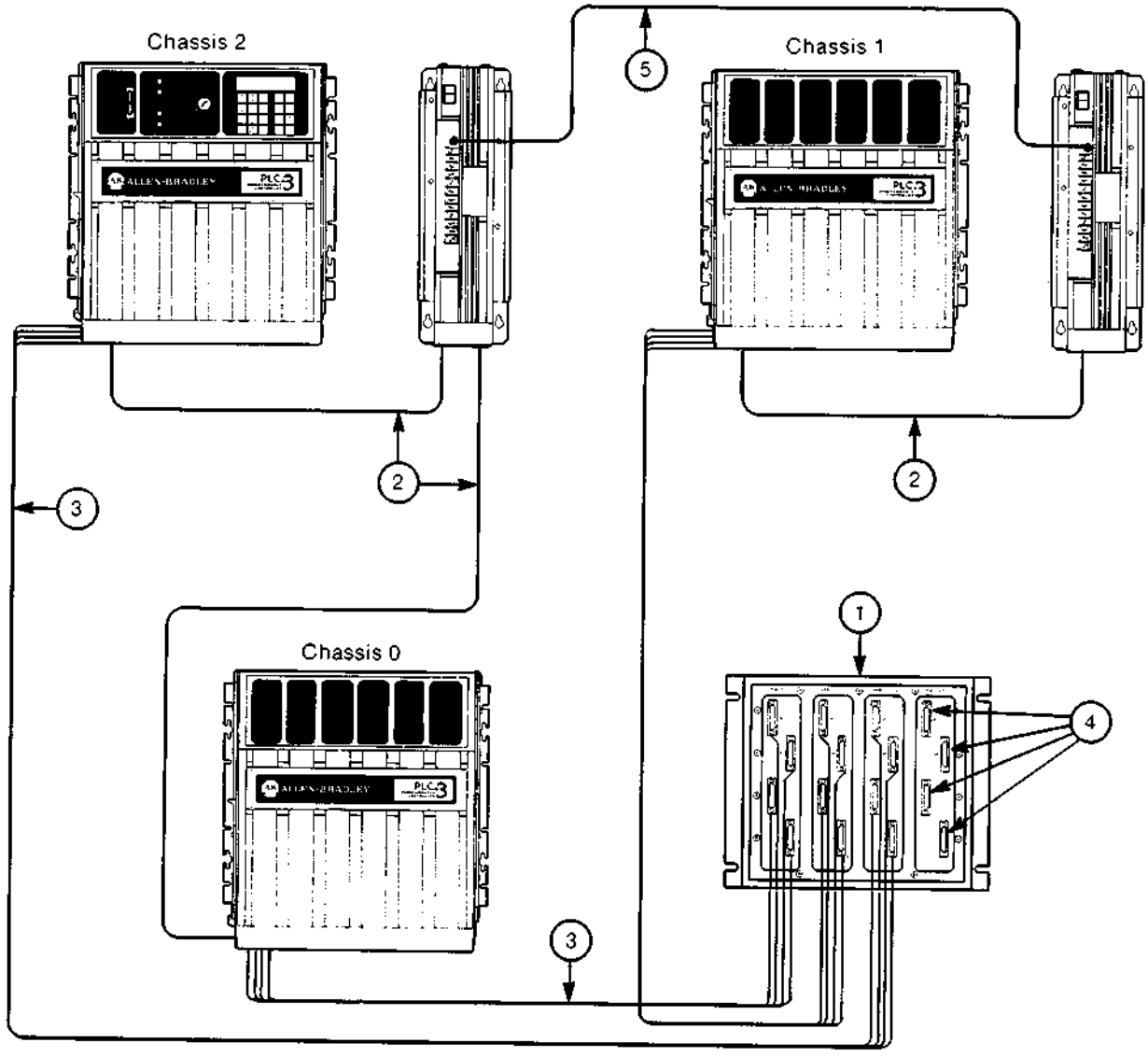
Figure 2.8 illustrates a 3-chassis configuration for a PLC-3 processor. This includes a main chassis and 2 expansion chassis. With more than 2 processor chassis, a second 1775-P1 power supply is needed. Use an 8 AWG copper wire or 1 inch copper braid to connect the SYSTEM COMMON terminal on one power supply to the SYSTEM COMMON terminal on the other.

During the installation procedures you will be required to set backplane switches to sequentially number each chassis starting with 0. You must use the same power supply for both chassis 0 and the highest numbered chassis.

In a 2-chassis configuration, you would connect an Expansion Cable Set (cat. no. 1775-CX) from the expansion module in the

one chassis to the expansion module in the second chassis. In a 3-chassis or 4-chassis configuration, you would connect an expansion cable set from each expansion module to an Expansion Distribution Panel (cat. no. 1775-CXD). In a 3-chassis configuration, you would connect an Expansion Terminator Set (cat. no. 1775-CXT) to the 4 connectors labeled CHASSIS 3 on the expansion distribution panel.

A 1775-CAK Front Panel Cable (15 in.) provides signal connections between the front panel on the main chassis door (cat. no. 1775-AD1) and the backplane of the chassis.



1—1775-CXD Expansion Distribution Panel
2—1775-CAP Chassis Power Cable, 6ft.
3—1775-CX Expansion Cable Set, 4 Cables, 10ft. each
4—1775-CXT Expansion Terminator Set, 4 Terminators
5—8 AWG Copper Wire (connect SYSTEM COMMON terminals)

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Figure 2.8 — A 3-Chassis Configuration Showing Power Cables, Expension Cables, and SYSTEM COMMON Connection

2.6 I/O Designation

On each I/O module, beside the I/O status indicators, is a blank identification label for I/O terminal identification. A similar label is on each field wiring arm beside the I/O terminal. For I/O modules, terminal identification is determined not only by the position of the terminal within the module, but also the position of the module within a 2-module group which makes up a word. The number is from 00 thru 07 on the left module of the pair and 10 thru 17 on the right module of the pair.

This numbering is indicated by labels (figure 2.9). These labels are on latches which are on the top edge of each I/O chassis to hold I/O modules in place. Each latch holds in place a pair of I/O modules which make up an I/O module group. These labels also identify the I/O module group numbers (0-7). I/O module group numbering is illustrated in Figure 2.10. Each I/O module group can have 16 I/O maximum, for a total of 128 I/O maximum within the I/O rack.

Each I/O chassis should be identified by a label which shows the I/O rack number of the I/O chassis. Put a blank user-supplied label on the latch above the I/O adapter module slot and write in the I/O rack number.

Within an I/O channel, an I/O rack is an addressing unit which can consist of as many as 4 I/O chassis maximum with a total of 8 I/O module groups (words) maximum of 16 I/O

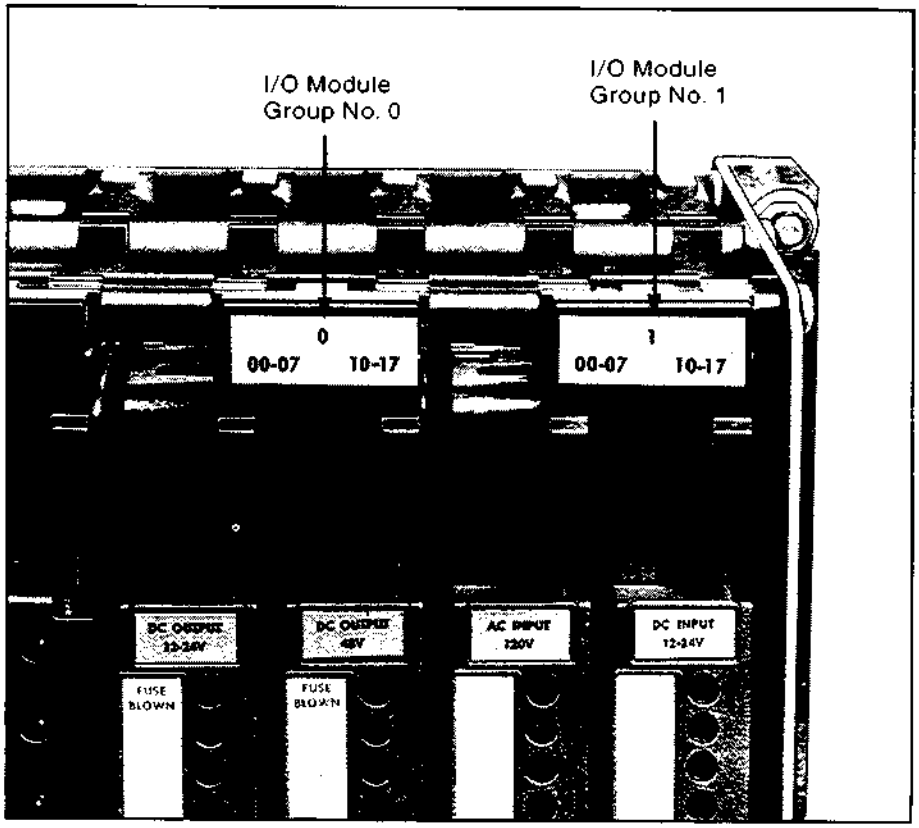


Figure 2.9 — I/O Module Group Lables

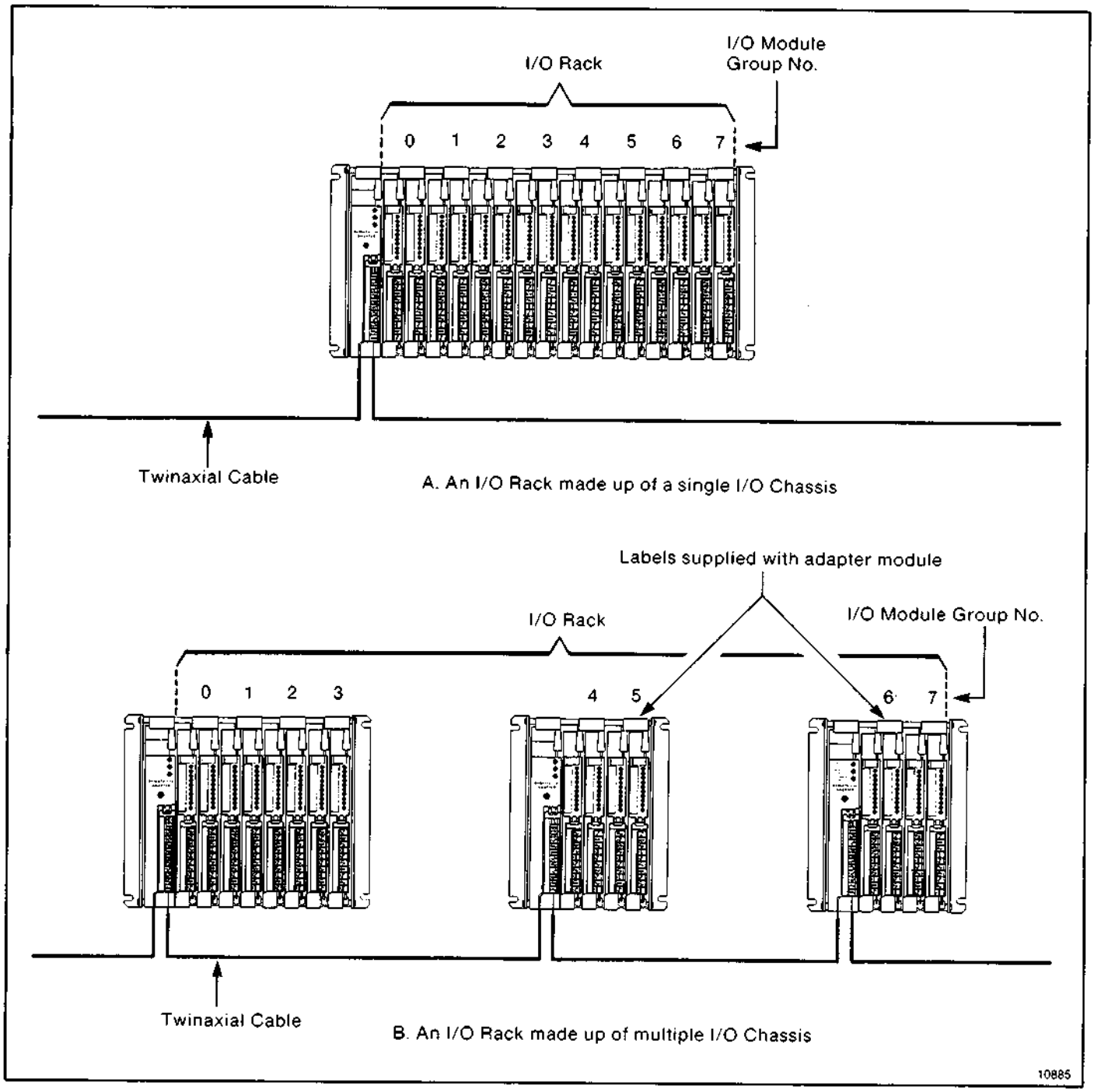


Figure 2.10 — I/O Module Group Numbering

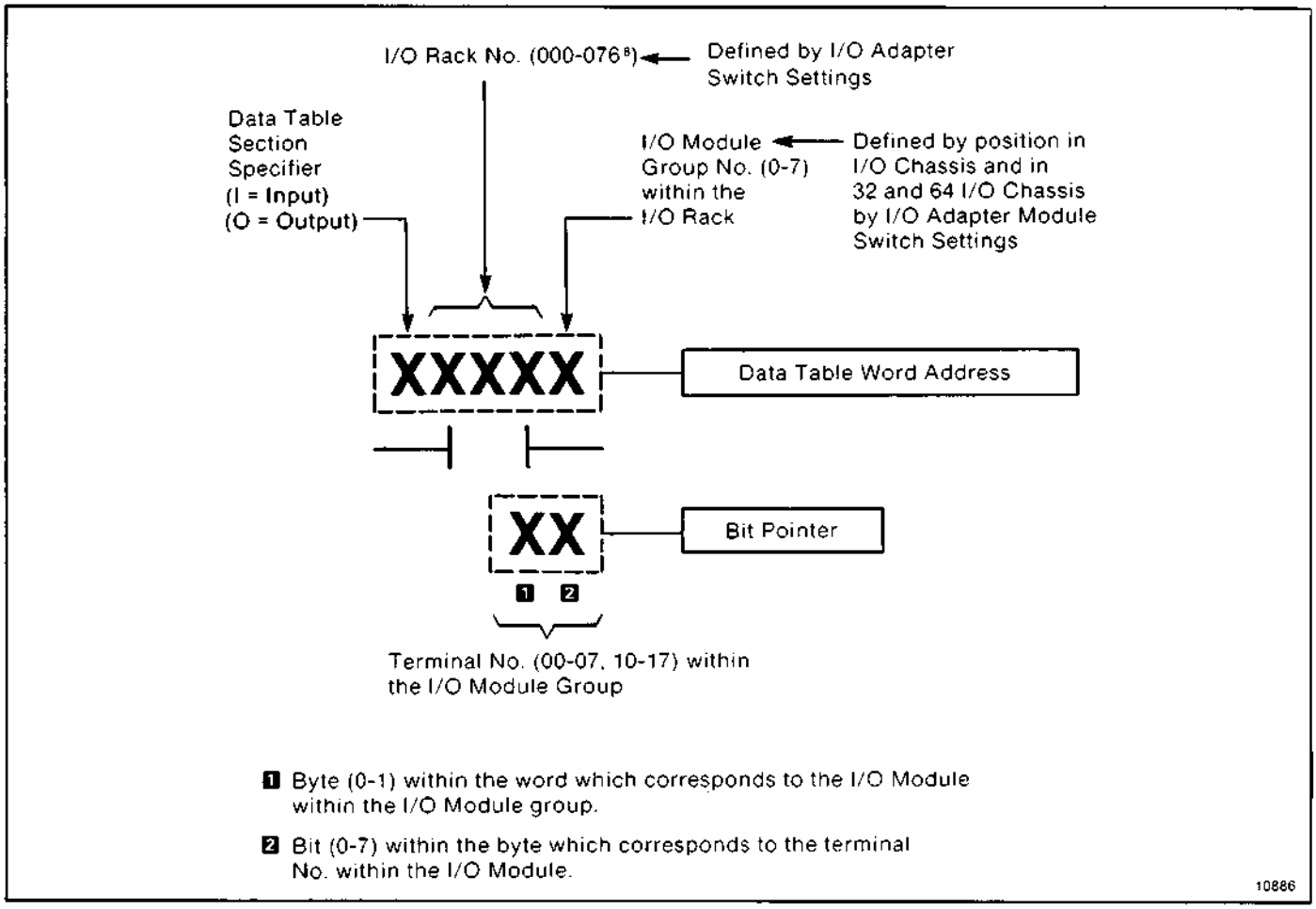


Figure 2.11 — Correspondence of Location Address to I/O Image Table Address

terminals for a total of 128 I/O terminals maximum. However, duplicate I/O rack numbers can be assigned on other I/O channels within the restrictions of the rules in section.2.7.2. The I/O rack number is defined by I/O adapter module switch settings described in chapter 3.

With an I/O rack made up of multiple I/O chassis, numbering of I/O module groups should begin with the first I/O chassis along the I/O channel. The numbering continues on through each successive I/O chassis on the I/O channel. On each I/O chassis shipped, the labels show the first module group number as 0. However, for multiple I/O chassis racks, put different labels on the second and subsequent I/O chassis in the I/O rack. For this purpose, an I/O Module Group Label Set (cat. no. 1771-XL) is shipped with each 1771-AS remote I/O adapter module assembly.

Each I/O terminal in a PLC-3 controller is assigned a location address for programming identification (figures 2.11, 2.12, 2.13, and 2-14). An I/O terminal location address is made up of its I/O rack number, its I/O module group number within the I/O rack, and its I/O terminal number within the I/O module group.

The first character of an I/O address designates either input (I) or output (O).

The second, third and fourth characters designate the I/O rack (000 thru 076_8) in which the module is located. This number is determined by your switch settings (figure 2.12) at the remote I/O adapter module.

The fifth character designates the specific I/O module group (word) number within the I/O rack (figure 2.13).

The sixth and seventh characters designate the specific input or output terminal within the I/O module group to which you make a connection (figure 2.14). The terminal identification labels on the I/O modules and wiring arms are blank when shipped. They are provided so that you can write in these terminal designations.

The 7-character address is a central concept of PLC-3 controller programming. Information given here is adequate for a basic understanding of the hardware aspects of the concept. Should more information be needed, refer to the PLC-3 Programming Manual (publication 1775-801).

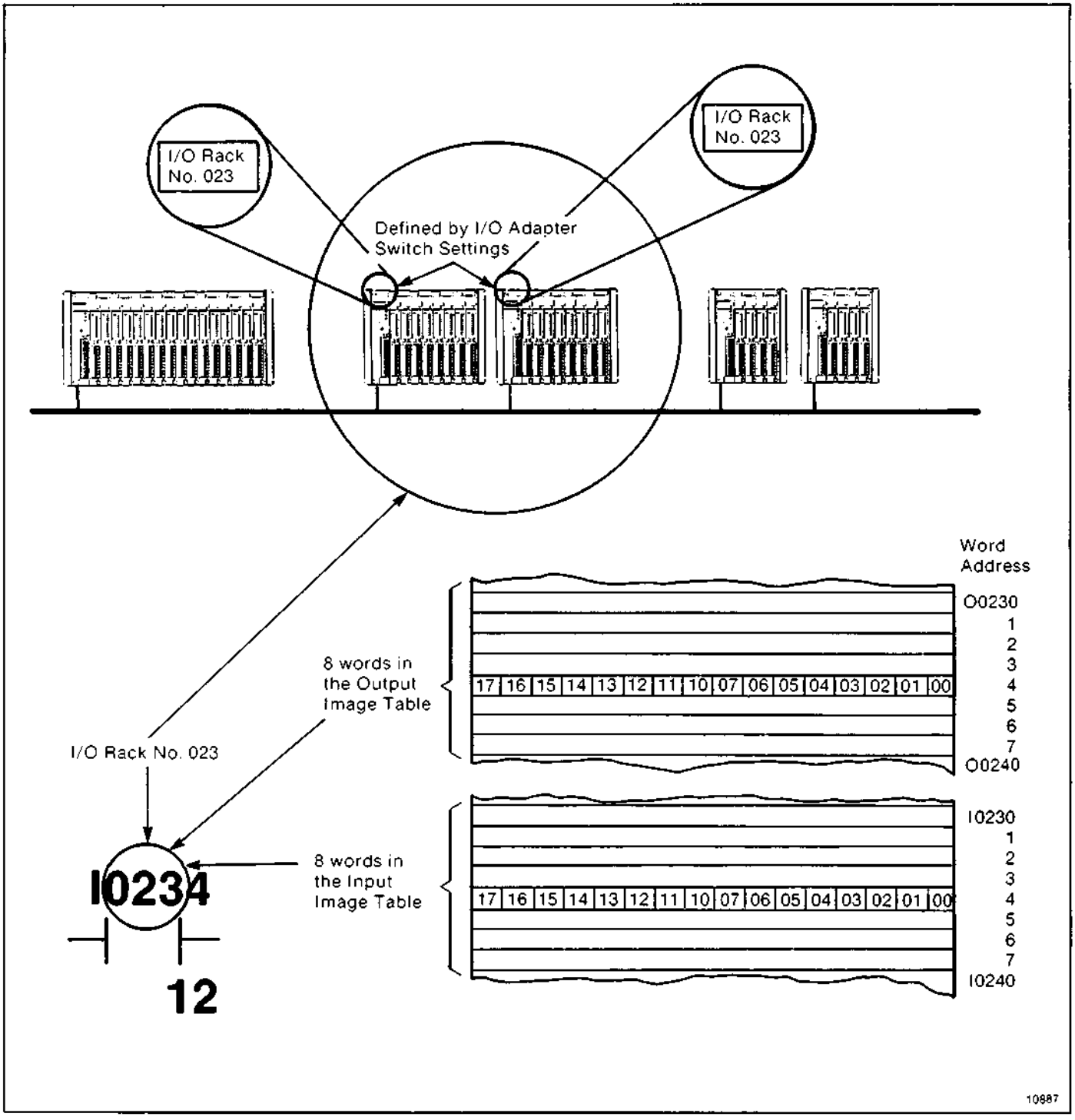


Figure 2.12 — Determining the Location of an I/O Rack Thru a Location Address

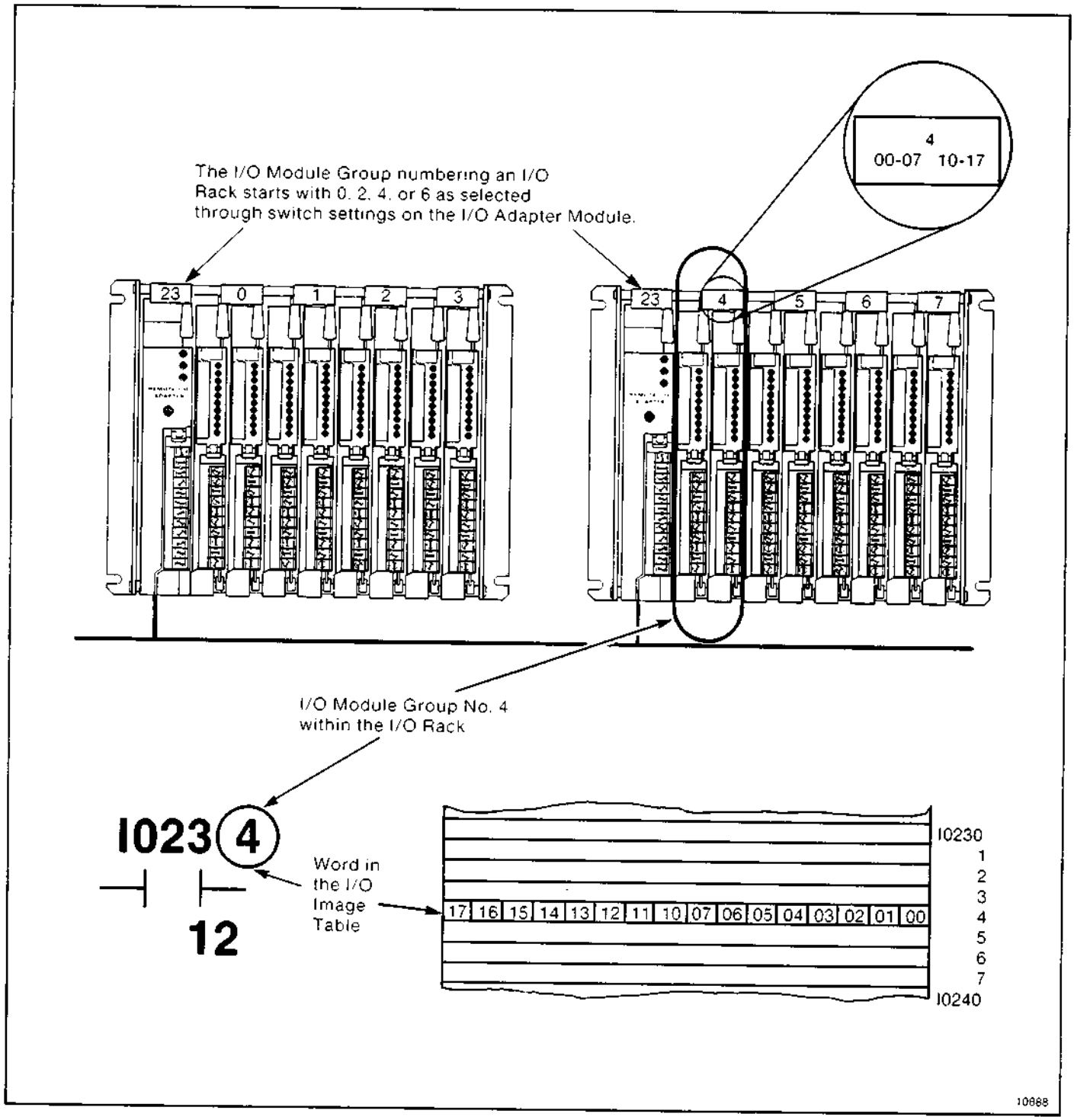


Figure 2.13 — Determining the Location of an I/O Module Group Within an I/O Rack Thru a Location Address

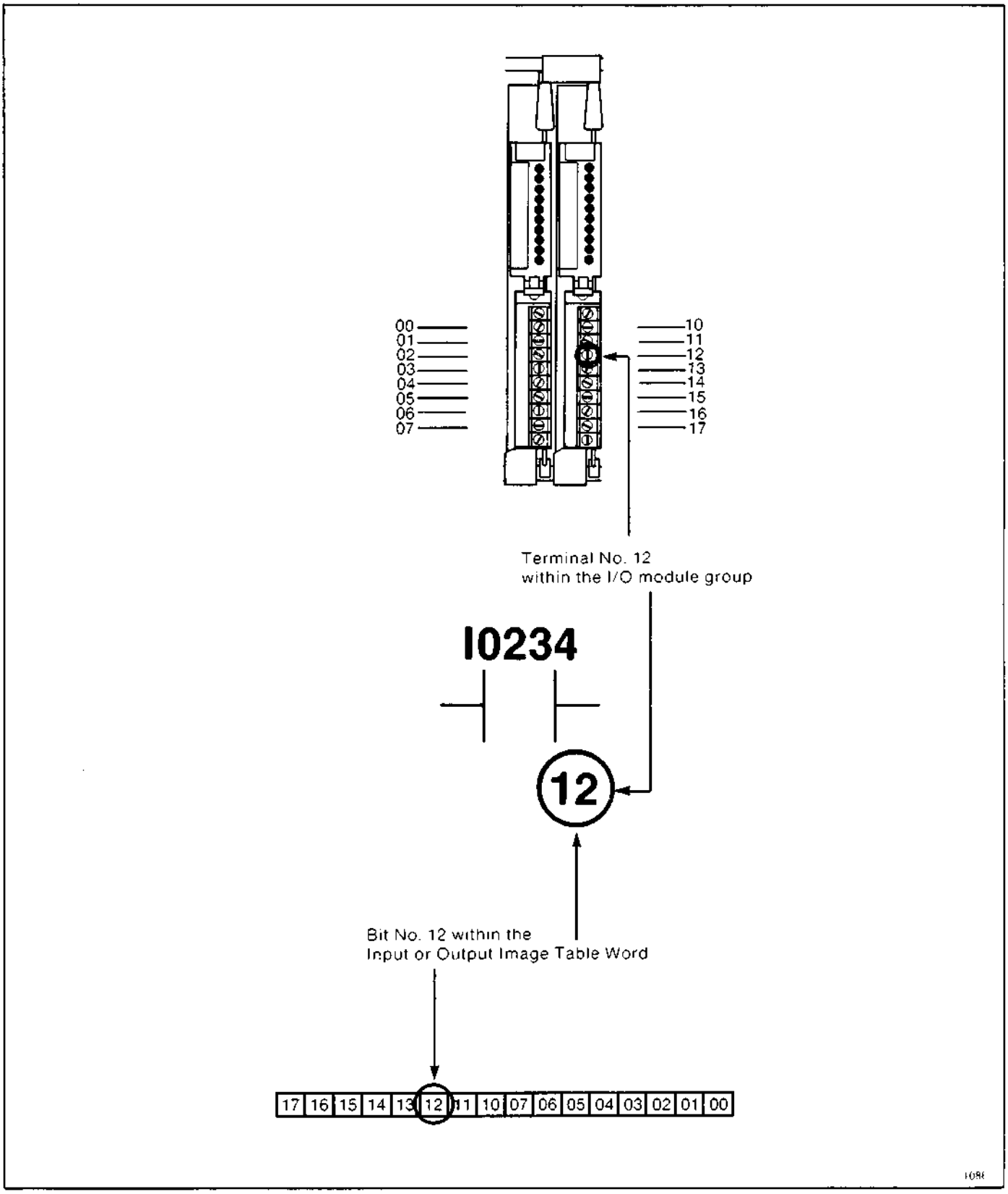


Figure 2.14 — Determining the Location of an I/O Terminal Within an I/O Module Group Thru a Location Address

2.7 Standard I/O Configurations

The input image table can reflect the status of 4096 standard input terminals. The output image table can contain 4096 bits for controlling standard output terminals. Therefore, the PLC-3 controller has a capacity of 4096 standard inputs plus 4096 standard outputs.

Presented here are two sets of rules for configuring the I/O channels of a PLC-3 Controller. One set of rules is for a configuration of 4096 I/O maximum. The other set of rules is for a configuration of more than 4096 standard I/O. An example of each type of configuration is also given.

2.7.1 4096 I/O Maximum (Unique I/O Location Addressing)

When 4096 or fewer I/O are needed the I/O configuration can provide a unique location address for each I/O terminal. An I/O terminal's location address is its I/O rack number, its I/O module group (word) number within the I/O rack, and its terminal number within its I/O module group (word). With this type of configuration, the location of any I/O terminal can be determined through its unique location address. This characteristic is helpful for the initial planning of the configuration, for initial startup checkout, and for troubleshooting. For this type of unique I/O location addressing configuration, refer to figure 2.15 and follow these rules:

- A maximum of 32 I/O racks (number 000 037$_8$) can be used with 2 or more I/O scanner modules. An I/O rack can consist of 4 I/O chassis maximum with a total of 8 I/O module groups (words) maximum of 16 I/O terminals each for a total of 128 I/O terminals maximum.
- Any I/O module slot can be used for either an input module or an output module.
- Each I/O module group must be assigned a unique location address.
- Any I/O scanner module can interface with I/O chassis having 16 unique I/O rack numbers for 2048 I/O maximum.
- A maximum of 16 I/O chassis are allowed on a single I/O channel, regardless of I/O chassis size.

Example

Figure 2.15 illustrates a unique I/O location addressing configuration example for 4096 I/O (256 I/O module groups) maximum. This figure shows only 1152 I/O (72 I/O module groups). However, by adding I/O chassis to the I/O channels shown and by adding I/O scanner modules to provide additional I/O channels, this type of configuration could be used to provide 4096 I/O.

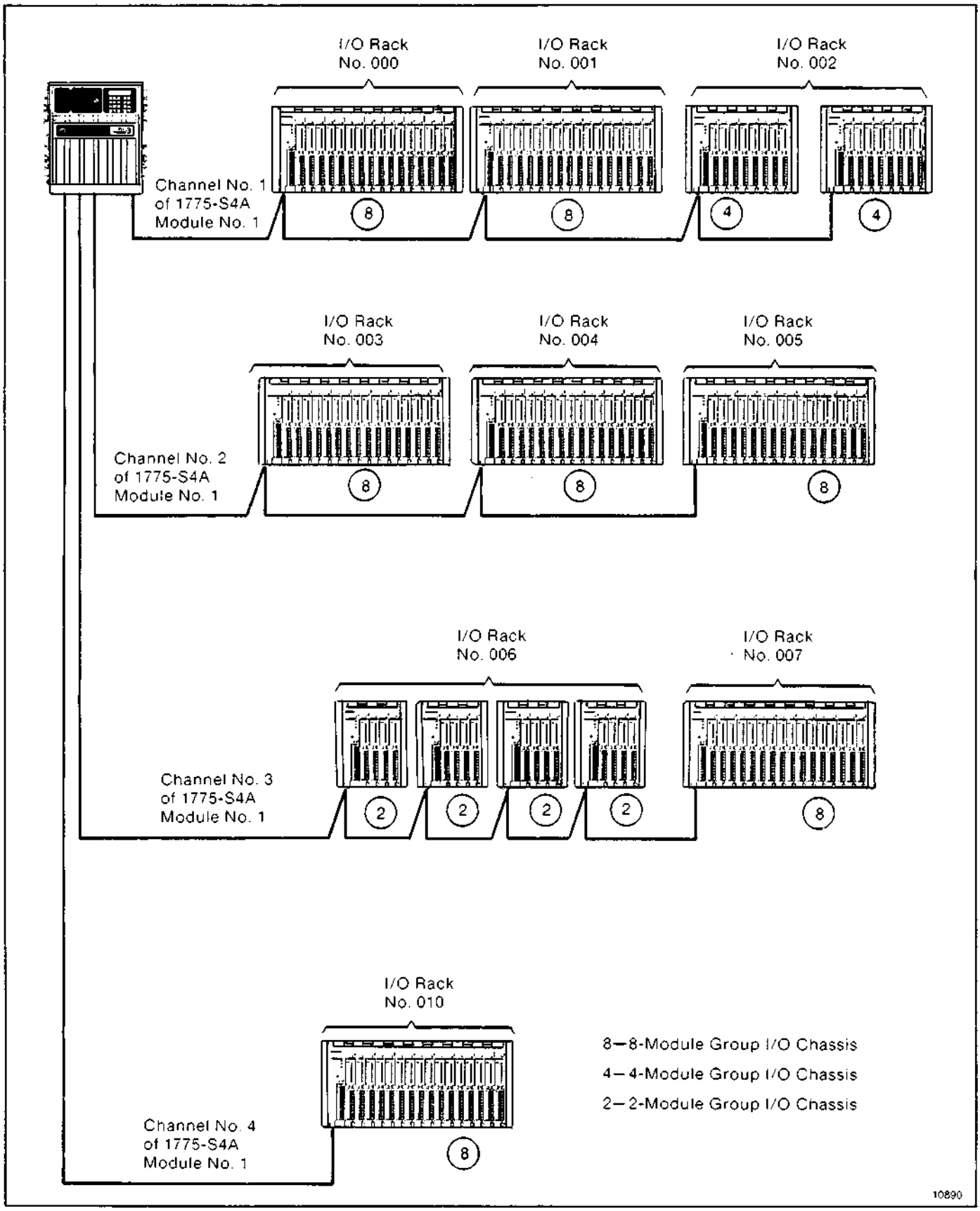


Figure 2.15 — I/O Channel Configuration Example for 4096 I/O Maximum (Unique I/O Location Addressing)

To take full advantage of the fact that each location address is unique, assign the I/O rack numbers and the I/O module group numbers within each I/O rack in sequential order by their position on the I/O channel as in figure 2.15. (I/O adapter module switch settings for these assignments are given in chapter 3.) This type of orderly arrangement could make it easier to locate an I/O terminal through its location address.

2.7.2 More Than 4096 I/O (Duplicate I/O Location Addressing)

When more than 4096 I/O are needed, the I/O configuration cannot provide a unique location address for each I/O terminal. An I/O terminal's location address is its I/O rack number, its I/O module group (word) number within the I/O rack, and its terminal number within its I/O module group (word). This type of configuration provides maximum standard I/O capability of 4096 inputs plus 4096 outputs by duplicating I/O module group location addresses from one I/O channel to another within an I/O scanner module. For this type of duplicate I/O location addressing configuration, refer to figure 2.16 and follow these rules:

- A maximum of 32 unique I/O rack numbers ($000\text{-}037_8$) can be assigned. Within an I/O channel, an I/O rack can consist of 4 I/O chassis maximum with a total of 8 I/O module groups (words) maximum of 16 I/O terminals each for a total of 128 I/O terminals maximum. However, duplicate I/O rack numbers can be assigned within the restrictions of these rules. This could provide 128 inputs plus 128 outputs in I/O chassis assigned to a single I/O rack number
- Each I/O scanner module can interface with I/O chassis having 16 unique I/O rack numbers maximum. However, each I/O module group (word) location address can be duplicated within the restrictions of these rules for 2048 inputs plus 2048 outputs.
- If 2 I/O module groups have the same location address, they must be on different I/O channels of the same I/O scanner module.
- An output module group can have the same location address as another output module group; however, these parallel outputs will be controlled by the same output image table word. This is **parallel output addressing**.
- An input module group cannot have the same location address as another input module group, although an input module group can have the same location address as an output module group. This is **complementary I/O addressing**.
- A maximum of 16 I/O chassis are allowed on a single I/O channel, regardless of I/O chassis size.

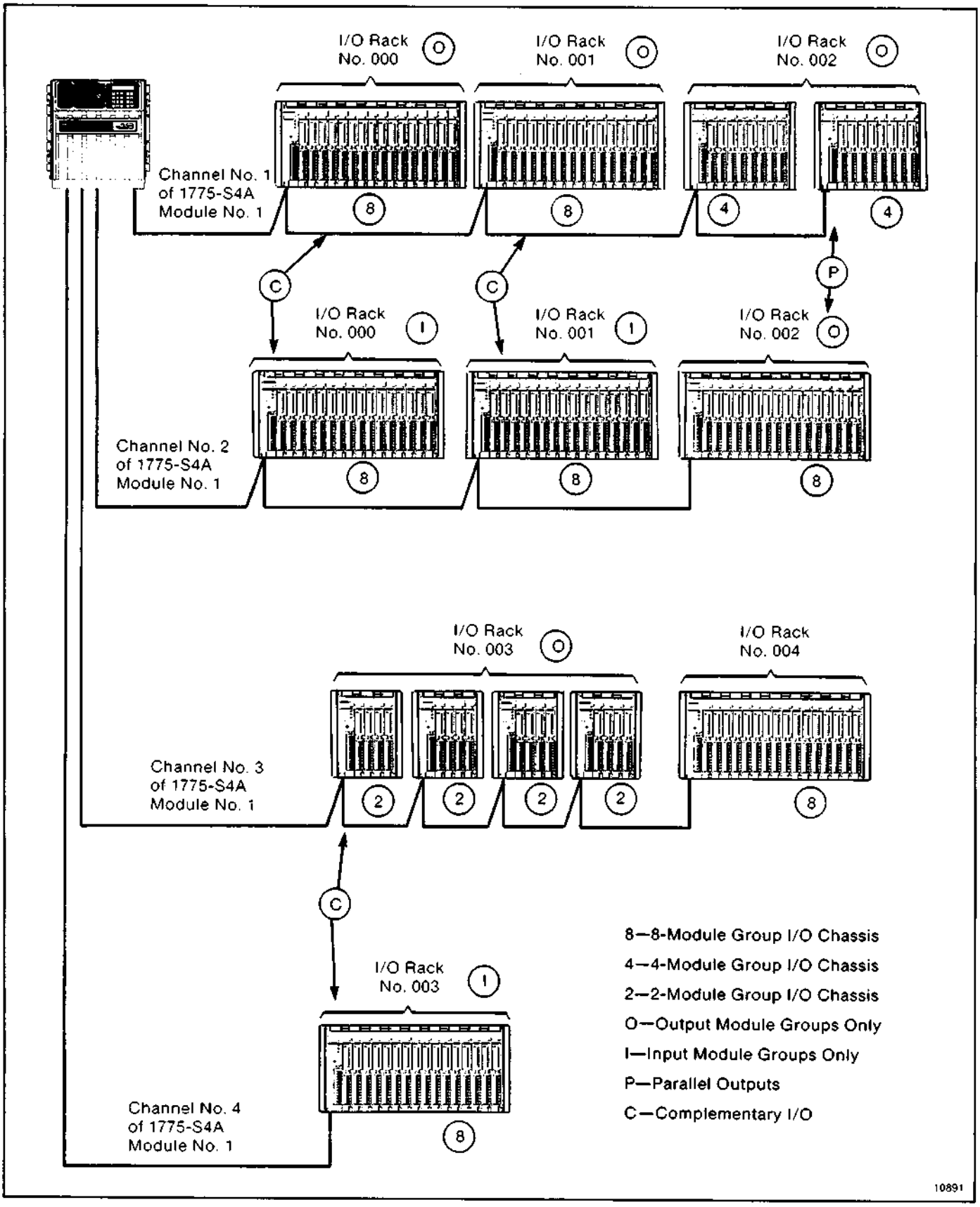


Figure 2.16 — Example of I/O Channel Configuration Which Would Allow More Than 4096 I/O (Duplicate I/O Location Addressing)

NOTE: Some I/O modules require bidirectional communication with the PLC-3 processor, using both an input word and an output word in memory. A block transfer is always bidirectional. Because it requires both an input word and an output word in memory, each bidirectional I/O module group must be assigned a unique location address.

Example

Figure 2.16 illustrates an example of duplicate I/O location addressing configuration which would allow more than 4096 I/O (256 I/O module groups). This figure shows only 1152 I/O (72 I/O module groups). However, by adding I/O chassis to the I/O channels shown and by adding I/O scanner modules to provide additional I/O channels, complementary I/O could be used to provide 4096 inputs plus 4096 outputs. Also, parallel output location addressing could be used to provide an additional 4096 outputs.

Within each I/O channel assign the I/O rack numbers and the I/O module within each I/O rack in sequential order by their position on the I/O channel as shown in figure 2.16. (I/O adapter module switch settings for these assignments are given in chapter 3.) This type of orderly arrangement could make it easier to locate an I/O terminal through its location address.

In the duplicate I/O location addressing example of Figure 2.16, both parallel outputs and complementary I/O are illustrated.

Parallel output location addressing is illustrated by assigning I/O rack number 002 to two 4-module group I/O chassis on I/O channel 1 and also assigning I/O rack number 002 to an 8-module group I/O chassis on I/O channel 2. Both I/O rack 002 on I/O channel 1 and I/O rack 002 on I/O channel 2 contain output module groups only. Both sets of 8 output module groups on the 2 I/O channels will reflect the status of the same set of 8 words in the output image table.

An application for which parallel output addressing would be useful would be an annunciator panel used to show the status of machinery being controlled. In figure 2.16, the 128 outputs of I/O rack 002 on I/O channel 1 could be used to control machinery while the 128 outputs of I/O rack 002 on I/O channel 2 could be used to drive the pilot lights of an annunciator panel which would thereby directly reflect the status of the machinery. For each of the corresponding 128 bits in the output image table, an output terminal of I/O rack 002 on I/O channel 1 and a corresponding output terminal of I/O rack 002 on I/O channel 2 are controlled in parallel just as if they were wired in parallel to the same point.

Complementary I/O location addressing is illustrated with I/O racks 000, 001 and 003. Both an 8-module group I/O chassis on I/O channel 1 and an 8-module group I/O chassis on I/O

channel 2 are assigned I/O rack number 000. I/O rack 000 on I/O channel 1 contains output module groups only. I/O rack 000 on I/O channel 2 contains input module groups only. The 8 output module groups on I/O channel 1 reflect the status of the 8 output image table words corresponding to I/O rack 000. The 8 input module groups on I/O channel 2 control the status of the 8 input image table words corresponding to I/O rack 000.

Similarly, I/O rack 001 on I/O channel 1 has all outputs while its complementary I/O rack 001 on I/O channel 2 has all inputs. Also, I/O rack 003 on I/O channel 3 has all outputs while its complementary I/O rack 003 on I/O channel 4 has all inputs. In each case the output terminals of the output rack on the one I/O channel reflect the status of the 8 corresponding output image table words while the input terminals of the complementary input rack on the other I/O channel control the status of the 8 corresponding input image table words.

2.7.3 I/O Scan Time

Each I/O channel of an I/O scanner module can be individually selected to have a data transmission rate of either 57.6k baud or 115.2k baud. Select the rate at each I/O adapter module through switch settings on the module as described in chapter 3. Select the rate of each I/O scanner module for each I/O channel individually through the LIST function (chapter 6)

The permissible cable length for an I/O channel set for 57.6k baud is 10,000 ft maximum. The permissible cable length for an I/O channel set for 115.2k baud is 5,000 ft maximum.

Table 2.F lists the nominal time it takes to scan a single I/O chassis of any size with no block transfer taking place and no supplementary I/O. When a block transfer takes place on any channel, the I/O scan time for all channels on that module increases to approximately 9ms per I/O chassis. This nominal time depends upon the data transmission rate and the number of active I/O channels on the I/O scanner module.

Table 2.F

Nominal I/O Scan Time per I/O Chassis (No Block Transfer Taking Place)

Number of Active Channels	Data Transmission Rate	
	115.2k Baud	57.6k Baud
1	5.5ms	6ms
2	6ms	6ms
3	6ms	6ms
4	6ms	6.5ms

Selecting through the LIST function for the I/O chassis to be for inputs only can also marginally lower the I/O scan time for the I/O chassis for some configurations.

The sequence in which the I/O chassis are scanned within an I/O channel can be selected through the LIST function. If each I/O chassis is listed once in the sequence, the nominal I/O update time of each I/O in the I/O channel is the sum of the nominal scan times of each of the I/O chassis in the I/O channel. For example, if each of the 3 I/O chassis on I/O channel number 2 is listed once in the sequence, with a rate of 115k baud, the nominal I/O update time of each I/O in the I/O channel is 18 ms. However, if I/O rack 001 is listed twice and I/O racks 000 and 002 are listed once each in the sequence, the nominal I/O update time of each I/O on I/O rack 001 is 12 ms and the I/O update time of each I/O on I/O racks number 000 and 002 is 24 ms.

The amount of time it takes to scan an I/O chassis will vary from one I/O scan to the next, depending on the amount of change that has taken place in the I/O data. However the time will not be less than the nominal time.

2.8 I/O Rack Number Restrictions

In the standard I/O configurations described in section 2.7 you are restricted to using I/O rack numbers from 00_8 thru 37_8 only. If you supplement a standard I/O configuration with I/O from I/O chassis which you assign I/O rack numbers above 37_8, you must be aware of additional limitations.

Assigning an I/O rack number above 37_8 causes words to be used in the input and output sections corresponding to that I/O rack number and all those between that number and 37_8. Also, each instruction addressing I/O in that I/O rack would use an additional word of memory.

Supplementary I/O with an I/O rack number greater than 37_8 has the limitation of longer I/O scan time than standard I/O. To the I/O scan times given in section 2.7.3 for standard I/O chassis, add another 1 ms if it is a supplementary I/O chassis with an I/O rack number greater than 37_8.

Supplementary I/O also has the limitation of longer program execution time compared to standard I/O. User program instructions addressing bits reflecting standard I/O are executed up to 10 times faster than instructions addressing bits reflecting supplementary I/O with I/O rack numbers greater than 37_8.

NOTE: Do not select 77 as an I/O rack number; it is used for internal processor functions.

2.9 Backup

On a 1775-S4A module, channel 1, 2, 3, or 4 can alternately be selected (through the LIST function) for a backup communication function. For backup communication, the channel of a 1775-S4A module in the primary processor chassis is connected to a channel of a 1775-S4A module in the backup processor chassis. Communication through a channel configured for backup together with other connections would allow the two PLC-3 processors to provide backup for each other so that if a fault would disable one PLC-3 processor, the other could take over control of the outputs. For details on backup, refer to the PLC-3 Controller Backup Concepts Manual (publication 1775-803).

2.10 Peer-to-Peer

On a 1775-S4A module, channel 1, 2, 3, or 4 can alternately be selected (through the LIST function) for a peer-to-peer communication function. For peer-to-peer communication, the channel of a 1775-S4A module in one PLC-3 controller is connected to a channel of a 1775-S4A module in each of up to 6 other PLC-3 controllers (figure 2.17). For a communication rate of 57.6K baud, the total cable length can be 10,000 feet maximum. For a communication rate of 115.2K baud, the total cable length can be 5,000 feet maximum.

One PLC-3 controller must be designated as the master of this communication network. Communication occurs only between the master and each slave. Figure 2.18 illustrates the concept of peer-to-peer communication. Data is transferred from a user-designated file in the master to a user-designated file in a slave and from another user-designated file in the slave to a user-designated file in the master. The master proceeds to communicate with each of the other slaves in succession before returning to the first slave.

Through the LIST function, the channel must be selected for either peer-to-peer master or peer-to-peer slave and the necessary files must be designated. At each slave, a file must be designated for incoming data and one for outgoing data. At the master, a pair of files must be designated for each slave; in figure 2.18, two slaves are shown so two pairs of files are shown at the master. Each file receiving data must be at least as large as the file from which the data is sent.

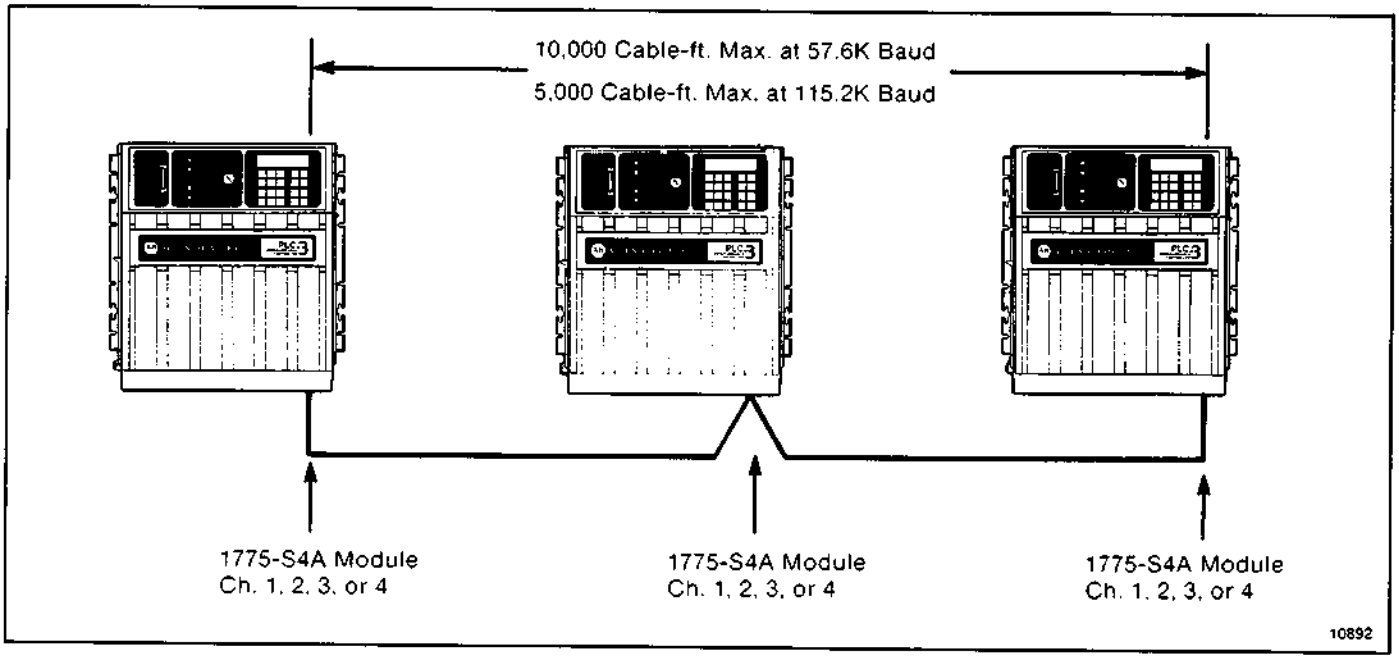


Figure 2.17 — Example of a Peer-to-Peer Communication Network Configuration

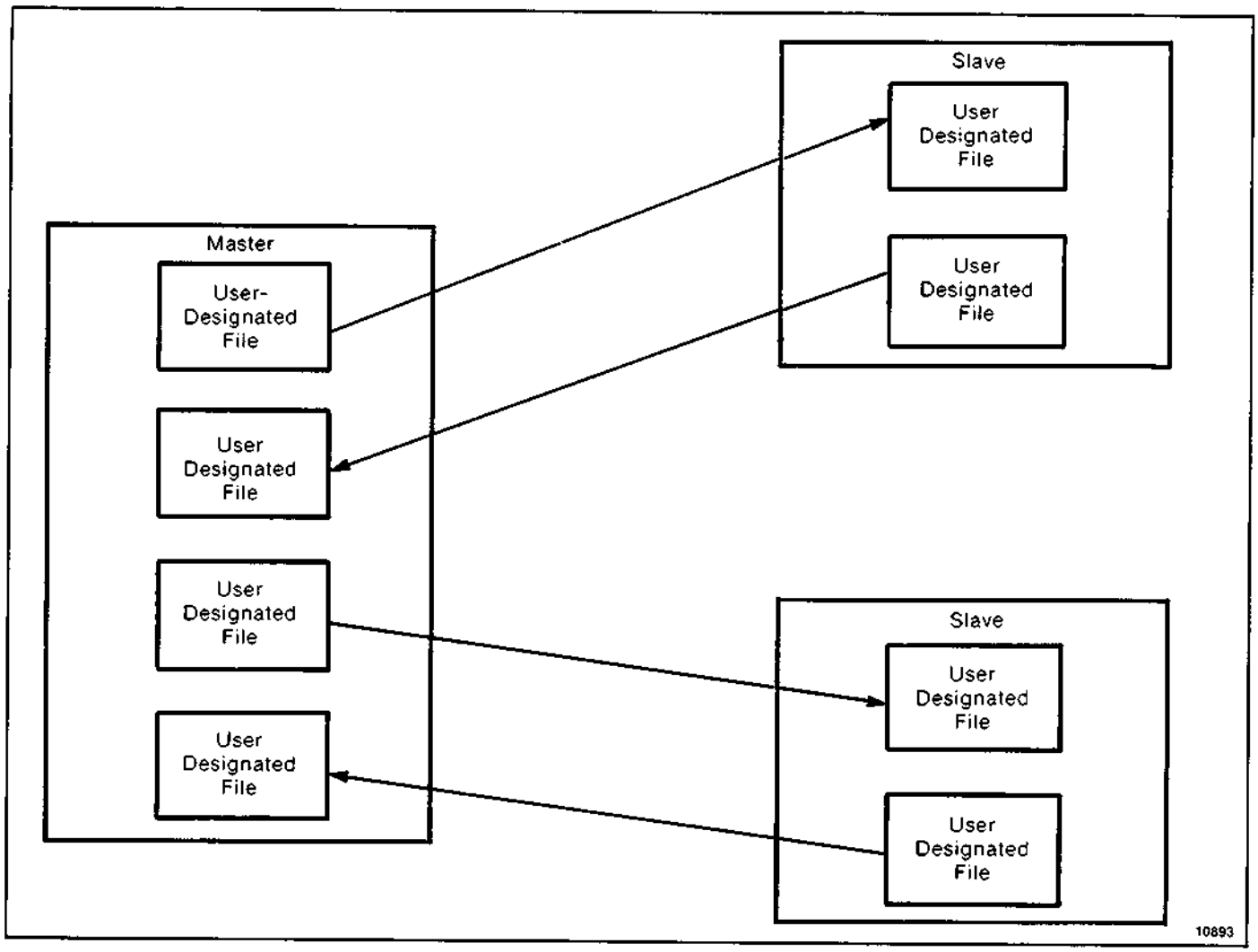


Figure 2.18 — Peer-to-Peer Communication Concept

Chapter

3

Installation Procedures

3.0 General

This chapter outlines the rules and procedures which must be followed in order to properly plan, layout, assemble and install a PLC-3 controller.

Of primary importance is a well-planned controller layout, which takes into consideration such things as the size of the various PLC-3 components and cable lengths. PLC-3 controller components can then be mounted. Then cables can be run and connected between the PLC-3 controller components and modules can be inserted.

> **CAUTION:** To avoid equipment damage, read and understand this entire manual before attempting to install or operate the PLC-3 controller.

3.1 General Layout Rules

The installation layout for a specific PLC-3 controller is dependent on the types and numbers of components that make up that controller. The maximum distances between PLC-3 controller components is limited by the cable lengths as illustrated in figures 2.7 and 2.8. The minimum component spacing is limited by heat dissipation considerations.

The temperature of the air must not exceed 60°C (140°F) at any point immediately below any chassis (processor chassis, I/O chassis, or power supply). The failure rate of the semiconductor devices may increase significantly if the temperature is raised above 60°C. Furthermore, a significant decrease in the failure rate of the semiconductor devices can be expected for every degree below 60°C that the ambient temperature can be kept.

The temperature will tend to be higher toward the top of the enclosure. Factors which determine the level at which the temperature will be 60°C include the size of the enclosure, the power dissipation within the enclosure, and the temperature of the air surrounding the enclosure.

Power dissipation includes not only the power dissipated through the power supplies for the processor chassis and I/O chassis backplanes, but also the user supplied power dissipated through the input and output circuits.

Note that the expansion distribution panel is only an interconnection point. It does not dissipate any power and is not affected by excessive heat as are semiconductor circuits .

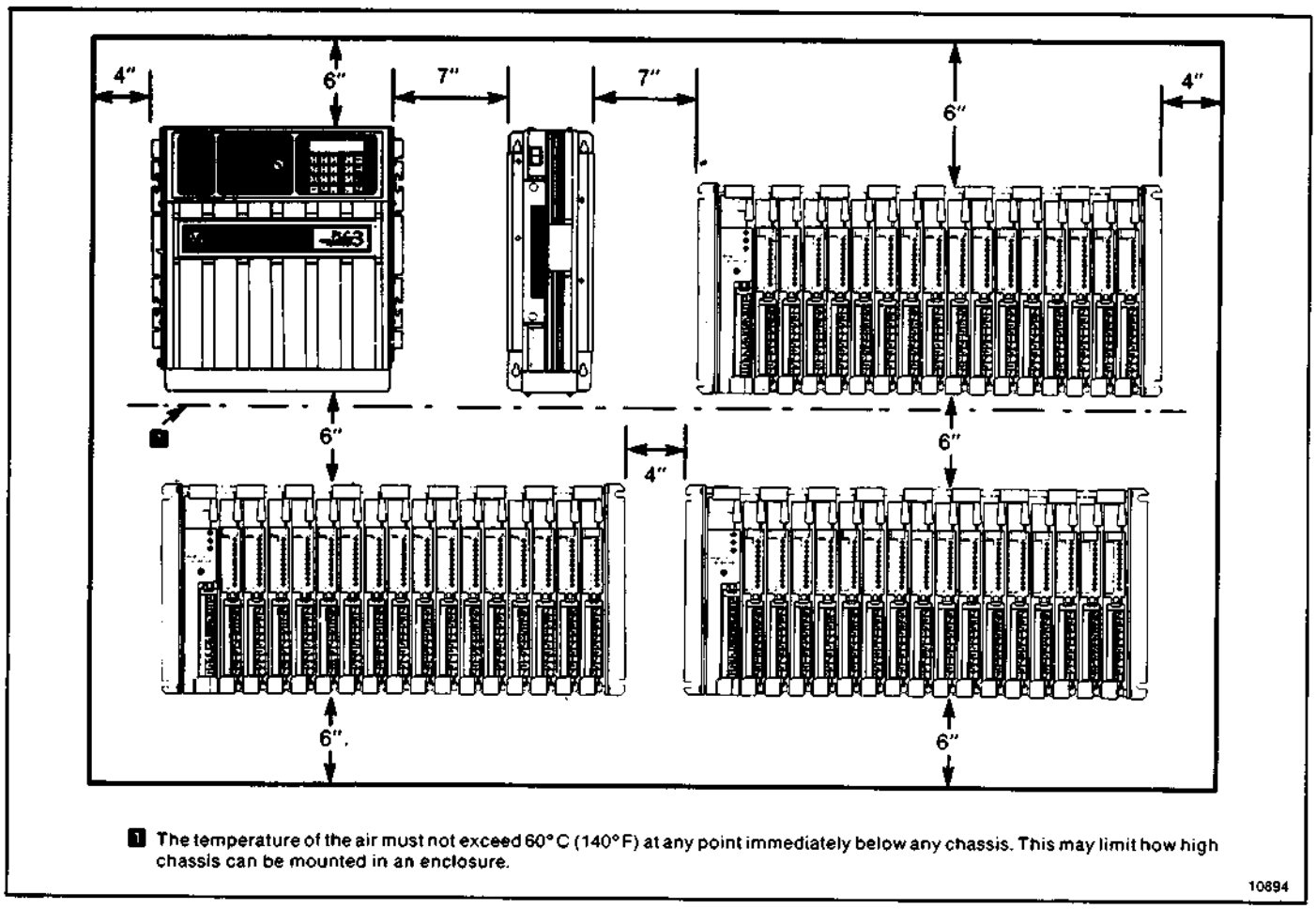


Figure 3.1 — Minimum Spacing for Necessary Air Flow for Cooling

To allow necessary air flow for cooling of components, refer to figure 3.1 and follow these rules:

Rule 1 — Do not mount an I/O chassis above a processor chassis or a 1775-P1 power supply.

Rule 2 — Mount the 1775-P1 power supply to the right of a processor chassis (7 inches minimum separation).

Rule 3 — Minimum vertical separation between chassis and to the top and bottom of the enclosure is 6 inches, with no chassis mounted above a 60°C air temperature level (figure 3.1).

Rule 4 — Minimum horizontal separation between chassis is 7 inches, with the exception that minimum horizontal separation between I/O chassis is 4 inches.

Rule 5 — Minimum horizontal separation to enclosure sides is 4 inches.

Rule 6 — Leave any excess space at the top of the enclosure where the temperature is the highest.

Rule 7 — Wiring ducts and terminal strips should be mounted no closer than 2 inches from any chassis.

3.2 Duct Layout Considerations

The duct layout of the PLC-3 controller is related to where the different types of I/O modules are placed in the I/O chassis. Therefore, I/O module placement should be determined prior to any programming or layout and assembly. The following duct layout considerations should be kept in mind.

3.2.1 Categories

When planning duct layout, the following catagories of wires and cables associated with the PLC-3 controller should be considered:

- Expansion cables carry low level signals between processor chassis backplanes.
- DC power cables carry regulated 5V and 15V power to I/O and processor chassis.
- Serial communication cables including data highway and I/O channel twinaxial cables carry data transmissions between processors, I/O chassis, computers, and peripheral terminals.
- Low level DC I/O lines carry low voltage (less than 10V), low power signals or their input circuits have short time constant filters so that short pulses can be detected. Low level DC I/O lines connect to TTL, analog, encoder/counter, selectable DC, multiplex, and fast response I/O modules. Also, I/O lines from any DC I/O module to solid state devices (such as proximity switches or photo-electric devices) are low level DC.
- AC I/O lines and high level DC I/O lines have a greater degree of noise immunity than low level DC I/O lines. High level DC I/O lines connect to all DC I/O modules not defined as low level.

3.2.2 Guidelines

The following are general guidelines for routing of wires and cables which connect to PLC-3 controller components. These guidelines are applicable to typical installations for user routing of wires and cables both inside and outside of the enclosure.

- All AC I/O lines and high level DC I/O lines can be routed with machine power lines of up to 600V AC (feeding up to 100 hp devices) if this does not violate local codes. Article 300-3 of the National Electrical Code requires all conductors (AC and/or DC) in the same duct to be insulated for the highest voltage carried by any one of the conductors in the duct.
- All low level DC I/O lines must be properly shielded and routed in a separate duct. Serial communication cables can also be routed with these lines.
- DC power cables and expansion cables should be routed external to all wiring ducts or in a duct not shared with other wiring.

3.3 I/O Module Placement

Module placement in I/O chassis is very flexible: physically, any module can be placed into any I/O slot. However, using a practical approach in the actual placing of I/O modules helps facilitate duct layout. Therefore, I/O module placement and duct layout should be planned in conjunction with one another.

Any 2-slot module must be placed into two slots of the same module group: never have a module straddle two module groups.

I/O modules should be segregated as much as possible into groups of AC and high level DC, low level digital DC (TTL, encoder, pulse output), and analog I/O modules. If a complete I/O chassis cannot be reserved for one of these types of I/O modules, one end of an I/O chassis can be reserved for one type of I/O modules, and the other end for another type. If there is to be a blank I/O module slot, choose a slot between two groups of different types of modules to further separate them. Also, where possible, segregate input modules from output modules because output circuits can conduct more current than input circuits.

When planning I/O module placement, refer to table 2.A to determine the total backplane current requirement of the 5V power supply circuit for each I/O chassis. Do not exceed the 6.5A limit of a 1771-P2 power supply or the 60A total limit of a 1775-P1 power supply. Even if a 1775-P1 power supply is used, do not exceed 6.5A for any single I/O chassis.

In some applications, it may be planned to dedicate some I/O chassis to all inputs and other I/O chassis to all outputs to allow duplicate I/O location addressing (section 2.7.2).

3.4 Rack Mounting

PLC-3 components are usually mounted on a back panel, which in turn is mounted in an enclosure. However, a Chassis 19-inch Rack Mounting Kit (cat. no. 1775-XA) provides rack mounting hardware for a PLC-3 processor chassis. Also, a Power Supply 19-inch Rack Mounting Kit (cat. no. 1775-XB) provides rack mounting hardware for a 1775-P1 power supply.

3.5 Enclosure Considerations

An enclosure to house PLC-3 controller components must fulfill the requirements for clearance and for cooling outlined in paragraph 3.1. Space must also be planned and allowed for isolation transformers, fusing, a disconnect switch, a master control relay, and terminal strips.

External dimensions for PLC-3 controller components are shown in figures 3.2, 3.3, 3.4, and 3.5. Note that the door of the processor chassis is hinged at the right. All mounting slots will accept 1/4-inch mounting bolts.

The temperature of the air must not exceed 60°C (140°F) at any point immediately below any PLC-3 controller chassis

(processor chassis, I/O chassis or power supply). In most applications, this requirement is met without special precautions as long as minimum clearances are provided, and the movement of air inside the enclosure around the assemblies is not obstructed (section 3.1).

CAUTION: Never place any obstruction (notebook, folder, envelope, paper) on top of any PLC-3 controller component. Overheating from such an obstruction to air flow may result in component failure.

In special cases, where a substantial amount of heat is being produced by other equipment inside or outside the enclosure, it may be necessary to place fans inside the enclosure to assist air circulation and to eliminate "hot spots" near the PLC-3 controller. However, do not bring in unfiltered outside air; it usually introduces harmful contaminants or dirt.

In extreme cases, air conditioning may be required to guard against excessive internal enclosure temperatures.

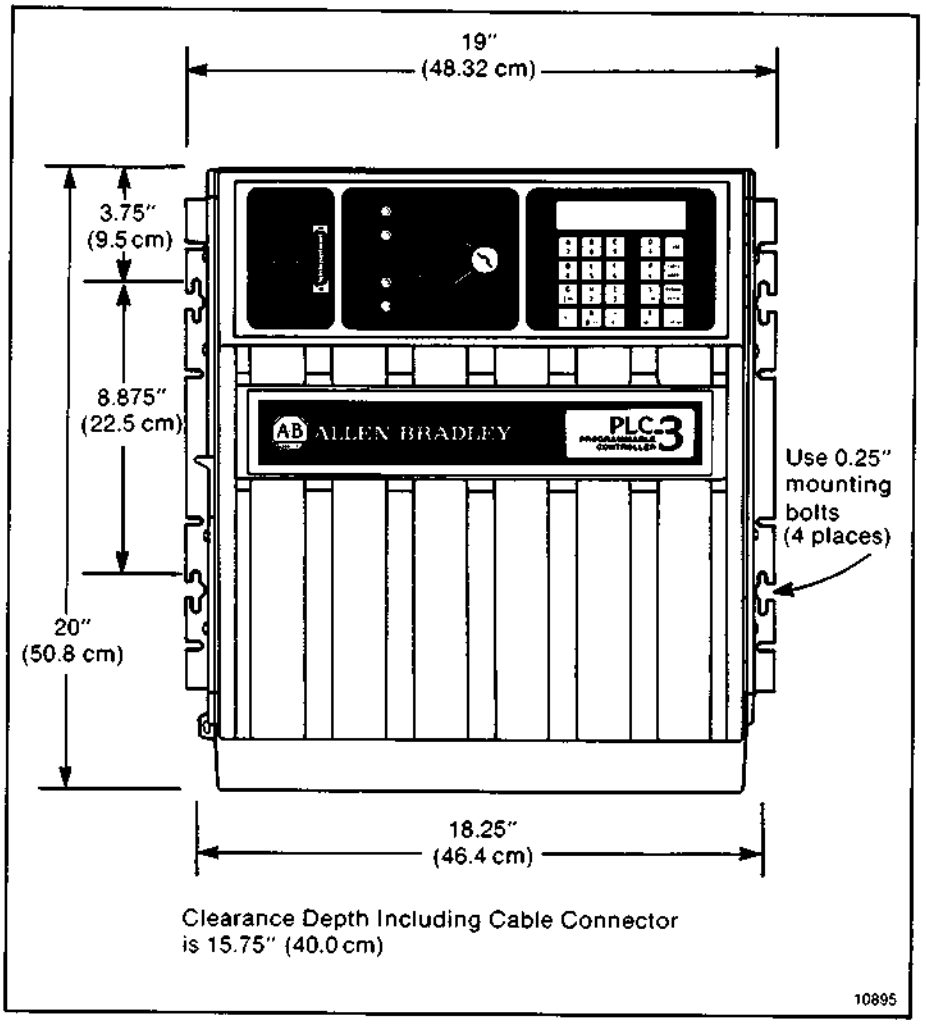


Figure 3.2 — Processor Chassis Dimensions

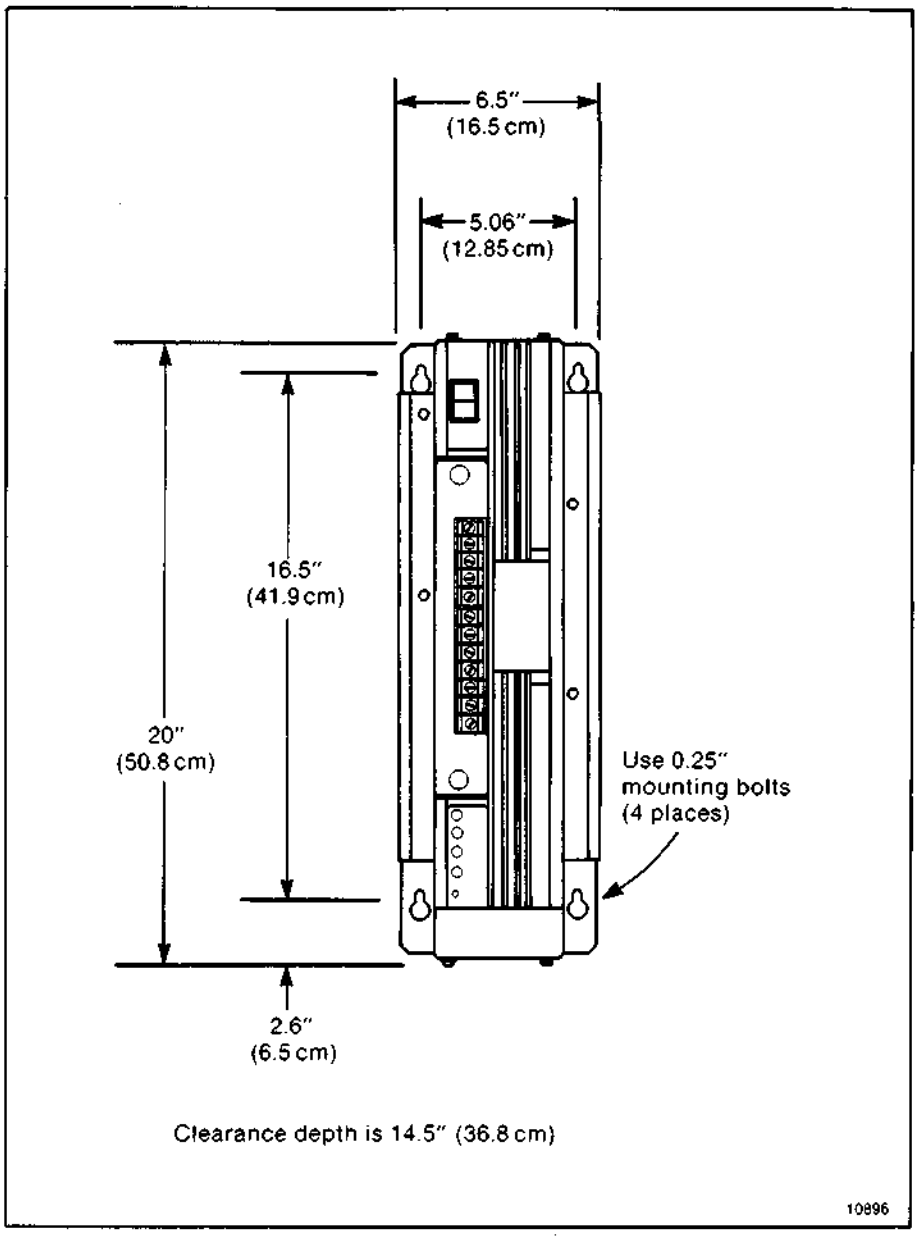


Figure 3.3 — 1775-P1 Power Supply Dimensions

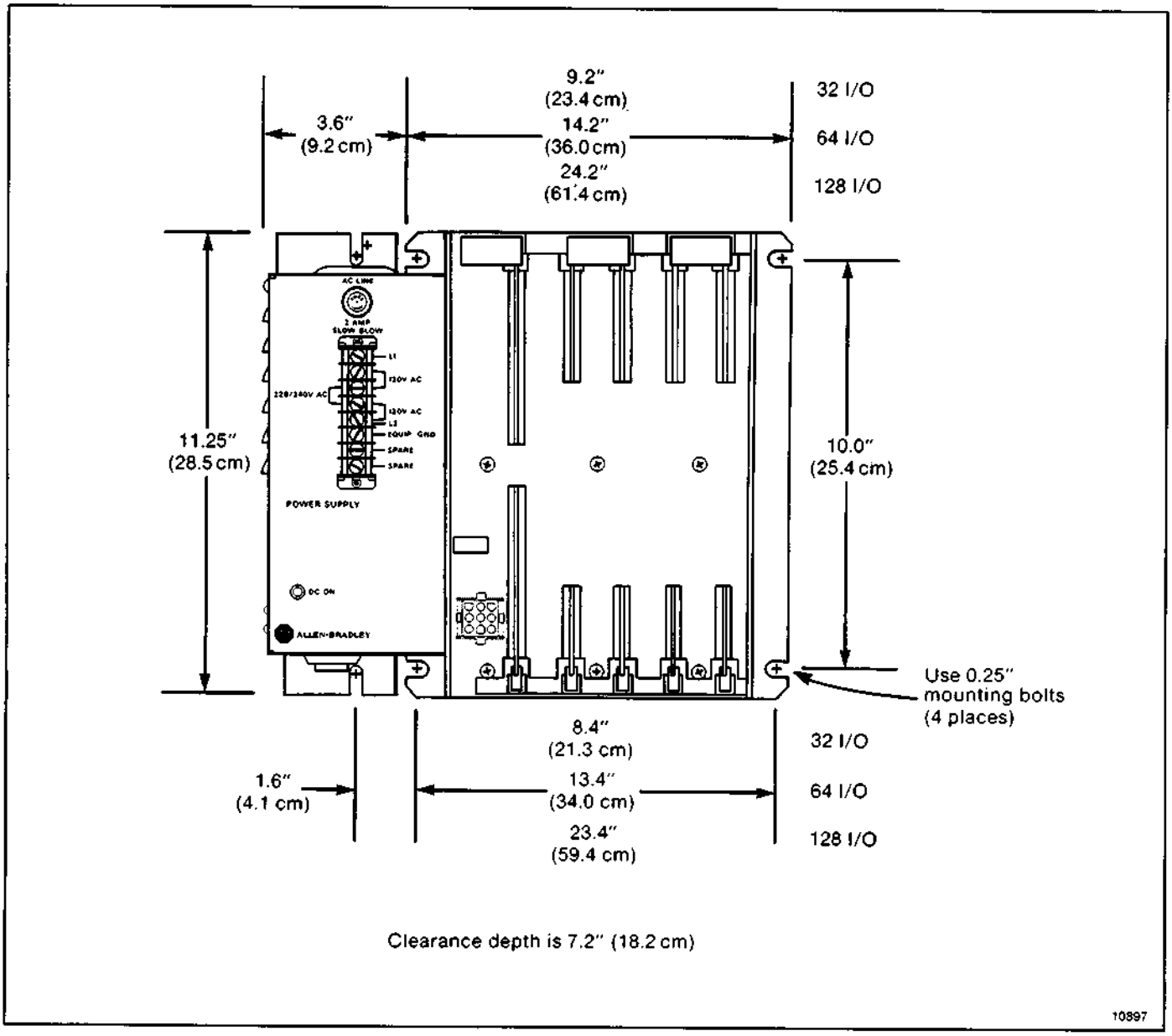


Figure 3.4 — 1771 I/O Chassis and 1771-P2 Power Supply Dimensions

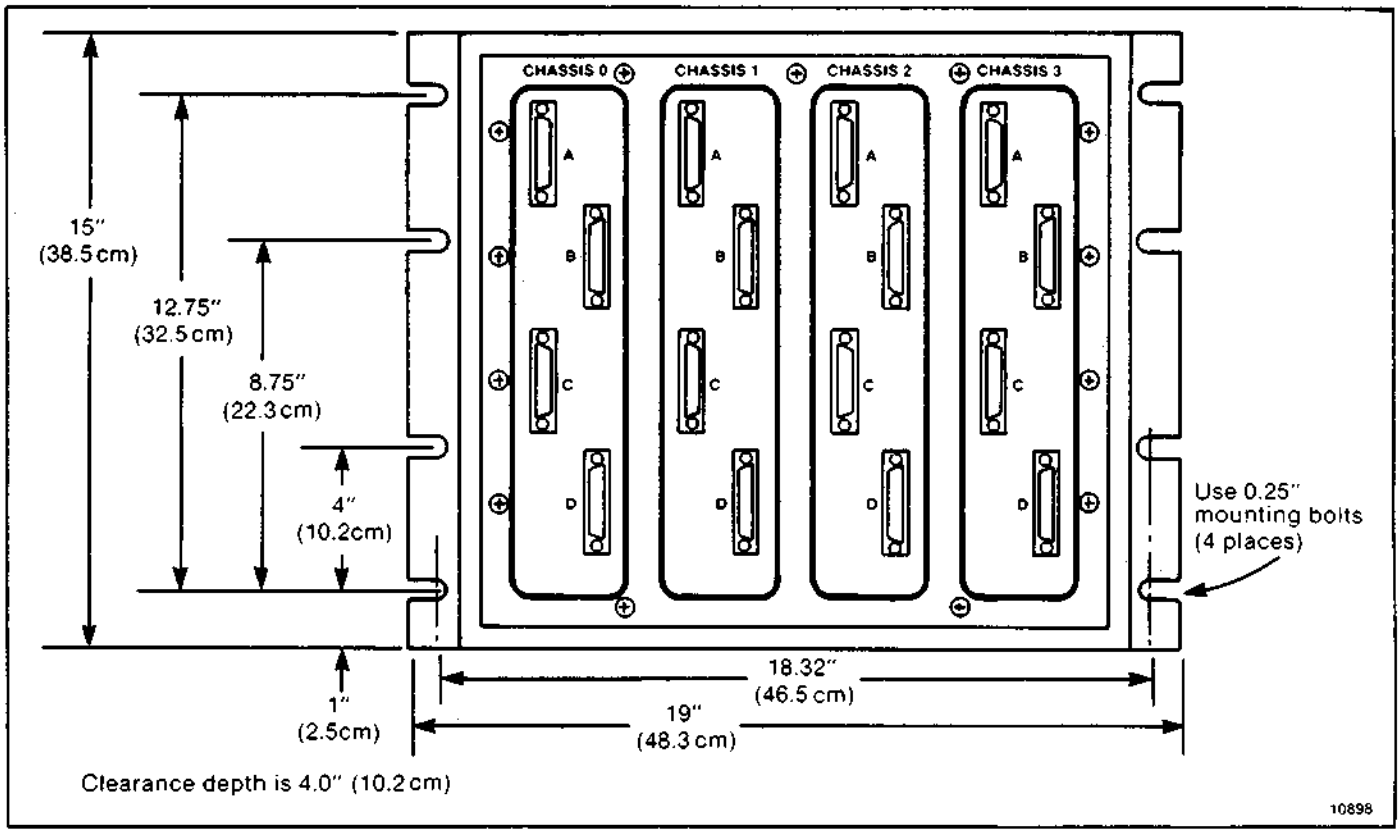


Figure 3.5 — 1775-CXD Expansion Distribution Panel Dimensions

3.6 Mounting Layout

Often, a 90-inch high NEMA type 12 enclosure is used to house PLC-3 controller components. The components are usually mounted on a back panel, which in turn is mounted in the enclosure. A typical back panel layout is shown in figure 3.6 for mounting a 1775-P1 power supply, a processor chassis, and a 128 I/O chassis with a 1771-P2 power supply attached in a single bay enclosure.

A typical back panel layout in a single bay enclosure is shown in figure 3.7 for mounting two 128 I/O chassis with a 1771-P2 power supply attached to each.

In figures 3.6 and 3.7, the 6 inch minimum space is exceeded below each I/O chassis. The extra space is provided to allow room for 24-terminal barrier strips mounted vertically and a 2 inch wide wiring duct.

A typical back panel layout in a single bay enclosure is shown in figure 3.8 for mounting two processor chassis and a 1775-P1 power supply. This spacing is limited by the 6 ft length of the power cable connection between the power supply and each processor chassis. This spacing is also limited by the 10 ft length of the expansion cable connections between the two processor chassis.

NOTE: Do not mount PLC-3 controller units behind the enclosure's door supports. Layout planning must allow the processor chassis door to freely swing open to the right.

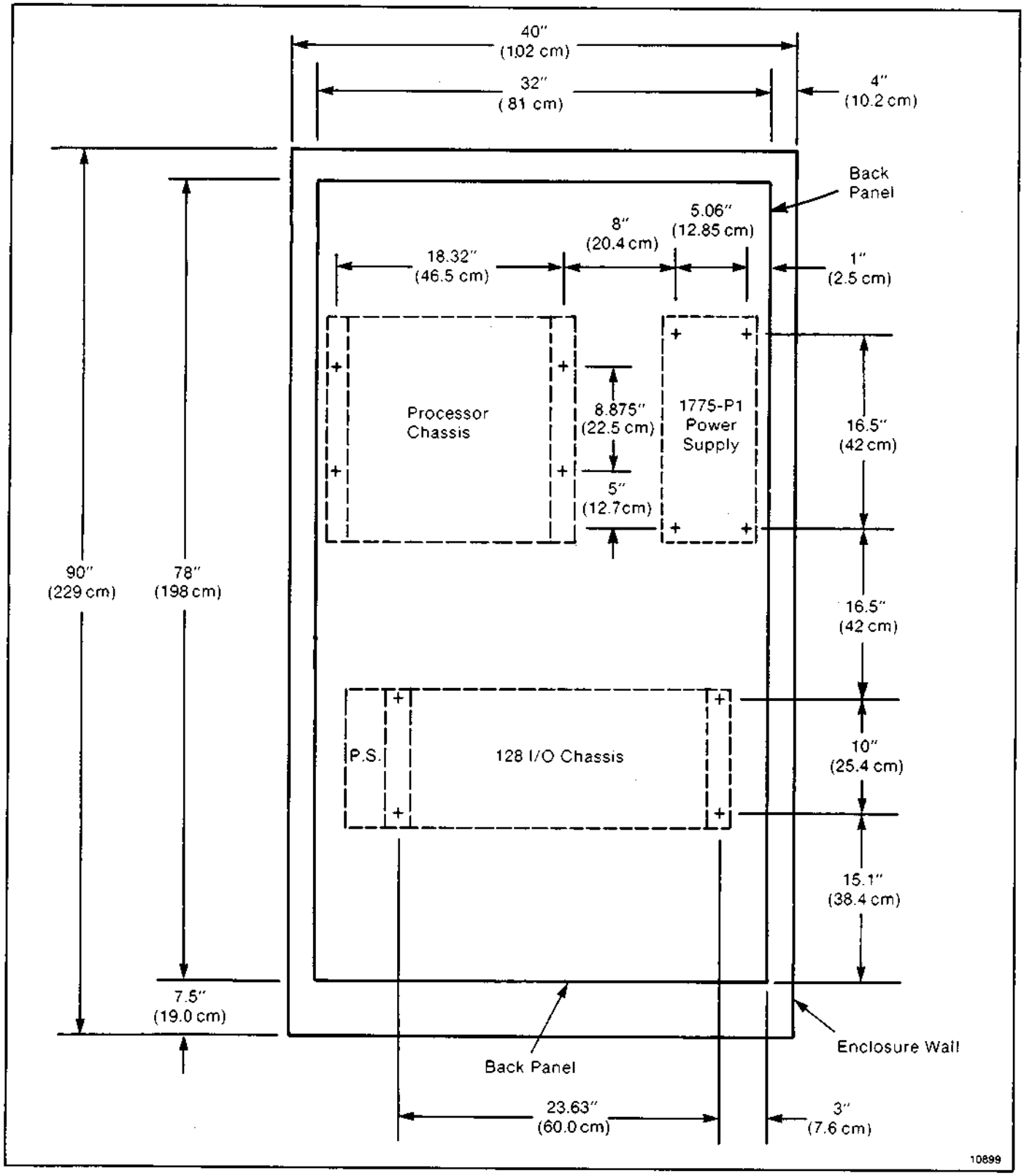


Figure 3.6 — Typical Back Panel Layout: A Processor Chassis, a 1775-P1 Power Supply, and a 128 I/O Chassis with a 1771-P2 Power Supply Attached.

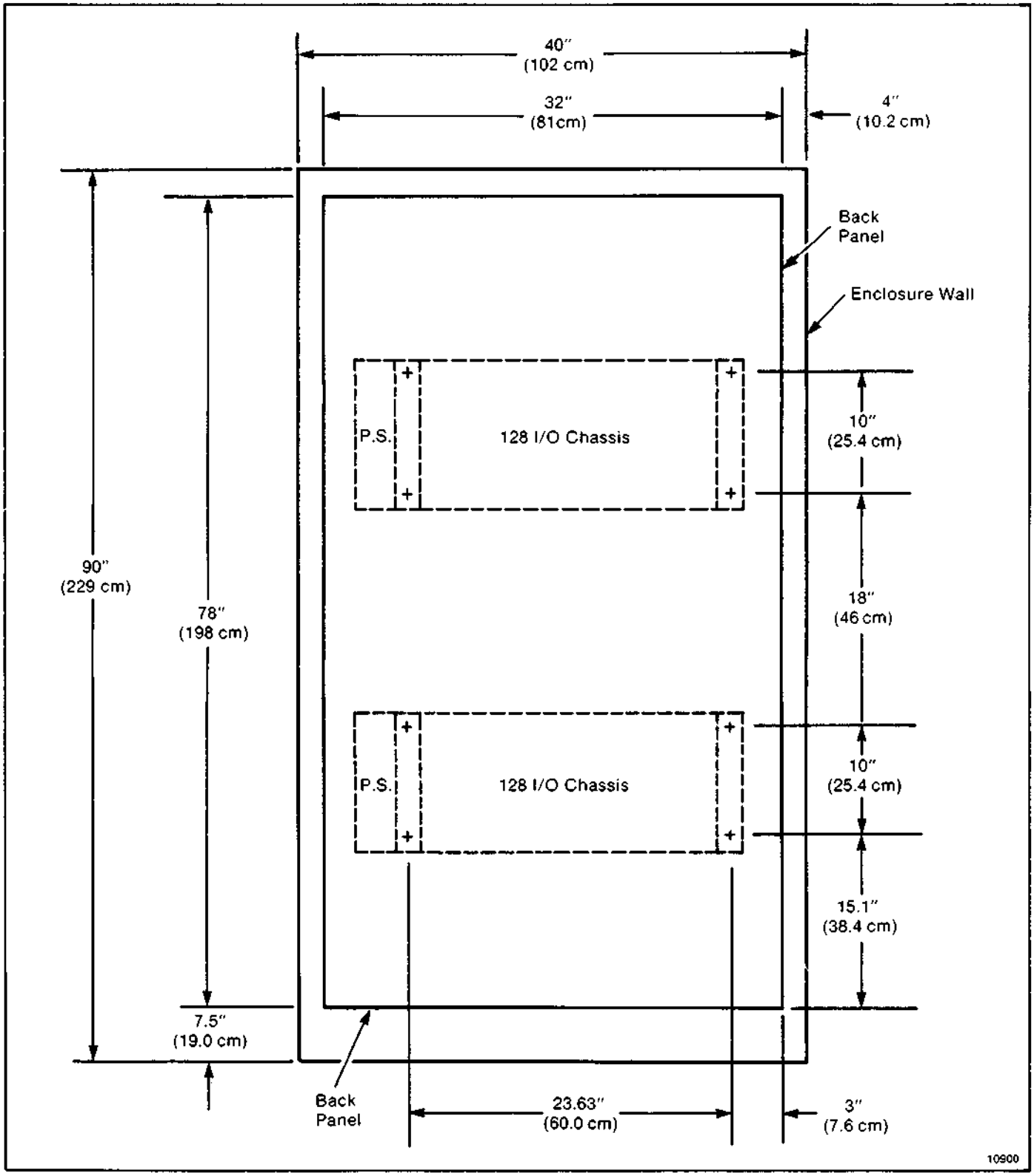


Figure 3.7 — Typical Back Panel Layout: Two 128 I/O Chassis with a 1771-P2 Power Supply Attached to Each

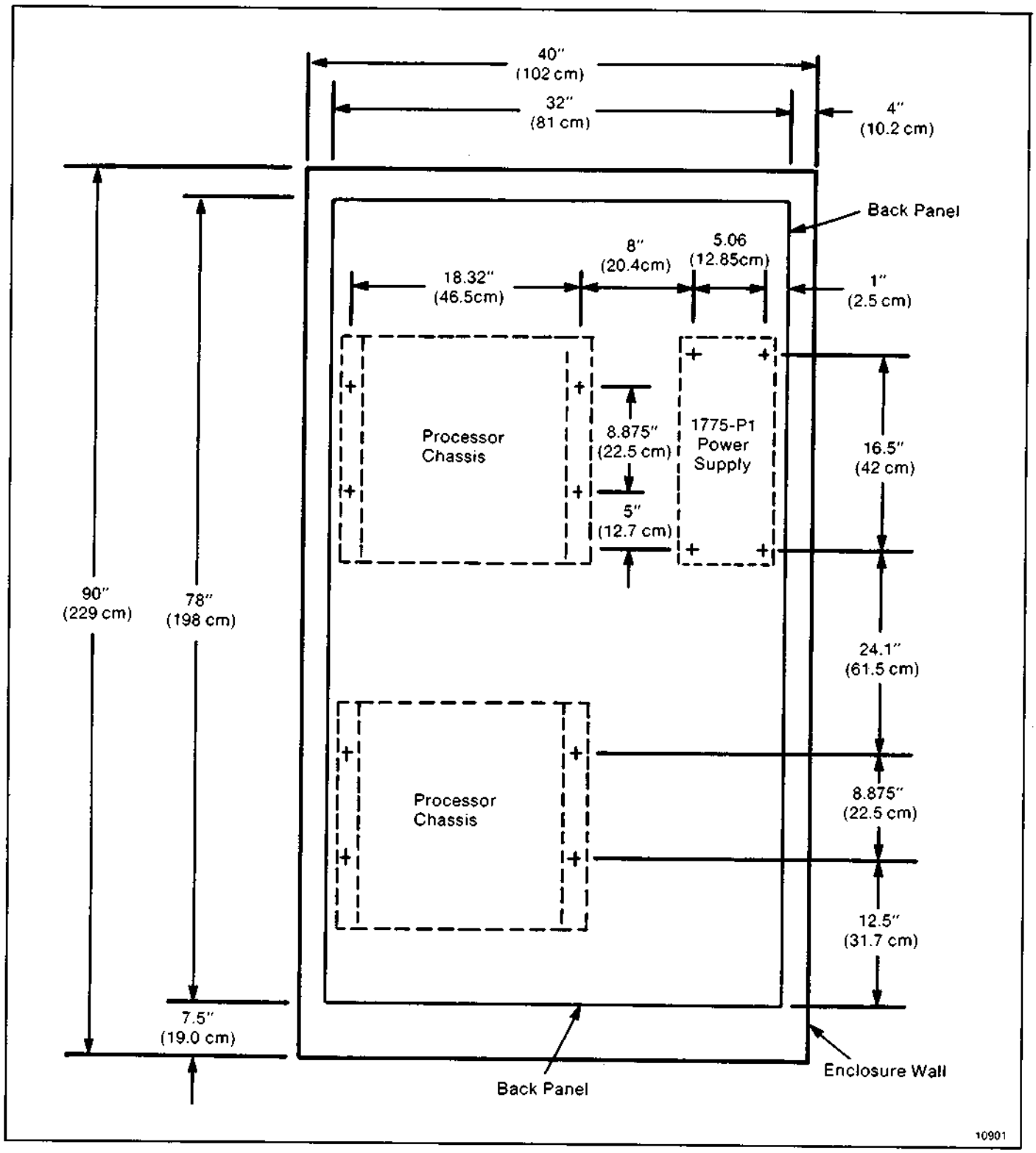


Figure 3.8 — Typical Back Panel Layout: 2 Processor Chassis and a 1775-P1 Power Supply

3.7 Mounting and Grounding of Chassis

After all layouts have been established, work can begin on mounting and properly grounding each chassis of a PLC-3 controller. The units can be mounted with the use of either bolts or welded studs.

Figure 3.9 shows mounting assembly details for stud mounting of a chassis or ground bus to a back panel, bolt mounting of a chassis or ground bus to a back panel, and stud mounting of a back panel to the back wall of an enclosure.

If the mounting brackets of a chassis do not lay flat before the nuts are tightened, use additional washers as shims so that the chassis will not be warped by tightening the nuts. Warping a chassis could damage the backplane and cause poor connections.

Make good electrical connection between each chassis, the back panel, and the enclosure through each mounting bolt or stud. Wherever contact is made, remove paint or other non-conductive finish from studs and the back panel so that good electrical contact is made at each bolt or stud.

In addition to the connection through each bolt or stud, use either 1-inch copper braid or 8 AWG copper wire to connect between each chassis, the back panel, the enclosure, and a ground bus which is connected to earth ground (the grounding electrode system) through a grounding electrode conductor. In this document, earth ground is defined as the central ground for all electrical equipment and AC power within any facility. All ground connections must be permanent and continuous to provide a low-impedence path to earth ground for induced noise currents and/or fault currents. Observe all applicable codes and ordinances when making these grounding connections.

Figures 3.10 and 3.11 show ground bus connection details. Figure 3.12 shows enclosure wall ground connection details.

Connect the equipment grounding conductor through only one mounting bracket of a chassis (figure 3.13). Connect the chassis in vertical groups and connect each vertical group to a ground bus mounted on the back panel of the enclosure. Connect the ground bus to the grounding electrode system through a grounding electrode conductor.

Avoid connecting more than two lugs to any single bolt because the connection can become loose due to the compression of the metal lugs.

An authoritative source for grounding requirements is the National Electrical Code published by the National Fire Protection Association of Boston, Massachusetts. Article 250 of the code provides such data as the size and types of conductors and methods of safely grounding electrical components. As defined in the Code, a grounding path must be permanent and continuous and be able to safely conduct ground-fault currents

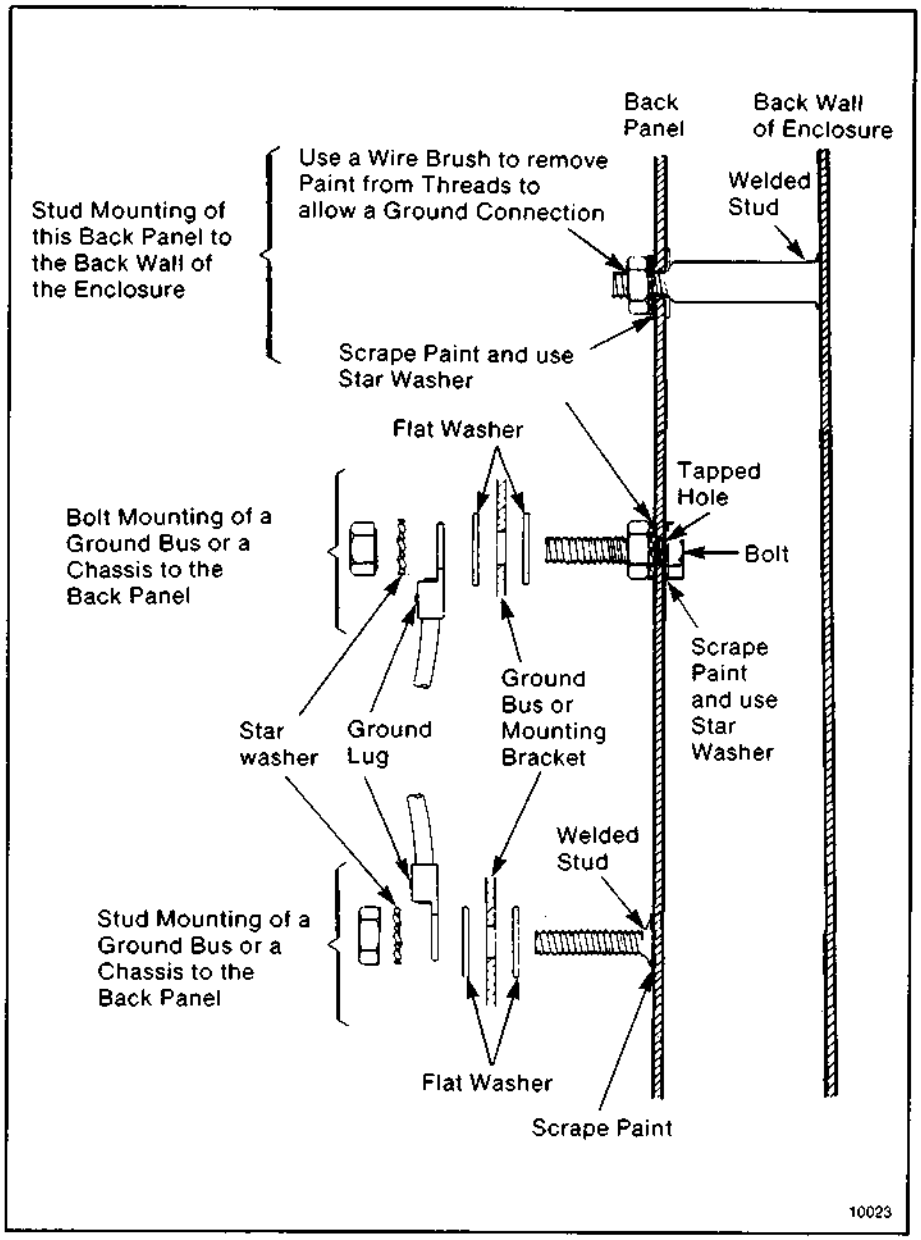


Figure 3.9 — Mounting Assembly Details

that may occur in the system to ground with minimum impedance. Also the connections to a grounding conductor must be of a permanent nature. Local codes and ordinances dictate which grounding method is permissable.

Grounding is an important safety measure in electrical installations. With solid state controls, grounding has an added value because it helps to reduce the effects of electromagnetic noise interference (EMI).

After the chassis of the PLC-3 controller are mounted, the duct work and terminal strips, if needed, can then be mounted.

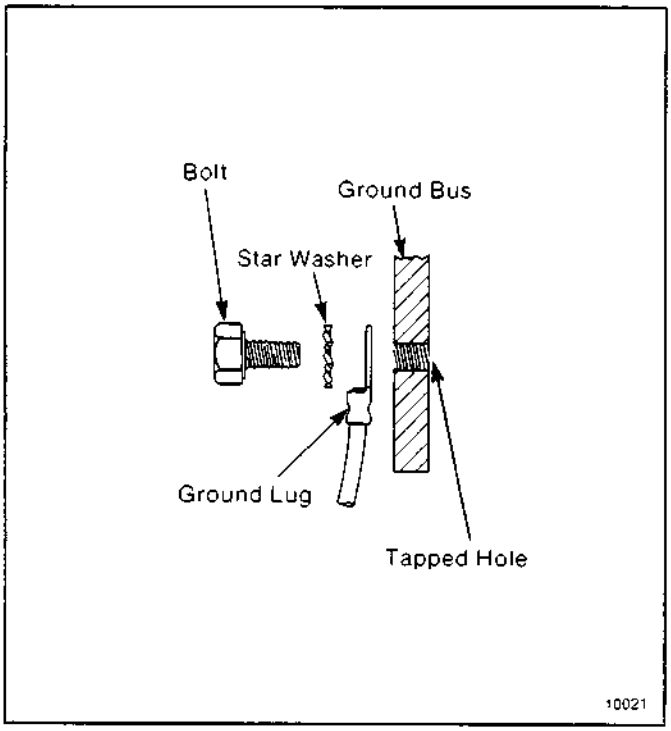


Figure 3.10 — Ground Bus Connection Details

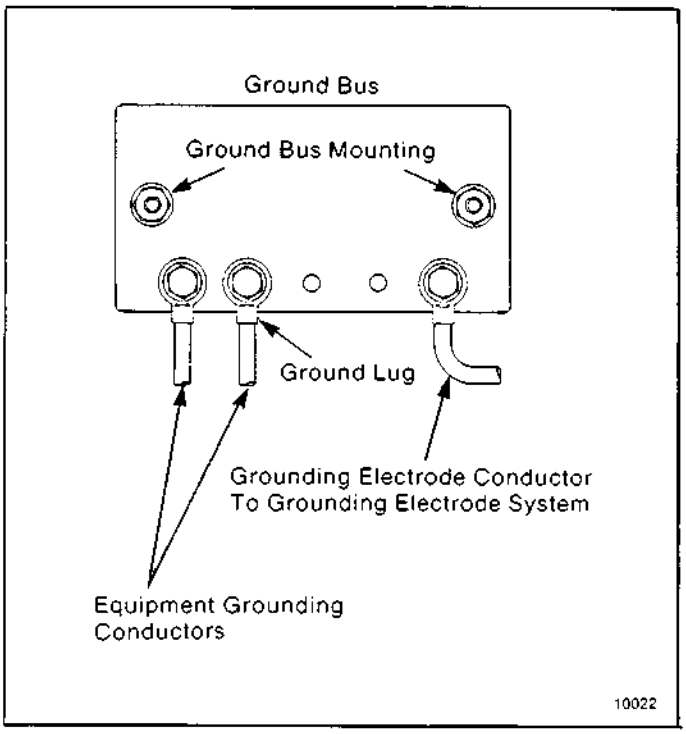


Figure 3.11 — Ground Bus Connections

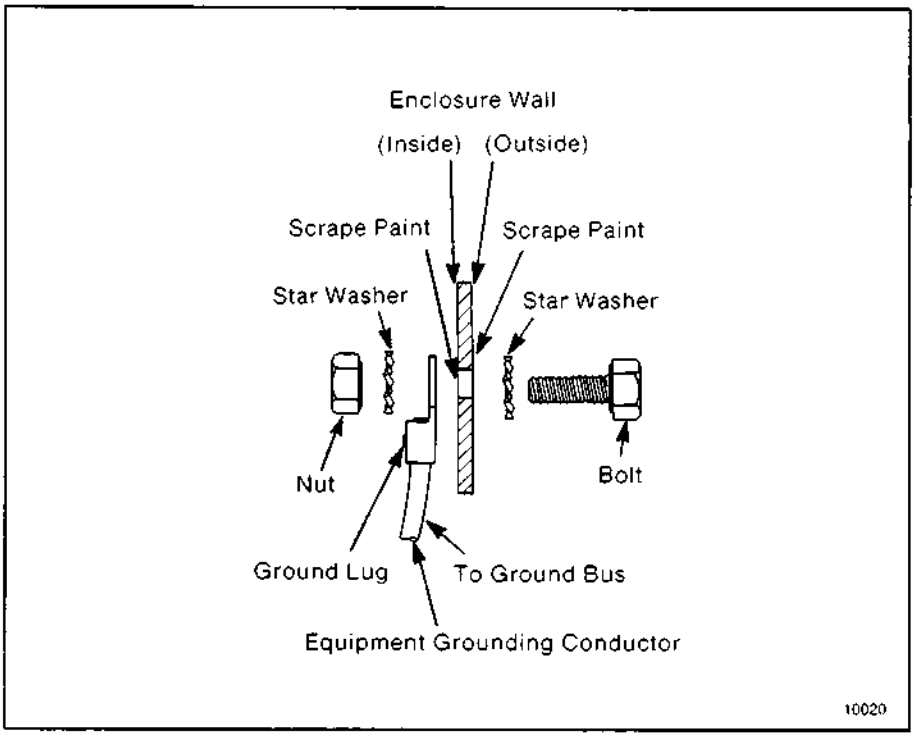


Figure 3.12 — Details of Ground Connections at Enclosure Wall

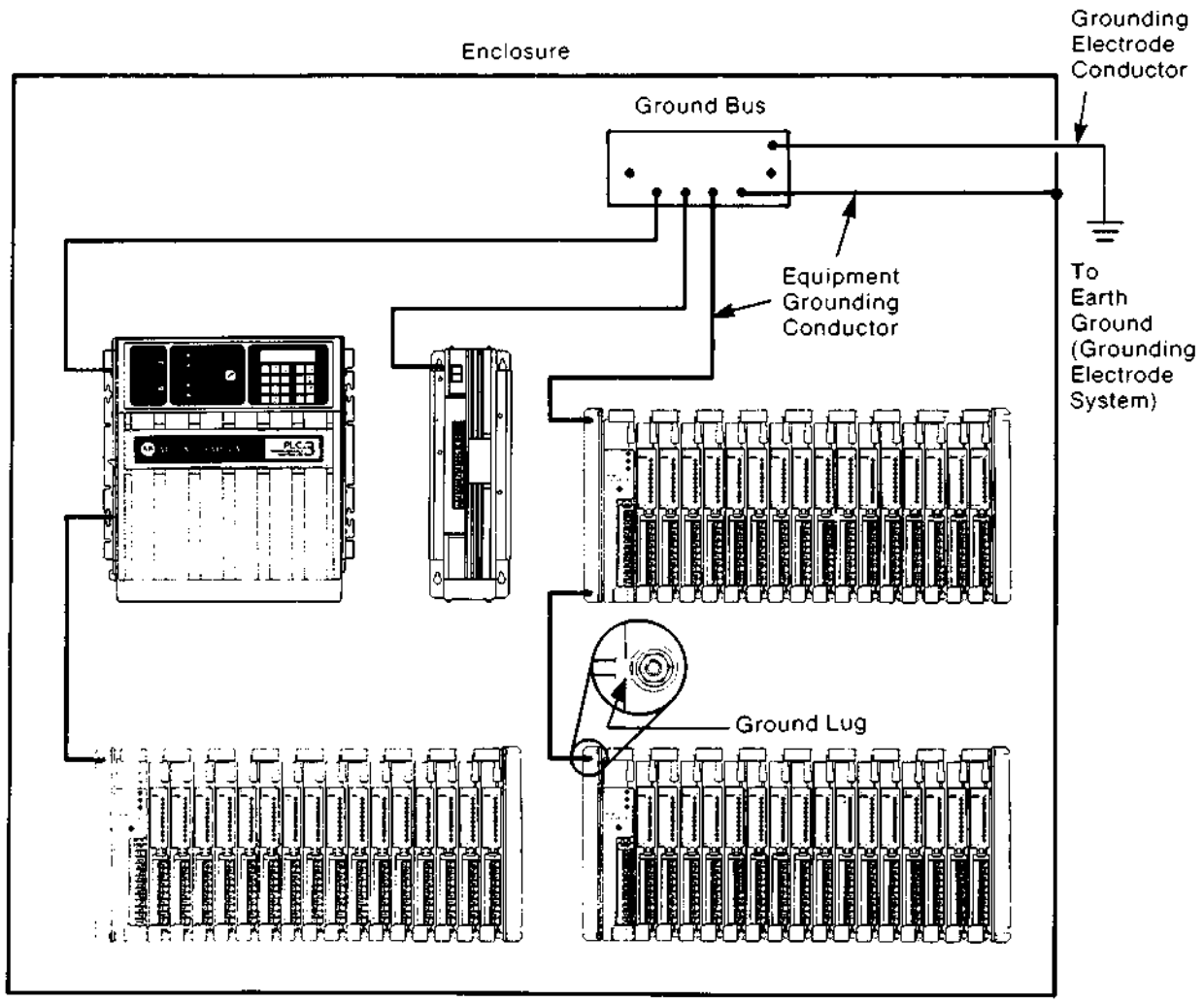


Figure 3.13 — Typical PLC-3 Controller Grounding Configuration

3.8 I/O Chassis Switches

A switch assembly is located on the backplane of each I/O chassis (figure 3.14). It contains 8 switches. Set these switches with a blunt pointed instrument such as the tip of a ball point pen. The function of this set of switches is illustrated in figure 3.15 and described in the following.

3.8.1 Last State

Switch 1 determines whether the outputs of that I/O chassis will be turned off or held in their last state when a major fault occurs at that I/O chassis:

- ON — Each output of that I/O chassis is held in its last state (on or off) in the event of a fault at that I/O chassis.
- OFF — The outputs of that I/O chassis are turned off in the event of a fault at that I/O chassis.

WARNING: Before setting this switch, consider the implications of the switch setting for your application. Setting this switch to OFF allows the outputs to be turned off for all faults. If you set this switch to ON, machine operation can continue after fault detection; this could result in damage to equipment and/or injury to personnel.

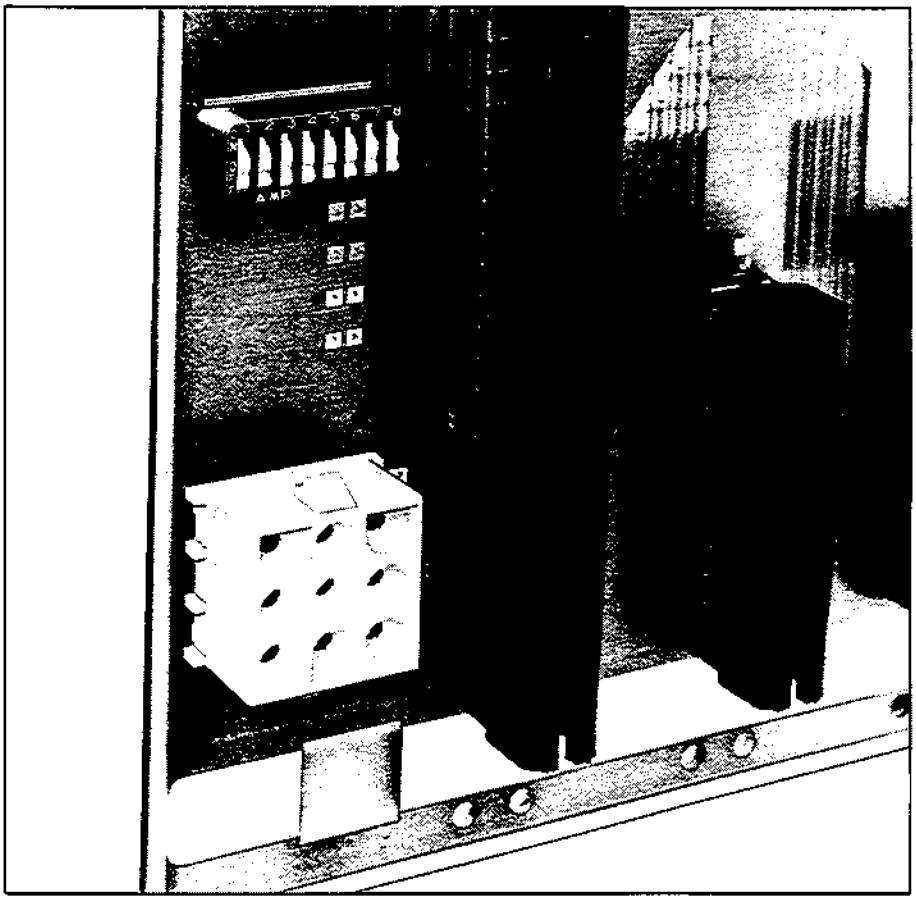


Figure 3.14 — 1771 I/O Chassis Switch Assembly and DC Power Socket

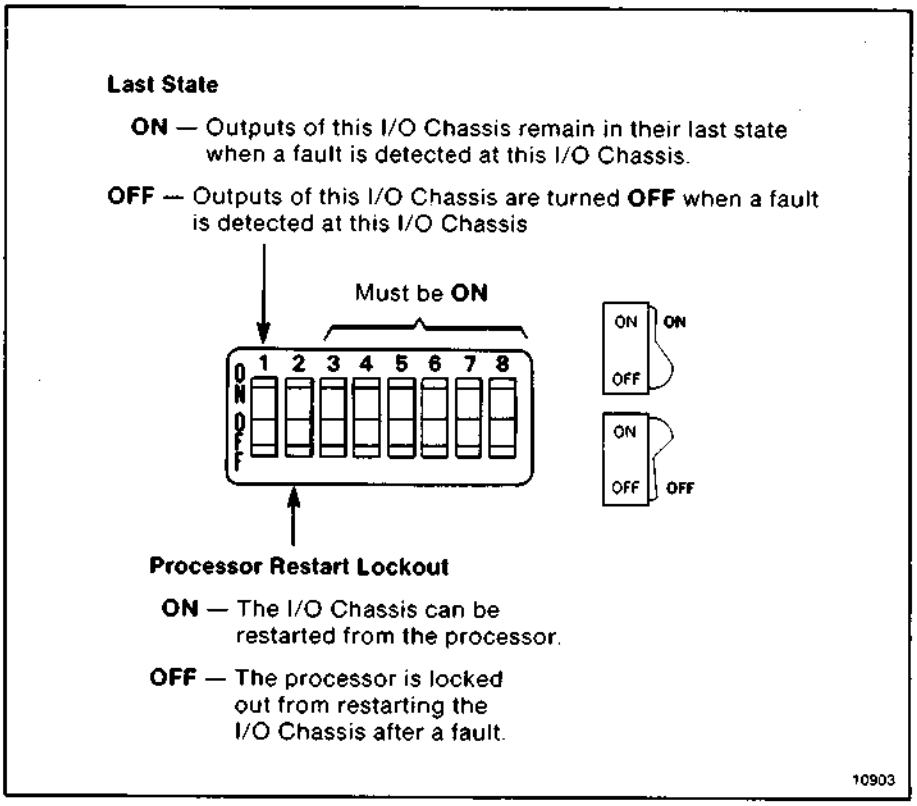


Figure 3.15 — 1771 I/O Chassis Switch Functions

3.8.2 Processor Restart Lockout

Switch 2 determines whether that I/O chassis can be restarted from the processor after a fault has been detected at that I/O chassis:

- ON — When faulted, that I/O chassis can be restarted from the processor.
- OFF — When faulted, that I/O chassis cannot be restarted from the processor.

With switch 2 set to either position when faulted, that I/O chassis can be restarted either by cycling power to the I/O chassis or by momentarily closing a user-supplied switch connected across the RESET terminals on its I/O adapter module (refer to figure 3.29).

3.9 I/O Adapter Module Switches

Set the I/O chassis address and data transmition rate thru switches at each I/O adapter module. Remove the small switch cover plate on the side of the I/O adapter module to access two switch assemblies (figure 3.16). Set these switches with a blunt pointed instrument such as a ball point pen.

3.9.1 Addressing Switch Assembly

The addressing switch assembly is shown in figure 3.17. Use switches 1 thru 6 to set the I/O rack number as indicated by table 3.A. Use switches 7 and 8 to set the starting I/O module group number for the I/O chassis as indicated by table 3.B.

3.9.2 Data Transmission Rate Switch Assembly

The data transmission rate switch assembly is shown in figure 3.18. Use switch 1 to select the rate:

- ON — 57.6K baud (10,000 ft max.)
- OFF — 115.2K baud (5,000 ft max.)

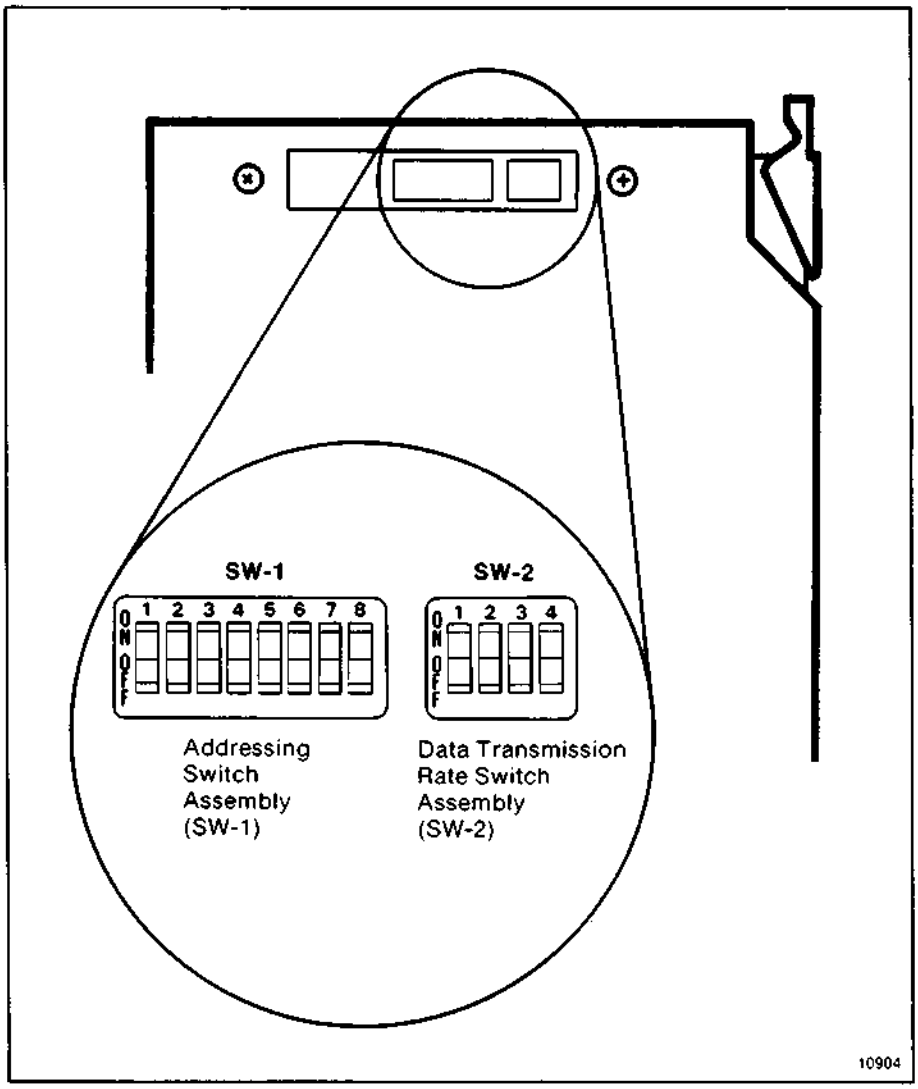


Figure 3.16 — I/O Adapter Module Switch Assembly

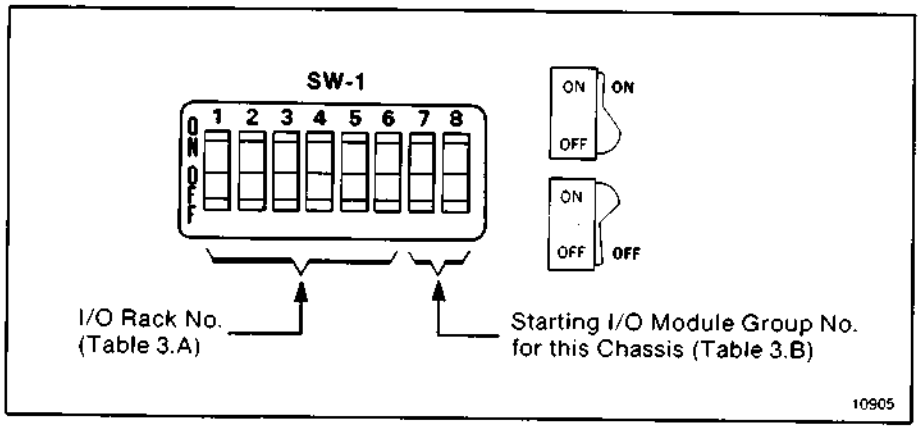


Figure 3.17 — Addressing Switch Assembly (SW-1)

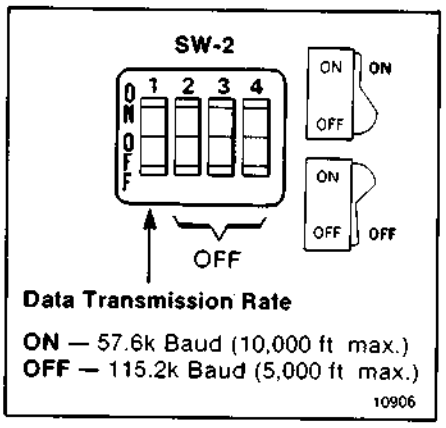


Figure 3.18 — Data Transmission Rate Switch Assembly (SW-2)

Table 3.A

I/O Rack Number Selection

I/O Rack Number (Octal)	Switch					
	1	2	3	4	5	6
0	ON	ON	ON	ON	ON	ON
1	ON	ON	ON	ON	ON	OFF
2	ON	ON	ON	ON	OFF	ON
3	ON	ON	ON	ON	OFF	OFF
4	ON	ON	ON	OFF	ON	ON
5	ON	ON	ON	OFF	ON	OFF
6	ON	ON	ON	OFF	OFF	ON
7	ON	ON	ON	OFF	OFF	OFF
10	ON	ON	OFF	ON	ON	ON
11	ON	ON	OFF	ON	ON	OFF
12	ON	ON	OFF	ON	OFF	ON
13	ON	ON	OFF	ON	OFF	OFF
14	ON	ON	OFF	OFF	ON	ON
15	ON	ON	OFF	OFF	ON	OFF
16	ON	ON	OFF	OFF	OFF	ON
17	ON	ON	OFF	OFF	OFF	OFF
20	ON	OFF	ON	ON	ON	ON
21	ON	OFF	ON	ON	ON	OFF
22	ON	OFF	ON	ON	OFF	ON
23	ON	OFF	ON	ON	OFF	OFF
24	ON	OFF	ON	OFF	ON	ON
25	ON	OFF	ON	OFF	ON	OFF
26	ON	OFF	ON	OFF	OFF	ON
27	ON	OFF	ON	OFF	OFF	OFF
30	ON	OFF	OFF	ON	ON	ON
31	ON	OFF	OFF	ON	ON	OFF
32	ON	OFF	OFF	ON	OFF	ON
33	ON	OFF	OFF	ON	OFF	OFF
34	ON	OFF	OFF	OFF	ON	ON
35	ON	OFF	OFF	OFF	ON	OFF
36	ON	OFF	OFF	OFF	OFF	ON
37	ON	OFF	OFF	OFF	OFF	OFF
40	OFF	ON	ON	ON	ON	ON

Table 3.A (Continued)

I/O Rack Number Selection

I/O Rack Number (Octal)	Switch					
	1	2	3	4	5	6
41	OFF	ON	ON	ON	ON	OFF
42	OFF	ON	ON	ON	OFF	ON
43	OFF	ON	ON	ON	OFF	OFF
44	OFF	ON	ON	OFF	ON	ON
45	OFF	ON	ON	OFF	ON	OFF
46	OFF	ON	ON	OFF	OFF	ON
47	OFF	ON	ON	OFF	OFF	OFF
50	OFF	ON	OFF	ON	ON	ON
51	OFF	ON	OFF	ON	ON	OFF
52	OFF	ON	OFF	ON	OFF	ON
53	OFF	ON	OFF	ON	OFF	OFF
54	OFF	ON	OFF	OFF	ON	ON
55	OFF	ON	OFF	OFF	ON	OFF
56	OFF	ON	OFF	OFF	OFF	ON
57	OFF	ON	OFF	OFF	OFF	OFF
60	OFF	OFF	ON	ON	ON	ON
61	OFF	OFF	ON	ON	ON	OFF
62	OFF	OFF	ON	ON	OFF	ON
63	OFF	OFF	ON	ON	OFF	OFF
64	OFF	OFF	ON	OFF	ON	ON
65	OFF	OFF	ON	OFF	ON	OFF
66	OFF	OFF	ON	OFF	OFF	ON
67	OFF	OFF	ON	OFF	OFF	OFF
70	OFF	OFF	OFF	ON	ON	ON
71	OFF	OFF	OFF	ON	ON	OFF
72	OFF	OFF	OFF	ON	OFF	ON
73	OFF	OFF	OFF	ON	OFF	OFF
74	OFF	OFF	OFF	OFF	ON	ON
75	OFF	OFF	OFF	OFF	ON	OFF
76	OFF	OFF	OFF	OFF	OFF	ON

NOTE: Do not select an I/O rack number greater than 37 without reading the restrictions given in section 2.8.

Table 3.B

Starting I/O Module Group Number Selection

Starting I/O Module Group Number:	Switch No. 7	Switch No. 8
0	ON	ON
2	ON	OFF
4	OFF	ON
6	OFF	OFF

3.10 Keying

A package of plastic Keys (cat. no. 1777-RK) is provided as standard with each I/O chassis. When properly placed, these keys can guard against the seating of all but a selected type of module in a particular I/O chassis module slot. Keys also help

align the module with the backplane connector. Misalignment could result in short circuits.

CAUTION: If keys are not installed, a module inserted into a wrong slot could be damaged due to improper voltages connected through the wiring arm. Also, with no keys, short circuits can result from misalignment.

Each module is slotted in two places at the rear edge. Positioning of the keys on the chassis backplane connector must correspond to these slots to allow the seating of the module.

Use long-nosed pliers to insert keys for I/O modules into the upper backplane connectors. Position the keys between the numbers at the right of the connectors. For the 1771-AS remote I/O adapter module, refer to figure 3.19 to determine the proper keying positions. Refer to table 2.C or the appropriate product data publication to determine the proper keying positions for each I/O module.

You can reposition keys if it becomes necessary to use a different type of module.

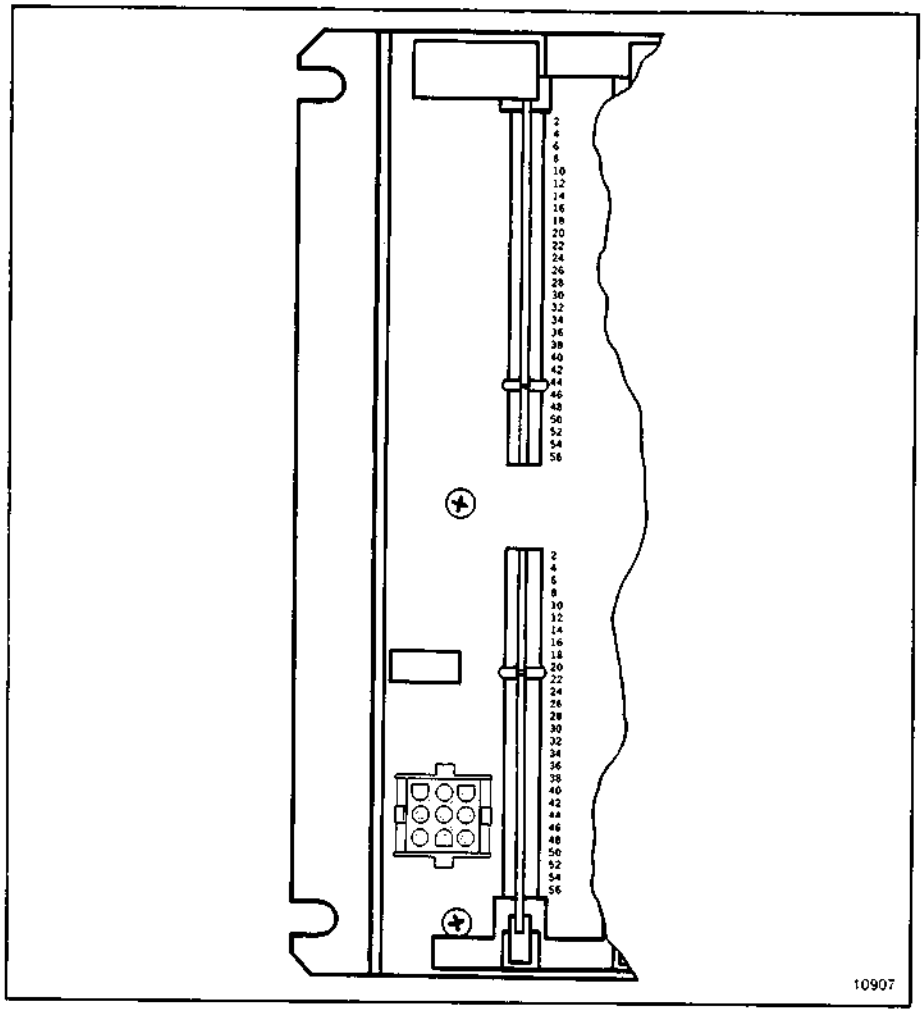


Figure 3.19 — I/O Adapter Module Keying

3.11 I/O Module Installation, Wiring

The installation of I/O modules, including wiring between wiring arms and various input and output devices, can now begin. Refer to figure 3.20 for nomenclature and location of 1771 I/O hardware components.

If followed carefully, this procedure can minimize wiring errors. Each I/O module must be correctly placed, and every I/O connection must be made at the proper wiring arm terminal. Color-coded labels identify the various types of I/O modules (tables 2.C and 2.D). Also, other labels allow the user to write in the address of each I/O terminal.

Insulation color is useful for identifying various groupings of wires. For example, the Bulletin 1790 Assembled Systems, optionally available from Allen-Bradley Factory Systems Division, typically have red AC wires and blue DC wires. However, follow all local electrical codes.

This installation procedure is necessarily general in nature. Many types of I/O modules are available, and the connections vary according to module type.

Several I/O modules require shielded-cable connections. The shields must be connected to ground at the I/O chassis (section 3.12).

The specific wiring required for each type of I/O module is in the separate product data publication for that specific module type. Therefore, refer to the appropriate product data publication during execution of the following steps:

> **CAUTION:** Do not force a module into a backplane connector; if you cannot seat a module with firm pressure, check the alignment and keying. Forcing a module can damage the backplane connector or the module.

Step 1 — Open each module locking latch and insert each I/O module into the slot keyed for it. Firmly press to seat each module into its backplane connector. After each I/O module group has been installed, secure these modules in place with the module locking latch.

Step 2 — Refer to table 2.C for the proper field wiring arm for each module. Snap each field wiring arm onto the horizontal bar at the lower front edge of the I/O chassis as shown in figure 3.21. Swing each arm up to connect on the front edge of its module as shown in figure 3.22. Push each arm in until it is held in place by its locking tab.

Step 3 — Use a flat-head screwdriver to remove the terminal cover from each wiring arm to expose the terminals as in figure 3.23. Connect the wires between the I/O devices and the wiring arm terminals. Trim the length of the wire to approximately 3/4 of an inch above its terminal. Strip approximately 3/8 of an inch insulation from the end of the wire. Bend the end of the

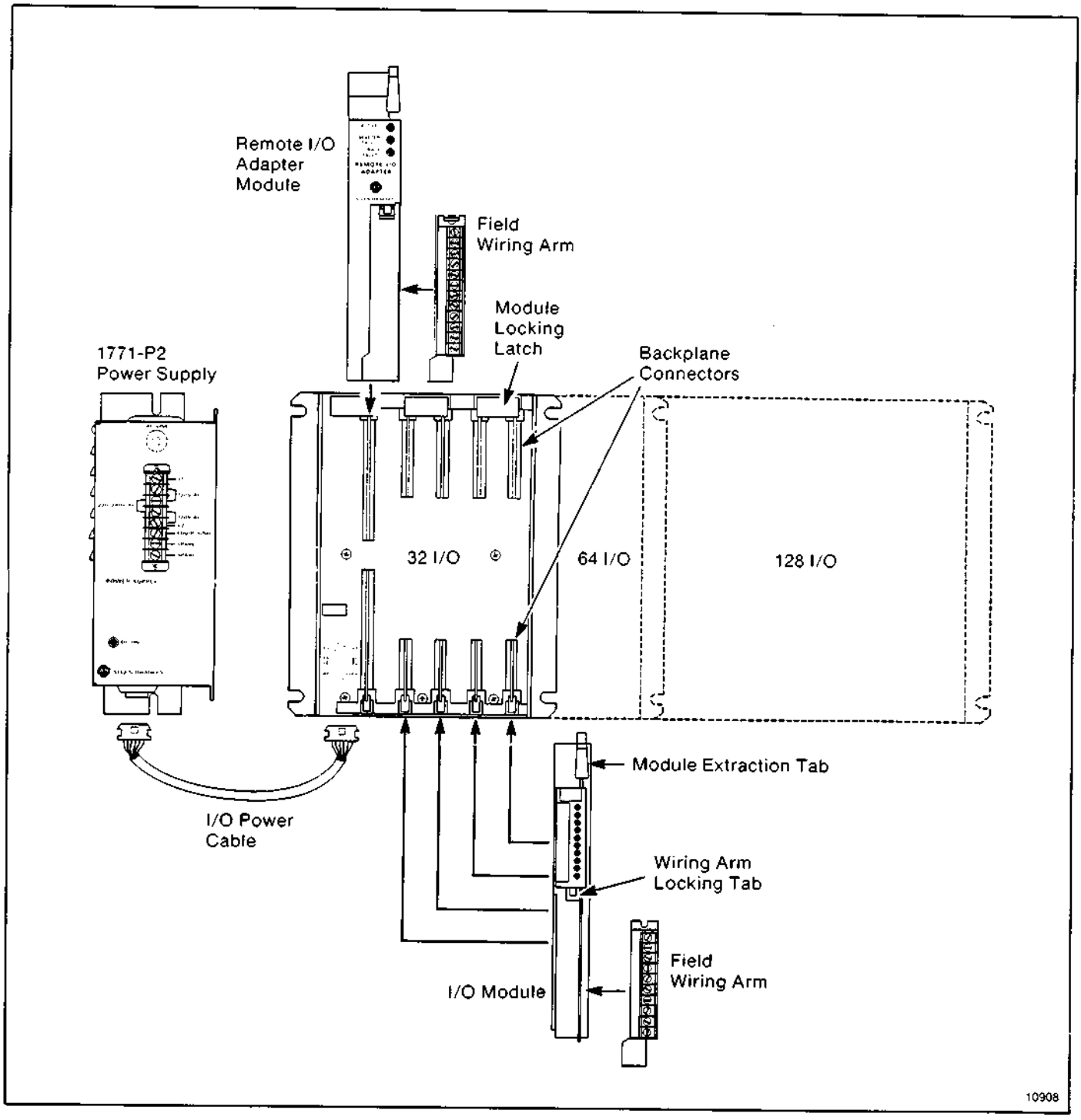


Figure 3.20 — 1771 I/O Hardware Components

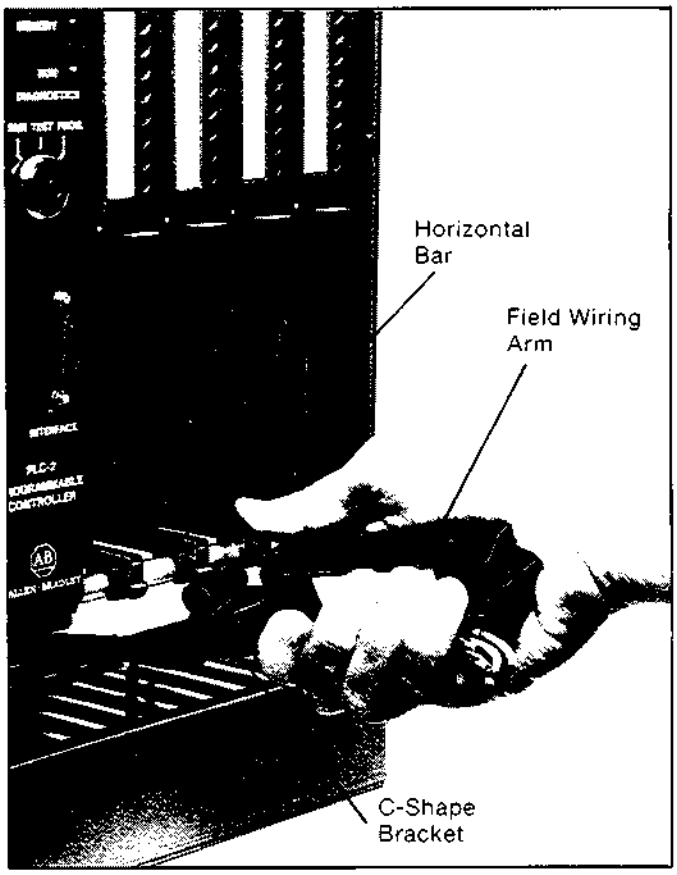


Figure 3.21 — Snapping Wiring Arm onto Chassis

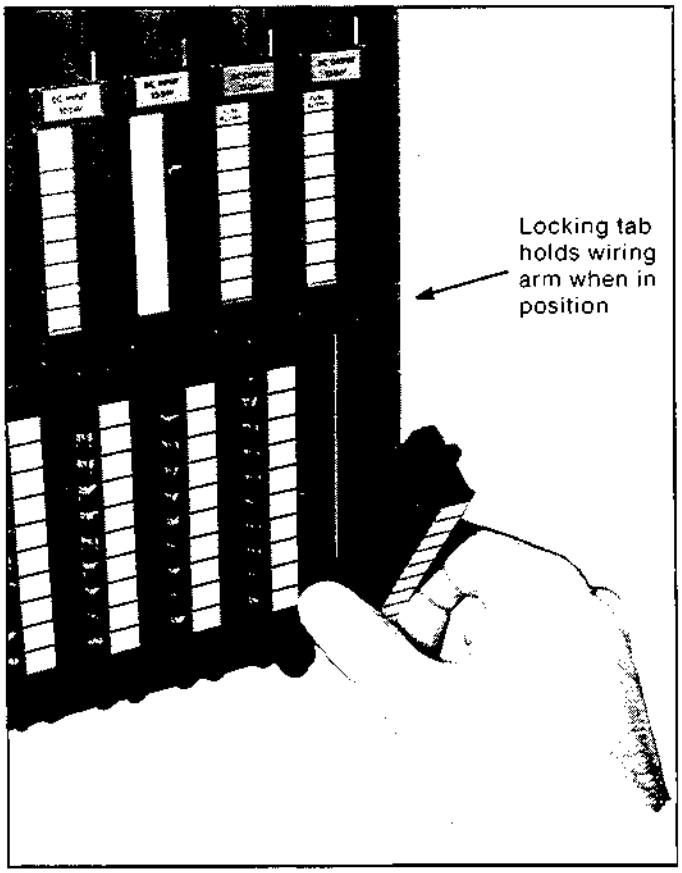


Figure 3.22 — Wiring Arms Installed

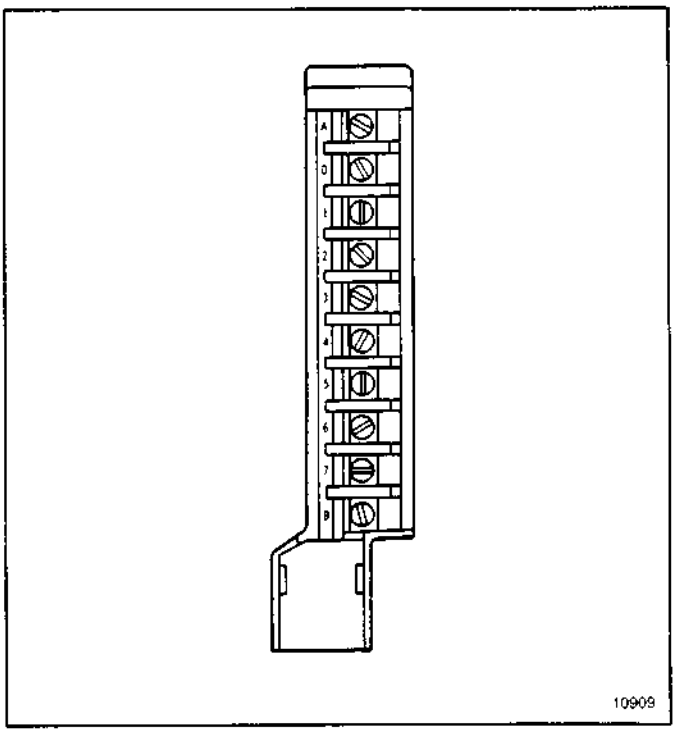


Figure 3.23 — Wiring Arm

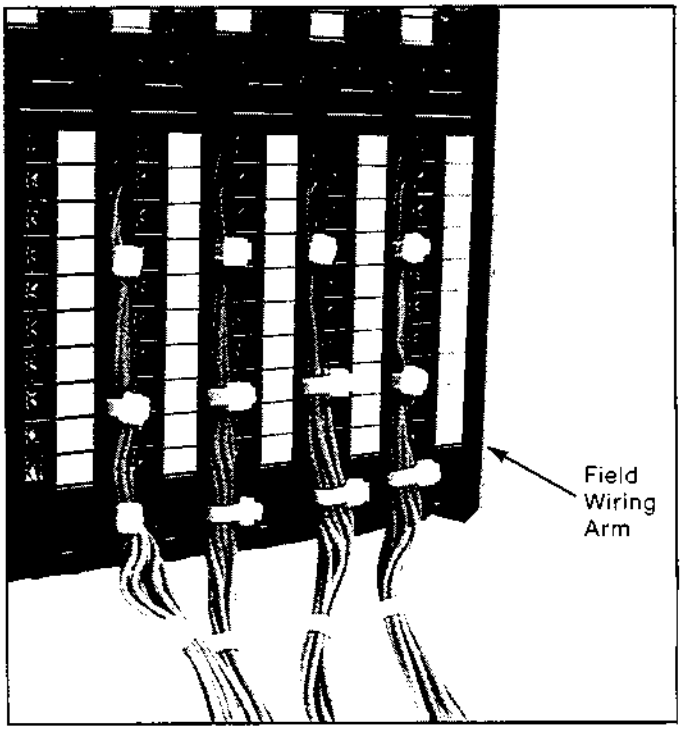


Figure 3.24 — Terminal Covers in Place Over Wiring Arms

wire to the right, and place the bare copper wire under the pressure plate of the terminal screw. (Optionally, a spade lug can be used.) Tighten the screw, and check that the wire is firmly in place. Several I/O modules require shielded-cable connections. The shields must be connected to earth ground at the I/O chassis (refer to section 3.12).

Step 4 — Determine that each I/O wire is correctly connected between its I/O terminal and its input or output device. Continuity tests are recommended. A simple continuity test may be accomplished as follows. Temporarily jumper an I/O terminal to ground. Then check for very low resistance to ground at the other end of the I/O wire where it connects to its input or output device. This test does not check for I/O components being shorted together or to ground. Note: Wire number labels should be provided at all wire connections, including those at any optional user-supplied terminal strips. The 7-digit I/O address codes are recommended as wire numbers.

WARNING: Do not turn on power to any input or output circuit at this time. To avoid exposing personnel to electric shock hazards, all input and output devices must remain de-energized until power is required during the check-out procedure.

Step 5 — Connect the various user-supplied power and "common" (ground) wires. These wires should be distributed among the wiring arms in such a way that no single wire exceeds its rated current.

CAUTION: It is your responsibility to calculate the maximum possible current in each power and common wire. Do not exceed the rated current for any particular wire size permitted by the local electrical code. Overheated wires and damaged insulation may result from overloading.

Step 6 — Use tie wraps to gather the wires at each wiring arm. Neatly bundle wires in a way that will allow the arms to pivot from vertical to horizontal.

Step 7 — Snap the terminal covers back onto the wiring arms (figure 3.24). There is a blank label on each terminal cover and beside the terminal status indicators on each I/O module. Write terminal designation information on these labels; it will be useful during system start-up and during troubleshooting.

3.12 Shielded Cables

Certain I/O modules require shielded-cable connections. A list of these is given in table 3.C. The recommended cable is Belden 8761, or equivalent.

Exact wiring connections are given in the individual product data publications corresponding to these modules. In general, however, cable installation practices must follow these outlined here.

Connect each transmission cable shield to earth ground at the I/O chassis mounting bracket. However, leave the shield unconnected at the external I/O device end of the cable. (Never ground any cable shield at both ends.)

Since each I/O chassis must be connected to earth ground, any connection to a properly mounted I/O chassis is also a connection to earth ground.

To properly connect a shielded cable at a field wiring arm, execute the following procedure:

Step 1 — Strip 3 ft of insulation from the cable at the end which is to connect to the wiring arm (figure 3.25).

Step 2 — Strip off the exposed foil. It may be necessary to insulate the bare drain wire with tape or shrink tubing along areas where it might otherwise come into contact with wiring arm terminals.

Step 3 — Trim both insulated wires to 2-inch lengths. Then strip approximately 3/8-inch of insulation from the end of each wire. The shield strand is left at its full 3-ft length (figure 3.25).

Step 4 — Connect the insulated wires at the wiring arm terminals specified in the I/O module product data publication. Fold back the bare drain wire as you route the cable. The insulated wires connect to the user device at the other end of the cable.

Step 5 — Connect the bare drain wire to ground. Route it from the wiring arm to an I/O chassis mounting bolt. The shield strand should be placed between the I/O chassis mounting bracket and the flat washer before the nut is tightened. A lug can be used (figure 3.26). In applications where many shielded cables are connected at a single I/O chassis it may be necessary to provide a ground bus for connection of many wires or to solder several drain wires together at a wiring arm so that only one drain is routed out.

Table 3.C

I/O Modules Requiring Shielded Cable Connections

I/O Module Assembly	Cat. No.
TTL (5V DC) Input	1771-IG
TTL (5V DC) Output	1771-OG
Encoder/Counter (4V DC)	1771-IJ
Encoder/Counter (12-24V DC)	1771-IK
Absolute Encoder Input (8 bit)	1771-DL
Analog (8 bit) Input	1771-IE
Analog (12 bit) Input	1771-IF
Analog (12 bit) Input Expander	1771-E1,-E2,-E3
Analog (12 bit) Output	1771-OF
Analog Output Expander	1771-E4
Thermocouple Input	1771-IX
Thermocouple Expander	1771-IY
Multiplex Input	1771-IS
Pulse Output Expander	1771-OJ
Servo (Encoder Feedback) Expander	1771-ES

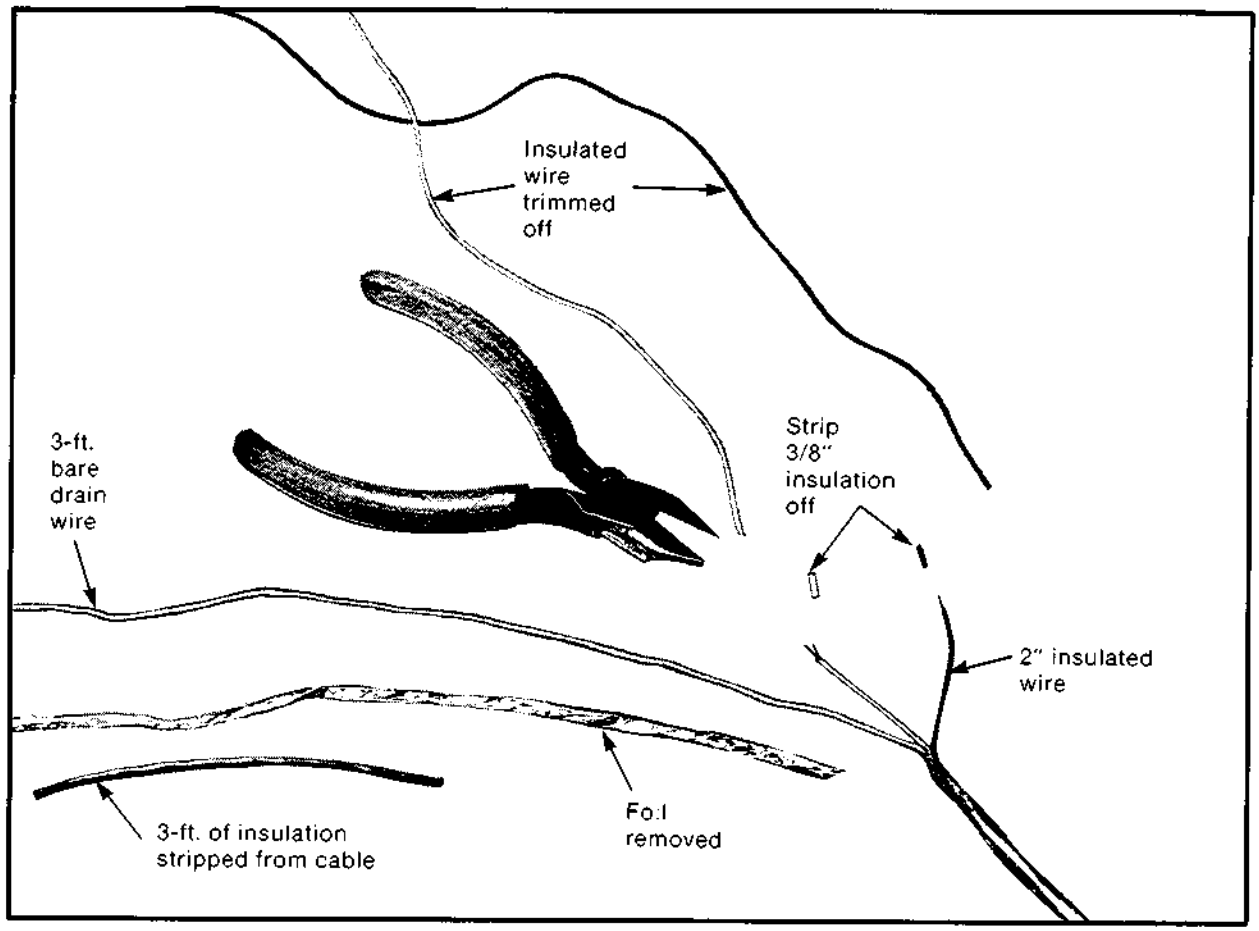


Figure 3.25 — Trim Foil and Unnecessary Insulated Wire

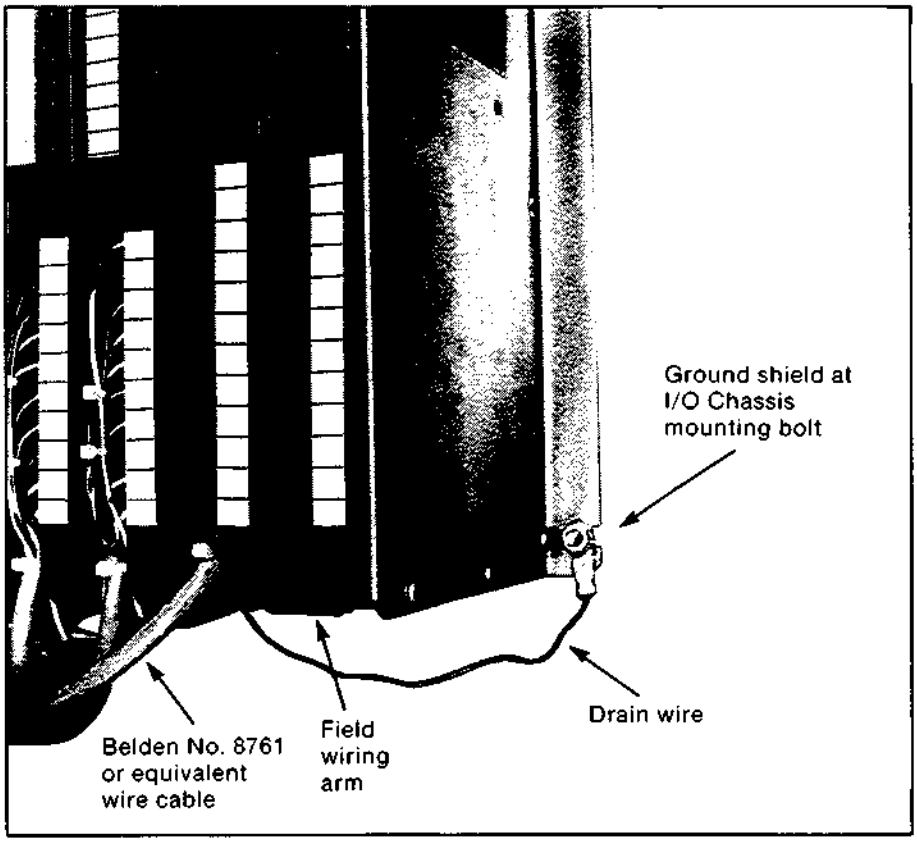


Figure 3.26 — Cable Shield Grounding

3.13 I/O Channel Connections

In figure 2.7, a simplified configuration of a single I/O channel is shown. I/O channel connections start at screw terminals on a detachable swing arm on the front of an I/O scanner module in a processor chassis. Figure 3.27 shows these terminals and indicates the connection orientation for each I/O channel of an I/O scanner module. Each I/O scanner module can provide 4 I/O channels. However, if 1775-S4A I/O scanner module number 1 is to provide a communication channel through the 25-pin female D-shell connector on the front of the module, I/O channel 4 on the module cannot be used.

Figure 3.28 shows the terminal identification label which indicates the proper connections for each I/O adapter module in an I/O channel. This label is on the side of the module. The connections are made at screw terminals on a wiring arm in front of each I/O adapter module.

Connect Twinaxial Cable (cat. no. 1770-CD) in a serial (daisy-chain) fashion from the I/O scanner module to each I/O chassis within the I/O channel as shown in figure 3.29 Connect the signal conductor with blue insulation to the LINI 1 terminal at the I/O scanner module and at each I/O adapter module in the I/O channel. Connect the signal conductor with clear insulation to the LINE 2 terminal. Connect the shield

drain wire to the SHIELD terminal. At each end of each I/O channel, connect a Terminator (cat. no. 1770-XT) between the terminals.

As an alternative to the serial (daisy-chain) wiring described here, a trunkline/dropline wiring configuration can be used as described in the Data Highway Cable Assembly and Installation Manual (publication 1770-810).

You can optionally connect a normally open, momentary contact switch between terminals 11 and 12 at each I/O adapter module. Such a RESET switch would be particularly useful if processor restart lockout is selected (figure 3.15). If a fault is detected at the I/O chassis, the RESET switch can be used to reset the I/O adapter module in an attempt to restart the I/O chassis.

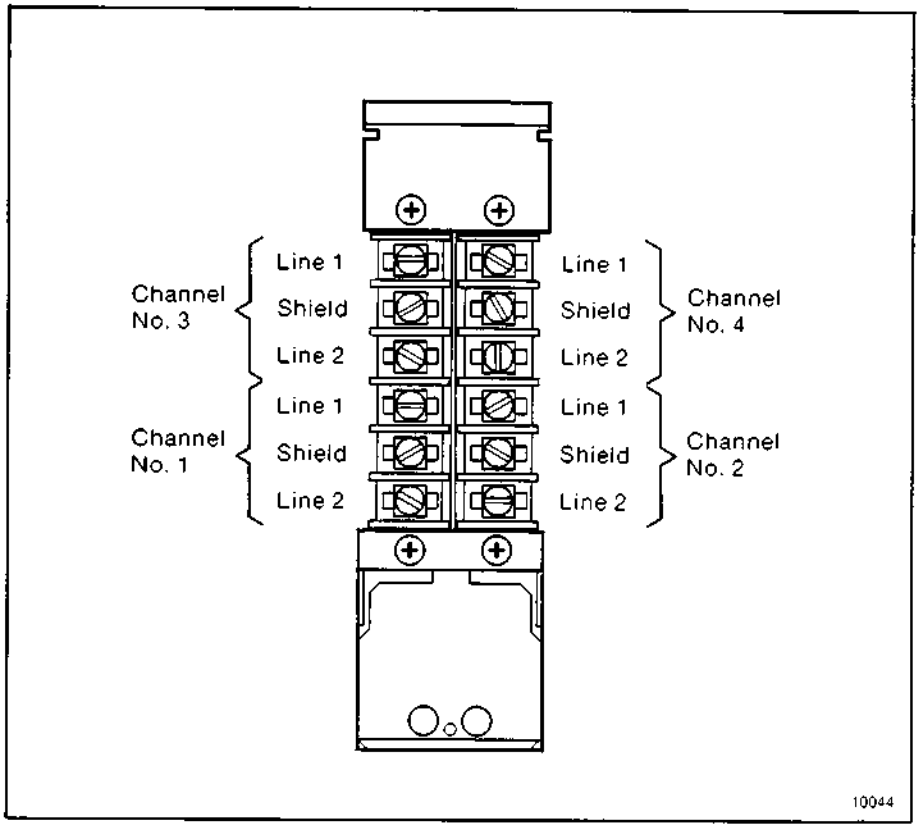


Figure 3.27 — I/O Scanner Module I/O Channel Connections

Terminal Identification Cat. No. 1771-ASC		
1	Line 1	Cable
2	Shield	
3	Line 2	
4	No connection	
5	No connection	
6	No connection	
7	No connection	
8	No connection	
9	No connection	
10	No connection	
11	IN	Reset
12	RET	

10910

Figure 3.28 — I/O Adapter Module Terminal Identification Label

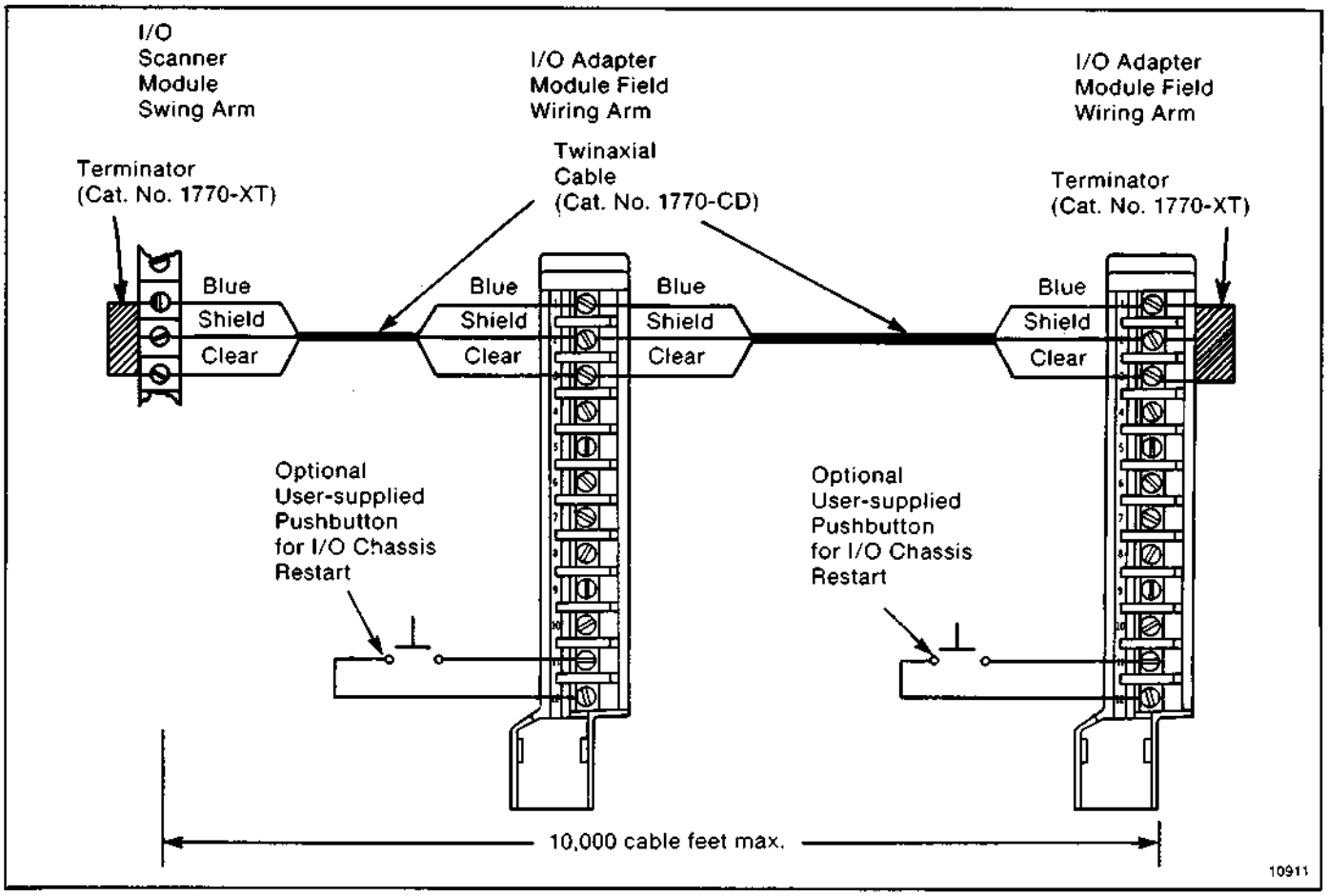


Figure 3.29 — I/O Channel Connections (2 I/O Chassis)

3.14 Peer-to-Peer Communication Channel Connections

In figure 2.17, a simplified configuration of a peer-to-peer communication network is shown. Connect Twinaxial Cable (cat. no. 1770-CD) to the screw terminals for channel 1, 2, 3, or 4 on the swing arm of a 1775-S4A scanner module. Figure 3.27 shows these terminals and indicates the proper connections for each channel. If the 1775-S4A module number 1 is to provide a communication channel through channel 5, channel 4 cannot be used.

Connect the cable in a serial (daisy-chain) fashion to each PLC-3 controller in the network as shown in figure 3.30. Connect the signal conductor with blue insulation to the LINE 1 terminal at each end of each cable segment. Connect the signal conductor with clear insulation to the LINE 2 terminal at each end of each cable segment. Connect the shield drain wire to the SHIELD terminal at only one end of each cable segment; cut the shield drain wire short at the other end. At each end of the network, connect a terminator (1770-XT) between the terminals.

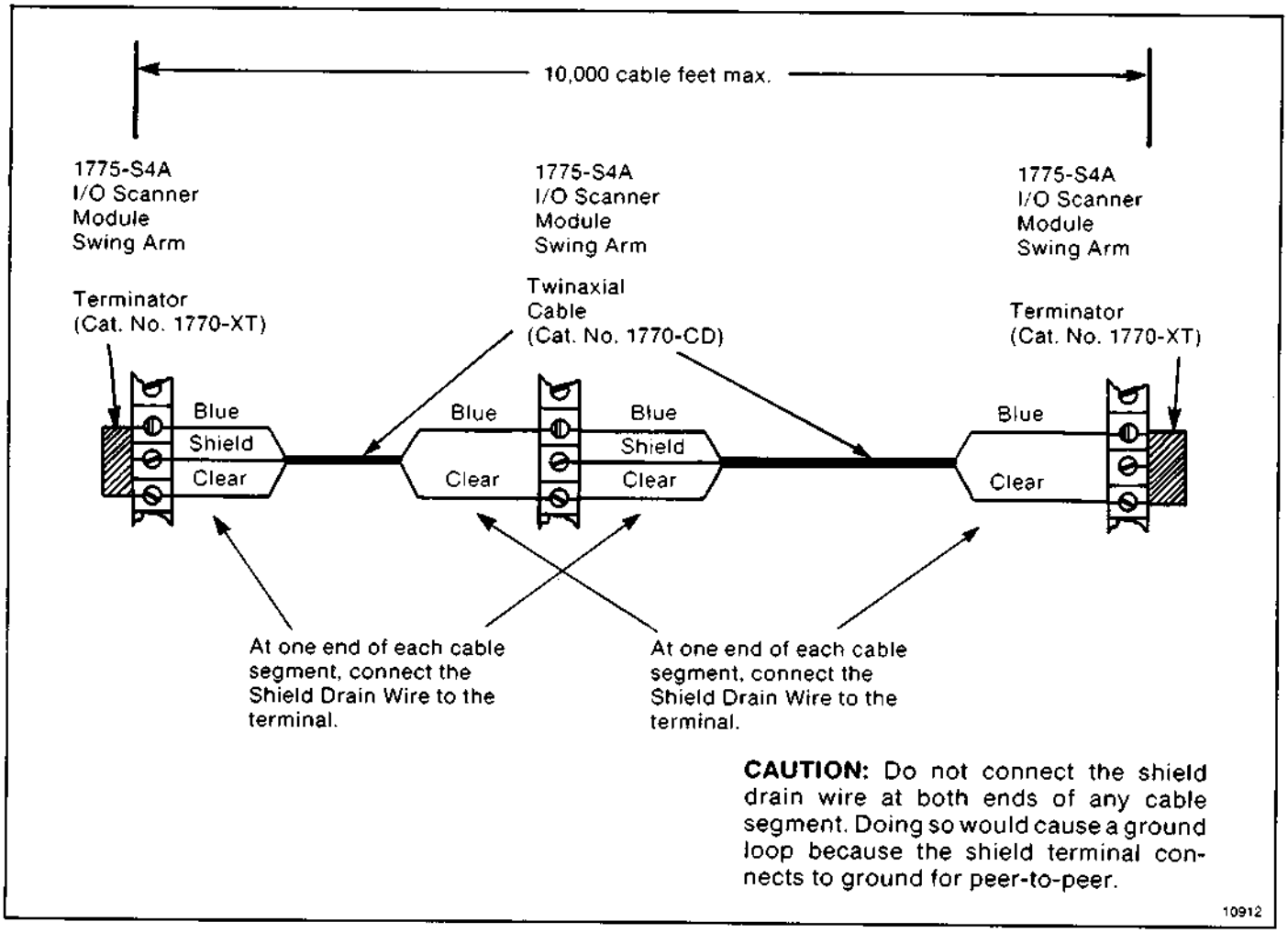


Figure 3.30 — Peer-to-Peer Communication Channel Connections

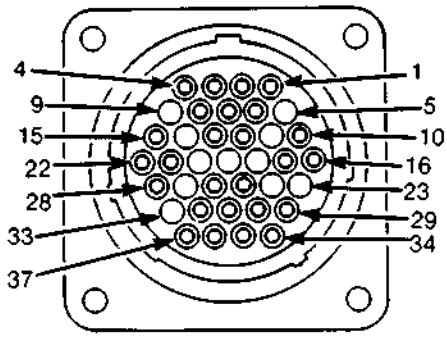
3.15 Power Cable Installation

Each power supply connector is keyed to guard against improper connection. The function of each pin in the 1775-P1 power supply is listed in figure 3.31. The function of each pin in the 1771-P2 power supply is listed in figure 3.32.

The 1775-P1 power supply has 4 DC power connectors (figure 3.33). Connect the 1775-CAP chassis power cable to the processor chassis as shown in figure 3.34.

An I/O power cable must be used to connect between each I/O chassis and a power supply. Figure 3.35A shows the connection between an I/O chassis and a 1775-P1 power supply. Figure 3.35B shows the connection between an I/O chassis and a 1771-P2 power supply.

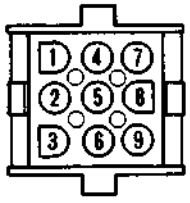
The square connectors have side snap locks which hold the mating connectors together once they have been pushed together sufficiently. To disconnect a cable, squeeze in on the two snap locks and pull firmly on the connector.



Function	Pin No.
+5V DC	1-4, 6, 7, 8, 12, 13
+15V DC	22
-15V DC	16
System Common	25, 26, 29-32, 34-37
Chassis Ground	28
$\overline{\text{AC OK}}$	15
$\overline{\text{DC OK}}$	17
$\overline{\text{Remote Shutdown}}$	10

10913

Figure 3.31 — 1775-P1 Power Supply DC Power Connectors (Outside View)



Function	Pin No.
+5V DC	1, 2
Power Supply Common	4, 5
Chassis	3
$\overline{\text{Power Up}}$ (Output)	9

10914

Figure 3.32 — 1771-P2 DC Power Supply Connector (Outside View)

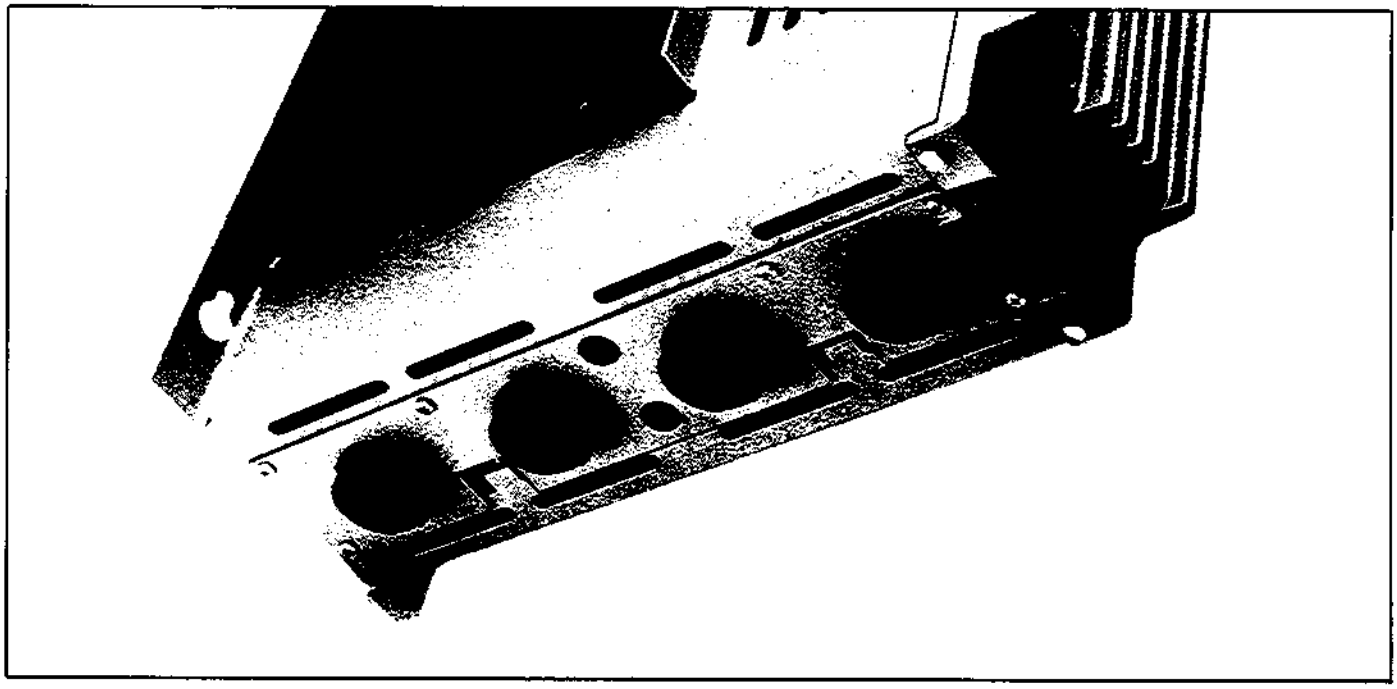


Figure 3.33 — Bottom View of 1775-P1 Power Supply

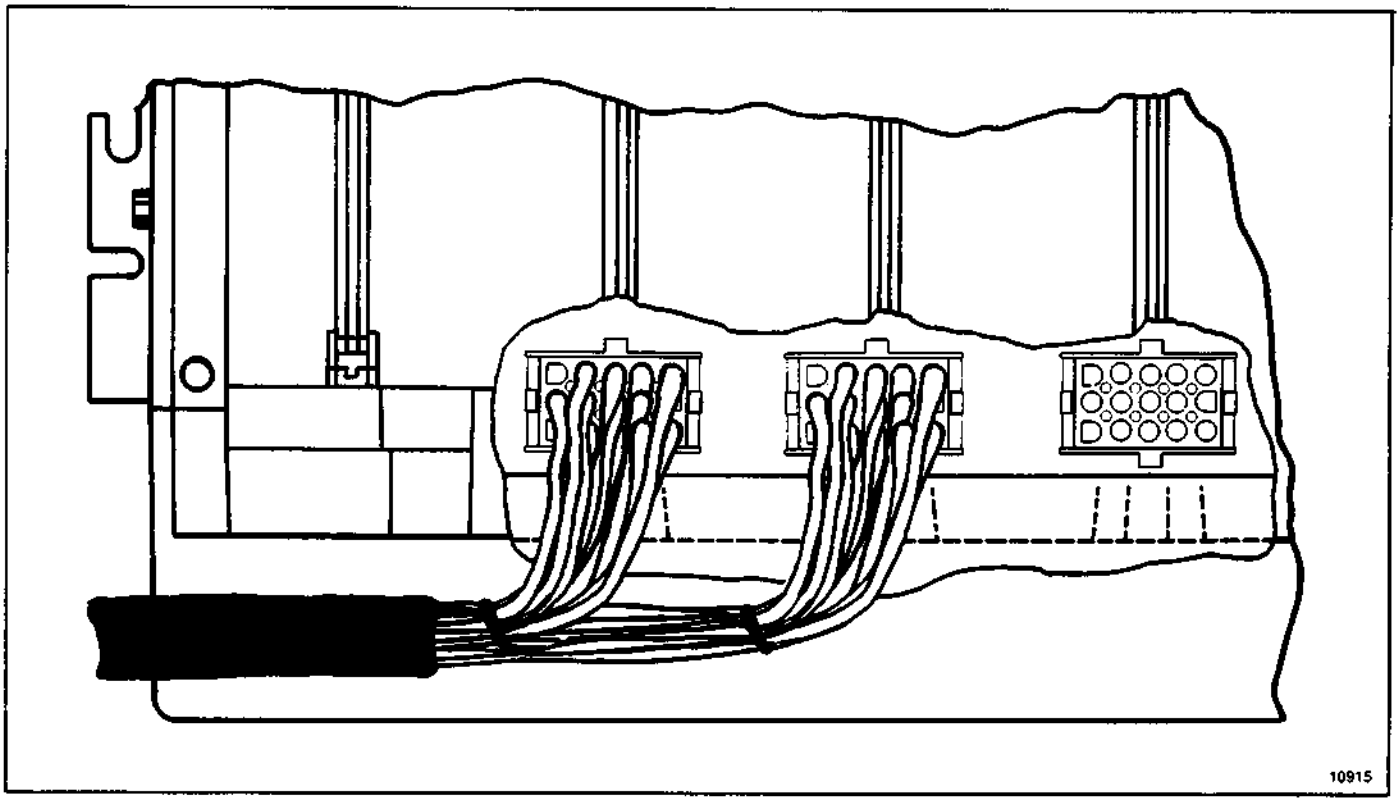


Figure 3.34 — A 1775-CAP Cable Connected to a Processor Chassis

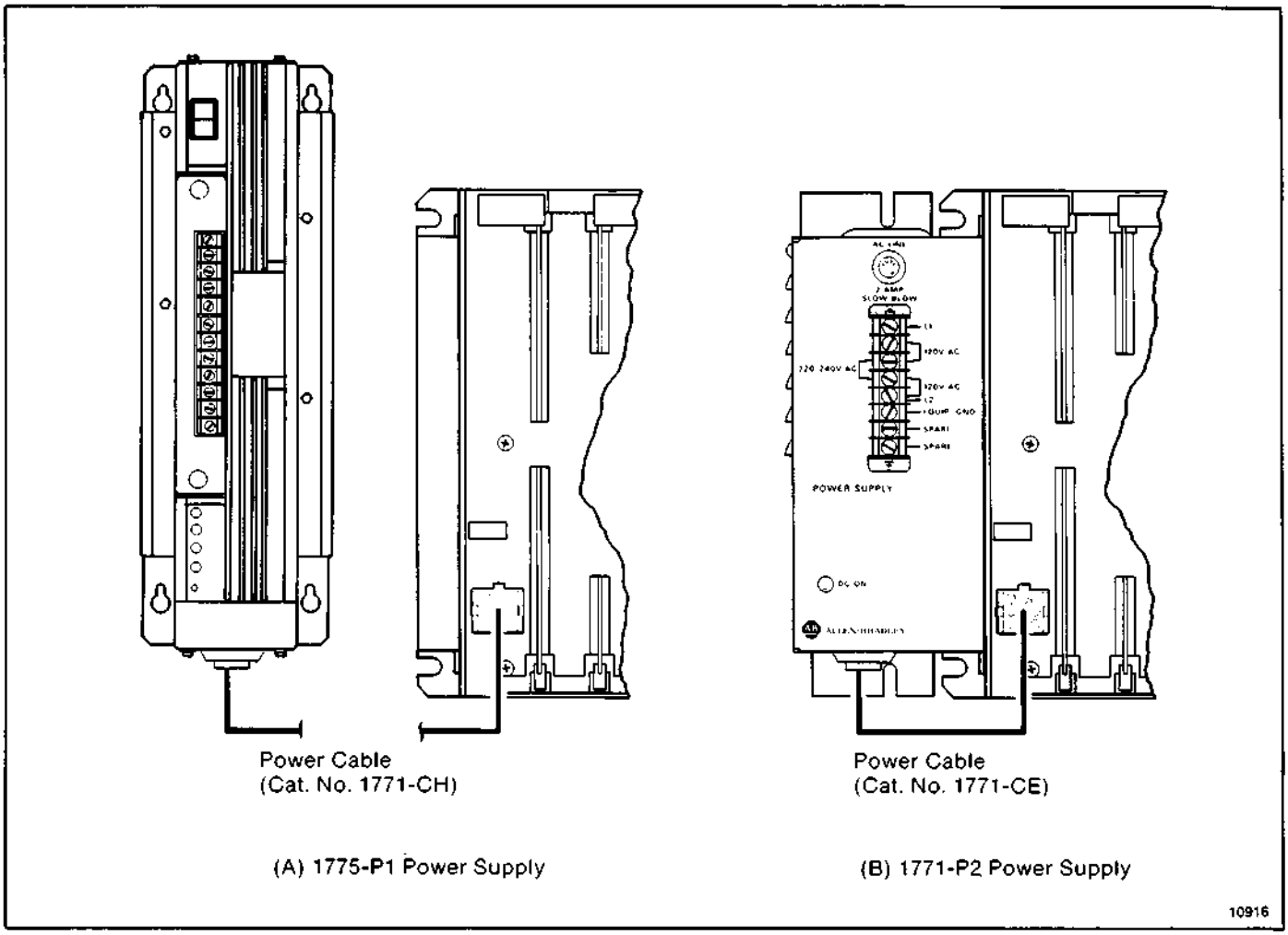


Figure 3.35 — Power Supply Connections to I/O Chassis

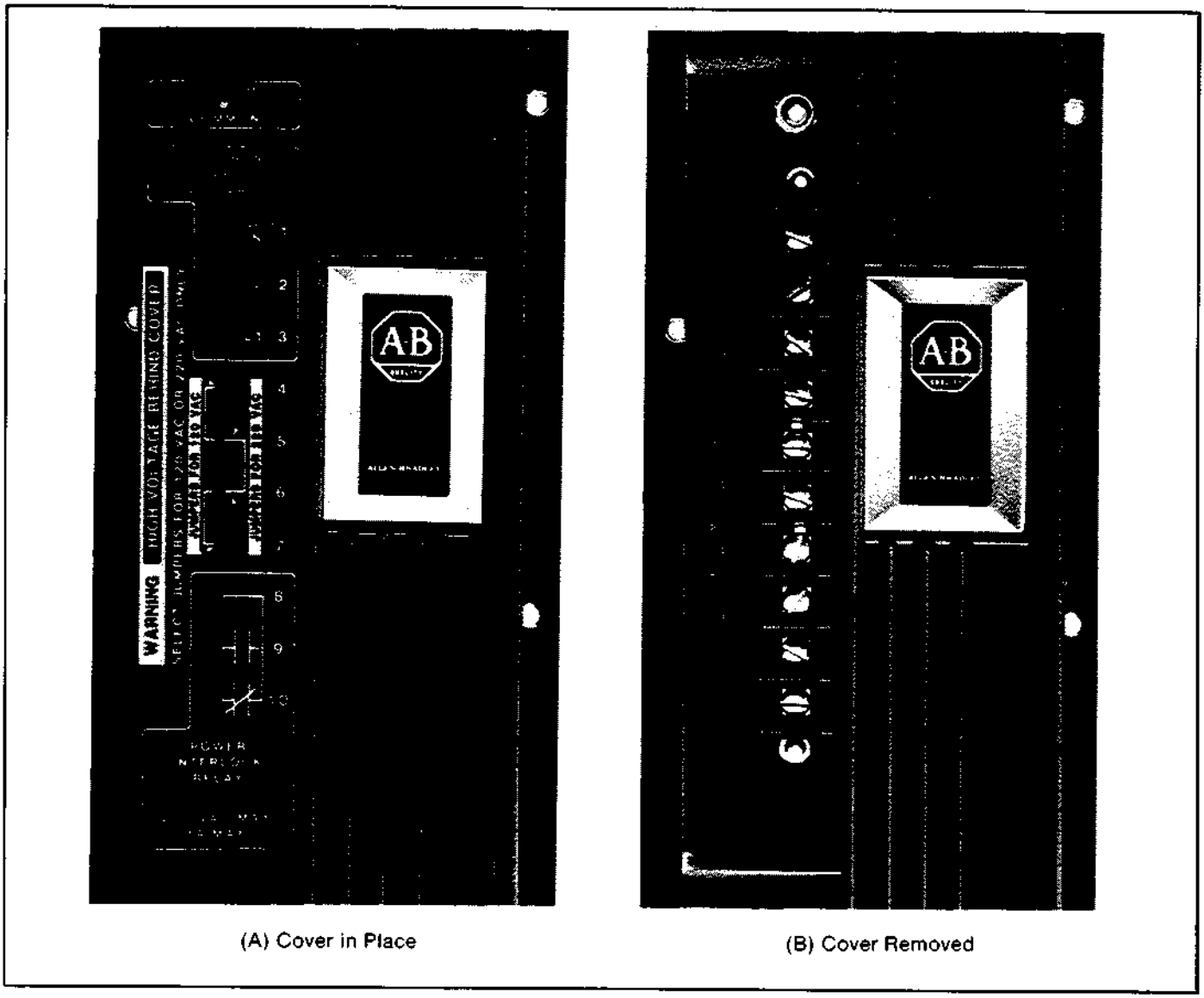
3.16 Power Interlock Relay

On the 1775-P1 power supply terminal strip, 3 terminals are provided for connection to power interlock relay form C contacts (figure 3.36). Normally closed contacts are provided across terminals 8 and 10. Normally open contacts are provided across terminals 8 and 9.

The power interlock relay contacts have a current rating of 1 ampere inductive. Contact noise suppression is supplied for 250V AC operation. Higher current or voltage operation should not be attempted.

The power interlock relay on the 1775-P1 power supply is energized whenever DC voltage is being generated at the output of the power supply.

Power interlock relay contacts can be used for alarm signal generation or machine system shut-down.



(A) Cover in Place

(B) Cover Removed

Figure 3.36 — 1775-P1 Power Supply Terminals

3.17 System Common

On each 1775-P1 power supply, separate from the terminal strip, is the SYSTEM COMMON terminal. The SYSTEM COMMON terminal provides connection to the DC common for all circuits powered by the power supply. SYSTEM COMMON is connected to chassis ground through an internal connection on the backplane of the processor chassis. If only one 1775-P1 power supply is used, do not make any external connections to the SYSTEM COMMON terminal. If multiple 1775-P1 power supplies are used in a multi-chassis system, connect the SYSTEM COMMON terminals together with 1-inch copper braid or 8 AWG copper wire.

3.18 AC Power Connections

An AC power source must be connected to each power supply at a terminal strip. The routing of the AC power lines must follow the duct layout rules in section 3.2.

For the 1775-P1 power supply, connect the high side of the isolation transformer (L1) to terminal 3; connect the low side (L2) to terminal 2 (figure 3.36).

For each 1771-P2 power supply, connect the high side of the isolation transformer to the L1 terminal; connect the low side to the L2 terminal (figure 3.35).

The 1775-P1 power supply is shipped with a jumper connected across terminals 4 and 5 and a jumper connected across terminals 6 and 7 (figure 3.36). With these jumper connections a 120V AC power source must be connected (figure 3.37A). If these jumpers are removed and both connected across terminals 5 and 6, a 220/240V AC power source must be connected (figure 3.37B).

Similarly, each 1771-P2 power supply (figure 3.35) is shipped with jumpers connected across two pairs of terminals which provide for the connection of a 120V AC power source (figure 3.38A). These jumpers can be removed and both connected across one pair of terminals which provides for the connection of a 220/240V AC power source (figure 3.38B).

> **CAUTION:** When connected for 220V AC operation, the 1A fuse in the 1771-P2 power supply must be replaced by a 0.5A fuse.

The jumpers and fuses are supplied as standard.

When the chassis of the power supply cannot be directly connected to the enclosure and ground bus as described in section 3.7, connect an equipment grounding conductor to the EQUIPMENT GROUND terminal on the power supply.

> **CAUTION:** Use a common AC power source for the power supply and all input devices connected to the I/O chassis powered by the same power supply. If separate AC power sources are used and if power is lost at the input devices while the power supply continues to operate, incorrect input data could be stored in memory.

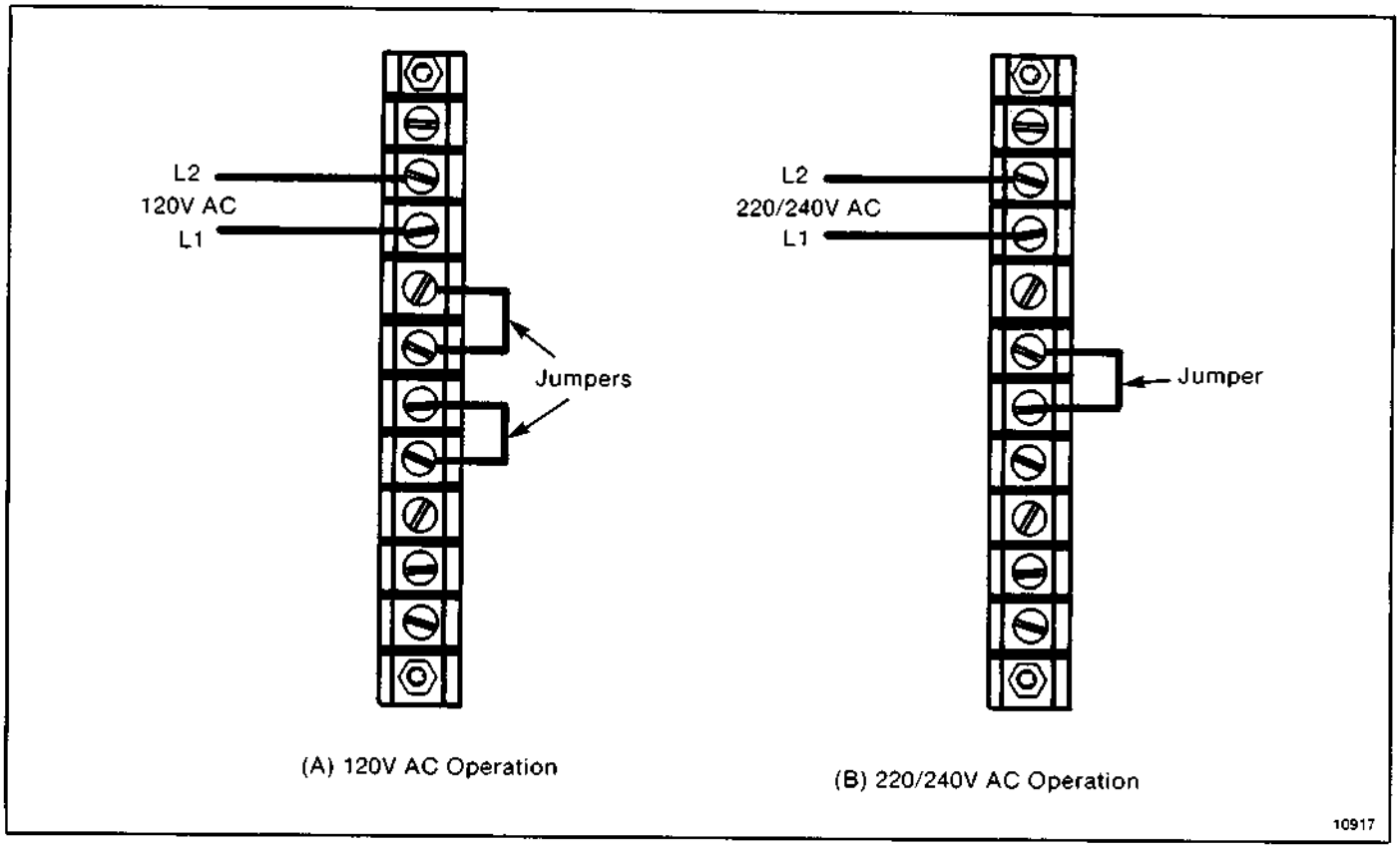


Figure 3.37 — 1775-P1 Power Supply AC Connections

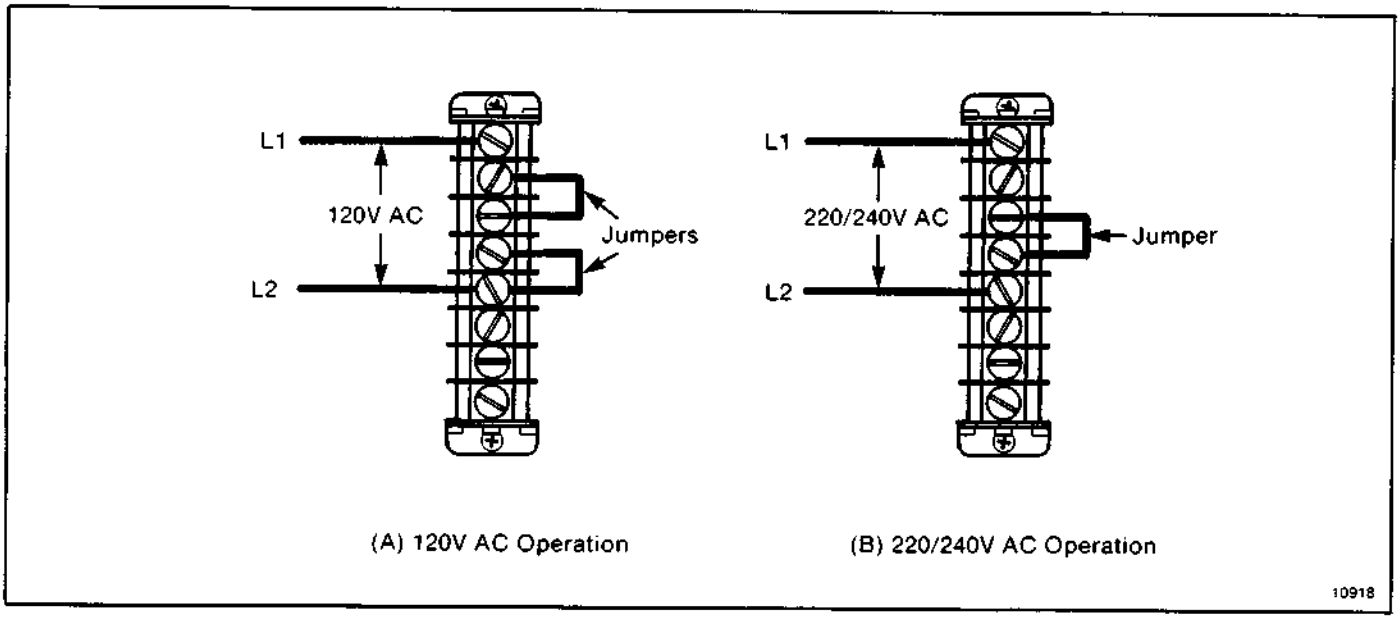


Figure 3.38 — 1771-P2 Power Supply AC Connections

3.19 Isolation Transformer

A separate isolation transformer (figure 3.39, 3.40) should be connected between the AC power source and the PLC-3 controller to minimize electromagnetic interference from other equipment. An isolation transformer may or may not be a constant voltage transformer. Connect the transformer primary to the AC source; connect the high side of the transformer secondary to the L1 terminal of the power supply; connect the low side of the transformer secondary to the L2 terminal of the power supply.

The maximum amount of AC power drawn by a 1775-P1 power supply is 600 watts. The maximum amount of AC power drawn by a 1771-P2 power supply is 60 watts. Multiply the power requirements of the PLC-3 power supplies by 2.5 to 3 and add all other power requirements (input circuits, output circuits) to determine the required rating of the transformer. The power requirements must take into consideration the surge currents of devices controlled by the PLC-3 controller. In many applications power is provided to the input and output circuits through a separate transformer.

Do not use an oversized transformer for an application because an oversized transformer will not provide as much isolation as a properly sized transformer.

A 1.5 KVA transformer could be used if a 1775-P1 power supply were the only load. A 2 KVA transformer could be used if there were 200 to 700 watts of load in addition to that of the 1775-P1 power supply.

Power supplies which are set up for 120V AC operation are designed to generate a shutdown whenever the AC line voltage drops below 97 volts, and to allow the PLC-3 controller to resume operation again when the line voltage reaches 97 volts again. A shutdown is necessary in that situation to ensure that only valid data is stored in the PLC-3 memory. For power supplies which are set up for 220V AC operation, the shutdown level is 194V AC.

In applications where the AC power source is especially "soft" and subject to unusual variations, a constant voltage transformer can stabilize the AC power source to the PLC-3 controller, thereby minimizing shutdowns.

If the PLC-3 power supplies receive their AC power through a constant voltage transformer, the input devices connected to the I/O chassis must also receive their AC power through the same constant voltage transformer. If the inputs receive AC power from another isolation transformer, the AC source voltage could go low enough that erroneous input data enters the PLC-3 memory while the constant voltage transformer prevents the power supply from shutting down the PLC-3 controller.

It is recommended that the output devices being controlled draw power from the same AC source as the constant voltage transformer, but not from the secondary side of the constant voltage transformer.

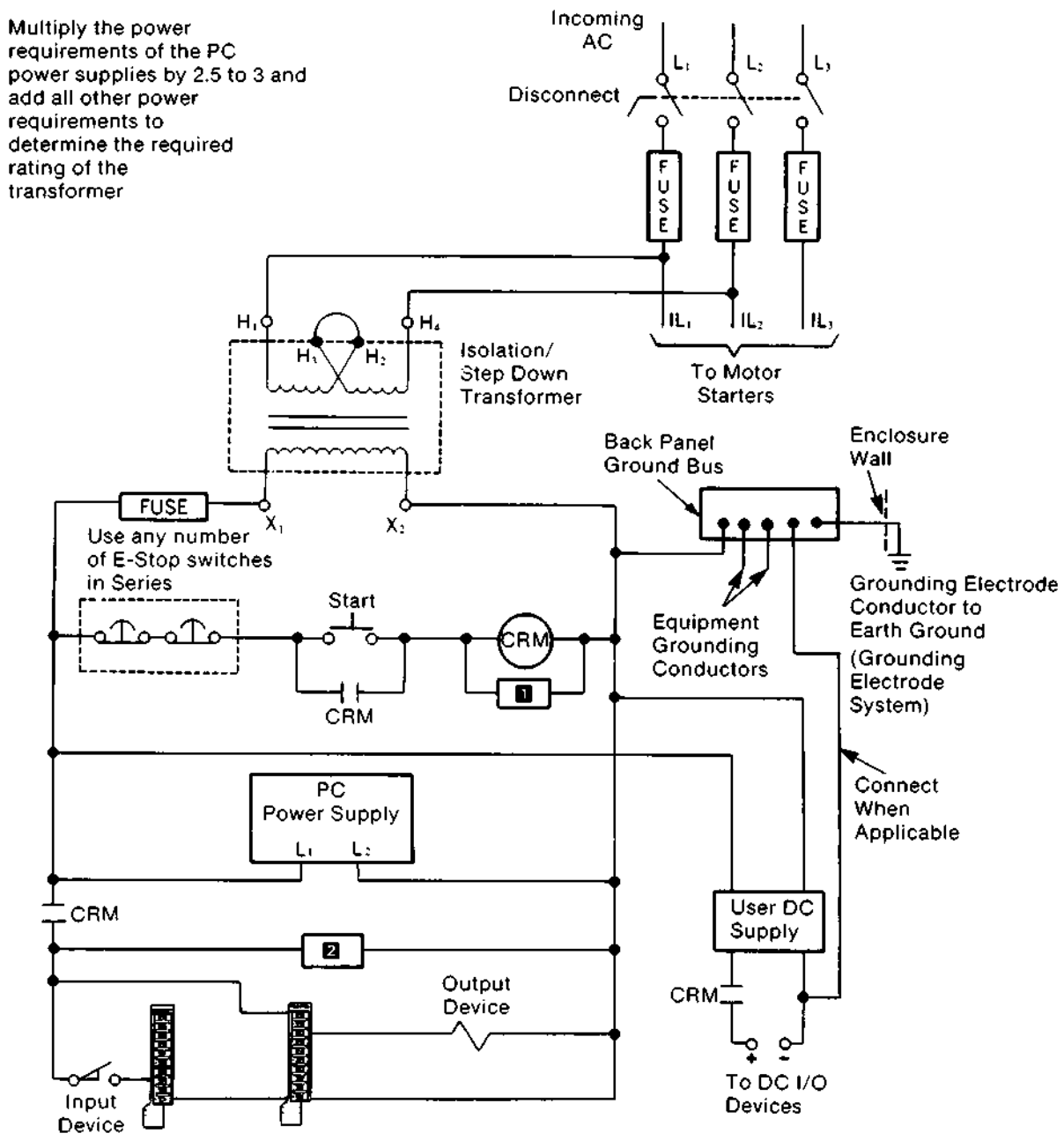


Figure 3.39 — Power Distribution with Master Control Relay, Grounded System

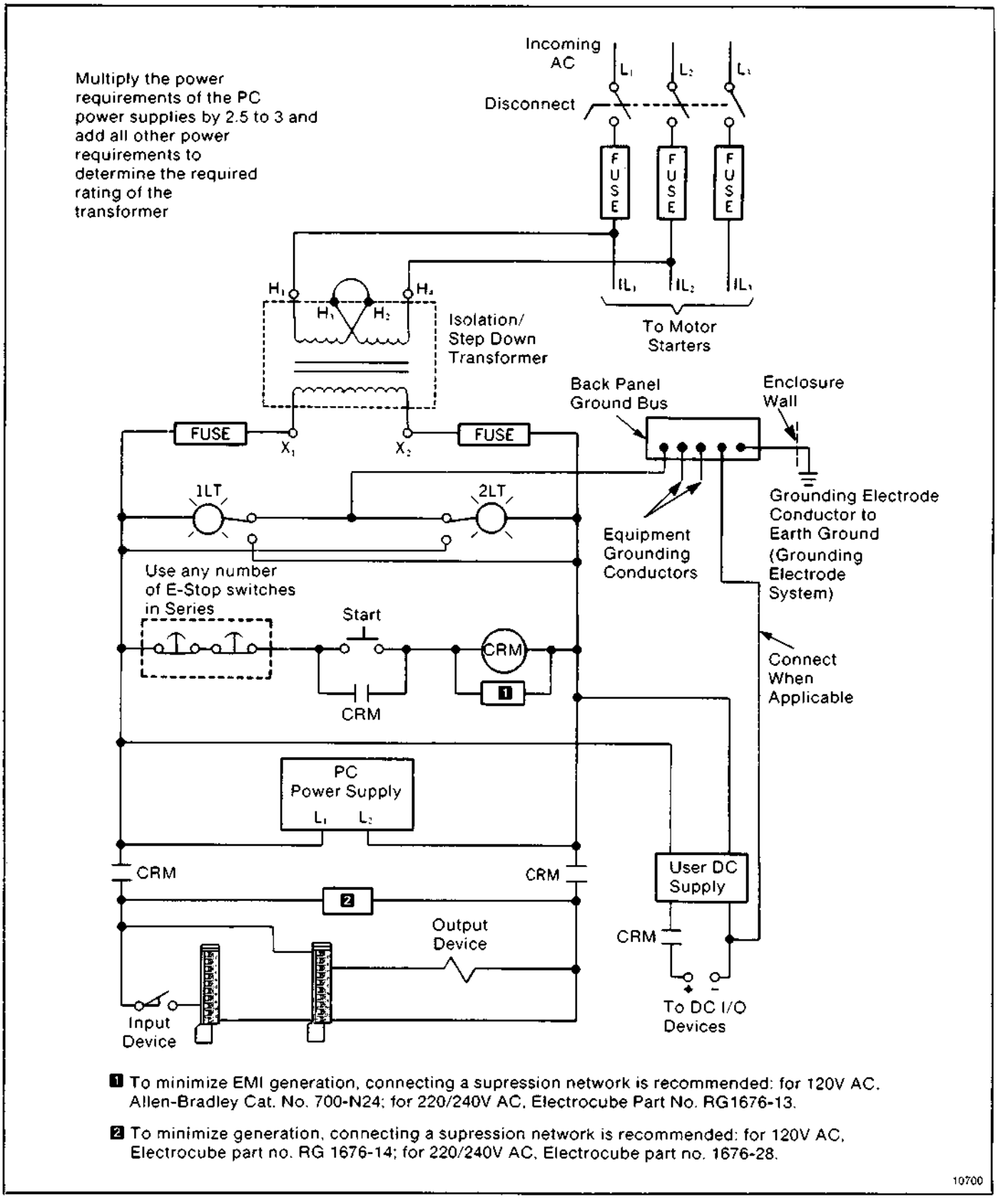


Figure 3.40 — Power Distribution with Master Control Relay, Ungrounded System

3.20 Master Control Relay

Every machine must have a master control relay which can inhibit machine motion whenever the relay de-energizes. In every case where unexpected machine motion could damage machinery or injure personnel, a master control relay in a machine shutdown circuit outside of the programmable controller must provide a backup to the controller. If a failure occurs in the controller this backup circuit must be able to stop machine motion.

3.20.1 Solid State Component Characteristics

PLC-3 programmable controller circuits are all solid state. For general information on application considerations for solid state controls, refer to publication SGI-1.1.

Solid state output circuits characteristically, though not absolutely, fail shorted rather than open. A shorted output circuit allows an output device to be held energized continuously; the controller becomes unable to de-energize the output device.

In many applications an output continuously energized may only be a nuisance. In other applications an output continuously energized may cause serious machine damage and personal injury due to unexpected machine motion. Where critical actions could occur, use extreme overtravel limit switches in a redundant hardwired circuit external to the programmable controller as a backup for shutting down machine motion.

3.20.2 Hardware Redundancy

A simplified example of overtravel detection is illustrated in figure 3.41. Limit switch 1LS is used as an input device to an input module. Normally, the user program would stop machine motion in that direction each time 1LS is activated. Limit switch 2LS is used in a hardwired circuit to control the master control relay CRM. If extreme overtravel occurs, 2LS de-energizes CRM which consequently removes power to the machine, thereby inhibiting all machine motion.

A stop pushbutton switch could also be used to turn off power to the machine; however, that depends on an operator sensing the problem and acting in time. Two stop pushbutton switches are shown in figure 3.41. A number of switches could be wired in series. Each operator station and accessable points on a machine should have a stop switch within easy reach.

The master control relay in figure 3.41 can only be energized by pressing the START pushbutton switch. The relay is then held energized through its own contacts in a hold-in path. Several other sets of contacts are in series with this relay; if any of them open, the relay de-energizes.

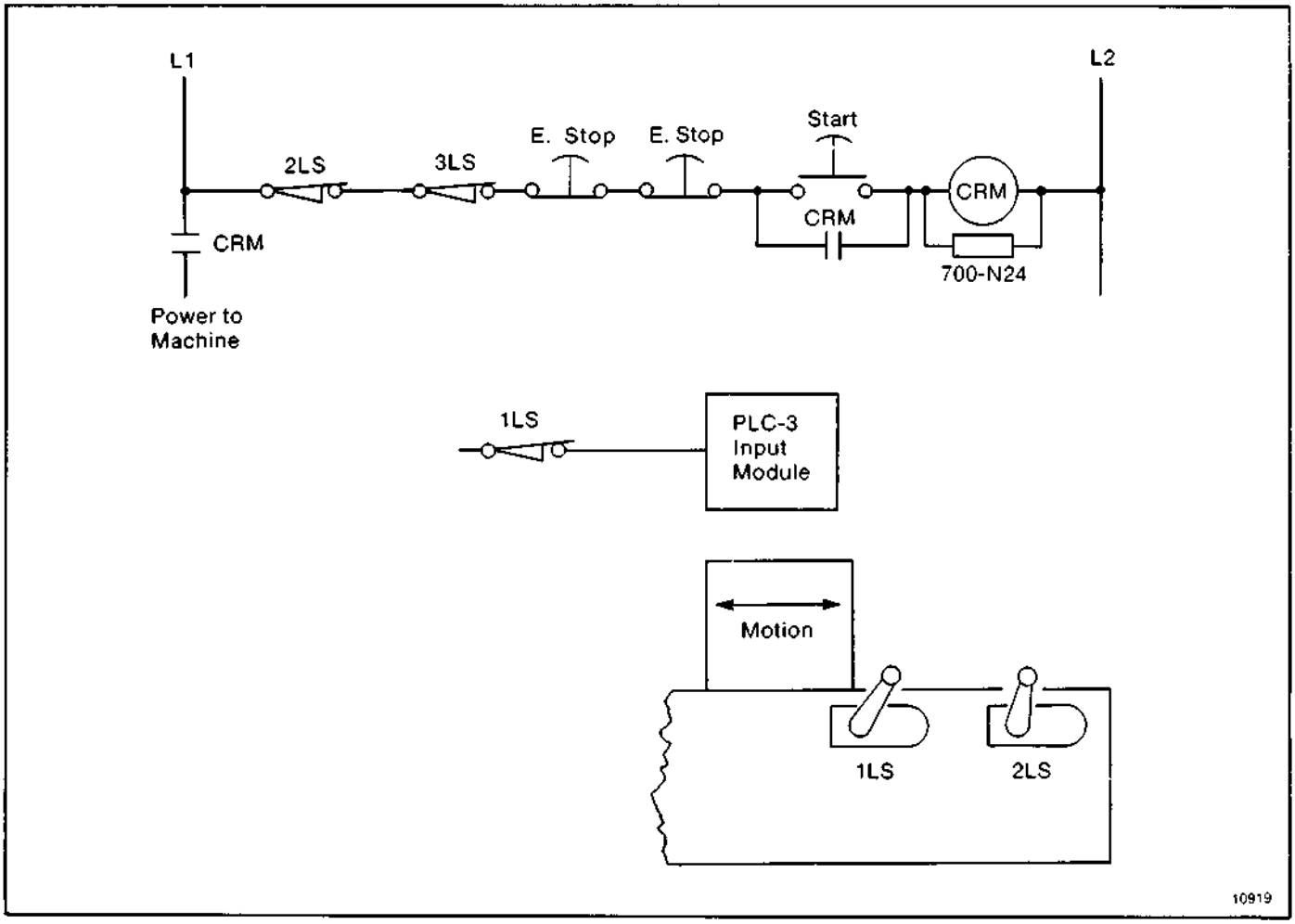


Figure 3.41 — Overtravel Detection for Machine Shutdown

Limit switch 3LS is shown in figure 3.41 as an example of a limit switch from another part of the machine. Any number of such switches can be put in series. 3LS could also be an interlock switch on a door which blocks access to a hazardous area. Opening such an interlocked door would cause all machine motion to be inhibited.

3.20.3 Power Distribution

The master control relay must be able to inhibit all machine motion by removing power to the machine input and output devices whenever the relay is de-energized. Power distribution to a master relay, a PLC-3 power supply, input devices, and output devices is illustrated in figure 3.39 and figure 3.40.

A grounded system is illustrated in figure 3.39. An ungrounded system is illustrated in figure 3.40. The difference between them is that the ungrounded system requires ground detector lights, fuses, and CRM contacts on both sides of the transformer secondary. (Refer to JIC, General Purpose Machine Tools, Publication EGP-1-67, Appendix B.)

It is important that DC power from a DC power supply be interrupted rather than AC power to the power supply being interrupted. This avoids additional delay time of power supply turn-on and turn-off. Therefore, the customer DC power supply receives power directly from the fused secondary of the transformer. However, the DC power to the DC input and DC output circuits is connected through a set of master control relay contacts. The AC power to the AC input and AC output circuits is connected through another set of master control relay contacts.

Note that only the high side of the DC power to the DC input and DC output circuits is connected through master control relay contacts. This assumes that the DC common is grounded as is the case with most DC circuits. However, if the DC common is left floating, it also must be connected through a separate set of master control relay contacts.

Note that de-energizing the master control relay only removes power from the coils of output devices such as motor starters. Power would still be available at the contacts of motor starters unless power is shut down with the main power disconnect switch.

When bringing AC power into the enclosure, the raceway or conduit may be an equipment grounding conductor which should be connected to the ground bus on the back panel.

Ground loops may introduce objectionable ground currents causing faulty operation of the programmable controller. If the use of the multiple grounding connections results in faulty operation, refer to Article 250-21 of the National Electrical Code for recommended methods of reducing the objectionable ground current. A proper earth ground should be maintained for the enclosure as described in section 3.7.

When AC power is supplied as a separately derived system through an isolation/step-down transformer, it can be connected as a grounded AC system or an ungrounded AC system.

In a grounded AC system, one side of the transformer secondary must be connected to the ground bus (figure 3.39).

In an ungrounded AC system, one side of the ground fault indicator test switch must be connected to the ground bus (figure 3.40).

3.20.4 Preventive Maintenance

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to ensure that they will stop machine motion when needed.

3.21 Interference Suppression

The effects of electrical interference along power and I/O lines have been reduced by the design and layout of the PLC-3 controller. However, when a PLC-3 controller is operated in an industrial environment, consideration must be given to possible electrical interference and methods of suppression in order to achieve maximum reliability.

Electrical noise can be generated whenever inductive devices such as relays, solenoids, motor starters, or motors are operated by "hard contacts" such as pushbutton or selector switches.

A metal enclosure helps protect against electromagnetic radiation. Further protection can be provided by a practical approach to AC power distribution: connect the PLC-3 controller to an AC power source separate from the AC power source for potential noise generators; run AC power lines to the PLC-3 controller in separate conduits from AC power lines to potential noise generators other than those controlled by the PLC-3 controller.

In some cases it may be necessary to use interference suppression networks. Connect suppression networks at the inductive loads. If they are connected at the switching devices, the wires connecting the switching devices to the inductive devices will act as antennas to radiate electrical noise.

Suggested electrical interference suppression for small inductive AC devices (i.e., relays, solenoids, and motor starters up to size 1) is given in figure 3.42. Larger contactors of Size 2 and above need in addition to the RC network, a parallel varistor for transient voltage limitation (figure 3.43). Three-phase motors are transient suppressed by providing discharge networks across all phases (figure 3.44). DC relays are suppressed by free wheeling diodes (Figure 3.45).

Allen-Bradley Industrial Products, bulletin 700 relays and bulletin 509, 709 motor starters have surge suppressors available as options. Table 3.D lists the surge suppressors and their particular use. These optional Allen-Bradley suppressors are designed for specific device coil characteristics and are suitable when interface suppression is required.

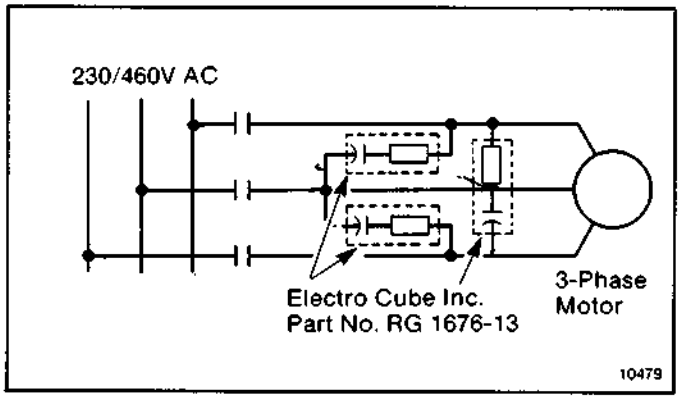


Figure 3.42 — Typical Interference Suppression for Small Apparatus

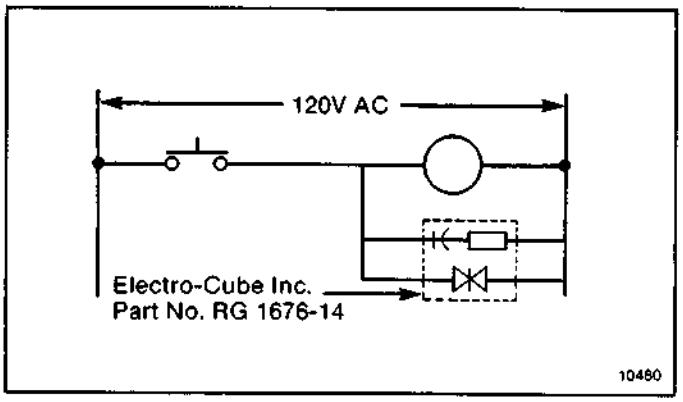


Figure 3.43 — Typical Interference Suppression for Large Apparatus

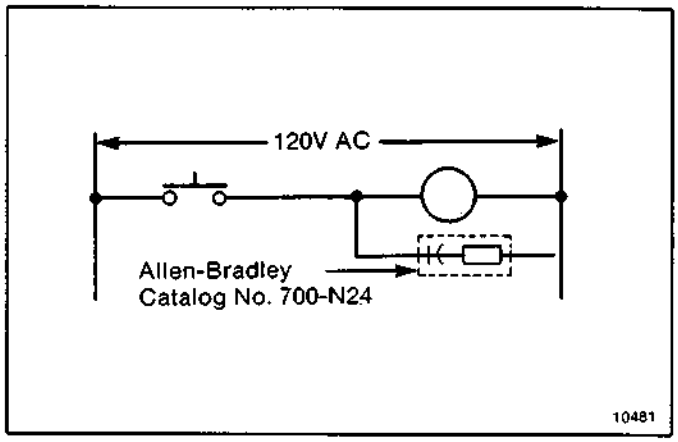


Figure 3.44 — Typical Interference Suppression for 3-Phase Apparatus

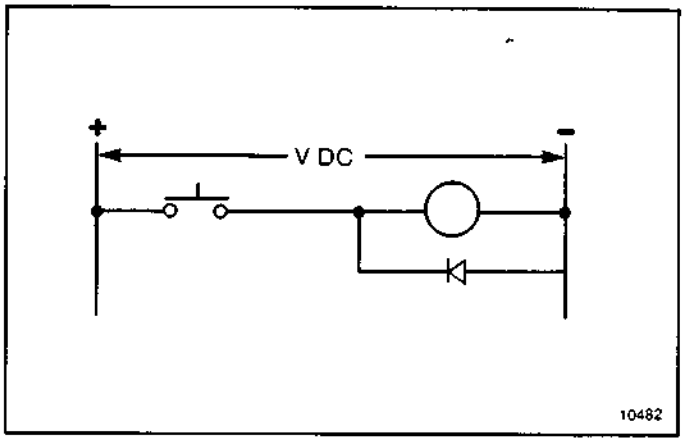


Figure 3.45 — Typical Interference Suppression for DC Relays

Table 3.D

Allen-Bradley Suppressors

Allen-Bradley Equipment	Suppressor Cat. No.
Motor Starter Bulletin 509	599-K04 [1]
Relay Bulletin 700 Type N or P	700-N24 [2]
Motor Starter Bulletin 709	1401-N10 [1]
Miscellaneous	700-N24 [3]

[1] For starters with 120V AC coils.

[2] Max. coil voltage: 150V AC or DC.

[3] The Bulletin 700-N24 is a universal surge suppressor. It can be used on electromagnetic devices with the limitation of 35 sealed VA, 150V.

3.22 Front Panel Cable

Connect the front panel cable (1775-CAK) between the front panel on the main chassis door and the connector in the upper right hand corner of the backplane of the chassis (figure 3.46). This ribbon cable must lie flat against the side of the chassis with no twist. If the cable is twisted, the connections will be reversed and improper operation will result.

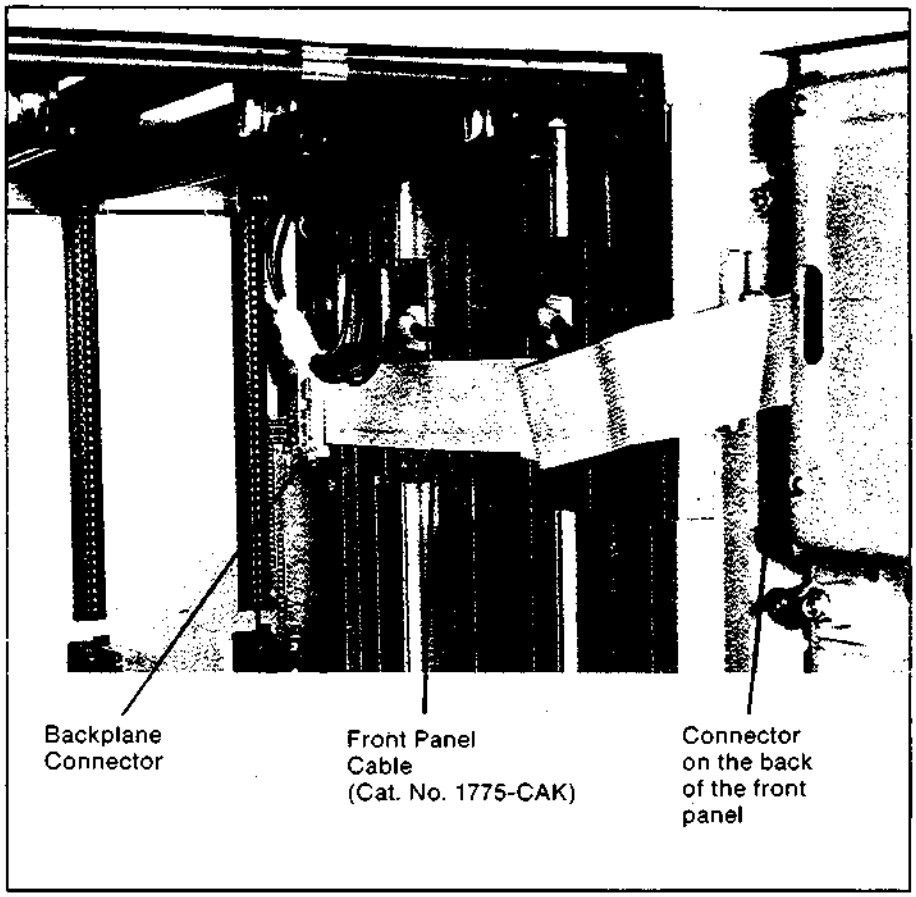


Figure 3.46 — Front Panel Cable Connection

3.23 Processor Chassis Switches

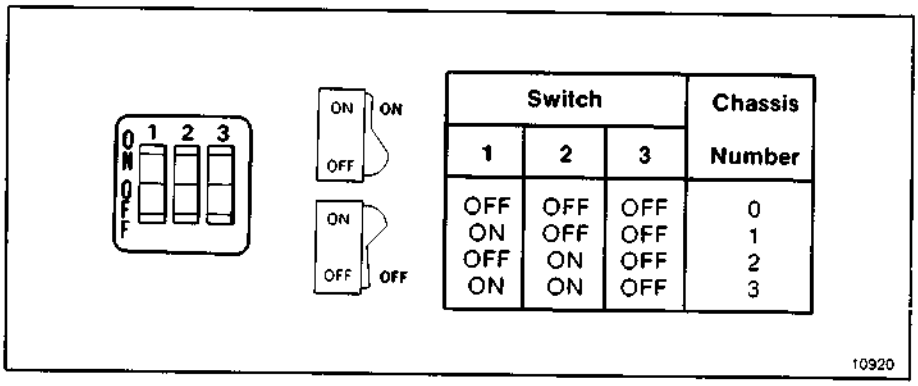
Near the upper left hand corner of the backplane of the chassis is a switch assembly of 3 switches (figure 3.47).

Refer to figure 3.47 to set these switches. If no expansion chassis are used, set the main chassis number to 0.

If expansion chassis are used, number the chassis consecutively starting with 0.

> **WARNING:** Number the chassis so that chassis 0 and the highest numbered chassis have the same power supply. Failure to configure the chassis in this way could result in unpredictable operation.

The main processor module must be placed into chassis 0. All other modules can function in any chassis. However, modules



Switch			Chassis
1	2	3	Number
OFF	OFF	OFF	0
ON	OFF	OFF	1
OFF	ON	OFF	2
ON	ON	OFF	3

Figure 3.47 — Processor Chassis Backplane Switch Settings

in lower numbered chassis have shorter response times due to higher backplane priority. This may be a consideration in module placement.

NOTE: When expansion chassis are used, the main chassis does not have to be set to number 0.

3.24 Processor Module Thumbwheel Switches

Two or more processor chassis modules of the following types can be used:

- Memory modules
- I/O scanner-programmer interface modules
- I/O scanner-message handling modules
- Communication adapter modules

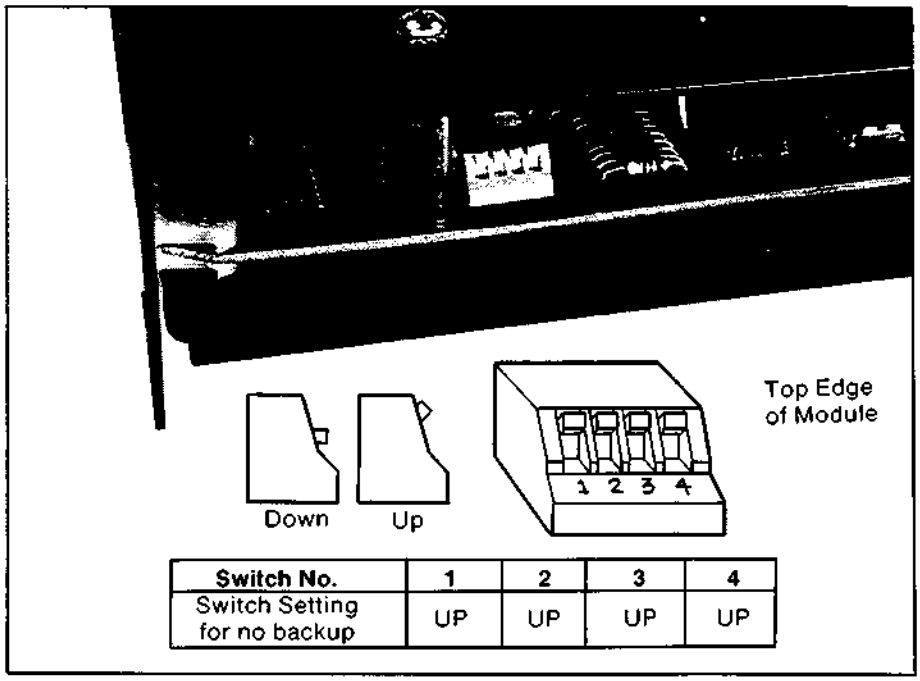
A thumbwheel switch on the front of each of these modules designates the number by which that module is distinguished from all other modules of its type. If there is only one module of a given type, designate it as number 1. If there are multiple modules of the same type, number them consecutively starting with number 1.

If each module of a type is not given a unique number, improper operation will result. If there is no 1775-S4A module number 1 in the main processor chassis, the PLC-3 controller will not function.

CAUTION: Do not change the setting of any thumbwheel switches while processor chassis power is ON; this would cause unpredictable operation.

3.25 Backup Switches

Near the top edge of each I/O scanner module is a switch assembly of 4 switches. Set these switches as indicated in figure 3.48 if there is no backup processor chassis provided. To provide processor chassis backup, refer to the PLC-3 Controller Backup Concepts Manual (publication 1775-803).



Switch No.	1	2	3	4
Switch Setting for no backup	UP	UP	UP	UP

Figure 3.48 — Backup Switches on the I/O Scanner Module (Cat. No. 1775-S4A,-S4B)

3.26 Memory Battery Installation

Install a Nickel-Cadmium Battery (cat. no. 1775-BH) or a Lithium Battery (cat. no. 1770-XR) into each CMOS RAM Memory Module (cat. no. 1775-MR4, -MR8, -ME4, -ME8). The positive terminal of the battery holder is at the top.

> **WARNING:** Refer to publication 1775-918 for detailed information for installing and handling nickel-cadmium batteries. Refer to publication 1770-951 for detailed information for installing and handling lithium batteries. Failure to follow this information could result in equipment damage and/or personal injury.

3.27 Expansion Cable Installation

When expansion chassis are used, an expansion module is required in each processor chassis. For a 2-chassis configuration, connect a set of expansion cables between the 2 expansion modules. Match the letter designations (A, B, C, D) on the cable connectors to that on the module connectors.

For a 3- or 4-chassis configuration, connect a set of expansion cables from each expansion module to the expansion distribution panel. The 4 sets of 4 connectors on the distribution panel are labeled CHASSIS 0, CHASSIS 1, CHASSIS 2, and CHASSIS 3. Connect from the distribution panel to the indicated chassis. Also, match the letter designations on the cable connectors to that on the distribution panel connectors.

For a 3-chassis configuration, connect a set of 4 expansion terminators to the 4 connectors labeled CHASSIS 3 on the expansion distribution panel.

Chapter

4

Front Panel Operation

4.0 General

Across the top of the main chassis door is the front panel (figure 4.1). The front panel includes a communication channel connector, indicators, the memory protect keyswitch, and the data access panel.

4.0.1 Peripheral Channel 0

A 25-pin D-shell connector (labeled PERIPHERAL CHANNEL 0) on the front panel provides connection for a peripheral communication channel (figure 4.2). An Industrial Terminal System (cat. no. 1770-T4) can be connected to communicate through this channel (5000 feet maximum cable length).

4.0.2 Indicators

There are 4 dual-color LED indicators on the front panel. These indicators provide important information about the status of the PLC-3 controller. Indicator functions are listed in table 4.A.

4.0.3 Memory Protect Keyswitch

The memory protect keyswitch has 3 positions. The key can be removed in any of its 3 positions. These positions are:

- MEMORY PROTECT ON — All sections of the memory are protected from being changed, and I/O cannot be forced.
- DATA CHANGE — Data table values can be changed; all other areas of memory are protected from being changed; I/O cannot be forced.
- MEMORY PROTECT OFF — The memory is not protected from being changed, and I/O can be forced.

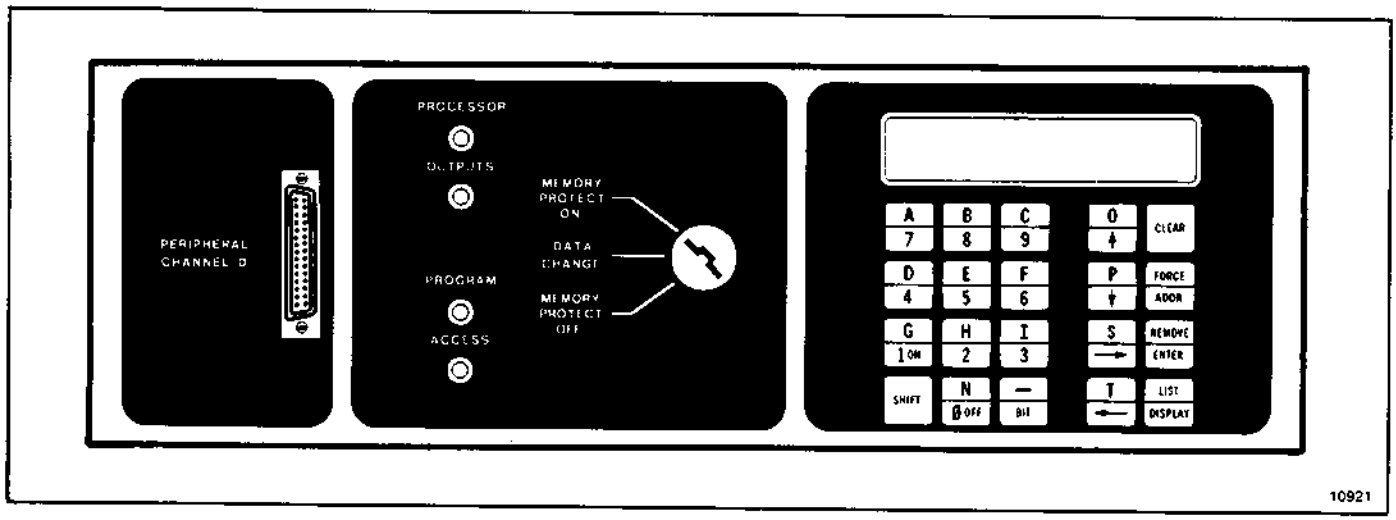


Figure 4.1 — Front Panel

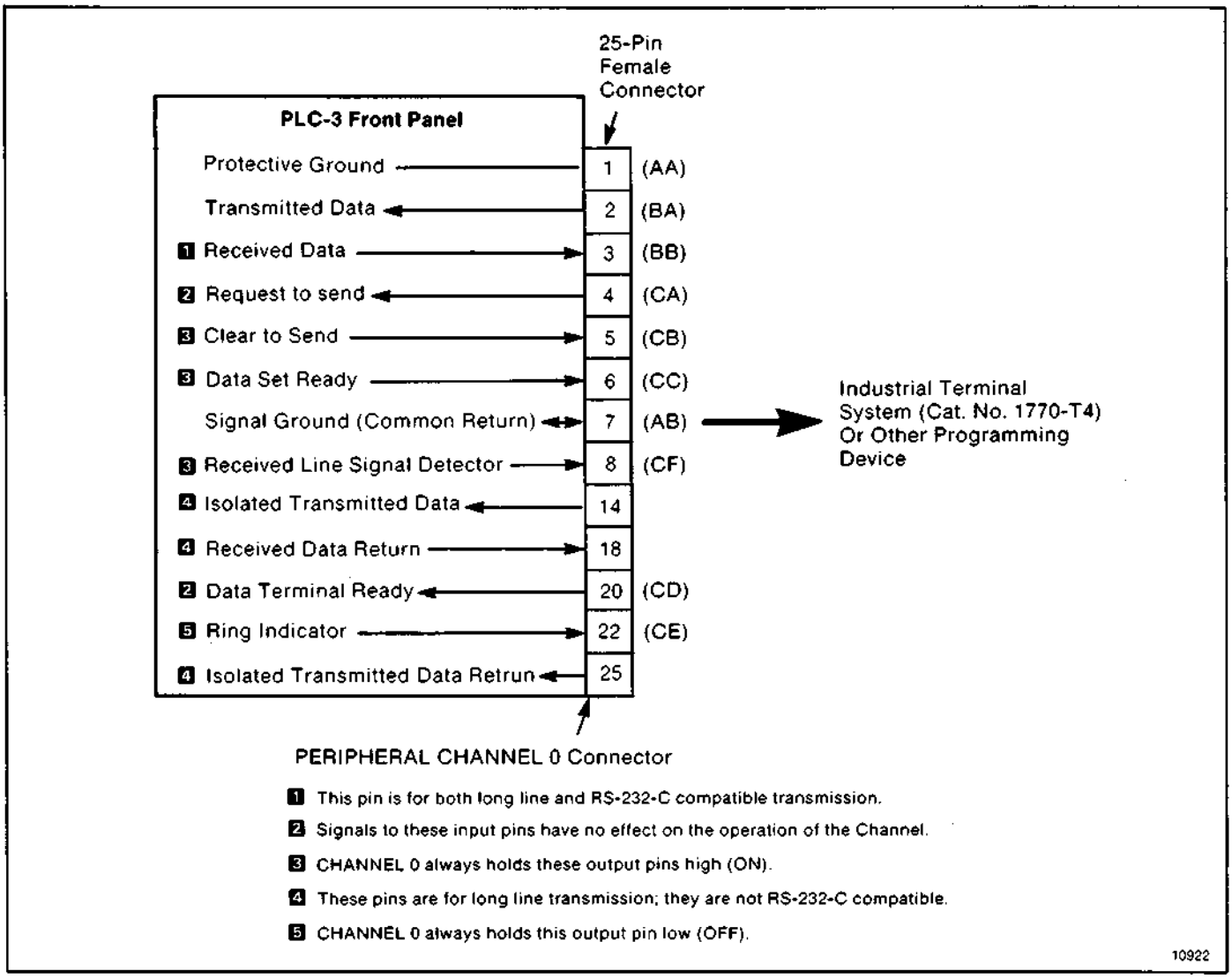


Figure 4.2 — Pin Assignments for the PERIPHERAL CHANNEL 0 Connector

Through the LIST function, you can configure each communication channel (including the data access panel) to fit your specific application. Among other options, you can select which area of memory can be accessed for change through the channel. As each memory area is selected for access by the channel, you have the option of selecting to ignore the setting of the memory protect keyswitch for that channel's access to that memory section.

4.0.4 Data Access Panel

The data access panel consists of a 16-character alphanumeric display and a 20-key keyboard. It functions as a peripheral terminal that can be used to monitor or change data table values either by word or by bit. The data access panel can also be used for forcing I/O.

Table 4.A

Front Panel Indicators

Name	Indication	Meaning
PROCESSOR	Green Red OFF	No major faults. Major fault. Power OFF.
OUTPUTS	Green Red OFF	Outputs enabled. Outputs disabled. Backup mode.
PROGRAM	Green Red OFF	Program load mode. Not used. Not in program load mode.
ACCESS	Green Red OFF	A peripheral device with power ON is connected to a peripheral communication channel (channel active). A peripheral device is editing the program. No peripheral communication channels active.

Through the LIST function, the data access panel can be used to monitor or change configuration information. Also, if a major fault is detected within the PLC-3 controller, a fault message will be displayed on the data access panel.

In this manual, certain conventions are used to indicate data access panel keystrokes and items displayed. A keystroke is shown in blue and may be indicated with brackets, such as:

[DISPLAY]

Double legends minimize the number of keys and maximize the functions available. The function associated with the upper legend of a key can be accessed by pressing the **[SHIFT]** key before pressing the key with the upper legend. Therefore, when we instruct you to press a key which we identify by its upper legend such as **[FORCE]**, to indicate that you must first press the **[SHIFT]** key, we precede it with (SFT) , such as:

(SFT) **[FORCE]**

In many cases, as you enter keystrokes, the corresponding characters are displayed. In that case, the keystrokes may be indicated as displayed by special type (letters always upper case) without brackets, such as:

NB:96

When we describe information displayed other than your direct input through the keypad, it will be indicated by the characters as displayed by black special type, (letters always upper case) such as:

```
N008:0096  32768
```

Keys **[0]** thru **[9]** are digit keys. Letter keys ([A] thru [T]) are used as identifiers and modifiers. Keys [A] thru [F] are also regarded as hexadecimal digit keys where appropriate. The **[CLEAR]** key is used as a command to negate your last action or to clear the display.

The **[BIT]** key generates a slash (/) on the display for a delimiter between the word number and the bit number when entering a bit address. The **[-]** key generates a colon (:) on the display for a delimiter between the file number and the word number when entering an address which includes a file number. The **[BIT]** key is also used to generate any delimiters needed for the LIST function.

The **[LIST]** key is used for accessing the LIST function. The **[ENTER]** key is used for moving within the LIST function, for changing data table values for forcing I/O, and for reconfiguring the memory into a default configuration after a fault has been detected.

The **[DISPLAY]** key is used to switch from displaying an address to displaying the value at that address. The **[ADDR]** key is used to switch from displaying a value to displaying the address of that value.

The **[FORCE]** key is used for entering, enabling and disabling the forcing of I/O. The **[REMOVE]** key is used to remove the forcing of I/O.

4.1 Initializing

Each time power to the main chassis is turned on, an initialization period occurs. This can take up to 5 seconds. During initialization, many diagnostic checks are performed while the data access panel displays the message:

```
AB PLC-3
```

Once all diagnostic tests are passed, initialization is complete; the display is cleared. If after 5 seconds the display is not cleared, refer to table A.A which lists initialization faults.

When a blank memory is initialized for the first time, after 5 seconds, the data access panel displays the message:

```
MEMORY AT xxxxxx
```

This initialization fault message will be displayed because the blank memory does not have any system pointers. The number in the message has no significance to the user. Press the **[ENTER]** key; this will clear any program from memory and establish a default memory configuration.

4.2 Accessing the Data Table

The data access panel can be used to monitor or control data table values. Table 4.B lists the data table sections which can be accessed, the corresponding data table section specifier, and the corresponding default format in which the data at the selected word will be displayed. The state of a bit will always be displayed as a 1 for on or a 0 for off.

Table 4.B
Default and Optional Front Panel Display Formats

Data Table Section	Default Display Format	Optional Display Format Specifiers
O — Output	Binary	O, H, D, N, A
I — Input	Binary	O, H, D, N, A
T — Timer	Unsigned Decimal Integer	None
C — Counter	Signed Decimal Integer	None
N — Integer	Signed Decimal Integer [1]	B, O, H, D, A
D — Decimal (BCD)	Decimal (assumes BCD storage)	B, O, H, N, A
B — Binary	Binary	O, H, D, N, A
A — ASCII	ASCII	B, O, H, D, N

[1] Binary storage is assumed.

4.2.1 Entering Addresses

The display must be cleared before a data table address can be entered from the keyboard. Type [SFT] [-] to generate a delimiter delimiter immediately preceeding the word number. The delimiter is displayed as a colon (:). Leading zeros need not be entered. The address is displayed as it is entered from the keyboard. The display format of a word address is:

sfff:wwww

Where:

s = section specifiers (I, O, T, C, N, D, B, A)

f = file number

w = word number

Example:

B671:35

When a bit address is entered, press the **[BIT]** key to generate a delimiter between the word number and the bit number. The delimiter is displayed as a slash (/). The display format of a bit address is:

sfff:wwww/bb

Where:

s = section specifier (I, O, T, C, N, D, B, A)

f = file number

w = word number

b = bit number

Example:

```
B671:35/15
```

4.2.2 Displaying Values

Once a word address has been entered, press **[DISPLAY]** to display the value at that address in the default format for that data table section as listed in table 4.B. With formats other than binary, the value will be displayed to the right of the address. For example, after entering an address which is then displayed such as:

```
N8:96
```

Press **[DISPLAY]** to display the value as:

```
N008:0096 32768
```

In this example, decimal 32768 is the value at the address. Note that when the value is displayed, leading zeros are displayed in the address.

If you had entered a nonexistant address, the data access panel will display the message:

```
BAD ADDRESS
```

With the binary format, the address will be replaced by the value because the binary value requires all 16 characters of the display. For example, with an address which is then displayed such as:

```
B671:35
```

Press **[DISPLAY]** to display the value as:

```
1000000000000101
```

All leading zeros will be displayed. To switch the display from the value back to the address, press **[ADDR]**

Table 4.C lists the 5 data formats available, together with the format control character for each format. To display a value in a format other than the default for the section, with the address displayed, press the key for the corresponding format control character, then the **[DISPLAY]** key. For example, after entering an address which is then displayed as:

```
B671:35
```

Press **[DISPLAY]** to display the binary value as:

```
1000000000000101
```

Table 4.C

Display Format Specifiers

Specifier	Display Format	Example
A	ASCII	B0434:0056 AB
B	Binary	0101010101010101
D	Decimal [1]	B010:0056 32768
H	Hexadecimal	I000:0067 AB16
O	Octal	I000:0056 177547
[1] Binary storage is assumed.		

Press [ADDR] to display the address as:

```
B671:0035
```

Press [SFT] [D][DISPLAY] to display the decimal value as:

```
B671:0035 32773
```

Once a bit address has been entered press [DISPLAY] to display the state of the bit (0 or 1) to the right of the address. For example, after entering an address which is then displayed such as:

```
B671:35/17
```

Press [DISPLAY] to display the bit state as:

```
B671:0035/17 1
```

4.2.3 Cursoring

With an address and/or value displayed, the cursor keys ([←], [→], [↑], [↓]) can be used to move to adjacent addresses. For the timer and counter sections, movement can occur throughout the section. All other sections are divided into files. In those sections, movement can only occur throughout the file. An attempt to move beyond these limits will result in the message display:

```
BAD ADDRESS
```

All 4 cursor keys are useful in moving among bit addresses. For example, with a bit being displayed such as:

```
B671:0035/17 1
```

Press [→] to display:

```
B671:0035/16 0
```

Press [↓] to display:

```
B671:0034/16 1
```

Press [←] to display:

```
B671:0034/17 0
```

Press [↑] to display:

```
B671:0035/17 1
```

Each timer or counter uses 3 words:

- The accumulated value word (ACC).
- The preset value word (PRE).
- The control word (CTL).

When a timer or counter is first accessed, the accumulated value is displayed. Use the cursor keys to move to other words of the timer or counter or to move to adjacent timers or counters. For example, enter [SFT][T][-][6][8][DISPLAY] to display the accumulated value of timer 68 such as:

```
TACC:0068 65535
```

Press [→] to display the preset value:

```
TPRE:0068 54535
```

Press [→] to display the control word value:

```
TCTL:0068 5350
```

Press [←] to display the preset value:

```
TPRE:0068 54535
```

Press [↓] to display the preset value of timer 67:

```
TPRE:0067 12345
```

Press [↑] to display the preset value of timer 68:

```
TPRE:0068 54535
```

In sections other than the timer and counter sections, use the cursor keys to move between adjacent word addresses. For example with a word being displayed such as:

```
B054:0145 32767
```

Press [↓] to display:

```
B054:0144 31897
```

Press [↑] to display:

```
B054:0145 32767
```

4.2.4 Data Change

With the memory protect keyswitch in the DATA CHANGE position or the MEMORY PROTECT OFF position, once a data table value has been displayed on the data access panel, you can change that value by keying in a new value followed by [ENTER]. Leading zeros do not need to be entered. The new value is accepted in the format in which the old value was displayed.

For a word value data change example, consider a word being displayed, such as:

```
CACC:0024 14263
```

Key in a new value to be displayed, such as:

```
859
```

Press **[ENTER]** to enter the data change from the old value to the new (displayed) value and display:

```
CACC:024 859
```

For a bit value data change example, consider a bit being displayed, such as:

```
B671:035/16 0
```

Key in a new value to be displayed, such as:

```
1
```

Press **[ENTER]** to enter the data change from the old value to the new value and display:

```
B671:035/16 1
```

After keying in a new value, but before pressing **[ENTER]**, you can cancel the new value by pressing **[CLEAR]**. The address and the old value will be displayed again.

4.2.5 Forcing I/O

When no inputs or outputs are being forced, input image table bits reflect the status of their corresponding input terminals and output terminals reflect the status of their corresponding output image table bits as determined by rungs in the user program.

When an input is forced, the input image table bit no longer reflects the state of the input terminal; it is forced into an arbitrary state (either 1 or 0) which you select. The user program will respond to the forced state of the input image table bit, not the state of the input terminal.

When an output is forced, the output terminal no longer reflects the state of the output image table bit; it is forced into an arbitrary state (either 0 or 1) which you select. The user program will respond to the state of the output image table bit, not the forced state of the output terminal.

For an example of forcing an input, consider an input being displayed such as:

```
I000:001/01 0
```

Press [SFT] **[FORCE][1]** to select to force the input to 1; the display will be:

```
FORCE 1
```

Press [ENTER]; the display will be:

```
I000:0001/01 0F1
```

The F1 following the actual state (0) of the input terminal indicates that this input bit has been selected to be forced on regardless of the actual state of the input terminal. Note that the actual state of the input terminal continues to be displayed to the left of the F. The absence of an asterisk (*) between the address and the state of the input indicates that forces have not yet been enabled. The forced states of any number of inputs and outputs can be selected before simultaneously enabling forces on all of the selected inputs and outputs. To enable forces, press [CLEAR] to clear the display; then press [SFT][FORCE][SFT][E]; the display will be:

```
FORCES ENABLED
```

Press [ENTER]; the display will clear and forces will then be enabled. With forces enabled, if a forced input or output is displayed, the display will be such as:

```
I000:001/01*1F1
```

The asterisk (*) indicates that forces have been enabled. Note that the state of the input section bit is now indicated as 1, reflecting the forced state, rather than 0, which was previously indicated when the bit was reflecting the state of the input terminal. However, when you force an output, the output section bit does not change state; only the state of the input terminal changes to the forced state.

To disable forces, press [CLEAR] to clear the display; then press [SFT][FORCE][SFT][D]; the display will be:

```
FORCES*DISABLED
```

Press [ENTER]; the display will clear and forces will then be disabled. With forces disabled, if an input or output selected for forcing is displayed, the display will be such as:

```
I000:0001/01 0F1
```

The absence of an asterisk (*) indicates that forces have been disabled. To remove the force selection from this input, press [SFT][REMOVE]; the display will be:

```
REMOVE FORCE
```

Press [ENTER]; the display will be:

```
I000:0001/01 0F
```

The absence of a 1 or 0 to the right of the F indicates that the input is not selected to be forced. However, the F indicates that this input is included in a force table established in memory. When an input is selected for forcing, a 16-word force table is established for all inputs of its I/O rack. When an output is selected for forcing, a 16-word force table is established for all

outputs of its I/O rack. Removing the force selection of each input or output does not remove the force table from memory. The force tables can be removed from memory only by removing all forces. To remove all force selections, press **[CLEAR]** to clear the display; then press [SHIFT]**[REMOVE]**; the display will be:

```
REMOVE ALL
```

Press **[ENTER]**; the display will clear and all force selections, including the force tables, will then be removed.

4.3 Operating List

Through the LIST function, you can select parameters to configure the PLC-3 controller to fit your particular application. You can also monitor parameter selections and other status information. The LIST function is described in detail in chapter 6.

The LIST function can be operated from either an industrial terminal or the data access panel. The LIST function is made up of many frames, with each frame consisting of a menu from which you can make selections. Each frame can be called up for display, one at a time. However, the data access panel has only a one-line display. Therefore, when a frame is displayed, it will be scrolled vertically one line at a time. Also, if the line exceeds 16 characters, it will be scrolled horizontally until all characters on the line have been displayed before scrolling down to the next line. For example, consider the following LIST frame:

```
01-I/O CHAN 4-CHASSIS
 1 003/2/0
 2 003/2/2
 3 004/8/0
ENTER NEXT >
```

On the industrial terminal, all five lines would be displayed at once as shown. However, on the data access panel, the sequence of the display would be as follows:

```
01-I/O CHAN 4-CHA
1-I/O CHAN 4-CHAS
-I/O CHAN 4-CHASS
I/O CHAN 4-CHASSI
/O CHAN 4-CHASSIS
1 003/2/0
2 003/2/2
3 004/8/0
ENTER NEXT >
```

To stop the scrolling, press any cursor control key. After stopping the scrolling, to move within the frame, use the cursor control keys.

When information is entered through the LIST function, it is sometimes necessary to enter delimeters to separate entries of information. When operating the LIST function through the data access panel, use the **[BIT]** key whenever a delimiter is needed. For example, consider again the LIST frame:

```
01-I/O CHAN 4-CHASSIS
1 003/2/0
2 003/2/2
3 004/8/0
ENTER NEXT >
```

Here, three I/O chassis are listed for this I/O channel. A fourth I/O chassis could be added through a proper key sequence, as for example:

[4][BIT][5][BIT][2][BIT][0][ENTER]

This would add an I/O chassis which would have 5 as its I/O rack number and would be a 2-module-group size I/O chassis starting with I/O module group 0. The frame would be changed to:

```
01-I/O CHAN 4-CHASSIS
1 003/2/0
2 003/2/2
3 004/8/0
4 005/2/0
ENTER NEXT >
```

Chapter

5

Peripheral Installation and Operation

5.0 General

The PLC-3 programmable controller supports various peripheral devices, including:

- Industrial Terminal System (cat. no. 1770-T4)
- Digital Cassette Recorder (cat. no. 1770-SA)
- Data Cartridge Recorder (cat. no. 1770-SB)
- Printer (RS-232-C compatible)

This chapter describes the installation and operation of an industrial terminal as a programming device. To use a computer as a programming device, refer to the I/O Scanner-Programmer Interface Module User's Manual (publication 1775-805).

This chapter describes the use of recorders for recording and loading programs. The 1770-SA recorder is also described in the Digital Cassette Recorder User's Manual (publication 1770-800). The 1770-SB recorder is also described in the Data Cartridge Recorder User's Manual (publication 1770-806).

This chapter describes the use of printers for printing memory data values, ladder diagram rungs, the text of message files in the message area, and memory map reports. To use a printer or CRT terminal for programmable report generation, refer to the I/O Scanner-Message Handling Module User's Manual (publication 1775-806).

When operating peripheral devices, it may be necessary to enter or interpret an extended address. For detailed information on memory organization and extended addressing, refer to the PLC-3 Programming Manual (publication 1775-801).

5.1 Industrial Terminal Installation

With the keyboard removed, locate the switch assembly on the front of the industrial terminal as shown in figure 5.1. Set switches 4 and 5 to the UP position. This allows the industrial terminal system to automatically select the PLC-3 mode at power-up if the PLC-3 processor is connected.

You can connect an industrial terminal to the PLC-3 controller as a programming device through a PLC-3 Industrial Terminal Cable (cat. no. 1775-CAT) as shown in figure 5.1. The end of the cable labeled INDUSTRIAL TERMINAL END connects to CHANNEL B of the industrial terminal. The end of the cable labeled PLC-3 END connects either to CHANNEL 0 on the

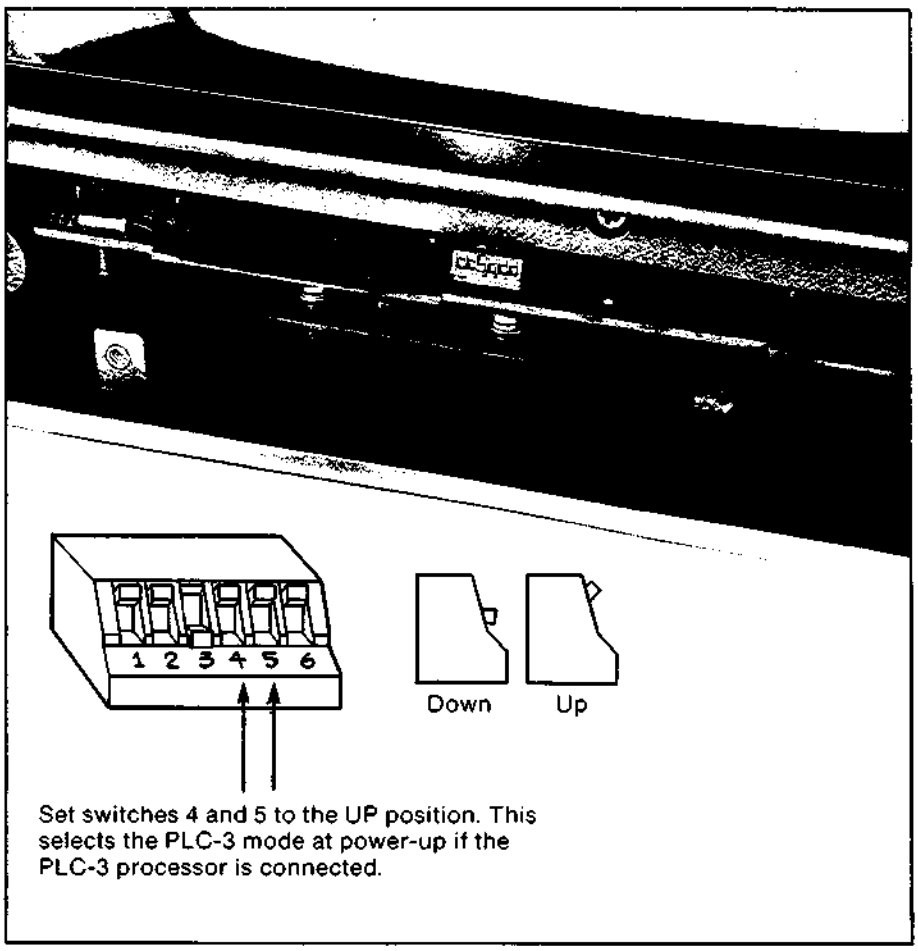


Figure 5.1 — Industrial Terminal Switch Selection

PLC-3 front panel or to CH 5 on an I/O Scanner-Programmer Interface Module (cat. no. 1775-S4A) in the chassis. The PLC-3 industrial terminal cable is 15 feet long. You can connect the industrial terminal up to 5000 cable feet from the PLC-3 processor as shown in figure 5.3. Use Belden 8723, or equivalent cable which can be purchased from Allen-Bradley using cat. no. 1778-CR. Use two 25-pin male connector kits (cat. no. 1770-XXP).

5.2 Installation of Other Peripheral Devices

Peripheral devices such as the digital cassette recorder, the data cartridge recorder, or printers must be connected through an industrial terminal. Connect the industrial terminal to the PLC-3 processor as shown in figure 5.2 or 5.3. Connect the peripheral device to CHANNEL C of the industrial terminal.

When connecting a digital cassette recorder or data cartridge recorder use the Digital Cassette Recorder Cable (cat. no. 1772-TH). Figure 5.4 shows a data cartridge recorder connected to a

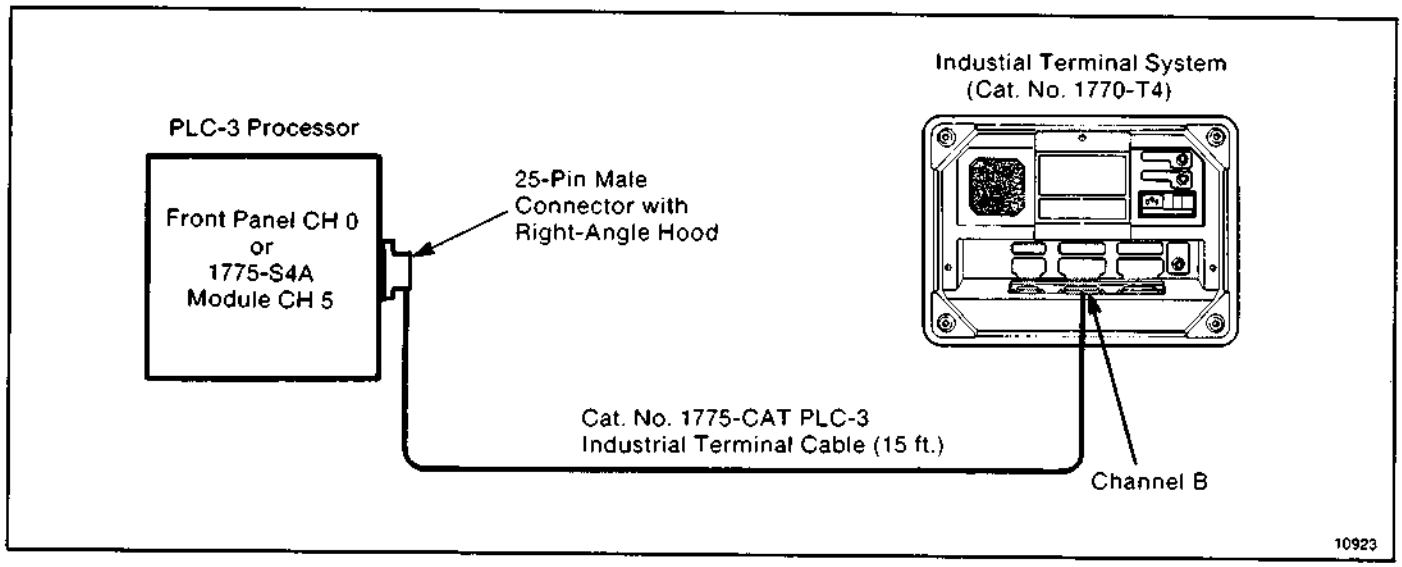


Figure 5.2 — Connection Diagram - PLC-3 Processor to Industrial Terminal thru PLC-3 Industrial Terminal Cable (Cat. No. 1775-CAT)

PLC-3 processor through an industrial terminal. For the digital cassette recorder, connect to the connector labeled OTHER PRODUCTS.

The cable required to connect other peripheral devices through CHANNEL C of the industrial terminal depends on the peripheral device. Figure 5.5 shows an RS-232-C compatible printer connected to CHANNEL C of the industrial terminal.

Cable length can be 50 ft. maximum. The cable supplied with the printer may connect directly to CHANNEL C. If you construct a cable, use a 25-pin male connector kit (cat. no. 1770-XXP).

CHANNEL C of the industrial terminal provides RS-232-C compatible communication. Figure 5.6 shows the CHANNEL C pin assignments with the RS-232-C designations and arrows to indicate the direction of each signal. Thru the PORT command (described in section 5.5.1) you can select several parameters which affect how CHANNEL C communicates with an RS-232-C compatible printer:

- Communication rate (110, 300, 600, 1200, 2400, 4800 or 9600 baud)
- Parity (none, odd, even)
- Stop bits (1, 1.5, 2)
- Hardware handshaking (off, on, auto)

Table 5.C lists the ways in which the hardware handshaking modes affect input and output signals at CHANNEL C.

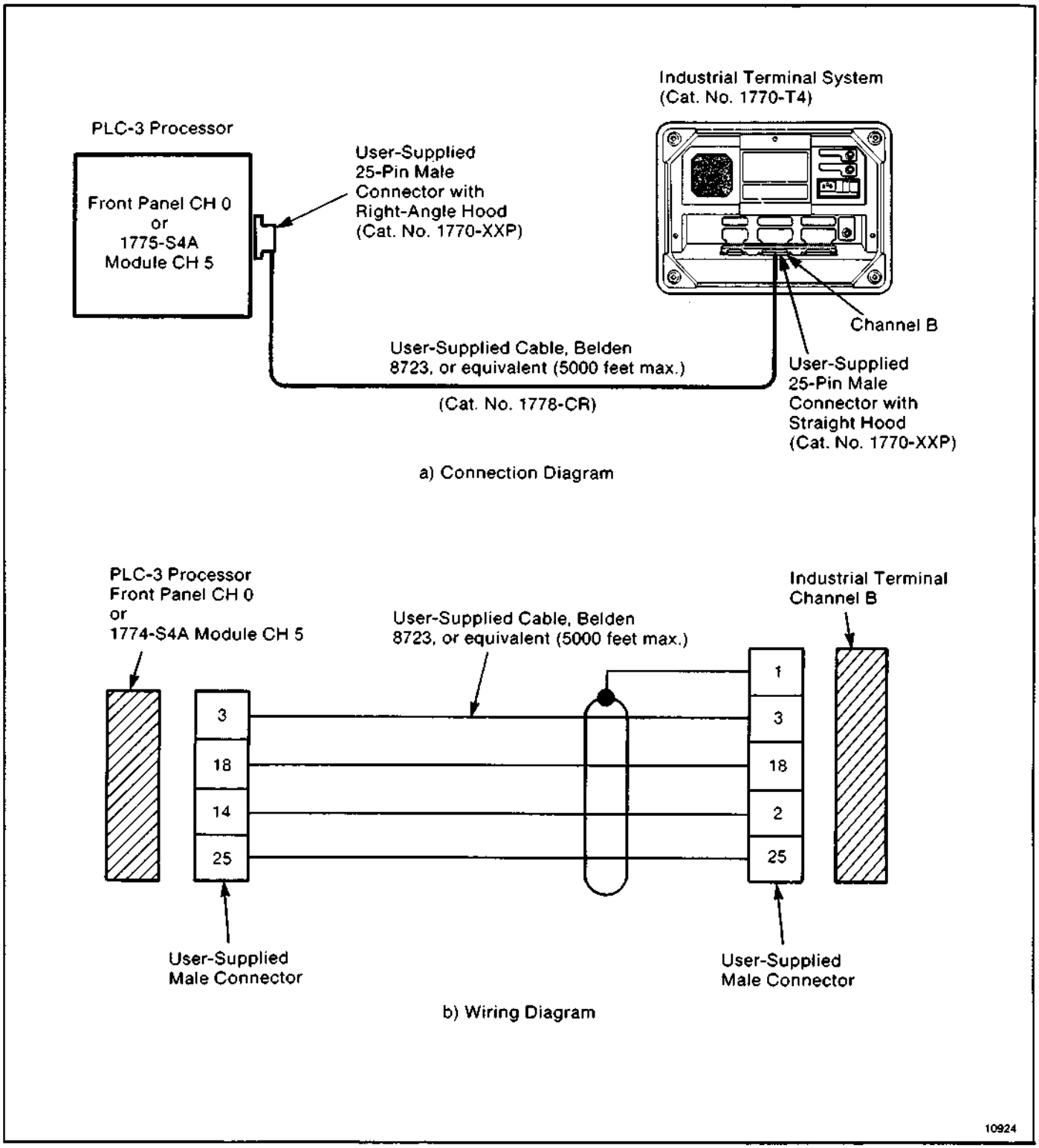


Figure 5.3 — PLC-3 Processor to Industrial Terminal Thru User-Supplied Cable

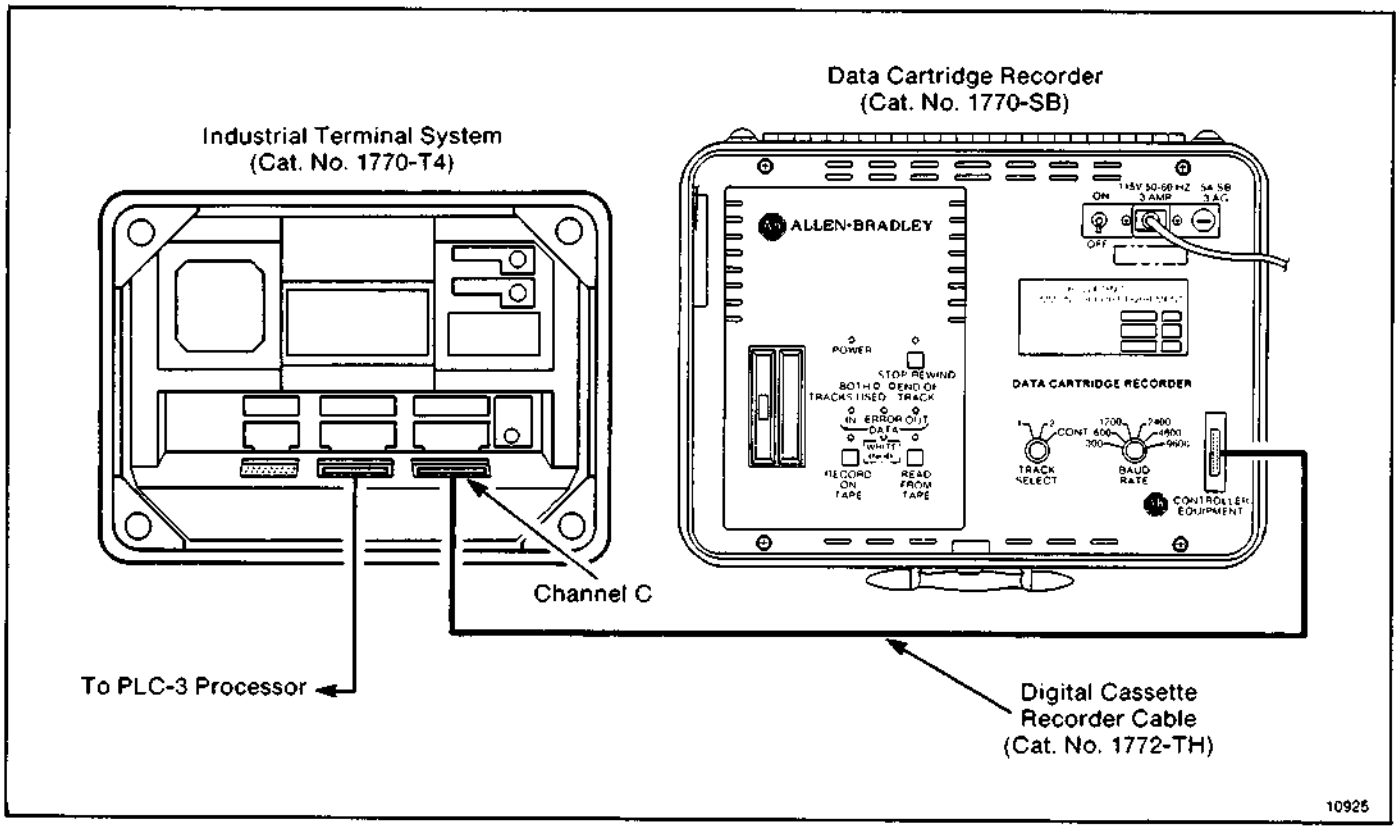


Figure 5.4 — Connection Diagram - Industrial Terminal to Data Cartridge Recorder

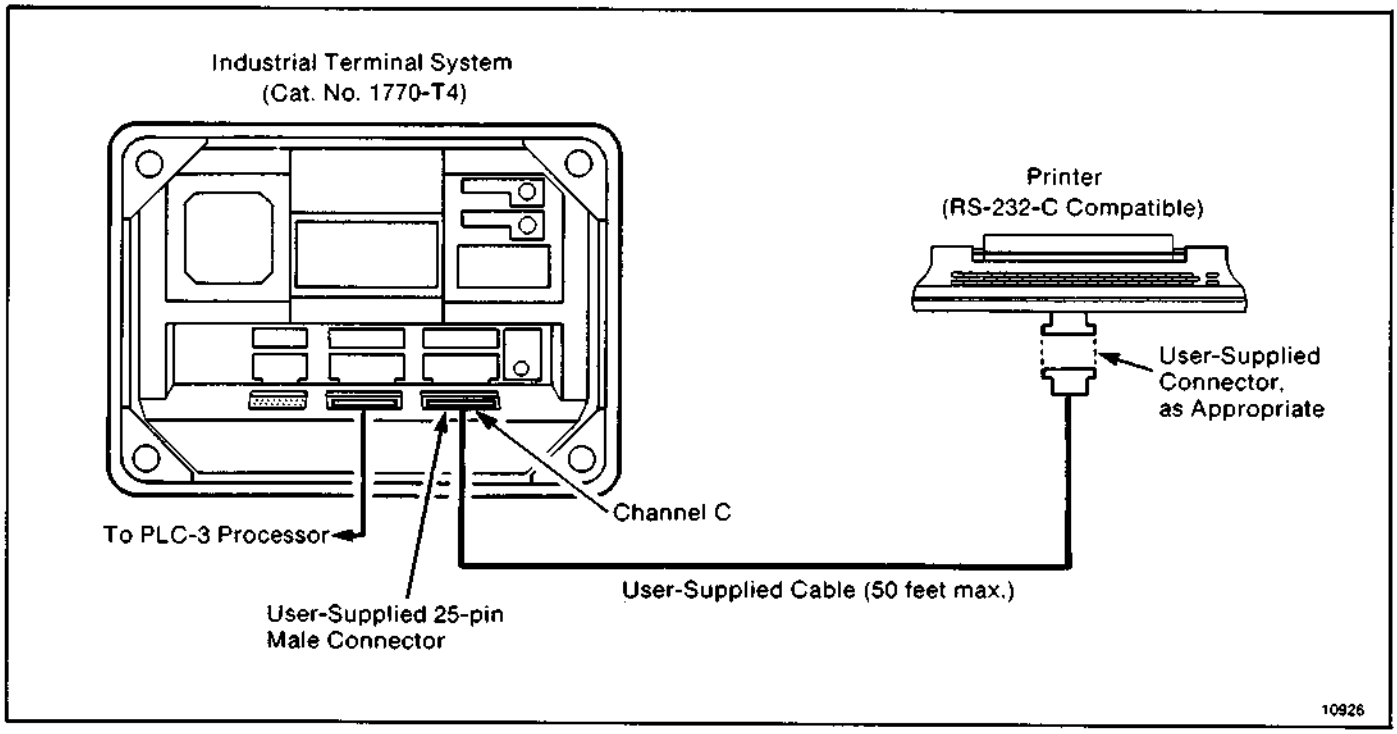


Figure 5.5 — Connection Diagram - Industrial Terminal to Printer

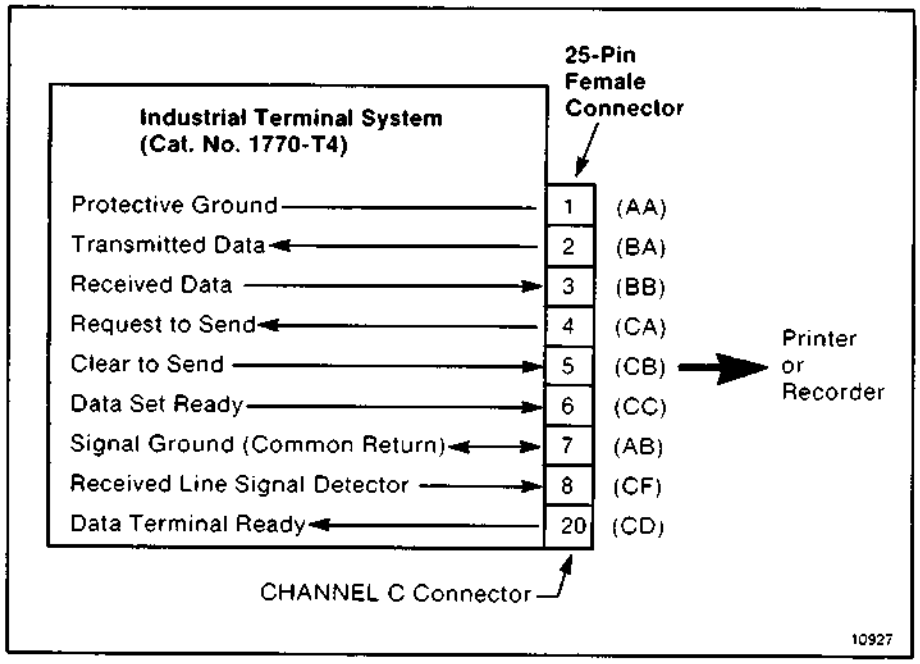


Figure 5.6 — Pin Assignments for the Industrial Terminal CHANNEL C Connector

5.3 Industrial Terminal Operation

Material in this section describes the operation of the industrial terminal system (cat. no. 1770-T4) as a programming terminal (PLC-3 mode). Information in this chapter supplements that of the Industrial Terminal System User's Manual (publication 1770-805).

5.3.1 Keyboard and Display Conventions

In this manual, certain notational conventions are used to indicate industrial terminal keystrokes and items displayed on the CRT. A keystroke is shown in blue and may be indicated with brackets such as:

[ENABLE]

Double legends minimize the number of keys and maximize the number of functions available. The function of the upper legend of a key can be accessed by first pressing the **[SHIFT]** key. Therefore, when we instruct you to press a key which we identify by the upper legend such as **[FORCE]**, to indicate that you must first press the **[SHIFT]** key, we precede it with [SFT], such as:

[SFT] **[FORCE]**

At the end of each line entry, you must press the **[ENTER]** key. We indicate this at the ends of lines by [ENT], such as:

[SFT] **[FORCE][ENABLE]** [ENT]

In many cases, as you enter a keystroke, the corresponding character is displayed on the CRT. In that case, the keystrokes may be indicated as displayed by special type (letters always upper case) without brackets such as:

DUMP

In some cases, rather than specific keystrokes, you may be instructed to type in a variable. In that case it will be in lower case and enclosed in less than (<) and greater than (>) symbols such as:

<address>

When we describe information displayed on the CRT other than your direct input through the keyboard, it will be indicated by the characters as displayed by black special type (letters always upper case) such as:

DUMP SYSTEM

This type of information is displayed to prompt you to proceed to the next step of the procedure.

5.3.2 Power-Up Sequence

Power to the industrial terminal should be applied after the PLC-3 controller has been powered up. Follow this procedure:

Step 1 — Power up the PLC-3 controller.

Step 2 — Install the keyboard module to the industrial terminal.

Step 3 — Connect one end of the PLC-3 industrial terminal cable to the controller. Connect the other end to CHANNEL B on the industrial terminal.

Step 4 — Power up the industrial terminal.

This procedure helps to ensure proper terminal/controller communication.

5.3.3 Ladder Diagram Display

Much useful information, such as I/O device status, controller operating mode, and fault reporting, is contained in the ladder diagram display on the CRT (figure 5.7). The following sections will help you use this information effectively.

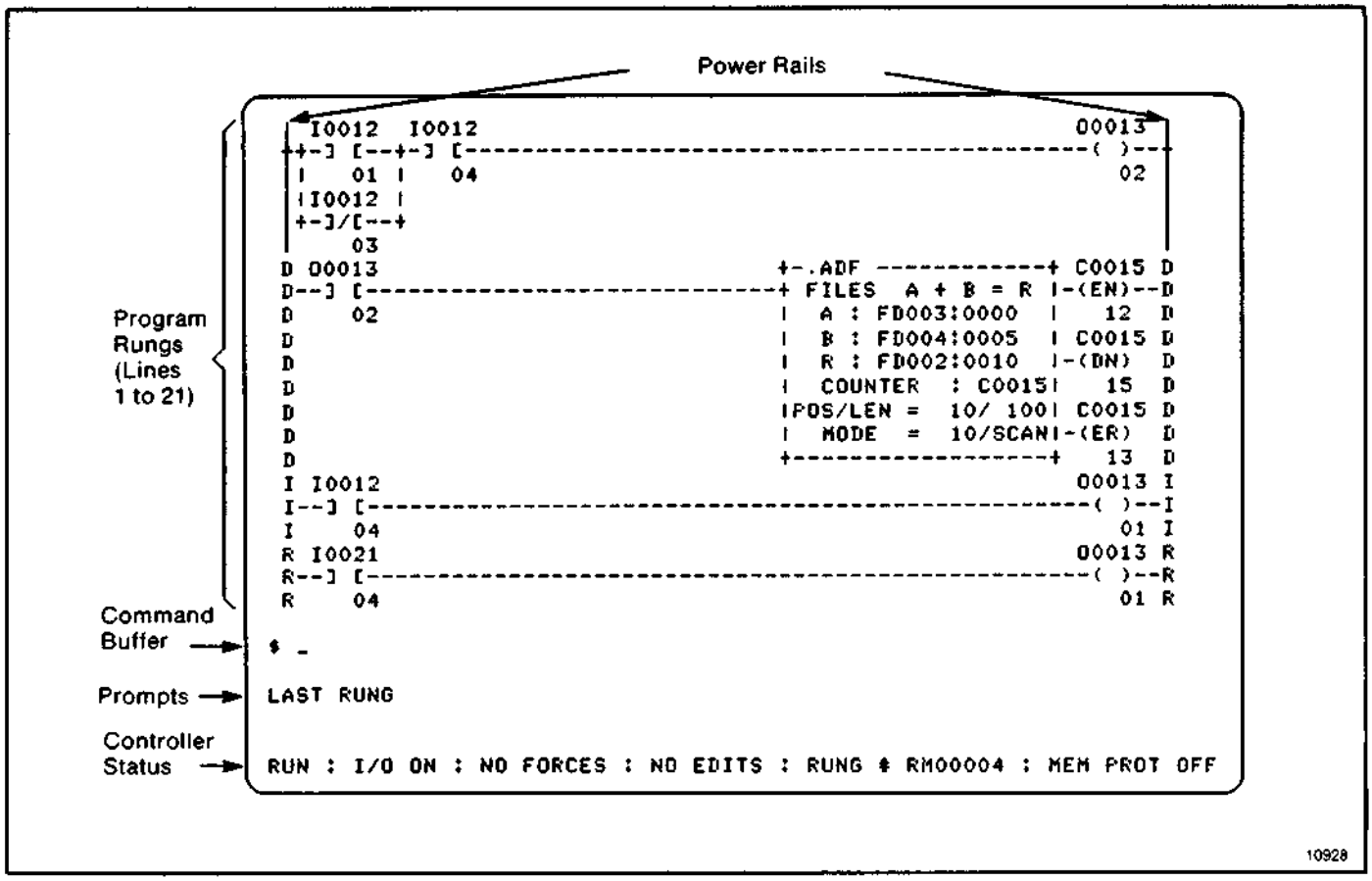


Figure 5.7 — Ladder Diagram Display Example

5.3.3.1 Rungs

As you program the PLC-3 controller, instructions build program rungs. Rung(s) can occupy lines 1 through 21 on the CRT.

Power rails indicate rung status as follows:

Power Rail	Meaning
Solid	Rung is part of the program
I	Rung is a new edit addition to the program
D	Rung marked for deletion from the program
R	Rung is going to be replaced

5.3.3.2 Question Marks

During instruction entry or replacement, question marks (?) show you what information needs to be entered. Once you enter this data, question marks are replaced with data. Also, to aid you during instruction entry, the next part of the instruction in need of data is displayed with question marks in a reverse video block. The reverse video block has a light backround and dark characters.

5.3.3.3 Command Buffer

Line 22 on the CRT shows the command buffer. All keystrokes entered since the completion of the last instruction or command are displayed here. As long as keystrokes are still in the command buffer, they can easily be deleted and replaced. Note that individual entries are separated by commas.

5.3.3.4 Prompts

Line 23 on the CRT is the prompt line. This line prompts you for data during instruction entry. It also displays error messages/prompts if you violate instruction syntax or its addressing.

When an entry error does occur, the command buffer cursor moves to the character that caused the error. This provides a convenient means of locating and removing or correcting the entry.

5.3.3.5 Status/Fault

Line 24 (bottom line) on the CRT displays the PLC-3 controller status. Information on this line includes:

- Controller operating mode: `PROG/LOAD` , `TEST`, or `RUN` is displayed to indicate the selected mode.
- I/O status: `I/O ON` is displayed when the PLC-3 outputs are enabled, `I/O OFF` is displayed when the PLC-3 outputs are disabled.
- Forced I/O status: `FORCES` is displayed if an input or output has been selected for forcing. `NO FORCES` is displayed if all force selections are cleared. The FORCES/NO FORCES display is intensified if forces are enabled. The display is normal intensity if forces are disabled.
- Editing status: `NO EDITS` is displayed if there are no edited rungs in the edits buffer. Reverse video is used if this channel has the edit resource. `EDITS` is displayed in reverse video if edited rungs are in the edits buffer.
- Rung number: The number displayed is the rung with the program cursor. Rung number can be from main program (RM), subroutines (RS), or fault routines (RF). `RUNG # RM00001` is for the rung number 1 in the main program. The rung number is reverse video if the rung is either the first or last rung in its program subsection. If the rung is being edited, `EDITING` is displayed before the rung number.
- Memory protect keyswitch status: `MEM PROT ON` , `MEM PROT OFF`, or `DATA CHANGE` is displayed to indicate the switch position.

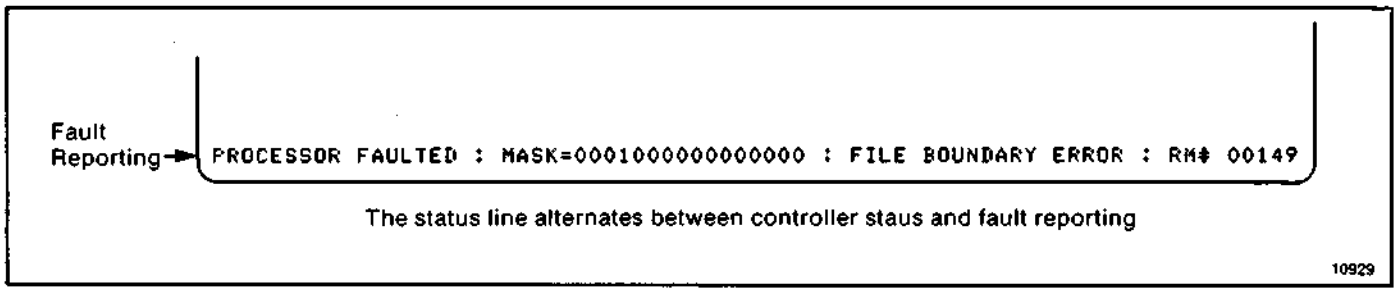


Figure 5.8 — Fault Reporting Display

Line 24 is also used for major fault reporting. If a major fault is recorded in word 1 of the status section of the data table, line 24 alternates at three second intervals between the normal status display as shown in figure 5.7 and the fault display shown in figure 5.8.

Fault display blinking continues until you have cleared all major faults. As shown in figure 5.8, the fault display is divided into four parts separated by colons. Each part of the fault display is described here:

- At the left most part of the line is the message, `PROCESSOR FAULTED`).
- Next is `MASK =` followed by the binary value at word 1 of the status section of the data table. The fault type is indicated by a bit set to 1.
- If the fault **is not** a program execution fault, the third part is left blank. If the fault **is** a program execution fault, one of the following messages will specify the type of program execution fault:

  - `INVALID SECTION IN`
  - `FILE BOUNDARY ERROR`
  - `FILE NOT FOUND IN`
  - `BAD ADDRESS IN`
  - `BAD OPCODE`

- If the fault **is not** a program execution fault, the fourth part is left blank. If the fault is a program execution fault, the fourth part will be the number of the rung being executed when the fault was detected.

5.3.4 Operating Mode Selection

You can change the PLC-3 controller operating mode between run, test, and program load from the industrial terminal without using the LIST function. You can make this mode selection thru a local channel at any time. However, you can only make this mode selection thru a remote channel when remote enable is selected.

To select the run mode, type:

`RUN , Y` [ENT]

In the run mode, program execution is enabled and outputs are enabled.

To select the test mode, type:

TEST, Y [ENT]

In the test mode, program execution is enabled and outputs are disabled.

To select the program load mode, type:

PROG, Y [ENT]

In the program load mode, program execution is disabled and outputs are disabled.

5.3.5 Context Switching

The PLC-3 controller can store multiple programs and execute any one of them at a given time. This is accomplished by using a different context for each program and program related parameters (data table, messages, symbols, forces). The context is numbered 0-15, with 0 being used to denote global data, which is defined in all contexts. The operating context of the PLC-3 controller is selected through the LIST function described in chapter 6.

When you turn on power to an industrial terminal, it automatically starts out in the context selected for the PLC-3 controller. However, you can select an industrial terminal context independant of the PLC-3 controller context. This would allow you to edit the program in the industrial terminal context while running the program in the PLC-3 controller context.

To switch the industrial terminal context, type:

CONTEXT, <number> [ENT]

To determine the current operating context of the industrial terminal, type:

CONTEXT [ENT]

The industrial terminal's context displays on the prompt line of the CRT.

5.3.6 Data Monitor/Change

To monitor data values in the default display format for the specified data table section, type:

DD, <address> [ENT]

The address can be either a word address or a bit address. The display will start with the specified word, and continue on through as many words as can fit on the display for the display format used. For example, consider the following keyboard input:

DD, 00:0 [ENT]

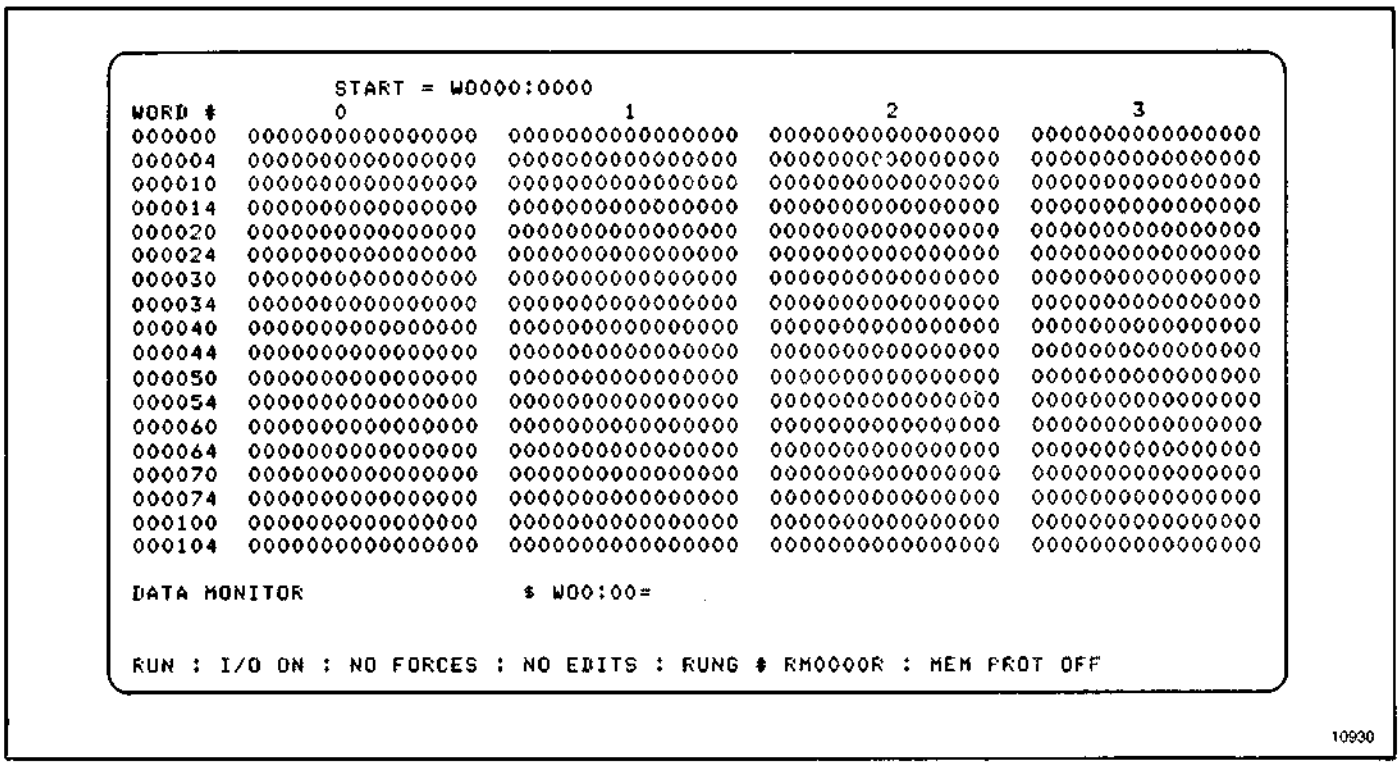


Figure 5.9 — Data Monitor Display

The resulting data monitor display is shown in figure 5.9. The output section of the data table is displayed in binary format by default. The starting address of the display data is shown at the top.

The cursor is shown in reverse video. Initially, the cursor is on the first word displayed. Use the cursor control keys to move the cursor left, right, up, and down by word through the display. If you move the cursor beyond the end of the initial display, the display shifts to show the word to which you moved the cursor.

Use the [RUNG↑] and [RUNG↓] keys to move to adjacent files.

Near the bottom of the display is an address which indicates the position of the cursor. In figure 5.9, this cursor position address is shown as:

```
$W00:00=
```

If you type in a new value for a word, it will be displayed here as for example:

```
$W00:00 1111000011110000
```

If you press [ENTER], this new value is stored at the address. If you do not enter a full word of digits (16 for binary format) leading zeros are assumed. Data entry is accepted in the same format as the display format.

Table 5.A

Display Format Specifiers

Display Format	Specifier
Octal	O
Hexadecimal	H
Binary	B
Decimal (assumes BCD storage)	D
Unsigned Decimal Integer	I
Signed Decimal Integer	N
ASCII	A

Note: H and D each select the same display format.

Alternately, you can enter a new value in an optional format by typing:

% <**format specifier**><**new value**> [ENT]

Table 5.A lists the available formats and their corresponding specifiers.

A data monitor display can also be called up through a bit address, as for example:

DD,00:0/17 [ENT]

The display would be virtually the same as in figure 5.9, except that the cursor position address displayed would be a bit address. Up-down cursor movement would be the same, but left-right movement would be by bit. If you type 1 [ENT] or 0 [ENT], you will set the bit to that value.

Alternately, data can be displayed in an optional format by typing:

DD, <**address**> ,%<**format specifier**> [ENT]

Table 5.A lists the available display formats and their corresponding specifiers. Table 5.B lists each data table section, its default display format, and the optional format specifiers which can be used with that section. For example, the same data displayed as binary values in figure 5.9, can also be displayed by typing:

DD,00:0,%H [ENT]

In this case, each value would be displayed in hexadecimal format. If you wanted to change a value, the default entry format of the new value would be hexadecimal.

Table 5.B

Default and Optional Display Formats

Data Table Section	Default Display Format	Optional Display Format Specifiers
O — Output	Binary	O, H, D, N, A, I
I — Input	Binary	O, H, D, N, A, I
T — Timer	Unsigned Decimal Integer	None
C — Counter	Signed Decimal Integer	None
N — Integer	Signed Decimal Integer	B, O, H, D, A, I
F — Floating Point	Floating Point Decimal	None
D — Decimal (BCD)	Decimal (assumes BCD storage)	B, O, H, N, A, I
B — Binary	Binary	O, H, D, N, A, I
A — ASCII	ASCII	B, O, H, D, N, I
H — High Order Integer	Signed Integer	None
P — Pointer	Unsigned Integer	None
S — Status	Binary	O, H, D, N, A, I

You can also change the format of an existing display by typing:

[DELETE], % <format specifier> [ENT]

5.3.7 Forcing I/O

When no inputs or outputs are being forced, input image table bits reflect the status of their corresponding input terminals and output terminals reflect the status of their corresponding output image table bits as determined by rungs in the user program.

When an input is forced, the input image table bit no longer reflects the state of the input terminal; it is forced into an arbitrary state (either 1 or 0) which you select. The user program will respond to the forced state of the bit, not the state of the input terminal.

When an output is forced, the output terminal no longer reflects the state of the output image table bit; it is forced into an arbitrary state (either 0 or 1) which you select. The user program will respond to the state of the bit, not the forced state of the output terminal.

You can move the cursor to an instruction to select the input or output corresponding to that instruction for forcing. Alternately, you can enter the address of the input or output to select it for forcing.

Select Force On

To select a force on for a specified input or output, type:

[SFT][FORCE] 1 [INSERT], <address> [ENT]

or:

FONI, <address> [ENT]

To select a force on for the input or output at the cursor, type:

[SFT][FORCE] 1 [INSERT][ENT] [ENT]

or:

FONI [ENT] [ENT]

Select Force Off

To select a force off for a specified input or output, type:

[SFT][FORCE] 0 [INSERT], <address> [ENT]

or:

FOFI, <address> [ENT]

To select a force off for the input or output at the cursor, type:

[SFT][FORCE] 0 [INSERT][ENT] [ENT]

or:

FOFI [ENT] [ENT]

After an input or output force on or off is selected, the command buffer is automatically loaded with the force remove instruction to remove the force. Thus, if the effect of the force is undesirable, it can be quickly removed by pressing [ENT]. To continue operation without removing the force, press [CANCEL CMD]

Remove Force

To remove the force selection for an input or output, type:

[SFT][FORCE] [REMOVE], <adddress> [ENT]

or:

FR, <address> [ENT]

To remove a force selection from an input or output at the cursor, type:

[SFT][FORCE] [REMOVE] [ENT] [ENT]

or:

FR [ENT] [ENT]

Remove (Clear) All Input Forces

To remove (clear) all input force selections, type:

I [SFT][FORCE] [CLEAR] [ENT]

or:

IFC [ENT]

Remove (Clear) All Output Forces

To remove (clear) all output force selections, type:

0 [SFT] **[FORCE] [CLEAR]** [ENT]

or:

OFC [ENT]

Remove (Clear) All Forces

To remove (clear) all force selections (input and output), type:

[SFT] **[FORCE] [CLEAR]** [ENT]

or:

FC [ENT]

Enable All Forces

The forced state of any number of inputs and outputs can be selected before simultaneously enabling forces on all of the selected inputs and outputs.

To enable (activate) all forces type:

[SFT] **[FORCE] [ENABLE]** [ENT]

or:

FE [ENT]

The force enable command loads the force disable command into the command buffer. Therefore, to disable the forces, press **[ENTER]** To continue operation without disabling the forces, press **[CANCEL CMD]**

Disable All Forces

To disable (deactivate) all forces without removing the force selections from memory, type:

[SFT] **[FORCE] [DISABLE]** [ENT]

or:

FD [ENT]

When a force on is selected the industrial terminal displays the word ON below instructions containing the address of that input or output. Similarly, when a force off is selected, the industrial terminal displays the word OFF below instructions containing the address of that input or output.

When you select to force an input, a 16-word force table is established in PLC-3 memory for all inputs of its I/O rack. When you select to force an output, a 16-word force table is established for all outputs of its I/O rack. With a force table established, the message on the status line becomes: FORCES.

Removing (clearing) each force selection individually will not remove any force tables. The force tables can only be removed thru a command to remove (clear) all force selections. With the

force tables removed, the message on the status line becomes: NO FORCES.

When forces are disabled, the ON or OFF at the instruction and the FORCES or NO FORCES on the status line are normal intensity. When forces are enabled, the ON or OFF and the FORCES or NO FORCES are intensified.

When forces have been inserted but forces are disabled, inputs and outputs are not yet forced. Inputs and outputs are forced only when forces are enabled.

NOTE: Only inputs and outputs (with their I/O chassis in the scanning sequence) can be forced. Input and output section bits which do not correspond to I/O terminals and bits in other data table sections can not be forced.

5.4 Recorder Operation

You can use either the digital cassette recorder or the data cartridge recorder to:

- Record (dump) user accessible PLC-3 memory onto tape.
- Load previously recorded data from tape into the PLC-3 memory.
- Compare data on tape to the corresponding data in PLC-3 memory.

5.4.1 Automatic Verification

During each record operation, after the data sent from the PLC-3 memory is recorded onto tape the industrial terminal and the recorder automatically verify the integrity of the data on tape thru a check-sum verification. To perform the automatic verification of the record operation, the 1770-SA recorder rewinds, then reads the tape; the 1770-SB recorder reads from the tape with one head while writing onto the tape with another head. During each load operation, while the data sent from the tape is loaded into PLC-3 memory the industrial terminal automatically verifies the integrity of the data sent to the PLC-3 memory thru a check-sum verification. If the industrial terminal detects an error through this verification function, it will abort the load or record operation and display an appropriate error message which would usually be CHECKSUM ERROR. When a verification error is indicated, start over with the recording or loading operation.

5.4.2 User Accessible Memory

You can record from and load into the following areas of PLC-3 memory:

- Area 2 (module status) — except for E2.0, E2.1, E2.2, E2.14, E2.15 and those subsections which have a 0 at the fourth level of the address (such as E2.3.1.0 or E2.3.2.0)

- Area 3 (data table)
- Area 4 (user program)
- Area 5 (message)
- Area 6 (system symbol)
- Area 10 (force table)

If you enter a command to record area 2, only the user accessible parts of area 2 will be recorded.

When you are entering a command to load data from tape into the PLC-3 memory, you will be prompted to specify whether you want to append this data to the data in memory. If your reply is yes, the data on tape will be appended to the data in memory. If your reply is no, the corresponding data in memory is first cleared and then replaced by the data from tape.

If you choose to **append** main user program rungs, they will be added at the end of the existing rungs in the main user program. If you choose **not to append** main user program rungs, the existing main user program rungs will be removed and replaced with the rungs from tape.

NOTE: If you load from tape into area 2 (module status) you **must** reply with a **yes** to the **append** prompt. If you respond to **not append** the data loaded into area 2, a fault may be generated.

5.4.3 Tape Data Organization

Each tape is organized into files. A file on tape does not necessarily have any relationship to any file in PLC-3 memory. Each time you enter a command to record (dump), a new file is generated. When you record the first file on a tape, you will be prompted to enter a name for the tape and a name for the file. When you record subsequent files on the tape, you will be prompted to enter a name for each file. These names are recorded on the tape for tape and file identification.

5.4.4 Preliminary Step

To use the 1770-SB recorder set it to 9600 baud. To use the 1770-SA recorder press its REMOTE pushbutton.

5.4.5 Commands

During recorder operations, enter all commands through the industrial terminal keyboard while following the prompts on the industrial terminal CRT. Press [CANCEL CMD] to terminate any tape function in progress.

5.4.5.1 Dump

To record user accessible PLC-3 memory, first type:

DUMP (ENT)

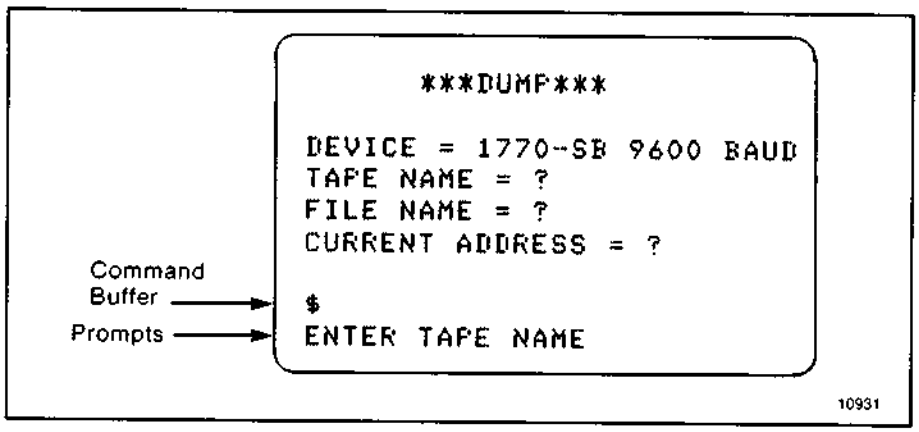


Figure 5.10 — Dump Display

The industrial terminal responds to the DUMP command with the DUMP display as illustrated in figure 5.10. If you enter the DUMP command while the tape is rewinding, the industrial terminal will reply with the prompt: DEVICE ERROR. In that case, wait until the tape stops and then re-enter the DUMP command.

Respond to the prompt, ENTER TAPE NAME by typing:

<tape name>(ENT)

Respond to the prompt, ENTER FILE NAME by typing:

<file name>(ENT)

Use names that will be useful for later identification (60 characters maximum with no spaces allowed). For example, you might type:

STARTUP-TEST-PROGRAM (ENT)

In response to your input, the industrial terminal will display your tape name and your file name on the CRT.

Specify All But Area 2

If you want to record areas 3, 4, 5, 6, and 10, in response to the prompt DUMP SYSTEM? (with CURRENT ADDRESS = ? displayed) type:

A (ENT)

Specify Contiguous Areas

Alternately, you can specify contiguous areas you want to record by typing:

A , <starting area> , <ending area>(ENT)

For example, to record areas 2, 3, 4, and 5, type:

A , 2 , 5 (ENT)

Specify Thru Current Address

Another alternative is for you to first type:

Y , <area> [ENT]

The area number entered appears on the CURRENT ADDRESS line. If you type only Y [ENT], the area number displayed is 3. With an area number displayed on the CURRENT ADDRESS line, you can move the address in the CURRENT ADDRESS display to point to an area, section, or sub-section you want to record. Type N [ENT] to advance the CURRENT ADDRESS one number at the same level (from 2 to 3, from 3.1 to 3.2, etc.). Type Y [ENT] to move the CURRENT ADDRESS to the next lower level (from 2.3 to 2.3.1, etc.). Type U [ENT] to move the CURRENT ADDRESS to the next higher level (from 2.3.1 to 2.3, etc.). For example, in response to the DUMP SYSTEM? prompt (with CURRENT ADDRESS = ? displayed) if you type:

Y , 4 [ENT]

the display becomes:

```
CURRENT ADDRESS = 4
```

If you then type:

Y [ENT]

the display becomes:

```
CURRENT ADDRESS = 4.1
```

If you then type:

Y [ENT]

the display becomes:

```
CURRENT ADDRESS = 4.1.0
```

If you then type:

N [ENT]

the display becomes:

```
CURRENT ADDRESS = 4.1.1
```

If you then type:

A [ENT]

you will record all of subsection E4.1.1.

With the CURRENT ADDRESS display pointing to the part of memory you want recorded, type:

A [ENT]

Once you specify the part of memory to be dumped through one of these three methods, the prompt becomes, DUMPING TO TAPE. After all the data you had specified has been dumped, the prompt again becomes, DUMP SYSTEM?.

At this point you have the option of specifying another part of memory to be dumped into this tape file through one of these three methods. After dumping all of the parts of memory that you want into the tape file, respond to the DUMP SYSTEM?, prompt by ending the file by typing:

E [ENT]

The prompt will then be FILE COMPLETE, ENTER NEXT FILE NAME. At this point you have the option of entering a name for another file on the tape and then specifying other parts of memory to be dumped into the new tape file. After you have ended the last file you want on the tape, in response to the FILE COMPLETE, ENTER NEXT FILE NAME prompt, end the tape by typing:

E [ENT]

The prompt will then be, FUNCTION COMPLETED.

5.4.5.2 Load

To load user accessible PLC-3 memory from tape, with the PLC-3 controller in the program load mode, first type:

LOAD [ENT]

The industrial terminal responds to the LOAD command with the LOAD display as illustrated in figure 5.11. Respond to the ENTER FILE NAME prompt by typing:

[ENT]

The tape name will be read from the tape and displayed. If you determine from the name that this is the tape from which you want to load, respond to the ENTER TAPE NAME prompt by typing:

><file name>[ENT]

Alternately, if you want to load the first file found on the tape, you can type:

[ENT]

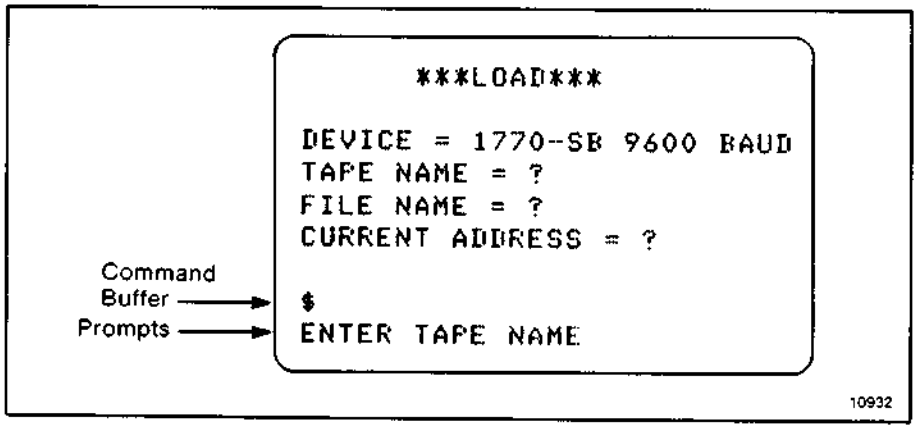


Figure 5.11 — Load Display

In either case, the file name will be displayed and the prompt will be . APPEND? . If you want to append the tape file to the corresponding data in memory, respond to the APPEND? prompt by typing:

Y [ENT]

If you want the tape file to replace the corresponding data in memory, respond to the APPEND? prompt by typing:

N [ENT]

Once you enter a proper response to the APPEND? prompt, the prompt becomes, LOADING FROM TAPE . After the tape file has been loaded into PLC-3 memory, the prompt becomes, FILE COMPLETE, ENTER NEXT FILE NAME.

At this point you have the option of specifying another tape file to be loaded into PLC-3 memory. The file must appear after the previous file, or it will not be found. After loading all of the tape files that you want into PLC-3 memory, respond to the FILE COMPLETE, ENTER NEXT FILE NAME prompt by typing:

E [ENT]

The prompt will then be, FUNCTION COMPLETED.

5.4.5.3 Compare

Automatic verification of data integrity takes place during each load and dump operation. However, at some later time you may want to compare data on tape to data in memory to ensure that the data in memory has not been altered.

To compare user accessible PLC-3 memory to a tape file, first type:

COMP [ENT]

The industrial terminal responds to the COMPare command with the COMPARE display as illustrated in figure 5.12.

Respond to the ENTER TAPE NAME prompt by typing:

[ENT]

The tape name will be read from the tape and displayed. If you determine from the name that this is the tape you want to compare, respond to the ENTER FILE NAME prompt by typing:

<file name> [ENT]

Alternately, if you want to compare the first file found on the tape, you can type just:

[ENT]

After the tape file has been compared to the corresponding data in PLC-3 memory the prompt becomes, FILE COMPLETE, ENTER NEXT FILE NAME.

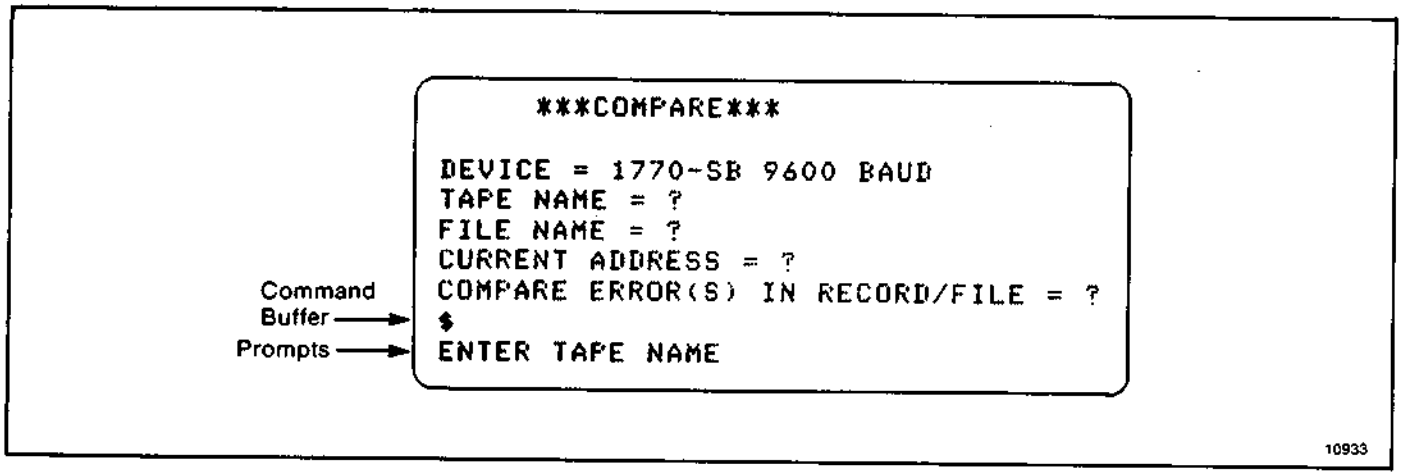


Figure 5.12 — Compare Display

If 0/0 is displayed on the compare errors line, no compare errors were found with that file. The total number of errors in the file is displayed on the right. If you want to know the address in PLC-3 memory where errors are found, watch the number on the left during a comparison. When a number is displayed on the left, the address where that error was found is displayed on the current address line. The address of the error will be displayed until another error is detected.

At this point you have the option of specifying another tape file to be compared. After comparing all tape files that you want, respond to the `FILE COMPLETE, ENTER NEXT FILE NAME` prompt by typing:

E (ENT)

The prompt will then be, `FUNCTION COMPLETED`.

NOTE: There are two parts of memory which you can't expect to compare without errors:

- Any part of the data table
- Any part defined by the extended address E4.x.1.0, where x is any context number.

5.5 Printer Operation

You can use a printer to print data, ladder diagram rungs, memory map reports, or messages. This section describes the commands you can use to perform these functions. Enter all commands through the industrial terminal keyboard while following the prompts on the industrial terminal CRT.

5.5.1 Peripheral Port Control

Before the industrial terminal can communicate with a printer, you must select the parameters of the channel C port to match those of the printer. You must make a selection for each of the following parameters:

Table 5.C

Hardware Handshaking Modes

CHANNEL C Pin No.	Input/ Output	Mode		
		Off	On	Auto
2	Input	Enabled	Enabled	Enabled if pin 4 is high (ON). Disabled if pin 4 is low (OFF).
3	Output	Enabled	Enabled	Enabled if pin 20 is high (ON). Disabled if pin 20 is low (OFF).
4	Input			High (ON) enables receiving data at pin 2. Low (OFF) disables receiving data at pin 2.
5	Output			High if clear to send when pin 4 is high (ON). Low if not clear to send or pin 4 is low (OFF).
6	Output	Low (OFF)	High (ON)	Low (OFF).
8	Output	Low (OFF)	High (ON)	High (ON) if data is waiting to be transmitted. Low (OFF) if no data is waiting to be transmitted.
20	Input			High (ON) enables transmitting data at pin 3. Low (OFF) disables transmitting data at pin 3.

- Communication rate (110, 300, 600, 1200, 2400, 4800, or 9600 baud)
- Parity (none, even, odd)
- Stop Bits (1, 1.5, 2)
- Hardware handshaking (off, on, auto - refer to table 5.C for hardware handshaking).

To select these parameters, first type:

PORT (ENT)

The industrial terminal responds to the PORT command with the display shown in figure 5.13. At this point you can make the selections as indicated on the display. The selections will be displayed as you change them.

Each time you type A, the communication rate displayed will be switched to a new selection. Each time you type B, the parity displayed will be switched to a new selection. Each time you type C, the stop bits displayed will be switched to a new selection. Each time you type D, the hardware handshaking displayed will be switched to a new selection.

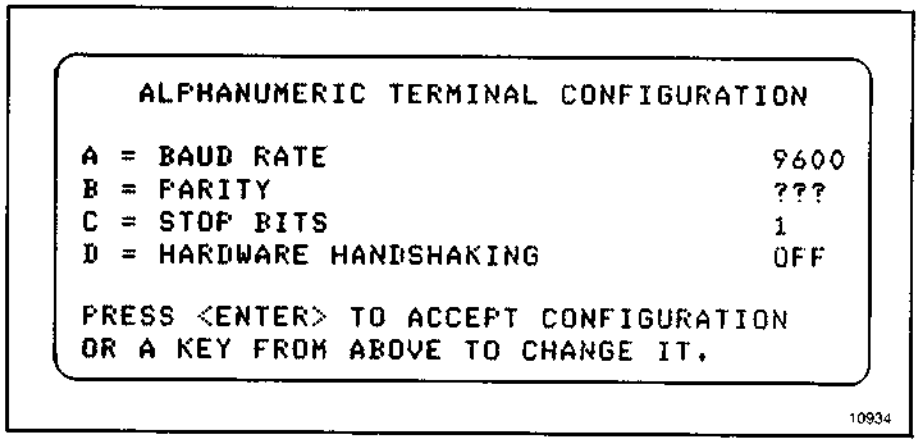


Figure 5.13 — Channel C Port Parameter Selection Display

When all of the selections that you want are displayed, type:

[ENT]

At this point the port is configured to your selections. Each time you power up the industrial terminal, you must repeat your selections before the industrial terminal can communicate with a printer.

5.5.2 Printing Data

To print data values in the default display format for the specified data table section, type:

[SFT]**[DATA]**[SFT]**[PRINT]**,**<address>** ,**<number of words>**[ENT]

or:

DF, **<address>** ,**<number of words>**[ENT]

The address can be either the data table address or the extended address of the first word to be printed. The number of words can range from 1 to the end of the file, or will be defaulted to the end of the file if not entered.

Data is printed in the default display format for that section, unless you specify another format by typing % **<display format>** after the number of words (or the address if number of words is not specified). For example, typing:

DF,B1:0,10,%H [ENT]

causes the printer to print the first 10 words of binary file 1, in hexadecimal. Table 5.A shows the available display formats and their corresponding specifiers. Table 5.B lists each data table section, its default display format, and the optional format specifiers which can be used with that section.

You can stop the printout at any time by pressing **[CANCEL CMD]**.

5.5.3 Printing Ladder Diagram Rungs

To print rungs from the ladder diagram program, type:

[SFT][RUNG][SFT][PRINT],<first rung>,<last rung>[ENT]

or:

RP,<first rung>,<last rung>[ENT]

For example, typing:

RP,RM0,RM10 [ENT]

causes the printer to print rungs 0 thru 10 in the main program area. As many rungs as possible will be printed on each page. Optionally, you can command the printout to be in the form of one rung per page by typing:

RP,<first rung>,<last rung>,Y [ENT]

For example, typing:

RP,RM0,RM10,Y [ENT]

causes the printer to print rungs 0 thru 10, each on a separate sheet of paper.

If only one rung number is entered, the printer prints from that rung to the end of the program.

If no rung numbers are entered, the entire program area is printed.

The rungs are printed with associated rung comments appearing above them if the industrial terminal is in the comment display mode. The terminal is normally in the comment display mode at powerup. You can switch out of the comment display mode into the multiple rung display mode by typing:

[SFT][DISPLAY] [ENT]

or:

DIS [ENT]

You can change into the comment mode at any time by typing:

[SFT][COMMENT][SFT][DISPLAY][ENT]

or:

CD [ENT]

You can stop the printout at any time by pressing [CANCEL CMD]

5.5.4 Printing Message Text

To print the text of a message from a specified address to the end of the message, type:

[SFT][MESSAGE][SFT][PRINT],<starting address>[ENT]

or:

MP,<starting address>[ENT]

The address must be the extended address of the first word to be printed. For example:

```
MP,E5.1.1.2.0 (ENT)
```

NOTE: This is not the same as executing a report generation message procedure. For information on executing a report generation message procedure, refer to the I/O Scanner-Message Handling Module User's Manual (publication 1775-806).

You can stop the printout at any time by pressing **[CANCEL CMD]**

5.5.5 Memory Map Reports

You can display a memory map report on the industrial terminal thru the command **MAP**. Similarly, with a printer connected to channel C, you can print a memory map report thru the command **MAPP**. The report would consist of 3 columns with the headings ADDRESS, SIZE, and NEXT LEVELS.

Following the command, you must specify the part of memory for which you want a memory map report. Consider the example:

```
MAPP,E3.1 (ENT)
```

This generates the memory map report printout shown in figure 5.14. Since the data table is area 3, this generates a memory map report of the data table in context 1. In the ADDRESS column is a list of the extended address of each section of the data table in context 1. In the SIZE column is the

```
$MAPP,E3.1
ADDRESS          SIZE          NEXT LEVELS
E3.1.1           595           3
E3.1.2           1970          1
E3.1.3           439           1
E3.1.4           160           1
E3.1.5           271           52
E3.1.6           6             1
E3.1.7           22            3
E3.1.8           240           52
E3.1.9           5             1
E3.1.10          6             1
E3.1.11          5             1
E3.1.12          106           1
E3.1.13          335           4
```

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Figure 5.14 — Memory Map Report Example

number of words in each section. In the NEXT LEVELS would be the number of files in each section.

Consider another example:

```
MAP'F',N [ENT]
```

This would generate a memory map report of the integer section of the data table in the operating context of the industrial terminal. In the ADDRESS column would be a list of the extended address of each file in the section. In the SIZE column would be the number of words in each file. In the NEXT LEVELS column would be the number of words in each file.

Refer to the PLC-3 Programmable Controller Programming Manual (publication 1775-801) for a general description of memory map reports, context, and extended addressing.

Chapter

6

LIST Function Operation

6.0 General

Operating parameters for the PLC-3 programmable controller are selectable thru the LIST function. You can access and operate the LIST function from either an industrial terminal or the PLC-3 front panel. Operation of LIST from the front panel is generally similar to operation from an industrial terminal, except that the displays are shown one line at a time. Other differences in operation between the front panel and an industrial terminal are noted with the discussion of specific functions. This chapter emphasizes operation from an industrial terminal.

The LIST function works by presenting you with a series of frames, each containing a list, or menu, that allows you to select and establish operating parameters. Many options in upper-level menus lead you to a submenu of more detailed options. This process continues until you have selected enough options to define a single parameter in full detail. To return to the preceding (next higher) level of LIST, press [ENT] without making a new entry.

Figures 6.1 thru 6.5 make up a complete LIST guide. You can follow from one figure to another to find your way through the entire LIST network. Some selections on some menus will only cause you to move on to another menu at the next lower level of LIST without affecting any operation. However, those selections shown in bold type in figures 6.1 thru 6.5 will affect the operation of the PLC-3 controller.

6.1 Accessing LIST

To access the PLC-3 LIST function from an industrial terminal, type:

[SFT] **[LIST]** [ENT]

or

LIST [ENT]

The following menu appears on the industrial terminal CRT:

```
SYSTEM-MODE
1 TEST-MONITOR
2*RUN MONITOR
3 PROGRAM LOAD
4 REMOTE ENABLE
5 SYSTEM STATUS
6 MODULE STATUS
ENTER NEXT>
```

This is the top level LIST menu.

To access LIST from the PLC-3 front panel, type:

[SFT][LIST]

6.2 Mode Selection

The first three lines of the top level LIST menu represent mutually exclusive selections for processor mode. An asterisk (*) beside the selection indicates the current processor mode. Thus, if you type:

3 [ENT]

when the top level LIST menu is displayed, the processor mode changes to program load, and the following appears:

```
SYSTEM-MODE
1 TEST-MONITOR
2 RUN MONITOR
3*PROGRAM LOAD
4 REMOTE ENABLE
5 SYSTEM STATUS
6 MODULE STATUS
ENTER NEXT>
```

You can make this mode selection thru a local channel at any time. However, you can only make this mode selection thru a remote channel when remote is enabled. A remote channel is one which has privilege 68 (remote) assigned to it thru LIST. A local channel is one which has privilege 67 (local) assigned to it thru LIST. The data access panel is given the local privilege by default. All other channels are given the remote privilege by default.

Selection 4 is a toggle selection. With the top level LIST menu displayed, typing:

4 [ENT]

alternately enables and disables remote. When remote is enabled, an asterisk (*) is displayed beside selection 4. You can only make a remote enable/disable selection thru a local channel.

6.3 System Status

When the top level LIST menu appears on the industrial terminal CRT, type:

5 [ENT]

on the industrial terminal keyboard to select system status. The following menu appears on the CRT:

```
SYSTEM
1 CONTEXT NO.
2 WATCHDOG SET UP
3 CLOCK
4 RTC INTERRUPT
5 MEMORY
ENTER NEXT>
```

You can get back to the top level LIST menu by pressing [ENT]

Each of the five selections in the system status display allows you to examine or change a different parameter (refer to figure 6.1).

6.3.1 Context

Selection 1 in the system status menu shows you the current PLC-3 operating context. A separate program and the parameters for that program can be stored in each context (1 to 15). For further information on PLC-3 context, refer to the PLC-3 Programmable Controller Programming Manual (publication 1775-801).

You can only change context in the program load mode. Change context by typing the desired context number and pressing [ENT]. You can also get back to the system status menu by just pressing [ENT]. The default context is 1.

6.3.2 Watchdog

Selection 2 in the system status menu is the watchdog set up. Typing:

2 [ENT]

while the system status menu is on the CRT causes the following menu to appear:

```
WATCHDOG
1 SET    xxx MS
2 HIGH   xxx MS
PRESENT xxx MS
ENTER NEXT>
```

From this menu you have three options.

Option 1:

You can change the watchdog timer set value by typing:

1 [ENT] <new value> [ENT]

The watchdog set value is the longest program scan time which the PLC-3 will allow before it declares a major fault. This value can range from 10 to 2550ms in 10ms increments. If you enter a value of 0, or if you never enter a value, the value 0 is displayed and the default value of 2550ms is used. You can then get back to the watchdog menu by pressing [ENT]

Option 2:

You can reset the high value by typing:

2 [ENT]

The high value indicates the longest program scan time since the last time it was reset (or since the initial startup if it has never been reset).

Option 3:

You can return to the system status menu be pressing [ENT]

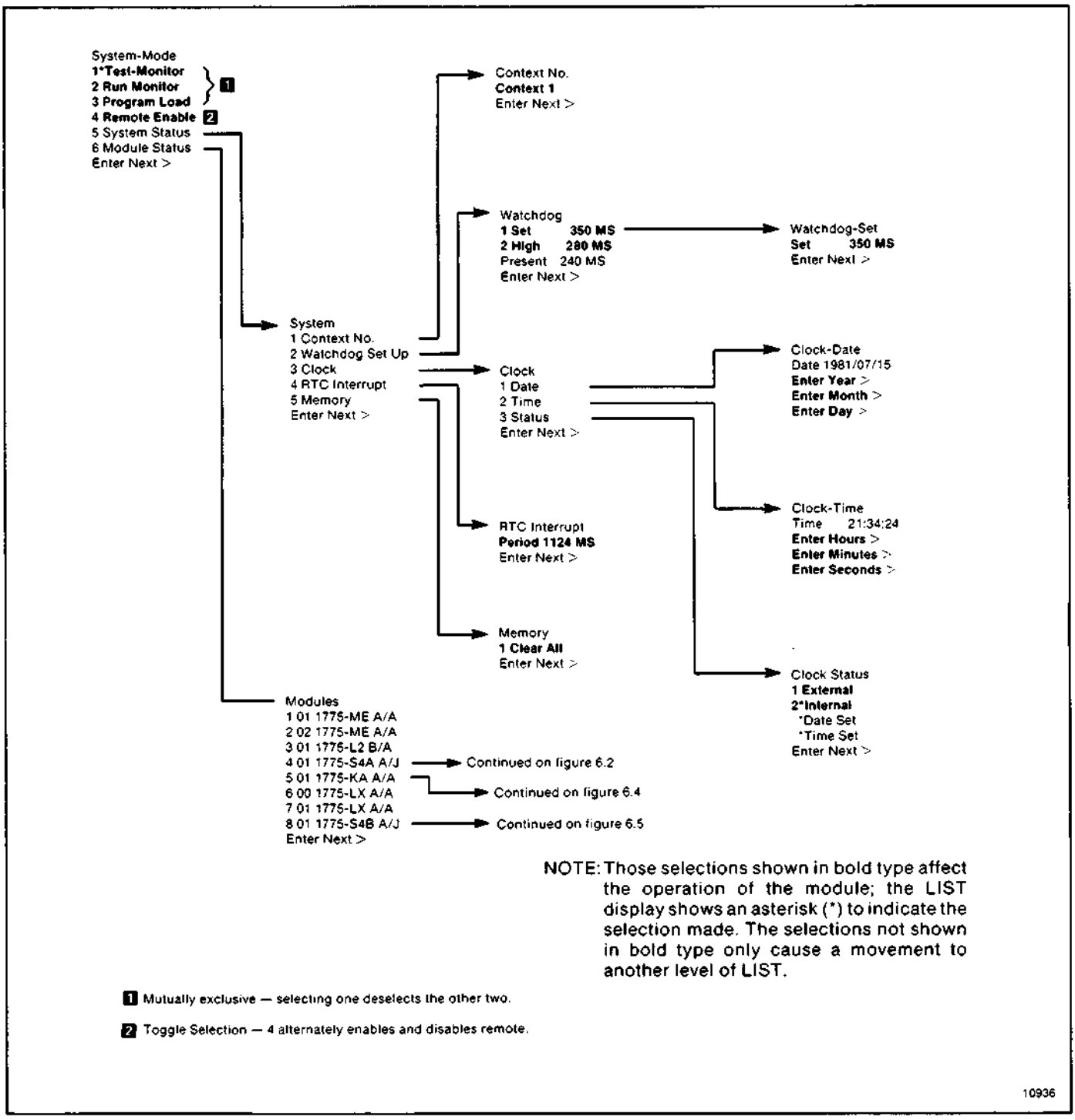


Figure 6.1 — System Status LIST Guide

6.3.3 Clock

Selection 3 in the system status menu is the clock.

Typing:

3 [ENT]

while the system status menu is displayed on the CRT causes the following menu to appear.

```
CLOCK
1 DATE
2 TIME
3 STATUS
ENTER NEXT>
```

To view the date, type:

1 [ENT]

Then respond to prompts for year, month, and day to set the date, or just press [ENT] to return to the system status menu.

To view the time, type:

2 [ENT]

Then respond to prompts for hours, minutes, and seconds to set the time, or just press [ENT] to return to the system status menu.

Selection 3 in the clock menu is clock status. Typing:

3 [ENT]

while the clock menu is on the CRT causes the following menu to appear:

```
CLOCK-STATUS
1 EXTERNAL
2*INTERNAL
 *DATE SET
 *TIME SET
ENTER NEXT>
```

In the clock status menu currently only an internal clock is allowed and 2 is selected by default, so don't make a selection here. An asterisk (*) will appear next to selection 2 (as shown above). This indicates whether the main processor module controls the clock (internal).

An asterisk (*) next to the date set or time set entries indicates that the specified parameter (date or time) has been set since the last power-up.

To return to the clock menu, press [ENT]

6.3.4 RTC Interrupt

Selection 4 in the system status menu shows you the real time clock (RTC) interrupt period. You can change the interrupt period (1ms increments) by typing the desired value and

pressing [ENT]. The interrupt value can be up to 65535ms. A value of 0 disables the real time interrupt. For information on real time interrupt routines, see the PLC-3 Programming Manual (publication 1775-801).

To return to the system status menu, press [ENT]

6.3.5 Memory

Selection 5 in the system status menu is the memory selection. When you type:

5 [ENT]

the following menu appears:

```
MEMORY
1 CLEAR ALL
ENTER NEXT>
```

If you type:

1 [ENT]

while this menu is shown, memory is cleared and returns to the default configuration. You can return to the system status menu without affecting the memory contents by pressing [ENT]

6.4 Module Status

Selection 6 of the top level LIST menu is module status. When you make this selection, a menu appears showing which modules are installed in the processor chassis. A typical menu at this level might look like the following:

```
MODULES
1 01 1775-MR8 A/A
2 02 1775-MR8 A/A
3 01 1775-L2 B/A
4 01 1775-S4A A/J
5 01 1775-KA A/A
6 00 1775-LX A/A
7 01 1775-LX A/A
8 01 1775-S4B A/J
9 02 1775-S4B A/J
ENTER NEXT >
```

This menu would be for a PLC-3 with nine modules.

The first column is the selection number.

The second column shows the thumbwheel setting. With the main processor module (cat. no. 1775-L1, -L2), which has no thumbwheel switch, this column always contains the value 01. With the expansion module, which has no thumbwheel switch. the chassis number is displayed.

The third column shows the catalog number of each module in the system.

The fourth column shows the series and revision level for each module.

For some modules, including memory modules, the main processor module, and expansion modules this is the only information available thru LIST. Other modules have parameters which can be examined and altered thru LIST. The following sections describe these selections.

6.5 1775-S4A Module Communication Channels

The 1775-S4A I/O scanner modules can communicate thru the channel 5 connector with an industrial terminal or a computer using the PLC-3 binary command language (BCL). BCL is described in the I/O Scanner-Programmer Interface Module User's Manual (publication 1775-805). The 1775-S4A scanner module with its thumbwheel set to 1 also communicates with the data access panel, as well as devices connected to channel 0 on the front panel. This section describes the effect of entries in LIST (figure 6.2) on this communication.

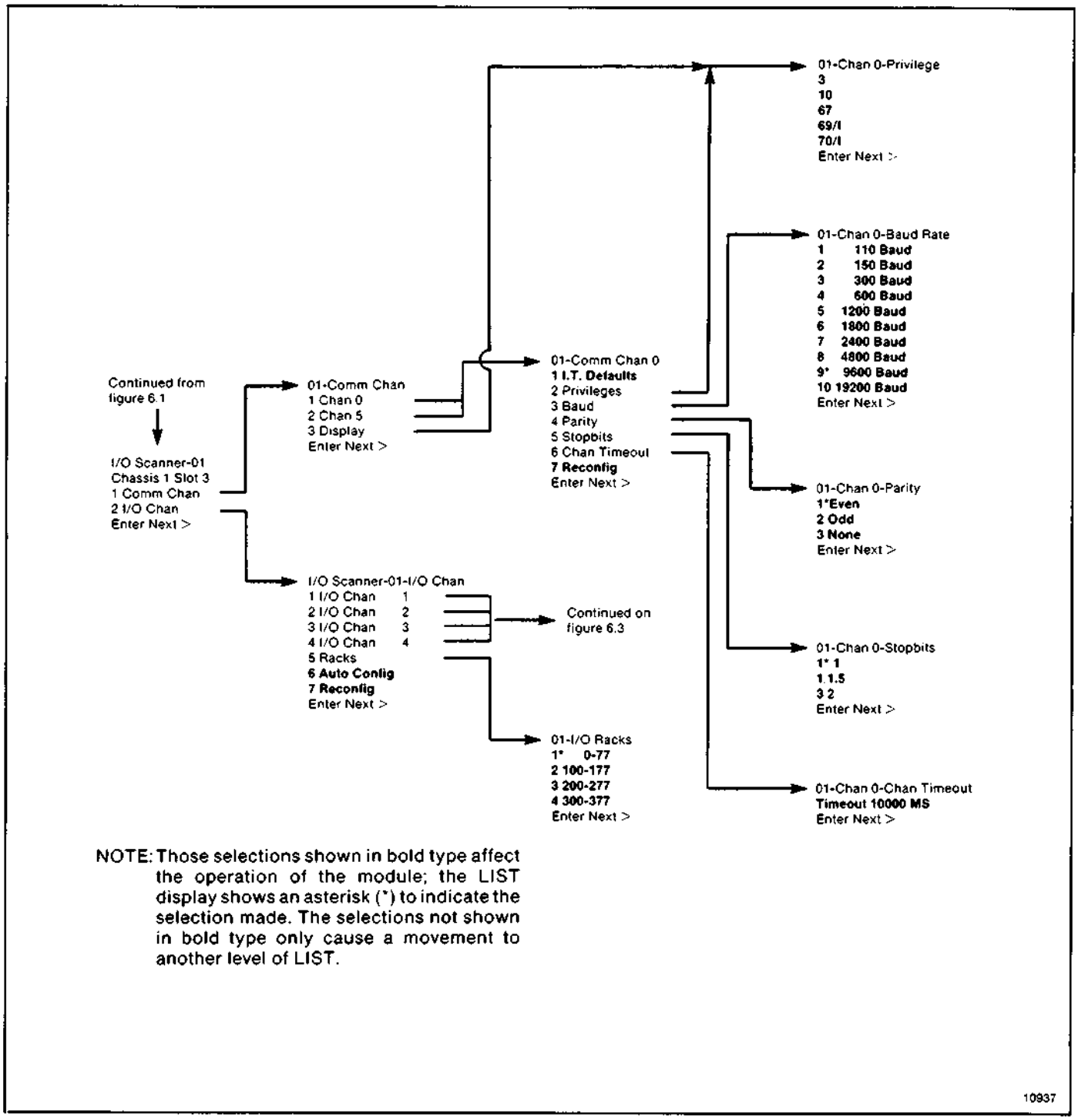
NOTE: At initial powerup, the 1775-S4A scanner module with its thumbwheel set to 1 has channels 0 thru 4 active. All other 1775-S4A scanner modules have channels 1 thru 5 active at initial powerup. To enable channel 5 on the number 1 1775-S4A scanner module, you must configure channel 4 to be a communication channel.

The CHAN 0 and DISPLAY selections are only valid for 1775-S4A I/O scanner module number 1. The DISPLAY selection refers to the data access panel which is made up of the 16-character display and the keypad. The only parameter that can be selected for the data access panel is privileges.

Selecting DISPLAY leads directly to the privileges menu. Selecting CHAN 0 or CHAN 5 causes the following menu to display:

```
01 COMM CHAN 0
1  I.T. DEFAULTS
2  PRIVILEGES
3  BAUD
4  PARITY
5  STOP BITS
6  CHAN TIMEOUTS
7  RECONFIG
ENTER NEXT>
```

Enter one of these numbers followed by (ENT) to call up the corresponding menu from which you can make your selection. The default selections are those listed as the I.T. default selections in section 6.5.4.



NOTE: Those selections shown in bold type affect the operation of the module; the LIST display shows an asterisk (*) to indicate the selection made. The selections not shown in bold type only cause a movement to another level of LIST.

Figure 6.2 — 1775-S4A I/O Scanner Module Communication Channel LIST Guide

6.5.1 Privileges

Thru LIST, you can assign privileges to each communication channel. Privileges 0 thru 63 allow devices connected to the channel to write into the corresponding memory area. For example, privilege 3 allows the device to write into the PLC-3 data table. Other privileges include:

- Privilege 64 — On-line editing. Allows devices on the channel to edit the application program while the processor is in the run mode.
- Privilege 65 — Section creation/deletion. Allows devices on the channel to allocate or deallocate memory.
- Privilege 66 — Change privileges. Allows devices on the channel to change privileges thru LIST.
- Privilege 67 — Local channel. A device on a channel with this privilege can change the processor operating mode without the remote enable selection activated.
- Privilege 68 — Remote channel. A device on a channel with this privilege can change the processor operating mode only if the remote enable selection is activated.
- Privilege 69 — LIST system configuration. Allows devices connected to this channel to make changes in the system status section of LIST.
- Privilege 70 — LIST module configuration. Allows devices connected to this channel to make changes in the module status section of LIST.
- Privilege 71 — Reserved.
- Privilege 72 — Physical write. Allows devices connected to this channel to perform a download operation as described in the I/O Scanner-Programmer Interface Module User's Manual (publication 1775-805).

The default privileges for the data access panel are 3, 10, 67, 69, and 70. The default privileges for channel 0 and channel 5 are 0, 2, 3, 4, 5, 6, 10, 64, 65, 66, 68, 69, 70, 71, and 72.

To add a privilege to a channel, type the number of the privilege. You can make a privilege independent of the memory protect keyswitch position by typing /I after the privilege number.

To delete a privilege from a channel, type /D after the privilege number.

6.5.2 Communication Rate

The rate at which the module communicates with devices connected to each channel is selectable thru LIST. Select the communication rate by typing the number corresponding to the desired communication rate. The current rate is indicated by an asterisk (*) next to the selection. The default selection is 9600 baud.

6.5.3 Parity

The module can communicate thru channel 5 using odd, even, or no parity. Select the proper parity for communication with the desired device thru LIST. The current parity is indicated by an asterisk (*) next to the selection. The default parity selection is even.

6.5.4 Stop Bits

The number of stop bits used in communication thru each channel is selected thru LIST. You can select 1, 1.5, or 2 stop bits. To change the number of stop bits, type the number corresponding to the desired selection. The current number of stop bits is indicated by an asterisk (*) next to the selection. The default stop bits selection is 1.

6.5.5 Channel Timeout

The amount of time which the PLC-3 controller will allow between operations on a channel before terminating communication is selectable thru LIST. If you set the channel timeout value to 0, the timeout is disabled. Enter timeout values in milliseconds, up to a maximum timeout of 32767ms. If you do not enter a channel timeout value, the value of 10000ms is used by default.

6.5.6 I.T. Defaults

The selection I.T. DEFAULTS in LIST configures the channel for normal communication with an industrial terminal. This is also the configuration at initial powerup. It is equivalent to making the following individual selections in LIST:

- Privileges — 0, 2, 3, 4, 5, 6, 10, 64, 65, 66, 68, 69, 70, 71, 72
- Communication rate — 9600 baud
- Parity — even
- Stop bits — 1
- Channel timeout — 10000 ms

6.5.7 Reconfiguration

The reconfiguration selection implements the changes which have been made in LIST. This selection is similar to the reconfiguration selection for I/O channels, but applies only to the channel which you are presently configuring. Thus, you must reconfigure each communication channel separately.

NOTE: If a communication channel is being used when you reconfigure the scanner, changes to that channel are not implemented until communication on the channel is terminated. If the channel timeout is disabled, you must terminate communication by sending a break character as described in the I/O ScannerProgrammer Interface Module User's Manual (publication 1775-805).

NOTE: Reconfiguration occurs automatically each time processor power is turned on.

6.6 1775-S4A Module I/O Channels

Each I/O scanner-programmer interface module has four I/O channels (channel 1 thru channel 4). All except the number 1 I/O scanner-programmer interface module can have all four I/O channels and communication channel 5 active at the same time. The number 1 I/O scanner-programmer interface module (which supports the PLC-3 front panel) can have communication channel 0, I/O channels 1, 2, and 3, and either I/O channel 4 or communication channel 5 active. Configure the channels thru the LIST function (figure 6.2 and 6.3) for their intended purposes. This section describes the entries to make in LIST, and the effect these entries have on the operation of the I/O channels.

6.6.1 I/O Rack Group Selection

The I/O rack group is selected in LIST if the channel is to be used for I/O scan. Currently only I/O rack numbers 0 to 76 are allowed and the first I/O rack group is selected by default, so don't make a selection here.

6.6.2 Communication Rate Selection

The communication rate for each I/O channel used is selected thru the LIST function. Either 57.6k baud or 115.2k baud can be selected. When you select 57.6k baud, the maximum channel length is 10,000 cable-feet. When you select 115.2k baud, the maximum channel length is 5,000 cable-feet. The default value is 115.2k baud.

6.6.3 I/O Chassis Scanning Sequence

When you configure an I/O channel for I/O scan, list the I/O chassis in the order in which you want the scanner to communicate with them. This allows you to assign a higher priority to some I/O chassis than to others by listing the higher priority chassis more than once. For example, if there are six entries in the I/O chassis list, and entries 1 and 4 are the same, then the chassis listed under entries 1 and 4 will be updated twice as often as the other chassis. A chassis can be listed as often as desired, provided that the list contains no more than 32 entries.

NOTE: I/O scan is the default configuration of each I/O channel at initial powerup.

Use the following format to enter chassis in the chassis list:

<entry number> / <rack number> / <chassis size> / <starting module group number> / <attributes>(ENT)

Entry number defines the position of the entry in the chassis list. For example, to insert an entry between the third and fourth entries, use entry number 4. The new entry will become the fourth entry, and all entries numbered 4 or greater will have their entry numbers incremented by one.

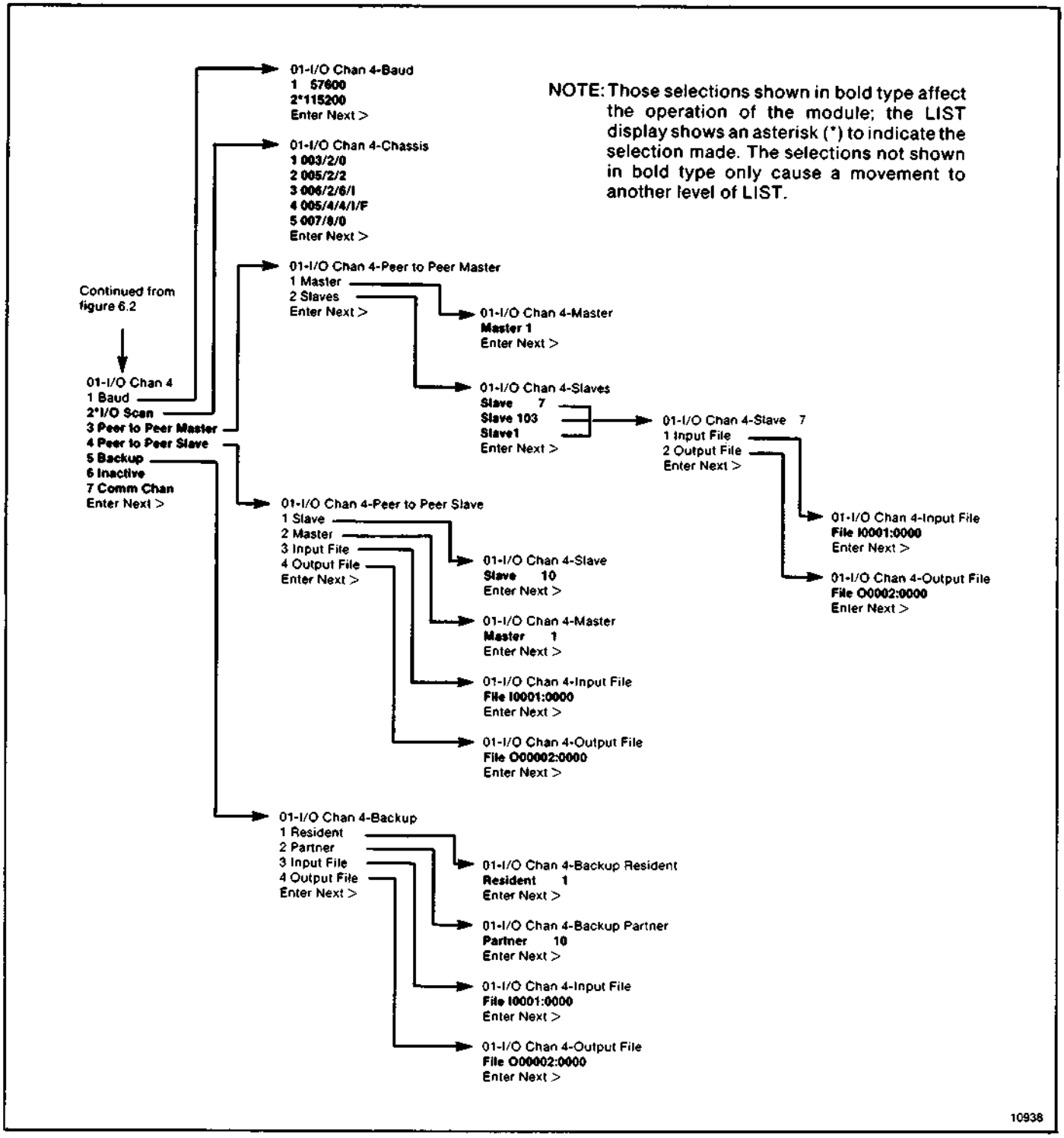


Figure 6.3 — 1775-S4A I/O Scanner Module I/O Channel LIST Guide

Rack number is the I/O chassis I/O rack number, in octal. The rack number must be within the range of the rack group selected for the scanner module. The last two digits of the rack number must correspond to the switch settings on the adapter module in the I/O chassis.

Chassis size is the number of module groups in the chassis. It can be 2, 4, or 8. Enter 2 for a 32 I/O chassis; 4 for a 64 I/O chassis; 8 for a 128 I/O chassis.

Starting module group is the lowest numbered module group in the chassis. It can be 0, 2, 4, or 6.

Attributes can be I if the chassis is for inputs only or F if a fault in the chassis is to be considered a major fault. There can be 0, 1, or 2 attributes associated with the chassis.

You can delete entries from the list by typing the entry number and pressing [ENT]. For example, type 3 [ENT] to delete the third entry in the rack list.

An asterisk (*) appearing before an entry in the rack list indicates that the corresponding I/O chassis is faulted.

6.6.4 Peer-to-Peer Communication

PLC-3 programmable controllers can communicate with other PLC-3 programmable controllers using peer-to-peer communication channels. A peer-to-peer communication channel includes one PLC-3 controller configured as the master and up to six PLC-3 controllers configured as slaves. The master communicates with all slaves on the channel, while each slave communicates only with the master.

Peer-to-Peer Master Configuration

When you configure a channel as a master on a peer-to-peer communication channel, the following parameters must be entered:

- Master number — identifies the master for communication with the slaves. There is only one master on each peer-to-peer communication channel. The master number can be 1 to 255.
- Slave numbers — identify the slaves which communicate with the master. There can be up to 6 slaves for each master. The slave number can be 1 to 255.
- Input files — identify the files into which data from each slave is placed. An input file must be declared for each slave. This file must be in the input section of the data table (LIST will not allow you to select another section).
- Output files — identify the files from which the master sends data to each slave. An output file must be declared for each slave. This file must be in the output section of the data table (the LIST will not allow you to select another section).

Peer-to-Peer Slave Configuration

When you configure a channel as a slave on a peer-to-peer communication channel, the following parameters must be entered:

- Slave number — identifies the slave for communication with the master. The slave number can be 1 to 255.
- Master number — identifies the master on the channel. The master number can be 1 to 255.
- Input file — identifies the file into which data from the master is placed. This file must be in the input section of the data table (LIST will not allow you to select another section). If you do not make a selection, it becomes input file 1 by default.
- Output file — identifies the file from which the slave sends data to the master. This file must be in the output section of the data table (LIST will not allow you to select another section). If you do not make a selection, it becomes output file 1 by default.

6.6.5 Backup Communication

When using the backup feature of the PLC-3 controller, you need a method of transferring data between the primary and backup processors. Peer-to-peer communication can not be used for this purpose, because the backup processor listens but does not respond to communication received on a peer-to-peer communication channel. When the primary processor receives no response to its transmissions, it stops communicating on the channel. Therefore, use backup communication for communication between the primary and backup processors.

Backup Configuration

When a channel is configured for backup communication, the following selections must be made in LIST:

- Resident number — identifies the PLC-3 processor being configured. The resident number can be 1 to 255.
- Partner number — identifies the other PLC-3 processor in the backup system. The partner number can be 1 to 255, and must be different from the resident number.
- Input file — identifies the file into which data from the partner is placed. This file must be in the input section of the data table (LIST will not allow you to select another section). If you do not make a selection, it becomes input file 1 by default.
- Output file — identifies the file from which data is sent to the partner. This file must be in the output section of the data table (LIST will not allow you to select another section). If you do not make a selection, it becomes to output file 1 by default.

6.6.6 I/O Channel Inactive Configuration

The I/O channel inactive configuration causes the scanner to stop communicating thru the channel. An inactive channel improves the I/O scan, block transfer, peer-to-peer, and backup communication times on the other channels. Therefore, configure unused channels as inactive.

6.6.7 Channel 4 Communication Configuration

To use channel 5 on the number 1 1775-S4A scanner module, configure channel 4 as a communication channel. With this selection, you can not use channel 4. This is necessary because the module has the added burden of channel 0 and the data access panel. This selection has no meaning for any channel other than channel 4 of 1775-S4A module number 1.

6.6.8 Reconfiguration and Auto Configuration

The I/O channel portion of LIST includes selections for reconfiguration and auto configuration.

A reconfiguration implements other changes which have been made in LIST. For example, if an I/O chassis is listed three times in the I/O chassis scanning sequence for that channel, and you change the list to include that chassis six times, the scanner will not change its polling sequence until you reconfigure the scanner module. Reconfiguration of I/O channels is performed on a scanner basis, not a channel basis. Therefore, you can reconfigure the I/O channels once, after making all I/O channel selections, instead of after making the selections for each channel.

NOTE: Reconfiguration occurs automatically each time processor power is turned on. Reconfiguration can be done in any mode.

An auto configuration first creates a new I/O chassis scanning sequence for each I/O channel in which each I/O chassis is given equal priority with no attributes assigned to it, then performs a reconfiguration.

The scanner performs an auto configuration at powerup under the following conditions:

- No channel configured for I/O scan has entries in the rack list.
- Neither auto configure nor reconfigure has been selected during a previous powerup (at least since the last time memory was cleared).

When forming the I/O chassis scanning sequence during an auto configuration, the scanner polls all valid rack addresses (0 to 76_8). If it receives a response to an address, it add that I/O chassis address to the list. To assign attributes or priorities to the I/O chassis, add them manually thru LIST and reconfigure the channel.

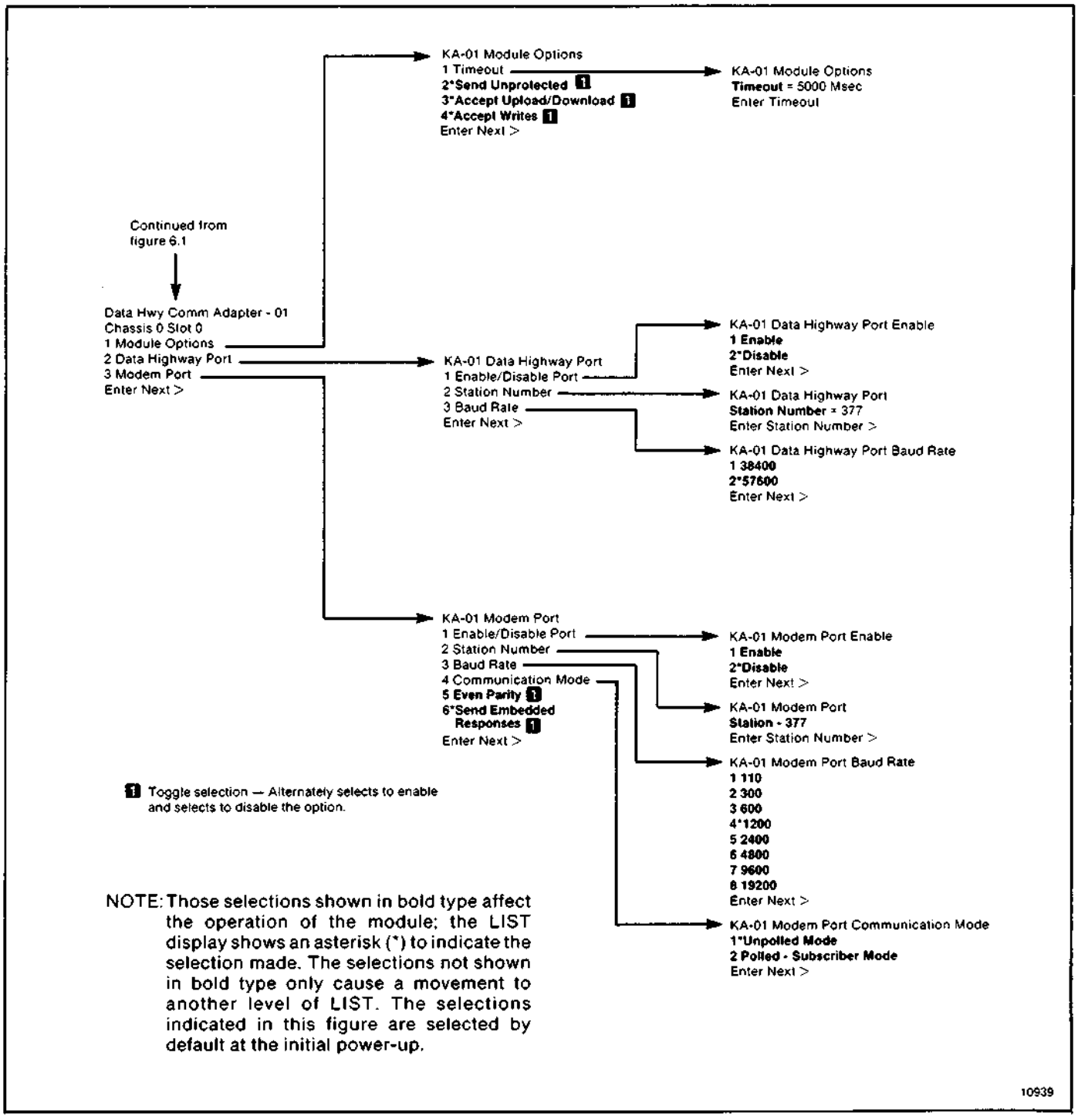


Figure 6.4 — Communication Adapter Module (1775-KA) LIST Guide

NOTE: An auto configuration can only be performed when the PLC-3 controller is in program load or test mode, power is applied to the I/O chassis, and switch 2 of each I/O chassis is set to ON to allow the I/O chassis to be restarted from the processor. If power is not applied to the I/O chassis, or switch 2 is set to OFF, the I/O scanner module will attempt to perform an auto configuration but, since the I/O chassis will not respond, the chassis will not be entered in the I/O chassis scanning sequence.

6.7 Communication Adapter Module Configuration

A number of parameters for the communications adapter module (cat. no. 1775-KA) can be programmed thru the LIST function. These functions are shown in figure 6.4. The default selections are indicated in the figure.

Selection 6 in the top level LIST menu is module status. Under module status, select the option for 1775-KA. At this point, LIST presents you with the following menu for the communications adapter module:

```
DATA HWY COMM. ADAPTER - 01
CHASSIS 0 SLOT 4
1 MODULE OPTIONS
2 DATA HIGHWAY PORT
3 MODEM PORT
ENTER NEXT >
```

6.7.1 Module Options

Selection 1 in the communications adapter module menu is module options. While this menu is displayed, typing:

1 [ENT]

causes the following menu to appear:

```
KA - 01 MODULE OPTIONS
1 TIMEOUT
2 SEND UPROTECTED
3 ACCEPT UPLOAD/DOWNLOAD
4 ACCEPT WRITES
ENTER NEXT >
```

These options are described below.

6.7.1.1 Timeout

The timeout is the maximum amount of time that the 1775-KA module will wait for another station to reply to one of its messages. The range of allowed timeout entries is 0 to 9999 in deciseconds. For example, if you enter a timeout value of 3999 deciseconds, the timeout period will be 399.9 seconds and display as 3999/10 sec.

If you enter no timeout value, it will be 5s (50/10 sec) by default.

LIST will keep you at this level and allow you to make repeated changes to the timeout value. To return to the preceding (next highest) level of LIST, press [ENT] again without entering a new timeout value.

6.7.1.2 Send Unprotected

This option determines whether the 1775-KA module will be able to send unprotected command messages to other stations. Each time you type:

2 [ENT]

you toggle between selecting to enable and selecting to disable the capability to send unprotected commands. The LIST display shows an asterisk (*) when this option is enabled. At the initial power-up, this option is enabled by default. If you disable this option, the module will be able to transmit only protected commands. For a description of protected and unprotected commands, refer to the PLC-3 Communications Adapter Module User's Manual (publication 1775-802).

6.7.1.3 Accept Upload/Download

This option determines whether the 1775-KA module will be able to execute upload and download commands sent to it by a computer. Each time you type:

3 [ENT]

you toggle between selecting to enable and selecting to disable the capability to accept upload and download commands. The LIST display shows an asterisk (*) when this option is enabled. At the initial power-up, this option is enabled by default. If you disable this option, the module will not be able to execute either of these two types of commands.

6.7.1.4 Accept Writes

This option determines whether the 1775-KA module will be able to unconditionally execute write commands sent to it by another station. When not enabled, write command execution is conditioned by the memory protect switch position. Each time you type:

4 [ENT]

you toggle between selecting to enable and selecting to disable the capability to accept writes unconditionally. The LIST display shows an asterisk (*) when this option is enabled. At the initial power-up, this option is disabled by default.

6.7.2 Data Highway Port

With the top level menu in figure 6.4 displayed, typing:

2 [ENT]

causes LIST to present the following menu:

```
KA - 01 DATA HIGHWAY PORT
1 ENABLE/DISABLE PORT
2 STATION NUMBER
3 BAUD RATE
ENTER NEXT >
```

These options are described below.

6.7.2.1 Enable/Disable Port

This option determines whether or not the 1775-KA module can communicate over the data highway. You must select the enable option in order to allow communication to take place. If you make no selection, the port will be disabled by default.

Note, however, that you can not use LIST to change any other parameters of the data highway port unless you first disable the port. After you are done entering parameters thru LIST, don't forget to enable the data highway port thru this selection.

6.7.2.2 Station Number

This option selects the octal number by which the PLC-3 station is identified on the data highway. The PLC-3 Communications Adapter Module User's Manual (publication 1775-802) provides guidelines for selecting a station number. In particular, note that the number 377 is illegal. Entering 377 as the station number will automatically disable the 1775-KA module, and you will not be able to enable it again thru LIST until you select a station number between 0 and 376_8. If you make no selection, the station number will be 377 by default.

6.7.2.3 Communication Rate

This option specifies the communication rate over the data highway. Select 57.6k baud. The default rate is 57.6k baud.

6.7.3 Modem Port

With the top level menu in figure 6.4 displayed, typing:

3 [ENT]

causes LIST to present the following menu:

```
KA - 01 MODEM PORT
1 ENABLE/DISABLE PORT
2 STATION NUMBER
3 BAUD RATE
4 COMMUNICATION MODE
5 EVEN PARITY
6*SEND EMBEDDED RESPONSES
ENTER NEXT >
```

These options are described below.

6.7.3.1 Enable/Disable Port

This option determines whether or not the 1775-KA module can communicate thru its RS-232-C port. You must select the enable option in order to allow this communication to take place. If you make no selection, the port will be disabled by default.

Note, however, that you cannot use LIST to change any other parameters of the RS-232-C port unless you first disable the port. After you are done entering parameters thru LIST, don't forget to enable the RS-232-C port thru this selection.

6.7.3.2 Station Number

This option selects the octal number by which the PLC-3 station is identified on an RS-232-C communication link. The PLC-3 Communications Adapter Module User's Manual (publication 1775-802) provides guidelines for selecting a station number. In particular, note that 377 is illegal. Entering 377 as the station number will automatically disable the RS-232-C port of the 1775-KA module, and you will not be able to enable it again thru LIST until you select a station number between 0 and 376_8. If you make no selection, the station number will be 377 by default.

6.7.3.3 Communication Rate

This option specifies the communication rate over the RS-232-C port. The choices are:

- 110 baud
- 300 baud
- 600 baud
- 1200 baud
- 2400 baud
- 4800 baud
- 9600 baud
- 19200 baud

The default rate is 1200 baud.

6.7.3.4 Communication Mode

This option determines whether the RS-232-C port of the 1775-KA module can operate in a polled or an unpolled mode. Select the unpolled mode for point-to-point communication thru the RS-232-C port. If the 1775-KA module is installed as a slave station on a multipoint modem link, select the polled mode. If you make no selection, the mode will be unpolled by default.

6.7.3.5 Even Parity

This option determines whether the 1775-KA module will use even parity in its communication thru the MODEM port. When not enabled, no parity is used. Each time you type:

5 [ENT]

you toggle between selecting to enable and selecting to disable the parity option. The LIST display shows an asterisk (*) when

this option is enabled. At the initial power-up, this option is disabled by default.

6.7.3.6 Send Embedded Responses

This option determines whether the 1775-KA module will be able to send embedded responses. Each time you type:

6 (ENT)

you toggle between selecting to enable and selecting to disable the ability to send embedded responses. The LIST display shows an asterisk (*) when this option is enabled. At the initial power-up, this option is enabled by default.

6.8 1775-S4B Module Configuration

The I/O Scanner-Message Handling Module (cat. no. 1775-S4B) has several parameters which can be selected in LIST. These parameters are shown in figure 6.5. For a full description of the effect that these selections have on the operation of the module, refer to the I/O Scanner-Message Handling Module User's Manual (publication 1775-806).

The I/O channel selections are the same as those for an I/O scanner-programmer interface module, except that peer-to-peer communication, backup communication, and channel 4 communication channel selections are not included. See section 6.4.2 for a description of these selections. The following sections describe the communication channel selections for the I/O scanner-message handling module.

6.8.1 Privileges

Thru LIST, you can assign privileges to each communication channel. Privileges 0 thru 63 allow devices connected to the channel to write into the corresponding memory area. for example, privilege 3 allows the device to write into the PLC-3 data table. Other privileges selectable for this module are:

- Privilege 65 — Section creation/deletion. Allows devices on the channel to edit or delete message procedures.
- Privilege 73 — Report generation keyboard. Allows a keyboard to send thru channel 5.

To add a privilege to a channel, type the number of the privilege. To delete a privilege from a channel, type /D after the privilege number. If you make no selection, the privileges will be 3, 5, 6, 65, and 73 by default.

6.8.2 Echo

The echo selection determines whether a character received by channel 5 will be echoed or transmitted to the data terminal which sent it. With the echo feature on, each keystroke is displayed or printed. With the echo feature off, keystrokes are not displayed at the data terminal unless the data terminal is

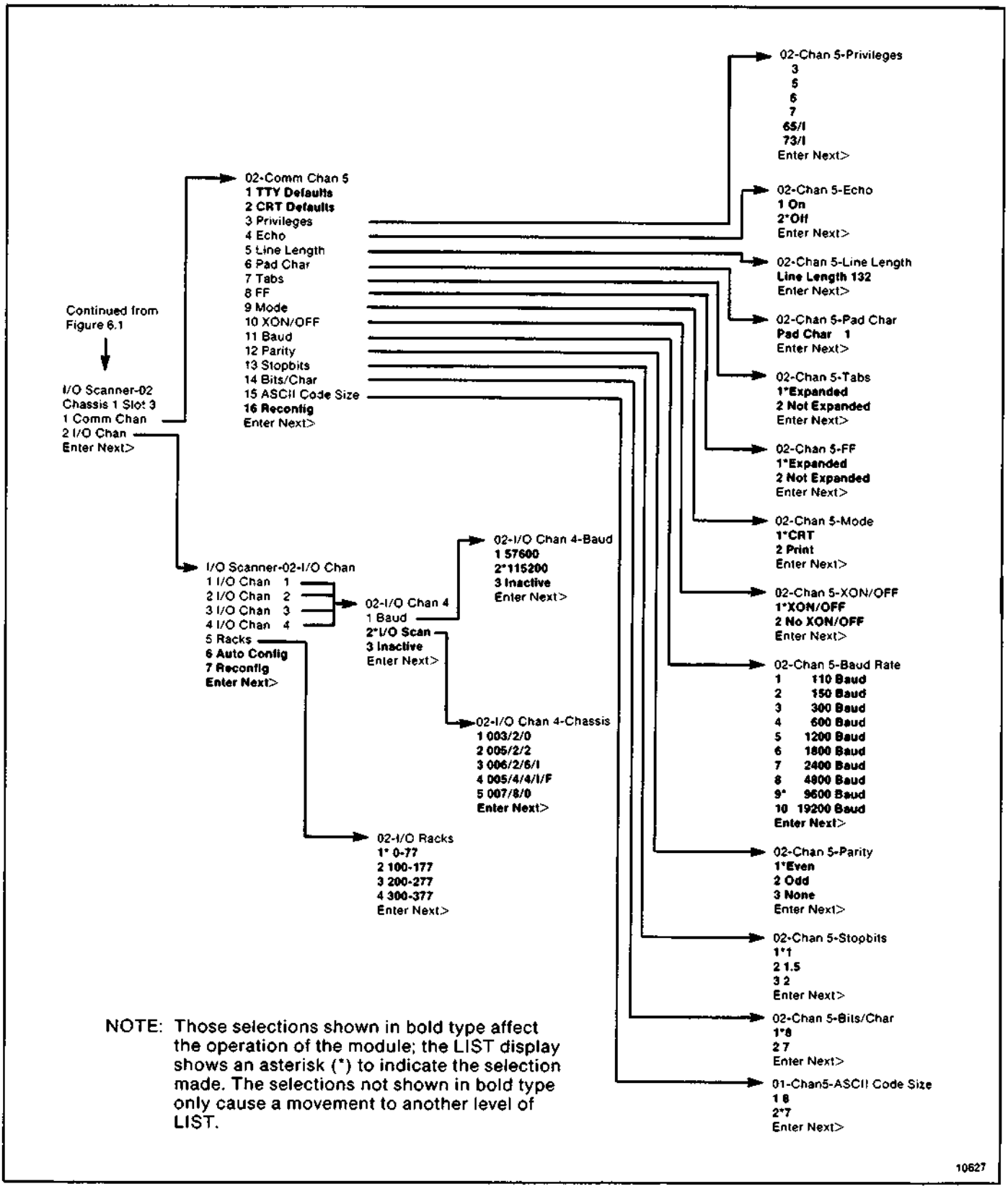


Figure 6.5 — 1775-S4B I/O Scanner Module List Guide

configured to display them. An asterisk after the selection number indicates the current selection. If you make no selection, echo will be on by default.

6.8.3 Line Length

The line length selection determines the maximum number of characters which the module will send for one line before beginning the next line. You can enter a value between 0 and 255.

Enter a line length of 0 to disable this feature. In this case, lines begin only where a carriage return is stored in the message procedure. You can use this for direct cursor addressing on a CRT. If you make no selection the line length will be 80 by default.

6.8.4 Pad Characters

The pad characters (PAD CHAR) selection is used to send null characters each time a carriage return and line feed are sent to start a new line. Use this feature to provide time for a printer to prepare for the next line of text. Enter a value between 0 and 255 to specify the number of pad characters. If you make no selection, there will be 0 pad characters by default.

6.8.5 Tabs

Tabs can be expanded or not expanded. The expanded selection causes the module to consider a tab position to exist every 8 spaces and to transmit the number of space characters needed to move to the next tab position when executing a tab character in the message procedure. The not expanded selection causes the module to transmit tab characters as they are stored in the message procedure. An asterisk after the selection number indicates the current selection. If you make no selection, tabs will be not expanded by default.

6.8.6 Form Feed

Form feed can be expanded or not expanded. The expanded selection causes the module to transmit 7 line feed characters when executing a form feed character in the message procedure. The not expanded selection causes the module to transmit form feed characters as they are stored in the message procedure. An asterisk after the selection number indicates the current selection. If you make no selection, form feed will be expanded by default.

6.8.7 Mode

You can select either of two modes: CRT or print. The selection determines the characters which the module sends back to the data terminal after receiving a delete character (if the echo feature is on). In the CRT mode, the module returns the

characters backspace, space, backspace. This erases the character from a CRT. In the print mode, the PLC-3 sends a slash (/) character, then repeats the character to be deleted and sends another slash character. An asterisk after the selection number indicates the current selection. If you make no selection, the mode will be CRT by default.

6.8.8 XON/XOFF

The XON/XOFF selection determines whether the module will respond to XON (DC1) and XOFF (DC3) characters for enabling and disabling transmissions. An asterisk (*) after the selection number indicates the current selection. If you make no selection, XON/XOFF will be enabled by default.

6.8.9 Communication Rate

The baud rate selection determines the communication rate thru channel 5. An asterisk (*) after the selection number indicates the current selection. If you make no selection, the communication rate will be 9600 baud by default.

6.8.10 Parity

The parity selection determines whether communication thru channel 5 uses odd, even, or no parity. Select the proper parity for communication with the desired device. An asterisk (*) next to the selection number indicates the current selection. If you make no selection, channel 5 will use no parity by default.

6.8.11 Stop Bits

The stop bits selection determines the number of stop bits that the module transmits after each character sent thru channel 5. The number of stop bits can be 1, 1.5, or 2. An asterisk (*) after the selection number indicates the current selection. If you make no selection, channel 5 will use 1 stop bit by default.

6.8.12 Bits Per Character

The bits per character (BITS/CHAR) selection determines the number of bits which the module transmits thru channel 5 for each character. Characters sent to the module thru this channel must have the same number of bits per character. Your options are 7 or 8 bits per character. An asterisk (*) after the selection number indicates the current selection. If you make no selection, there will be 8 bits per character by default.

6.8.13 ASCII Code Size

The ASCII code size selection is meaningful only when you have selected 8 bits per character. This selection determines the number of bits (7 or 8) which the module will actually use in decoding the character. An asterisk (*) after the selection number indicates the current selection. If you make no selection, the ASCII code size will be 7 by default.

6.8.14 TTY Defaults

The TTY DEFAULTS selection is equivalent to the following individual selections:

- Privileges — 3, 5, 6, 65, 73
- Echo — on
- Line length — 80
- Pad characters — 4
- Tabs — expanded
- FF — expanded
- Mode — print
- XON/XOFF — XON/XOFF
- Baud — 300
- Parity — none
- Stop bits — 1
- Bits/character — 8
- ASCII code size — 7

6.8.15 CRT Defaults

The CRT DEFAULTS selection is equivalent to the following individual selections:

- Privileges — 3, 5, 6, 65, 73
- Echo — on
- Line length — 80
- Pad characters — 0
- Tabs — not expanded
- FF — expanded
- Mode — CRT
- XON/XOFF — XON/XOFF
- Baud — 9600
- Parity — none
- Stop bits — 1
- Bits/character — 8
- ASCII code size — 7

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